



# Northern Colorado Plateau Network Landbird Monitoring Report 2024



Pinyon jay (*Gymnorhinus cyanocephalus*)  
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# **Northern Colorado Plateau Network landbird monitoring report 2024**

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## **Abstract**

In 2024, the University of Delaware, in cooperation with the National Park Service, completed the nineteenth year of a habitat-based landbird monitoring program in park units of the Northern Colorado Plateau Network. This program is designed to provide rigorous population trend data for most diurnal, regularly occurring breeding landbird species throughout the network. Using data from 2005 to 2024, density trends were estimated for 61 species in at least one of three habitats surveyed: low-elevation riparian, pinyon-juniper, and sage shrubland. Eighteen of these trends were significant, with seven negative trends and eleven positive trends. This population information is a useful decision-making tool for land managers and supports the National Park Service's goal of long-term monitoring of biological indicators for network parks.

## Executive Summary

In 2024, university biologists surveyed 43 out of 45 survey locations within 11 National Park Service units. Fifteen transects were in each of the three habitats of interest: low-elevation riparian, pinyon-juniper, and sage shrubland. Each location was surveyed once. In addition to the habitat-based surveys, four point-counts and an area search were conducted at Pipe Spring National Monument using a modified monitoring design.

Over 19 years of data collection, 16,996 point-count surveys have been conducted in 11 Northern Colorado Plateau Network units, detecting 166 unique species. During the 2024 field season, 618 point-count surveys were conducted, detecting 110 unique species.

Using data from 2005 to 2024, 118 population-density trends were estimated across the three habitats. There were sufficient sample sizes to estimate the densities of 61 species in at least one of the three habitats surveyed. Eighteen density trends (30% of the total) were statistically significant ( $p$ -value < 0.05). These included seven negative trends observed in the following species and habitats: mourning dove (*Zenaida macroura*) and white-throated swift (*Aeronautes saxatalis*) in low-elevation riparian areas; mourning dove, white-throated swift, Bewick's wren (*Thryomanes bewickii*) and mountain bluebird (*Sialia currucoides*) in pinyon-juniper habitats; and Western meadowlark (*Sturnella neglecta*) in sagebrush shrubland. Additionally, eleven positive trends were identified: hairy woodpecker (*Leuconotopicus villosus*), bushtit (*Psaltiriparus minimus*), American robin (*Turdus migratorius*), yellow warbler (*Setophaga petechia*), and yellow-breasted chat (*Icteria virens*) in low-elevation riparian areas; lazuli bunting (*Passerina amoena*), yellow-rumped warbler (*Setophaga coronata*), vesper sparrow (*Pooecetes gramineus*), and western tanager (*Piranga ludoviciana*) in pinyon-juniper habitats; and western tanager and Grace's warbler (*Setophaga graciae*) in sagebrush shrubland.

# 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 (Browder et al. 2002, Sauer et al. 2003, Gregory et al. 2007).

In 2019, Rosenberg and others (2019) estimated a loss of nearly 3 billion birds across North America since 1970. 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), although relationships between bird species and climate variables are complex and habitat dependent in the study area (Roberts et al. 2021). Habitat loss and degradation due to grazing and agriculture (Fleischner 1994, Rosenberg et al. 2016), 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 of 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 Northern Colorado Plateau Network's (NCPN) landbird monitoring program is designed to provide managers of 11 national parks in Colorado, Utah, and Wyoming with long-term population trend data for breeding birds in three habitats: low-elevation riparian, pinyon-juniper, and sagebrush shrubland. Using modified methods, monitoring is also conducted at Pipe Spring National Monument in Arizona. 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 NCPN landbird monitoring. In 2024, the University of Delaware, in cooperation with the National Park Service (NPS), completed the nineteenth year of the habitat-based landbird monitoring program in NPS units of the Northern Colorado Plateau Network.

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.

## Methods

### 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 (Table 1; Figure 1). Each transect consists of 15 point-count locations, each 250 meters apart (Figures 2 through 4).

**Table 1.** The number of transects within each park by habitat.

| <b>Park</b>                                | <b>Low-elevation<br/>Riparian</b> | <b>Pinyon-juniper</b> | <b>Sagebrush<br/>Shrubland</b> |
|--------------------------------------------|-----------------------------------|-----------------------|--------------------------------|
| Arches National Park                       | 3                                 | 1                     | 0                              |
| Black Canyon of the Gunnison National Park | 0                                 | 1                     | 1                              |
| Bryce Canyon National Park                 | 0                                 | 1                     | 2                              |
| Canyonlands National Park                  | 3                                 | 2                     | 0                              |
| Capitol Reef National Park                 | 2                                 | 2                     | 0                              |
| Colorado National Monument                 | 0                                 | 2                     | 0                              |
| Curecanti National Recreation Area         | 0                                 | 0                     | 5                              |
| Dinosaur National Monument                 | 3                                 | 4                     | 5                              |
| Fossil Butte National Monument             | 0                                 | 0                     | 2                              |
| Natural Bridges National Monument          | 2                                 | 1                     | 0                              |
| Zion National Park                         | 2                                 | 1                     | 0                              |

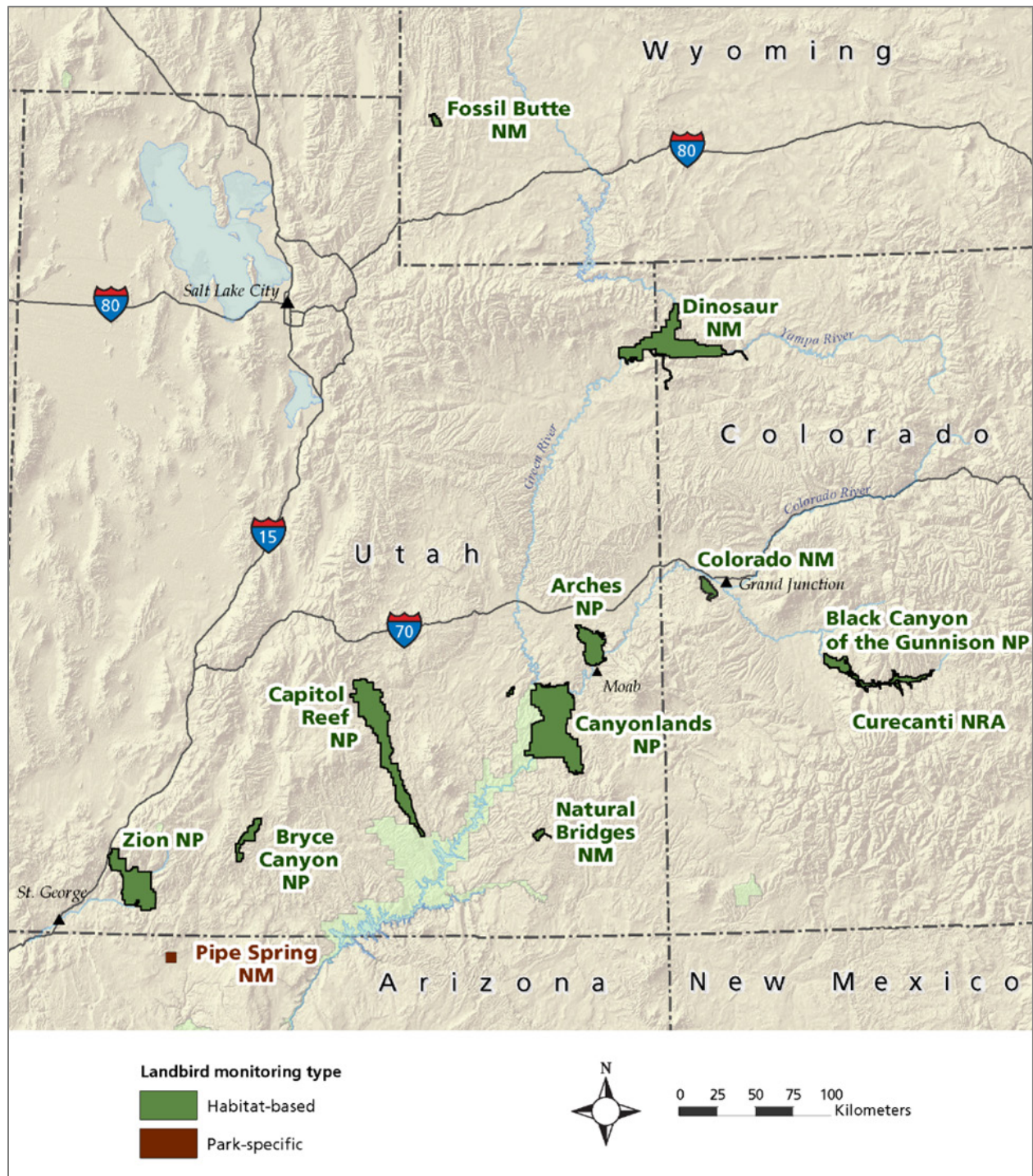


**Figure 1.** Northern Colorado Plateau Network parks where landbirds are monitored. NPS

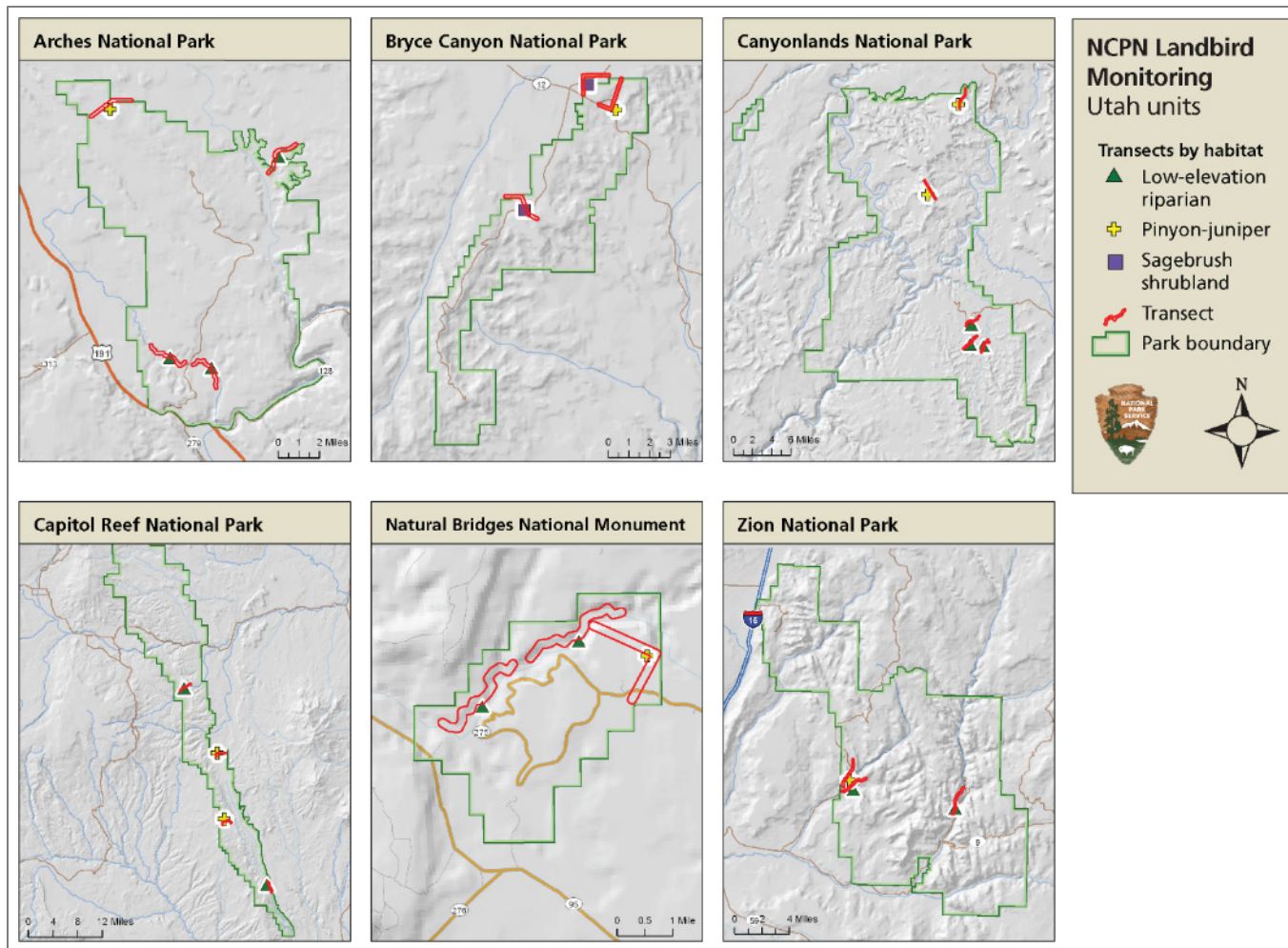


**Figure 2.** Transect locations by habitat, Utah units. NPS

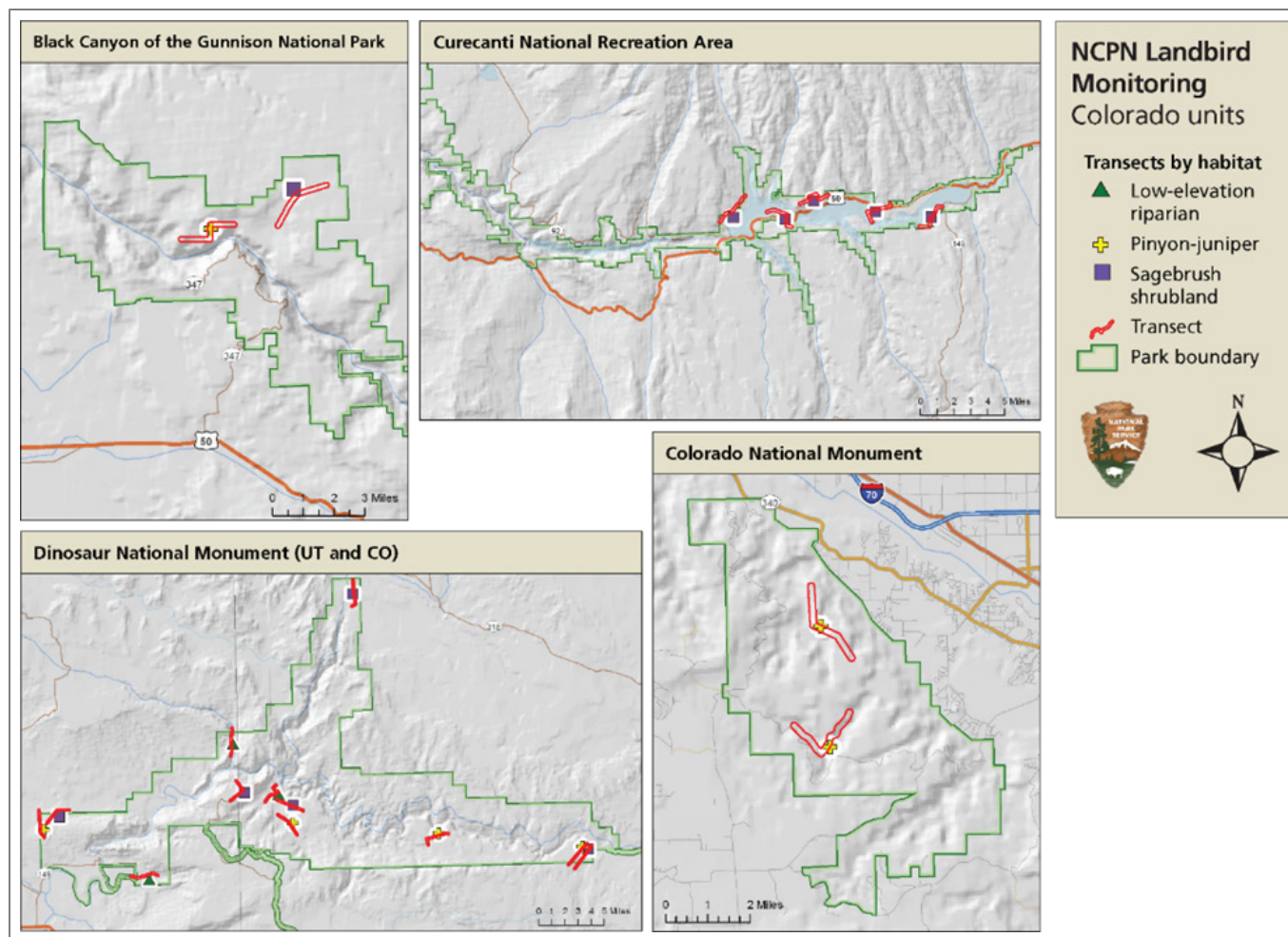


**Figure 3.** Transect locations by habitat, Colorado units. NPS

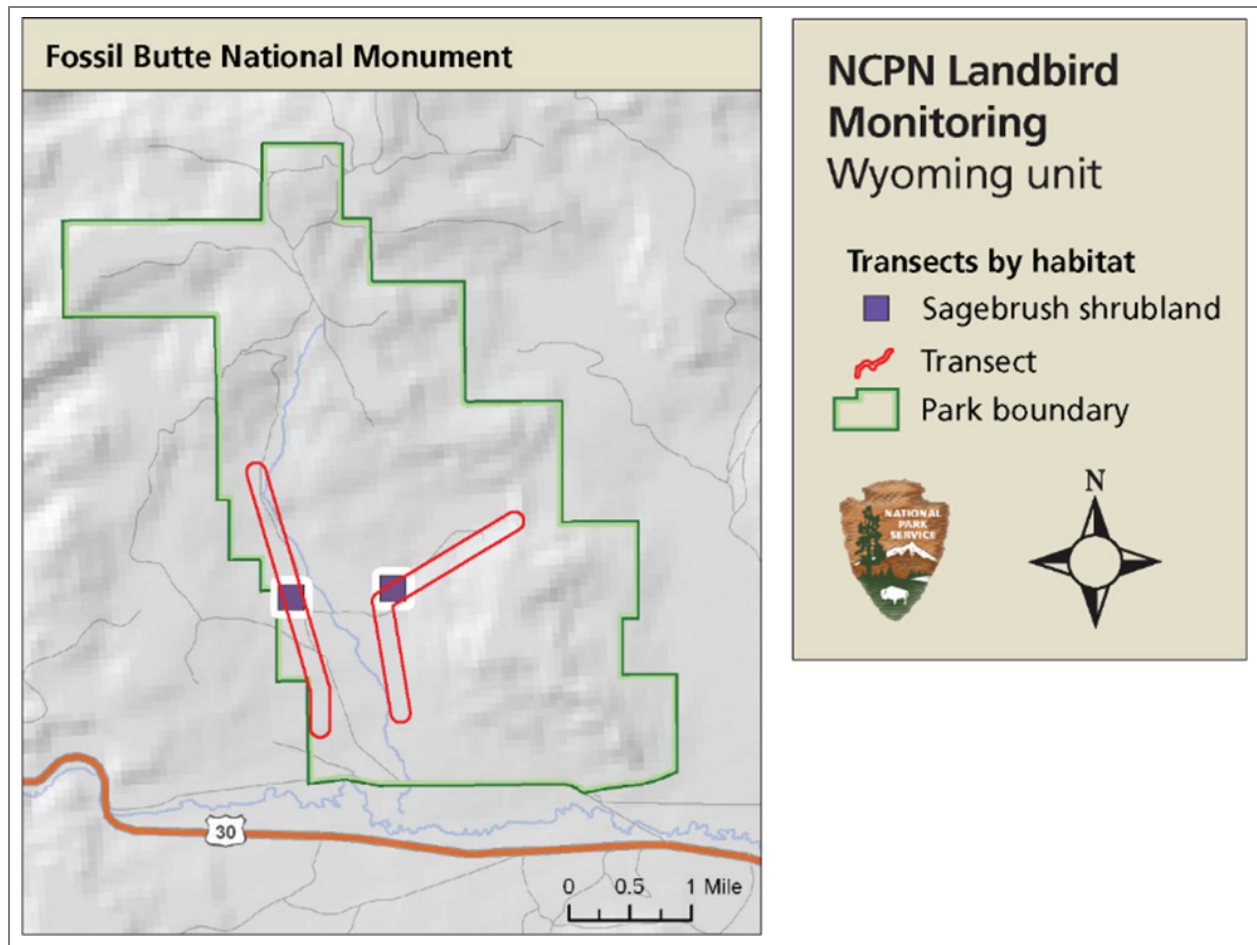


**Figure 4.** Transect locations, Fossil Butte National Monument. NPS

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 that 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.

Since 2005, the locations of all 45 transects have remained unchanged and have been surveyed annually as scheduled for this monitoring program. From 2005 to 2013, each transect was surveyed by a field team twice per year. Starting in 2014, the survey effort was reduced to one visit per year. The number of completed surveys varied by year, with >75% completion of planned surveys annually (Table 2).

**Table 2.** The annual number of point visits within each habitat. When possible, points were visited twice from 2005 to 2013.

| Year | Low-elevation Riparian | Pinyon-juniper | Sagebrush Shrubland |
|------|------------------------|----------------|---------------------|
| 2005 | 436                    | 447            | 432                 |
| 2006 | 440                    | 432            | 443                 |
| 2007 | 445                    | 439            | 438                 |
| 2008 | 447                    | 409            | 407                 |
| 2009 | 378                    | 406            | 392                 |
| 2010 | 385                    | 429            | 438                 |
| 2011 | 401                    | 383            | 434                 |
| 2012 | 365                    | 412            | 440                 |
| 2013 | 325                    | 324            | 395                 |
| 2014 | 153                    | 165            | 205                 |
| 2015 | 157                    | 151            | 196                 |
| 2017 | 222                    | 205            | 219                 |
| 2018 | 219                    | 197            | 219                 |
| 2019 | 209                    | 221            | 225                 |
| 2020 | 0                      | 0              | 205                 |
| 2021 | 217                    | 202            | 218                 |
| 2022 | 206                    | 208            | 219                 |
| 2023 | 192                    | 197            | 210                 |
| 2024 | 191                    | 221            | 206                 |

## Field Methods

Each year, at the beginning of the field season, field technicians attend a week-long training session to practice bird and plant identification, review field protocols, and hone distance-estimation skills (see section *Distance Sampling*, below). All transects are surveyed 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 during the peak breeding season at each location.

Observers complete one transect per day, beginning within 30 minutes of sunrise and ending in less than 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 weather data including temperature, percent cloud cover, precipitation type, and estimated wind speed using the Beaufort scale. Surveys are not conducted if winds exceed 13–18 mph or precipitation is heavier than a drizzle.

During habitat assessments, observers record the seral stage, canopy cover, mean height, and relative abundance of the five most dominant tree or shrub species for both the overstory and 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 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.

For more detailed information about survey protocols, refer to Daw and others (2017) and the Northern Colorado Plateau Inventory and Monitoring Network website <https://www.nps.gov/im/ncpn/landbirds.htm>. Links to past and current protocols and annual reports may also be found at that site.

## **Data Analyses**

### ***Distance Sampling***

We used the “Distance” package in program R [version 3.1.3; RCoreTeam (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.
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.

### ***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 analysis. With survey locations only 250 meters apart, there can be double counting of individuals from multiple points. To avoid this, we set a cut-off distance of 125 meters and only included detections within this distance in our analysis.

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.
5. Hazard rate key function with cosine series adjustments.

We ranked models using Akaike’s Information Criterion (AICc) to select the top model with the most parsimonious detection function for each species (Burnham and Anderson 2002). We used this model to estimate density of each species in each habitat for each year. We then fit a simple linear model to the annual densities for each species to determine trend direction and significance. In our trend analyses we only included annual density estimates for a species in a habitat with a minimum of 10 acceptable detections (i.e., within the 125 meters distance cut-off) to avoid inaccurate density estimates (MacKenzie et al. 2006). The datasets analyzed in this report are available at:

<https://irma.nps.gov/DataStore/Reference/Profile/2305588>.

## Results

Over 19 years of data collection, 16,996 point-count surveys have been conducted in 11 NCPN units (see Table 1), detecting 166 unique species. Of those 166 species, 164 were within 125 meters of the observer, the established distance cut-off for our analyses (see next section, *Habitat-based Density Trends*). In 2024, between May 15 and June 21, field technicians visited 43 of the 45 planned habitat-based transects, for a total of 618 point-count surveys. A total of 5,144 individual birds of 110 unique species were recorded. One new species was detected in the NCPN for this monitoring program: an American wigeon (*Mareca americana*) in Fossil Butte National Monument.

Several species were detected in individual park units for the first time in this monitoring program. Red-naped sapsucker (*Sphyrapicus nuchalis*) and Cassin's kingbird (*Tyrannus vociferans*) were detected in Bryce Canyon National Park, chukar (*Alectoris chukar*) was detected in Canyonlands National Park, white-breasted nuthatch (*Sitta carolinensis*) was detected in Capitol Reef National Park, gray catbird (*Dumetella carolinensis*) was detected in Curecanti National Recreation Area and Dinosaur National Monument, Eurasian collared-dove (*Streptopelia decaocto*) and sandhill crane (*Antigone canadensis*) in Dinosaur National Monument, and American wigeon (*Mareca americana*), and white-throated swift (*Aeronautes saxatalis*) in Fossil Butte National Monument.

### Habitat-based Density Trends

We excluded density estimates with a detection probability coefficient of variance of  $>100$ . We had sufficient sample sizes to estimate at least three annual densities of 61 species in at least one of the three habitats surveyed. In total, we estimated 118 population density trends across the three habitats (Table 3). Eighteen of the estimated density trends were significant ( $p\text{-value} < 0.05$ ), including seven negative trends and eleven positive trends (Table 4).

With the addition of 2024 density estimates, we observed the following changes: the bushtit, American robin, yellow warbler, and yellow-breasted chat density trends changed from non-significant to significantly positive in lower riparian; the lark sparrow trend changed from significantly positive to non-significant in sagebrush shrubland; and the western meadowlark trend changed from non-significant to significantly negative in sagebrush shrubland.

**Table 3.** Population-density trend slope, R<sup>2</sup> values, and sample size of estimated annual densities for individual species in low-elevation riparian, pinyon-juniper, and sagebrush shrubland habitats in the Northern Colorado Plateau Network, 2005–2015 and 2017–2024. Sample sizes are the number of years in which densities could be estimated. Models could not be fit for each species-habitat combination for all years due to low detection sample sizes. Note that in 2020 only sagebrush shrubland transects were surveyed.

| Common Name             | Low-elevation Riparian |                |             | Pinyon-juniper     |                |             | Sagebrush Shrubland |                |             |
|-------------------------|------------------------|----------------|-------------|--------------------|----------------|-------------|---------------------|----------------|-------------|
|                         | Slope <sup>A</sup>     | R <sup>2</sup> | Sample Size | Slope <sup>A</sup> | R <sup>2</sup> | Sample Size | Slope <sup>A</sup>  | R <sup>2</sup> | Sample Size |
| Mourning dove           | -0.61 <sup>D</sup>     | 0.57           | 16          | -0.99 <sup>C</sup> | 0.37           | 18          | -0.13               | 0.13           | 11          |
| White-throated swift    | -0.72 <sup>C</sup>     | 0.40           | 18          | -0.49 <sup>C</sup> | 0.43           | 17          | -1.00               | 0.12           | 4           |
| Hairy woodpecker        | 0.80 <sup>B</sup>      | 0.82           | 5           | NA                 | NA             | NA          | NA                  | NA             | NA          |
| Northern flicker        | NA                     | NA             | NA          | NA                 | NA             | NA          | -0.05               | 0.24           | 7           |
| Western wood-pewee      | -0.04                  | 0.01           | 13          | NA                 | NA             | NA          | NA                  | NA             | NA          |
| Gray flycatcher         | NA                     | NA             | NA          | -0.38              | 0.04           | 18          | 0.01                | 0.00           | 9           |
| Dusky flycatcher        | NA                     | NA             | NA          | -0.21              | 0.06           | 15          | 0.18                | 0.05           | 19          |
| Black phoebe            | 0.16                   | 0.02           | 7           | NA                 | NA             | NA          | NA                  | NA             | NA          |
| Say's phoebe            | -0.10                  | 0.11           | 16          | -0.13              | 0.67           | 4           | 0.05                | 0.31           | 8           |
| Ash-throated flycatcher | -0.18                  | 0.02           | 18          | -0.02              | 0.00           | 18          | -0.13               | 0.24           | 5           |
| Gray vireo              | 0.13                   | 0.38           | 9           | 0.10               | 0.02           | 18          | NA                  | NA             | NA          |
| Plumbeous vireo         | -0.08                  | 0.01           | 18          | 0.02               | 0.00           | 17          | 0.15                | 0.29           | 3           |
| Warbling vireo          | 0.08                   | 0.01           | 18          | NA                 | NA             | NA          | 0.10                | 0.30           | 7           |
| Pinyon jay              | NA                     | NA             | NA          | -0.01              | 0.00           | 15          | NA                  | NA             | NA          |
| Woodhouse's scrub-jay   | 0.05                   | 0.02           | 14          | 0.09               | 0.01           | 14          | NA                  | NA             | NA          |
| Black-billed magpie     | NA                     | NA             | NA          | NA                 | NA             | NA          | -0.05               | 0.08           | 13          |
| Horned lark             | NA                     | NA             | NA          | NA                 | NA             | NA          | -0.05               | 0.01           | 12          |
| Violet-green swallow    | -3.88                  | 0.07           | 16          | 1.00               | 0.12           | 16          | 0.13                | 0.12           | 14          |

<sup>A</sup> slope with no other table note = p-value > 0.05

<sup>B</sup> p-value ≤ 0.05

<sup>C</sup> p-value ≤ 0.01

<sup>D</sup> p-value ≤ 0.001.

**Table 3 (continued).** Population-density trend slope, R<sup>2</sup> values, and sample size of estimated annual densities for individual species in low-elevation riparian, pinyon-juniper, and sagebrush shrubland habitats in the Northern Colorado Plateau Network, 2005–2015 and 2017–2024. Sample sizes are the number of years in which densities could be estimated. Models could not be fit for each species-habitat combination for all years due to low detection sample sizes. Note that in 2020 only sagebrush shrubland transects were surveyed.

| Common Name             | Low-elevation Riparian |                |             | Pinyon-juniper     |                |             | Sagebrush Shrubland |                |             |
|-------------------------|------------------------|----------------|-------------|--------------------|----------------|-------------|---------------------|----------------|-------------|
|                         | Slope <sup>A</sup>     | R <sup>2</sup> | Sample Size | Slope <sup>A</sup> | R <sup>2</sup> | Sample Size | Slope <sup>A</sup>  | R <sup>2</sup> | Sample Size |
| Cliff swallow           | NA                     | NA             | NA          | NA                 | NA             | NA          | -0.14               | 0.01           | 6           |
| Mountain chickadee      | NA                     | NA             | NA          | -0.03              | 0.00           | 12          | NA                  | NA             | NA          |
| Juniper titmouse        | -0.29                  | 0.08           | 10          | -0.83              | 0.22           | 17          | NA                  | NA             | NA          |
| Bushtit                 | 0.9 <sup>B</sup>       | 0.48           | 11          | -0.60              | 0.02           | 14          | NA                  | NA             | NA          |
| White-breasted nuthatch | NA                     | NA             | NA          | -0.01              | 0.00           | 10          | NA                  | NA             | NA          |
| Rock wren               | -0.07                  | 0.02           | 18          | -0.01              | 0.00           | 15          | -0.14               | 0.2            | 19          |
| Canyon wren             | 0.00                   | 0.00           | 11          | NA                 | NA             | NA          | NA                  | NA             | NA          |
| House wren              | 0.52                   | 0.12           | 18          | NA                 | NA             | NA          | 0.13                | 0.31           | 8           |
| Bewick's wren           | -0.34                  | 0.14           | 14          | -0.58 <sup>B</sup> | 0.27           | 18          | NA                  | NA             | NA          |
| Blue-gray gnatcatcher   | -0.83                  | 0.02           | 18          | -1.61              | 0.06           | 18          | 0.38                | 0.09           | 17          |
| Western bluebird        | NA                     | NA             | NA          | NA                 | NA             | NA          | 0.25                | 0.38           | 3           |
| Mountain bluebird       | NA                     | NA             | NA          | -0.35 <sup>B</sup> | 0.44           | 13          | 0.04                | 0.00           | 17          |
| Hermit thrush           | NA                     | NA             | NA          | 0.02               | 0.03           | 4           | NA                  | NA             | NA          |
| American robin          | 1.38 <sup>B</sup>      | 0.46           | 10          | 0.34               | 0.24           | 9           | 0.87                | 0.2            | 14          |
| Sage thrasher           | NA                     | NA             | NA          | NA                 | NA             | NA          | 0.03                | 0.01           | 18          |
| European starling       | NA                     | NA             | NA          | NA                 | NA             | NA          | NA                  | NA             | NA          |
| Lucy's warbler          | 1.02                   | 0.20           | 13          | NA                 | NA             | NA          | NA                  | NA             | NA          |
| Virginia's warbler      | -0.15                  | 0.09           | 13          | 0.10               | 0.03           | 15          | 0.09                | 0.15           | 17          |

<sup>A</sup> slope with no other table note = p-value > 0.05

<sup>B</sup> p-value ≤ 0.05

<sup>C</sup> p-value ≤ 0.01

<sup>D</sup> p-value ≤ 0.001.

**Table 3 (continued).** Population-density trend slope, R<sup>2</sup> values, and sample size of estimated annual densities for individual species in low-elevation riparian, pinyon-juniper, and sagebrush shrubland habitats in the Northern Colorado Plateau Network, 2005–2015 and 2017–2024. Sample sizes are the number of years in which densities could be estimated. Models could not be fit for each species-habitat combination for all years due to low detection sample sizes. Note that in 2020 only sagebrush shrubland transects were surveyed.

| Common Name                 | Low-elevation Riparian |                |             | Pinyon-juniper     |                |             | Sagebrush Shrubland |                |             |
|-----------------------------|------------------------|----------------|-------------|--------------------|----------------|-------------|---------------------|----------------|-------------|
|                             | Slope <sup>A</sup>     | R <sup>2</sup> | Sample Size | Slope <sup>A</sup> | R <sup>2</sup> | Sample Size | Slope <sup>A</sup>  | R <sup>2</sup> | Sample Size |
| Common yellowthroat         | -0.09                  | 0              | 13          | NA                 | NA             | NA          | NA                  | NA             | NA          |
| Yellow warbler              | 2.65 <sup>B</sup>      | 0.33           | 18          | NA                 | NA             | NA          | 0.2                 | 0.19           | 8           |
| Yellow-rumped warbler       | 0.11                   | 0              | 6           | 0.67 <sup>C</sup>  | 0.81           | 7           | 0.38                | 0.27           | 6           |
| Grace's warbler             | NA                     | NA             | NA          | 0.10               | 0.04           | 7           | 0.14 <sup>B</sup>   | 0.86           | 5           |
| Black-throated gray warbler | 0.16                   | 0.04           | 17          | -0.83              | 0.06           | 18          | -0.01               | 0              | 11          |
| Yellow-breasted chat        | 0.35 <sup>B</sup>      | 0.35           | 17          | NA                 | NA             | NA          | NA                  | NA             | NA          |
| Green-tailed towhee         | NA                     | NA             | NA          | 0.24               | 0.82           | 4           | 0.12                | 0.00           | 19          |
| Spotted towhee              | -0.51                  | 0.01           | 18          | 0.51               | 0.19           | 18          | 0.17                | 0.06           | 19          |
| Chipping sparrow            | -0.36                  | 0.08           | 8           | -0.32              | 0.04           | 17          | -0.11               | 0.01           | 18          |
| Brewer's sparrow            | NA                     | NA             | NA          | NA                 | NA             | NA          | -0.58               | 0.02           | 19          |
| Vesper sparrow              | NA                     | NA             | NA          | 0.33 <sup>C</sup>  | 0.69           | 9           | -0.33               | 0.03           | 19          |
| Lark sparrow                | NA                     | NA             | NA          | 0.08               | 0.03           | 12          | 0.42                | 0.19           | 19          |
| Black-throated sparrow      | -0.10                  | 0.01           | 16          | -0.12              | 0.01           | 17          | 0.18                | 0.21           | 6           |
| Sagebrush sparrow           | NA                     | NA             | NA          | NA                 | NA             | NA          | -0.25               | 0.29           | 6           |
| Song sparrow                | 0.11                   | 0.01           | 15          | NA                 | NA             | NA          | NA                  | NA             | NA          |
| Dark-eyed junco             | NA                     | NA             | NA          | -0.13              | 0.02           | 4           | NA                  | NA             | NA          |
| Western tanager             | 0.06                   | 0.07           | 8           | 0.12 <sup>B</sup>  | 0.34           | 12          | 0.13 <sup>B</sup>   | 0.67           | 6           |
| Black-headed grosbeak       | 0.00                   | 0              | 13          | 0.26               | 0.33           | 7           | -0.02               | 0.07           | 3           |

<sup>A</sup> slope with no other table note = p-value > 0.05

<sup>B</sup> p-value ≤ 0.05

<sup>C</sup> p-value ≤ 0.01

<sup>D</sup> p-value ≤ 0.001.

**Table 3 (continued).** Population-density trend slope, R<sup>2</sup> values, and sample size of estimated annual densities for individual species in low-elevation riparian, pinyon-juniper, and sagebrush shrubland habitats in the Northern Colorado Plateau Network, 2005–2015 and 2017–2024. Sample sizes are the number of years in which densities could be estimated. Models could not be fit for each species-habitat combination for all years due to low detection sample sizes. Note that in 2020 only sagebrush shrubland transects were surveyed.

| Common Name          | Low-elevation Riparian |                |             | Pinyon-juniper     |                |             | Sagebrush Shrubland |                |             |
|----------------------|------------------------|----------------|-------------|--------------------|----------------|-------------|---------------------|----------------|-------------|
|                      | Slope <sup>A</sup>     | R <sup>2</sup> | Sample Size | Slope <sup>A</sup> | R <sup>2</sup> | Sample Size | Slope <sup>A</sup>  | R <sup>2</sup> | Sample Size |
| Blue grosbeak        | 0.26                   | 0.12           | 11          | NA                 | NA             | NA          | NA                  | NA             | NA          |
| Lazuli bunting       | 0.84                   | 0.05           | 17          | 1.52 <sup>B</sup>  | 0.53           | 9           | 0.10                | 0.03           | 11          |
| Western meadowlark   | NA                     | NA             | NA          | -0.45              | 0.27           | 6           | -0.19 <sup>B</sup>  | 0.24           | 19          |
| Brewer's blackbird   | NA                     | NA             | NA          | NA                 | NA             | NA          | -0.01               | 0.00           | 11          |
| Brown-headed cowbird | -0.24                  | 0.04           | 7           | -0.13              | 0.04           | 9           | 0.03                | 0.01           | 8           |
| Bullock's oriole     | 0.22                   | 0.34           | 9           | NA                 | NA             | NA          | NA                  | NA             | NA          |
| Cassin's finch       | NA                     | NA             | NA          | NA                 | NA             | NA          | NA                  | NA             | NA          |
| House finch          | -0.62                  | 0.13           | 17          | 0.00               | 0.00           | 17          | 0.08                | 0.08           | 13          |
| Red crossbill        | NA                     | NA             | NA          | NA                 | NA             | NA          | NA                  | NA             | NA          |
| Pine siskin          | NA                     | NA             | NA          | NA                 | NA             | NA          | NA                  | NA             | NA          |
| Lesser goldfinch     | -0.78                  | 0.13           | 16          | -0.09              | 0.02           | 6           | NA                  | NA             | NA          |

<sup>A</sup> slope with no other table note = p-value > 0.05

<sup>B</sup> p-value ≤ 0.05

<sup>C</sup> p-value ≤ 0.01

<sup>D</sup> p-value ≤ 0.001.

**Table 4.** Significant density trends for landbird species in the Northern Colorado Plateau Network, 2024.

| Species               | Habitat <sup>A</sup>      |                |                        |
|-----------------------|---------------------------|----------------|------------------------|
|                       | Low-elevation<br>Riparian | Pinyon-juniper | Sagebrush<br>Shrubland |
| Mourning dove         | ↓                         | ↓              | –                      |
| White-throated swift  | ↓                         | ↓              | –                      |
| Hairy woodpecker      | ↑                         | NA             | NA                     |
| Bushtit               | ↑                         | –              | NA                     |
| Bewick's wren         | –                         | ↓              | NA                     |
| Mountain bluebird     | NA                        | ↓              | –                      |
| American robin        | ↑                         | –              | –                      |
| Yellow warbler        | ↑                         | NA             | –                      |
| Yellow-rumped warbler | –                         | ↑              | –                      |
| Grace's warbler       | NA                        | –              | ↑                      |
| Yellow-breasted chat  | ↑                         | NA             | NA                     |
| Vesper sparrow        | NA                        | ↑              | –                      |
| Western tanager       | –                         | ↑              | ↑                      |
| Lazuli bunting        | –                         | ↑              | –                      |
| Western meadowlark    | NA                        | –              | ↓                      |

<sup>A</sup> Where NA = not enough data available; – = no trend, ↑ = increasing trend, and ↓ = decreasing trend

We excluded raptors (i.e., hawks, eagles, and owls) and common raven (*Corvus corax*) from our density and trend estimates. While these larger avian species were included in previous years' analyses (with only enough detections of common raven to estimate trends in density), we do not believe this was appropriate, as our study design and the use of point counts as a monitoring method is not effective for species with minimal vocalizations and large territories, as is the case with raptors and common ravens. Similarly, we excluded hummingbirds from our trend estimates because point-counts are not suited to detect hummingbirds effectively. While some hummingbirds do sing and many perform mating displays, these behaviors are less frequent and consistent than that of most passerines (songbirds) and the detection of hummingbirds is most commonly due to their audible wing-whir, which can only be detected within a short distance from the observer. As a result of this exclusion, black-chinned hummingbird (*Archilochus alexandri*) and broad-tailed hummingbird (*Selasphorus platycercus*) trends are no longer present in this report.

### Pipe Spring National Monument Summary

In 2024, we completed all four point-count surveys and the area search in Pipe Spring National Monument. We detected a total of 105 individuals of 27 species (Table 5). Sample sizes were too low for density trend estimations. No new species were detected for the monitoring program at Pipe Spring in 2024.

**Table 5.** Number of individuals detected during point counts and area searches in Pipe Spring National Monument, 2009–2024. Surveys were not conducted in Pipe Spring National Monument in 2016 or 2020.

| Species                       | Point Counts |      | Area Searches |      | Total |
|-------------------------------|--------------|------|---------------|------|-------|
|                               | 2009–2023    | 2024 | 2009–2023     | 2024 |       |
| Mallard                       | 0            | 0    | 1             | 0    | 1     |
| Gambel's quail                | 50           | 4    | 45            | 2    | 101   |
| Black-crowned night-heron     | 1            | 0    | 12            | 0    | 13    |
| Cooper's hawk                 | 3            | 0    | 4             | 1    | 8     |
| Red-tailed hawk               | 1            | 0    | 4             | 0    | 5     |
| Eurasian collared-dove        | 53           | 1    | 88            | 0    | 142   |
| Mourning dove                 | 32           | 0    | 54            | 0    | 86    |
| Greater roadrunner            | 0            | 0    | 1             | 0    | 1     |
| Great horned owl              | 0            | 0    | 1             | 0    | 1     |
| Common poorwill               | 0            | 0    | 3             | 0    | 3     |
| White-throated swift          | 20           | 0    | 4             | 20   | 44    |
| Black-chinned hummingbird     | 2            | 0    | 3             | 2    | 7     |
| Broad-tailed hummingbird      | 1            | 0    | 4             | 0    | 5     |
| Downy woodpecker              | 1            | 0    | 0             | 0    | 1     |
| Hairy woodpecker              | 1            | 0    | 1             | 0    | 2     |
| American kestrel              | 5            | 0    | 11            | 0    | 16    |
| Peregrine falcon              | 5            | 0    | 0             | 1    | 6     |
| Prairie falcon                | 1            | 0    | 1             | 0    | 2     |
| Western wood-pewee            | 3            | 0    | 10            | 0    | 13    |
| Gray flycatcher               | 1            | 0    | 2             | 0    | 3     |
| Black phoebe                  | 6            | 0    | 18            | 0    | 24    |
| Say's phoebe                  | 35           | 3    | 31            | 2    | 71    |
| Ash-throated flycatcher       | 37           | 3    | 30            | 4    | 74    |
| Cassin's kingbird             | 63           | 0    | 38            | 0    | 101   |
| Western kingbird              | 45           | 2    | 49            | 1    | 97    |
| Gray vireo                    | 8            | 1    | 9             | 1    | 19    |
| Warbling vireo                | 0            | 0    | 4             | 1    | 5     |
| Pinyon jay                    | 1            | 0    | 1             | 0    | 2     |
| Woodhouse's scrub-jay         | 3            | 0    | 7             | 0    | 10    |
| Common raven                  | 43           | 1    | 31            | 1    | 76    |
| Violet-green swallow          | 30           | 1    | 72            | 1    | 104   |
| Northern rough-winged swallow | 11           | 0    | 6             | 0    | 17    |
| Cliff swallow                 | 0            | 0    | 2             | 0    | 2     |

**Table 5 (continued).** Number of individuals detected during point counts and area searches in Pipe Spring National Monument, 2009–2024. Surveys were not conducted in Pipe Spring National Monument in 2016 or 2020.

| Species                     | Point Counts |      | Area Searches |      | Total |
|-----------------------------|--------------|------|---------------|------|-------|
|                             | 2009–2023    | 2024 | 2009–2023     | 2024 |       |
| Barn swallow                | 2            | 0    | 0             | 0    | 2     |
| Juniper titmouse            | 6            | 0    | 2             | 0    | 8     |
| Bushtit                     | 0            | 3    | 1             | 0    | 4     |
| Rock wren                   | 29           | 2    | 6             | 0    | 37    |
| Canyon wren                 | 2            | 0    | 1             | 0    | 3     |
| House wren                  | 2            | 0    | 2             | 0    | 4     |
| Bewick's wren               | 24           | 1    | 36            | 3    | 64    |
| Blue-gray gnatcatcher       | 8            | 1    | 6             | 1    | 16    |
| Ruby-crowned kinglet        | 0            | 0    | 1             | 0    | 1     |
| American robin              | 3            | 0    | 0             | 0    | 3     |
| Northern mockingbird        | 29           | 0    | 8             | 0    | 37    |
| Sage thrasher               | 1            | 0    | 0             | 0    | 1     |
| European starling           | 28           | 0    | 92            | 0    | 120   |
| Cedar waxwing               | 1            | 0    | 3             | 0    | 4     |
| Northern waterthrush        | 0            | 0    | 1             | 0    | 1     |
| Orange-crowned warbler      | 0            | 0    | 2             | 0    | 2     |
| Virginia's warbler          | 0            | 0    | 1             | 0    | 1     |
| MacGillivray's warbler      | 2            | 0    | 0             | 1    | 3     |
| Common yellowthroat         | 2            | 0    | 9             | 1    | 12    |
| Yellow warbler              | 15           | 2    | 86            | 16   | 119   |
| Yellow-rumped warbler       | 2            | 0    | 5             | 0    | 7     |
| Black-throated gray warbler | 5            | 0    | 2             | 0    | 7     |
| Wilson's warbler            | 0            | 1    | 8             | 2    | 11    |
| Yellow-breasted chat        | 0            | 1    | 2             | 1    | 4     |
| Green-tailed towhee         | 3            | 0    | 11            | 0    | 14    |
| Spotted towhee              | 6            | 0    | 0             | 0    | 6     |
| Chipping sparrow            | 1            | 0    | 1             | 0    | 2     |
| Brewer's sparrow            | 6            | 0    | 3             | 0    | 9     |
| Lark sparrow                | 1            | 0    | 23            | 0    | 24    |
| Black-throated sparrow      | 106          | 6    | 54            | 2    | 168   |
| Lincoln's sparrow           | 0            | 0    | 1             | 0    | 1     |
| White-crowned sparrow       | 28           | 0    | 101           | 1    | 130   |
| Summer tanager              | 1            | 0    | 0             | 0    | 1     |

**Table 5 (continued).** Number of individuals detected during point counts and area searches in Pipe Spring National Monument, 2009–2024. Surveys were not conducted in Pipe Spring National Monument in 2016 or 2020.

| Species                 | Point Counts |           | Area Searches |           | Total       |
|-------------------------|--------------|-----------|---------------|-----------|-------------|
|                         | 2009–2023    | 2024      | 2009–2023     | 2024      |             |
| Western tanager         | 3            | 0         | 7             | 0         | 10          |
| Black-headed grosbeak   | 7            | 0         | 11            | 0         | 18          |
| Blue grosbeak           | 5            | 0         | 5             | 0         | 10          |
| Lazuli bunting          | 2            | 0         | 11            | 0         | 13          |
| Red-winged blackbird    | 1            | 0         | 0             | 0         | 1           |
| Western meadowlark      | 2            | 0         | 1             | 0         | 3           |
| Yellow-headed blackbird | 1            | 0         | 1             | 0         | 2           |
| Brewer's blackbird      | 0            | 0         | 2             | 0         | 2           |
| Brown-headed cowbird    | 16           | 0         | 23            | 0         | 39          |
| Bullock's oriole        | 35           | 0         | 32            | 0         | 67          |
| House finch             | 151          | 2         | 110           | 3         | 266         |
| Pine siskin             | 2            | 0         | 31            | 0         | 33          |
| Lesser goldfinch        | 10           | 0         | 11            | 1         | 22          |
| House sparrow           | 8            | 0         | 53            | 1         | 62          |
| <b>Total</b>            | <b>1018</b>  | <b>35</b> | <b>1313</b>   | <b>70</b> | <b>2436</b> |

## Discussion

As the western landscape continues to change due to anthropogenic land use and climate change, bird populations that are unable to adapt are at risk for decline. 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 shifts in populations.

In this report, we present 19-year population-density trends within low-elevation riparian, pinyon-juniper, and sagebrush shrubland habitats for 61 species (a total of 118 species/habitat combinations; Appendix A). The majority of density trend estimates were non-significant, indicating the potential for stable populations for many species in these protected national park units.

Of the 118 trend estimates, eighteen were significant ( $p$ -value  $< 0.05$ ), seven with negative trends and eleven with positive trends. Bird species with negative trends are mourning dove (*Zenaida macroura*) and white-throated swift (*Aeronautes saxatalis*) in low-elevation riparian; mourning dove, white-throated swift, Bewick's wren (*Thryomanes bewickii*) and mountain bluebird (*Sialia currucoides*) in pinyon-juniper; and Western meadowlark (*Sturnella neglecta*) in sagebrush shrubland. Bird species with positive trends include hairy woodpecker (*Leuconotopicus villosus*), bushtit (*Psaltiriparus minimus*), American robin (*Turdus migratorius*), yellow warbler (*Setophaga petechia*), and yellow-breasted chat (*Icteria virens*) in low-elevation riparian; lazuli bunting (*Passerina amoena*), yellow-rumped warbler (*Setophaga coronata*), vesper sparrow (*Pooecetes gramineus*), and western tanager (*Piranga ludoviciana*) in pinyon-juniper; and western tanager and Grace's warbler (*Setophaga graciae*) in sagebrush shrubland. There were sufficient sample sizes to estimate the densities of 61 species in at least one of the three habitats surveyed.

It should be noted that it is possible that some species have a significantly negative or positive trend, but because annual density estimates were not constructed for species with fewer than 10 detections per habitat within a year, years with a low number of detections were excluded, leading to a non-significant trend. Of course, this is only relevant for difficult to detect and low-abundance species. Changes in trends of species with high abundance should be detected with the methods used in this study.

While this study does not explore specific factors linked to the bird population trends in the NCPN, we provide evidence of long-term regional declines and increases in individual bird populations within these 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 also be able to more confidently assess the causes of longer-term changes to bird populations relative to surrounding landscape and climate variables.

It is important to note that 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, many species detected within 125 meters of an observer during riparian point counts are not 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 evaluate the drivers of population trends for landbird species within the network. Including habitat and climate variables in density models, for instance, will allow us to identify prominent threats to declining species and estimate causes of variance in these trends across the NCPN.

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## **Appendix. Individual Species Habitat-based Density Trends by Habitat**

Figures 5 through 20 show the individual species density trends by habitat. Red lines indicate significant trends from a simple linear regression model (LR = Low-elevation Riparian, PJ = Pinyon-juniper, SA = Sagebrush Shrubland).

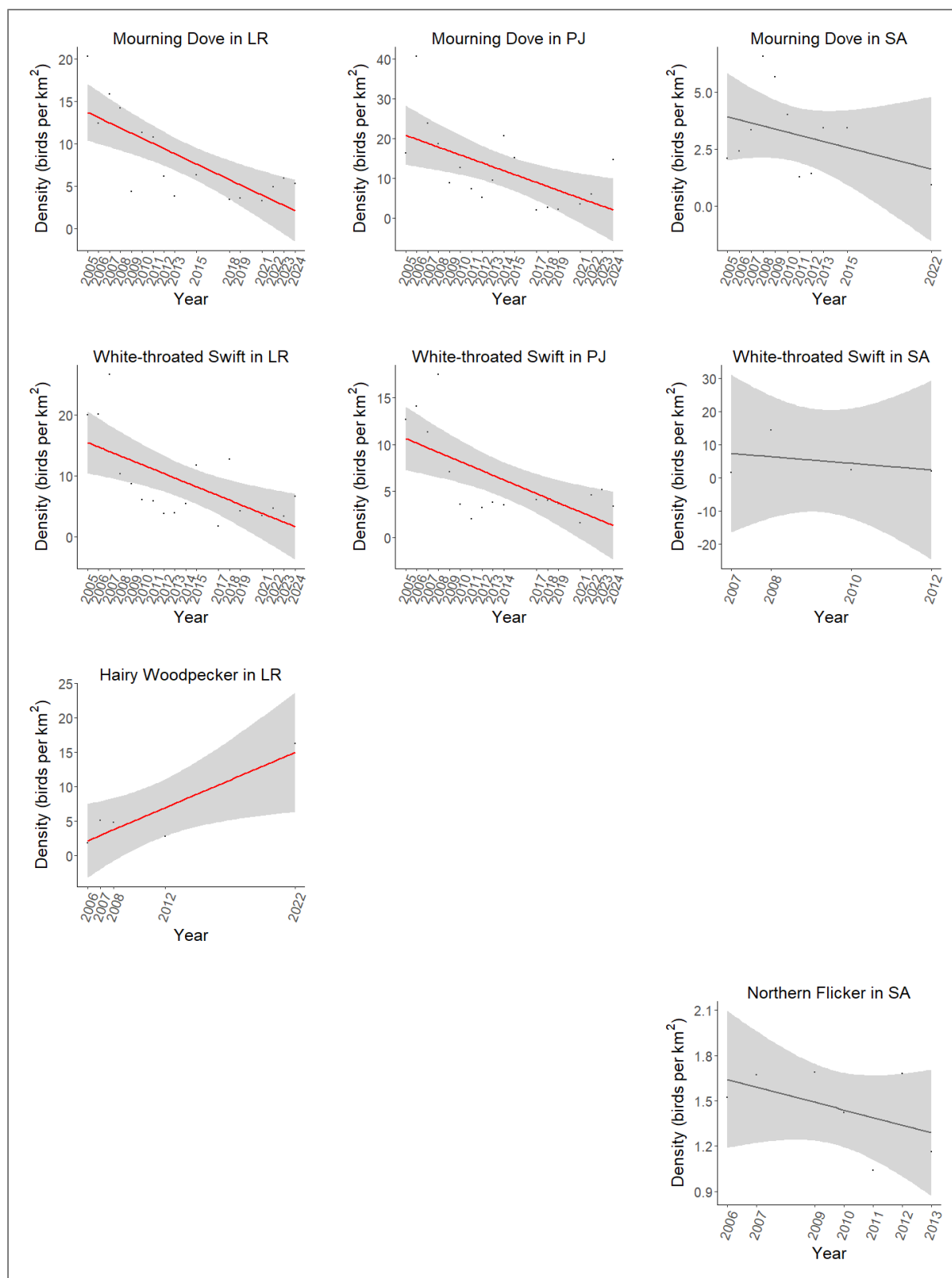


**Figure 5.** Trend lines in habitats for mourning dove, white-throated swift, hairy woodpecker, and northern flicker. NPS / TAYLOR SCHMIDT

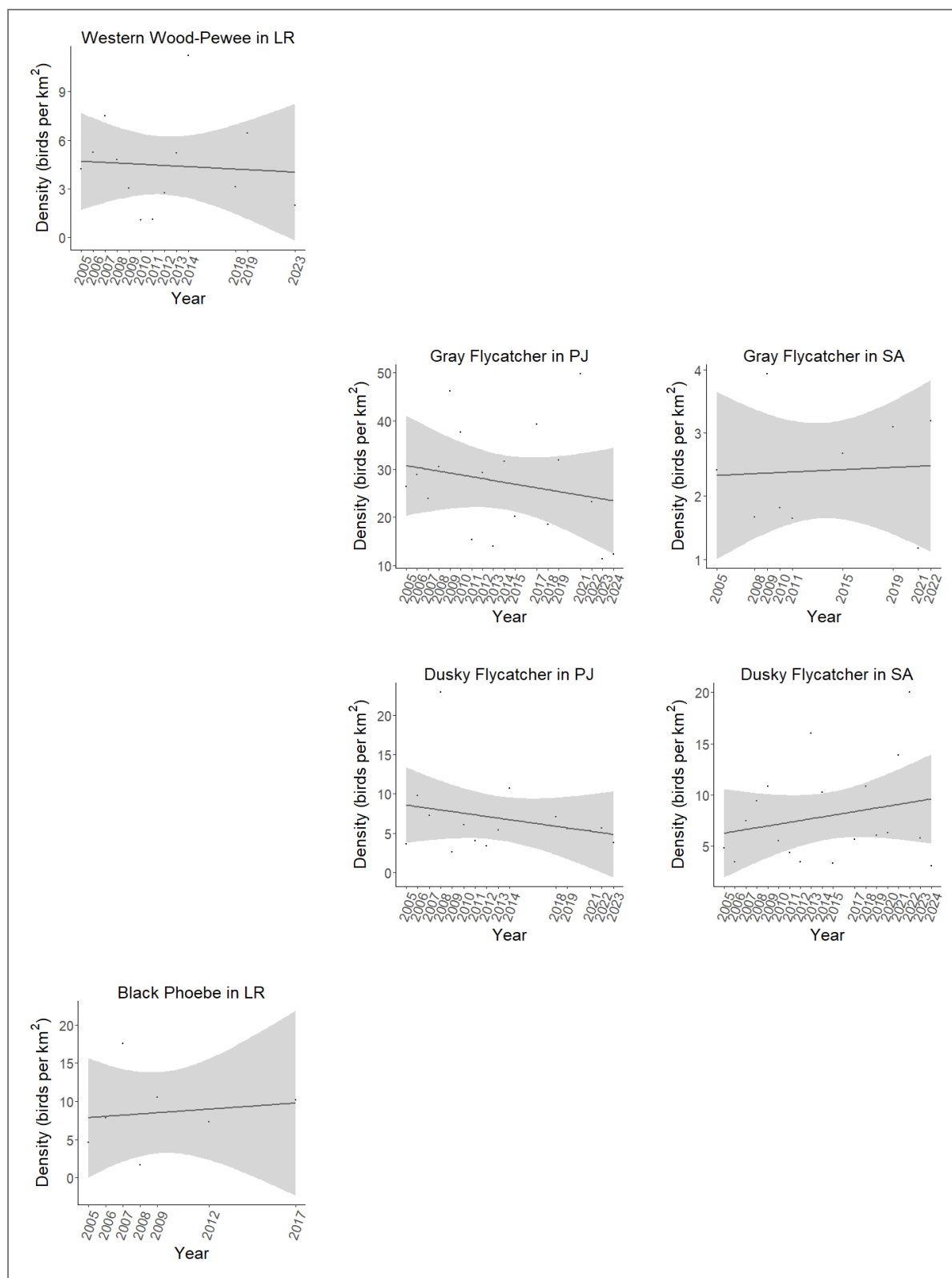


**Figure 6.** Trend lines for western wood-pewee, gray flycatcher, dusky flycatcher, and black phoebe.  
NPS / TAYLOR SCHMIDT

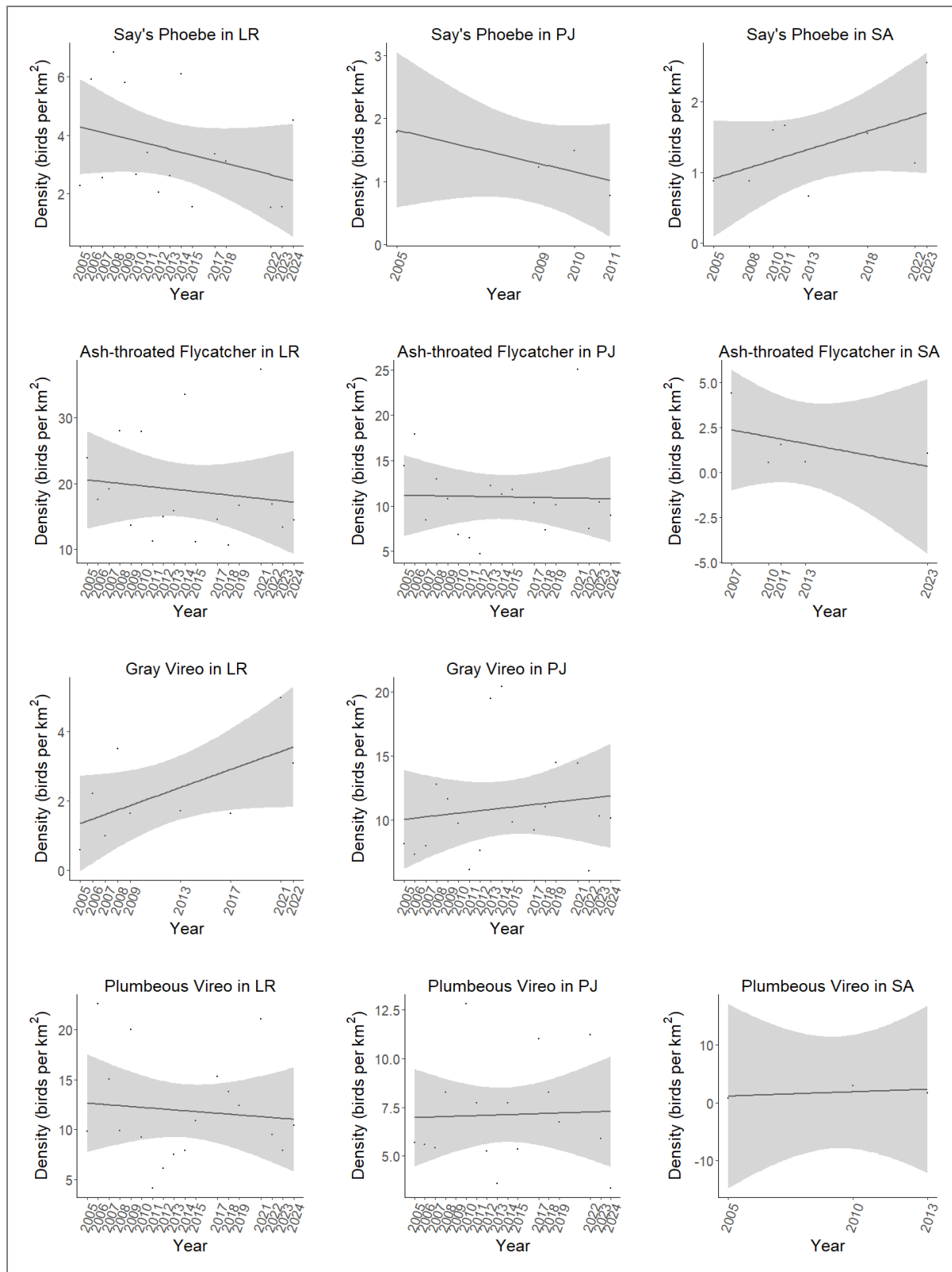


**Figure 7.** Trend lines for Say's phoebe, ash-throated flycatcher, gray vireo, and plumbeous vireo.  
NPS / TAYLOR SCHMIDT

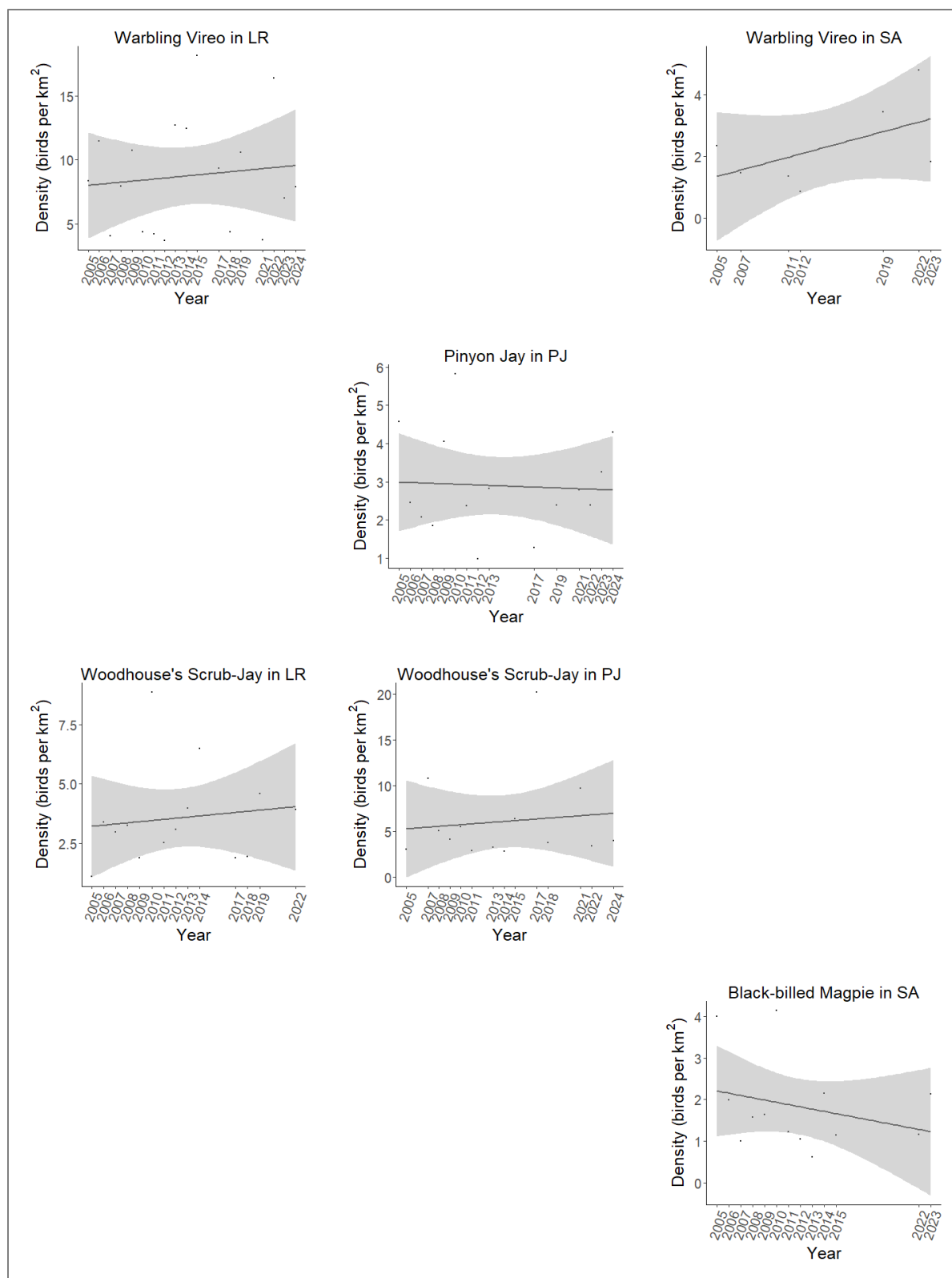


**Figure 8.** Trend lines for warbling vireo, pinyon jay, Woodhouse's scrub-jay, and black-billed magpie. NPS / TAYLOR SCHMIDT

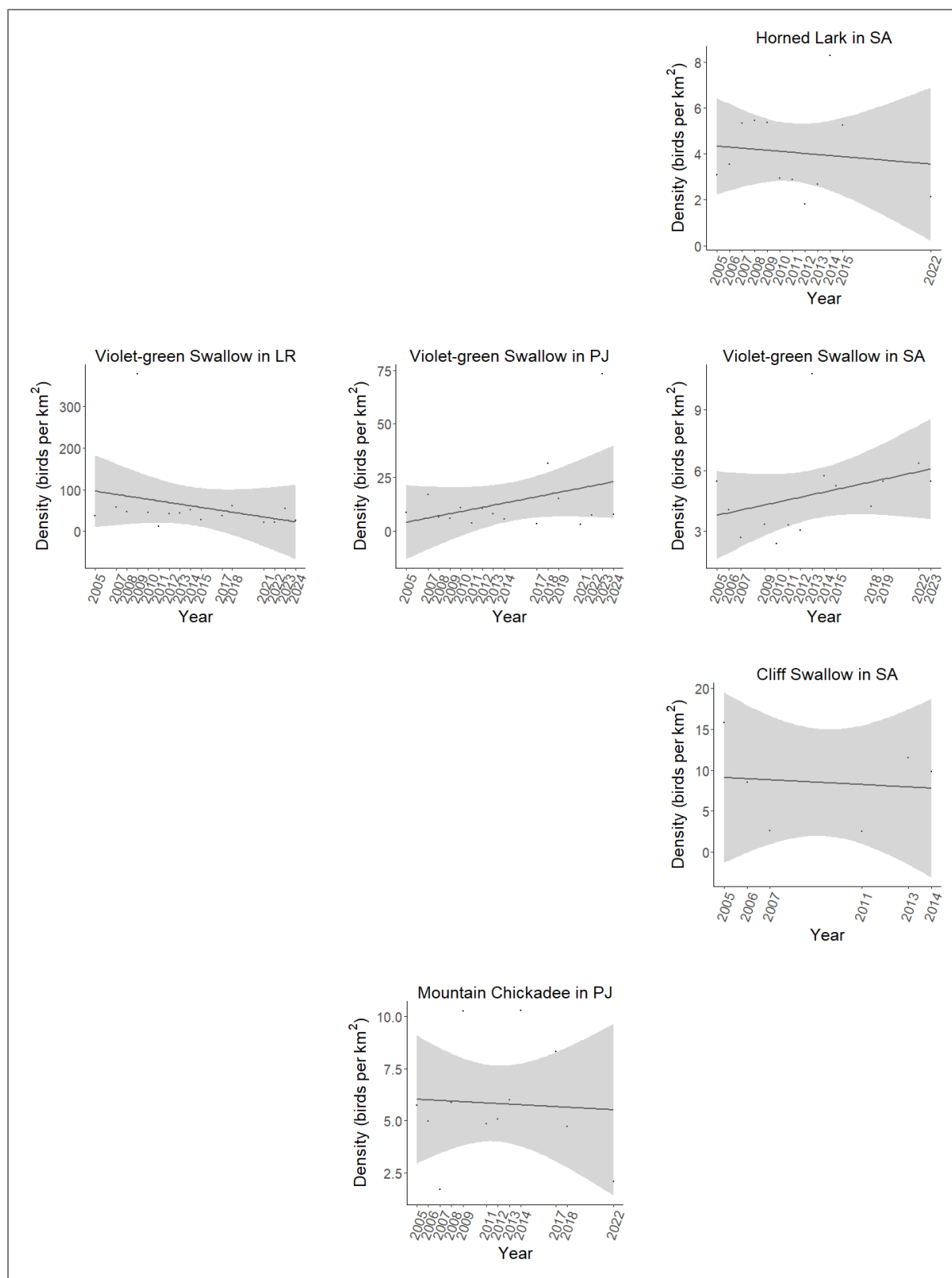


**Figure 9.** Trend lines for horned lark, violet-green swallow, cliff swallow, and mountain chickadee.  
NPS / TAYLOR SCHMIDT

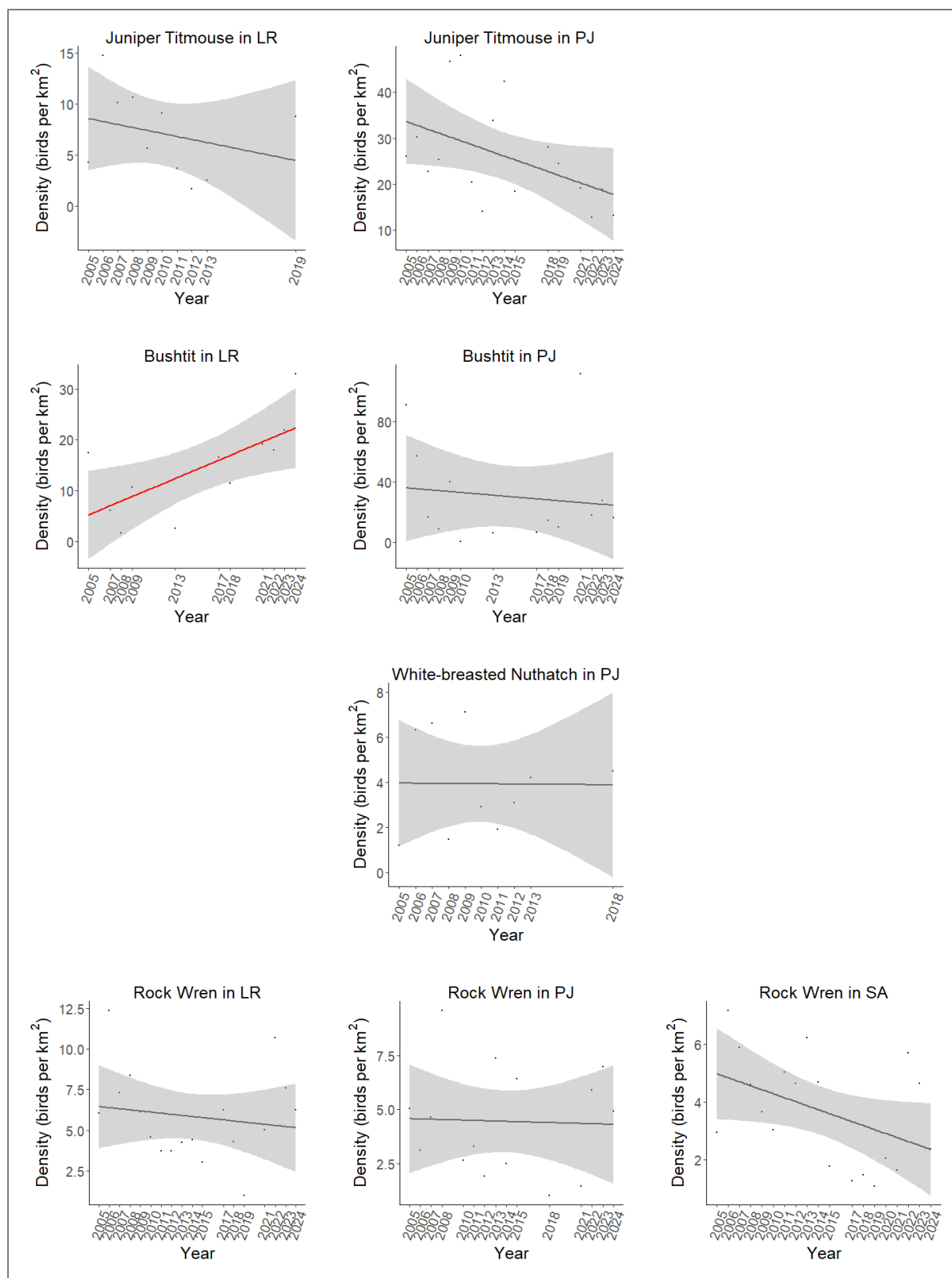


**Figure 10.** Trend lines for juniper titmouse, bushtit, white-breasted nuthatch, and rock wren.  
NPS / TAYLOR SCHMIDT

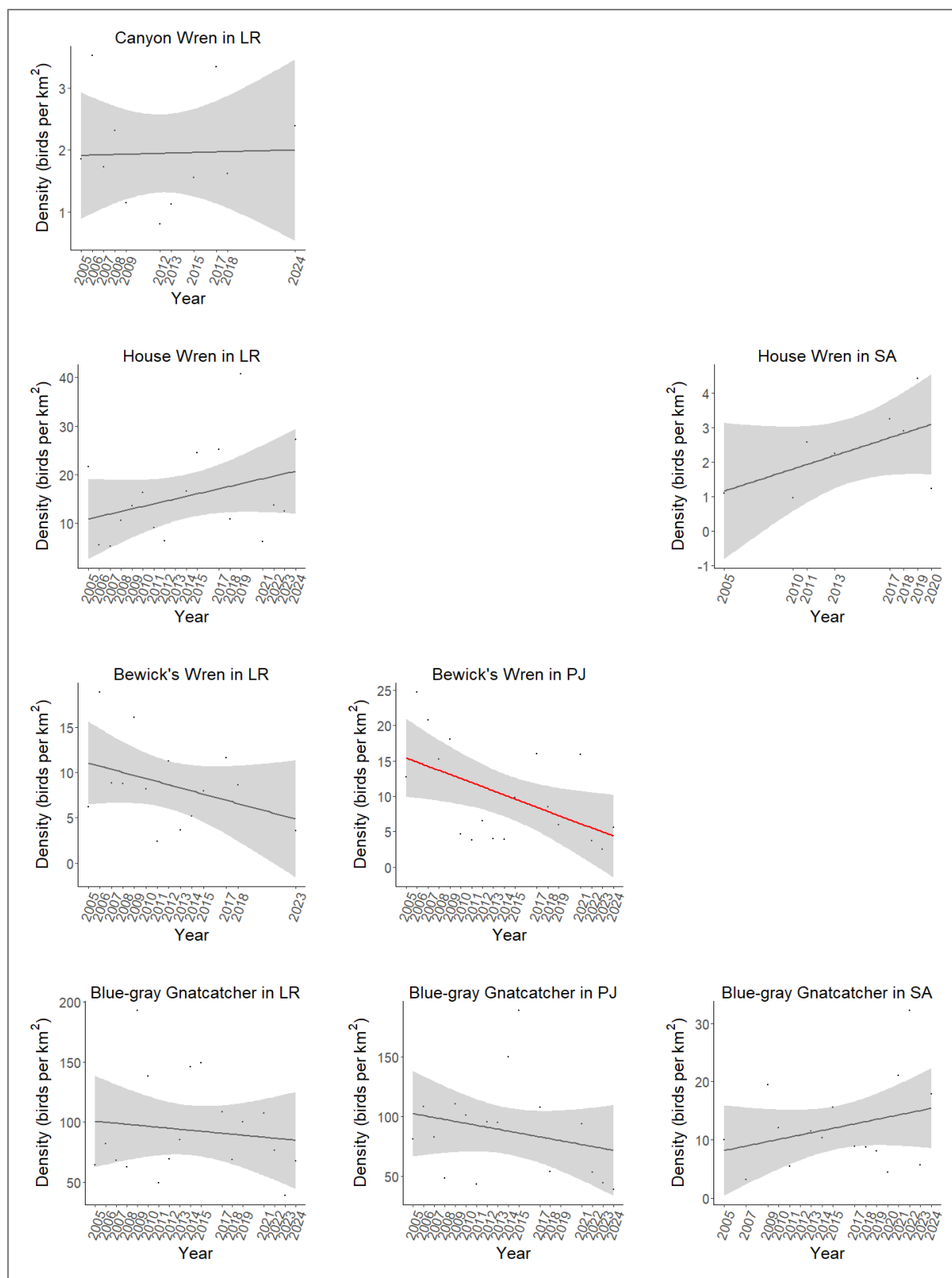


**Figure 11.** Trend lines for canyon wren, house wren, Bewick's wren, and blue-gray gnatcatcher.  
NPS / TAYLOR SCHMIDT

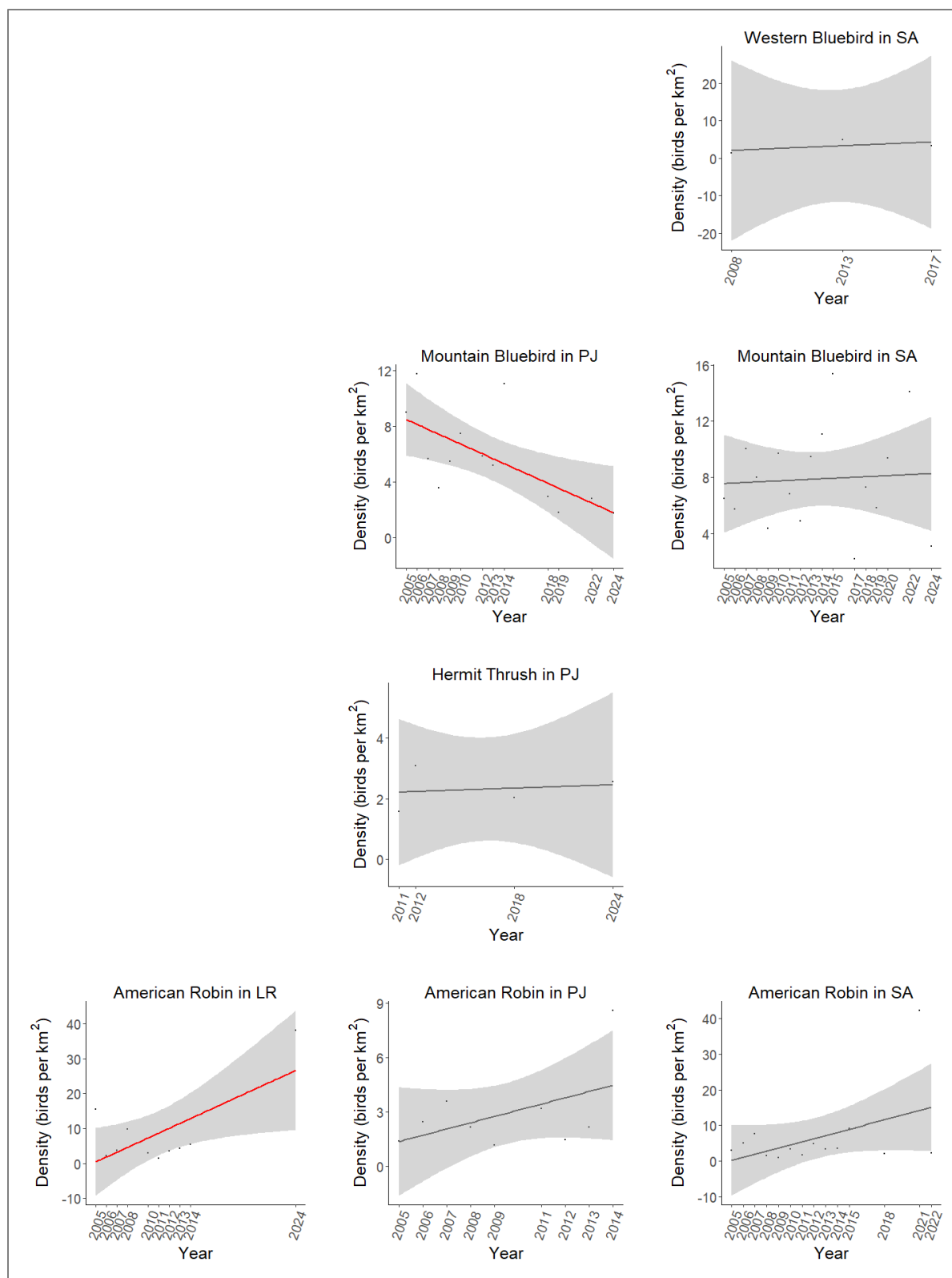


**Figure 12.** Trend lines for western bluebird, mountain bluebird, hermit thrush, and American robin.  
NPS / TAYLOR SCHMIDT

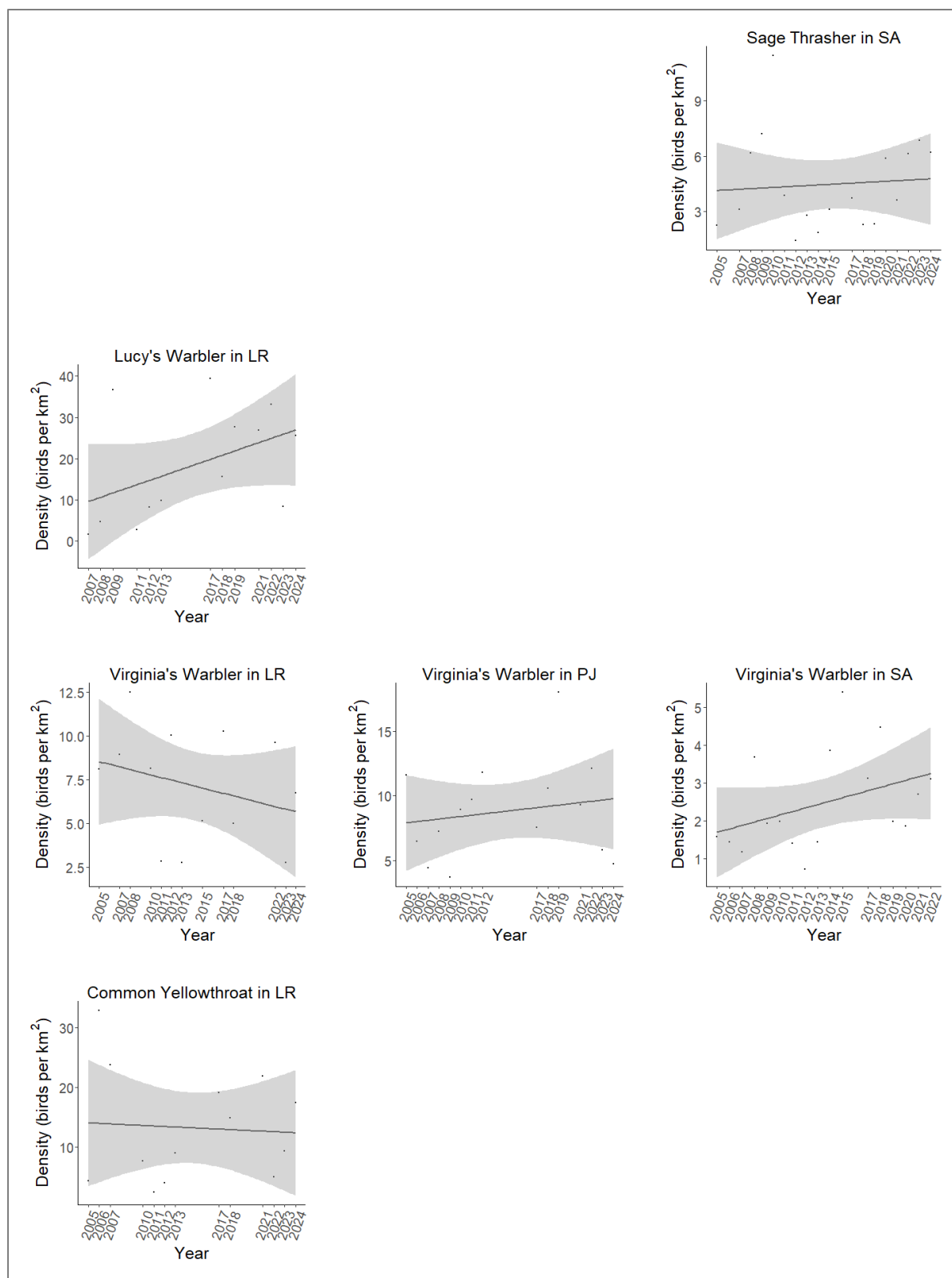


**Figure 13.** Trend lines for sage thrasher, Lucy's warbler, Virginia's warbler, and common yellowthroat.  
NPS / TAYLOR SCHMIDT

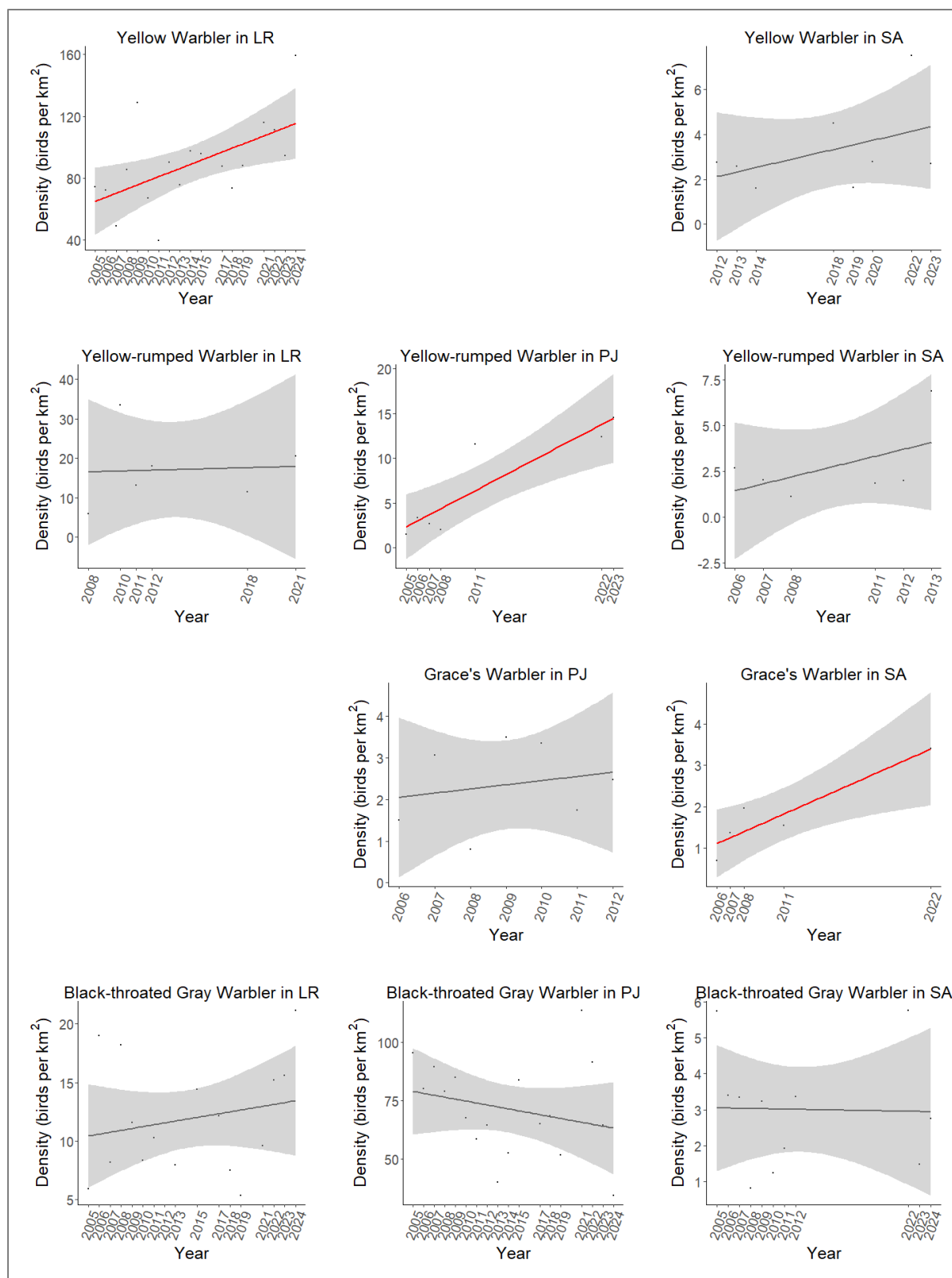


**Figure 14.** Trend lines for yellow warbler, yellow-rumped warbler, Grace's warbler, and black-throated gray warbler. NPS / TAYLOR SCHMIDT

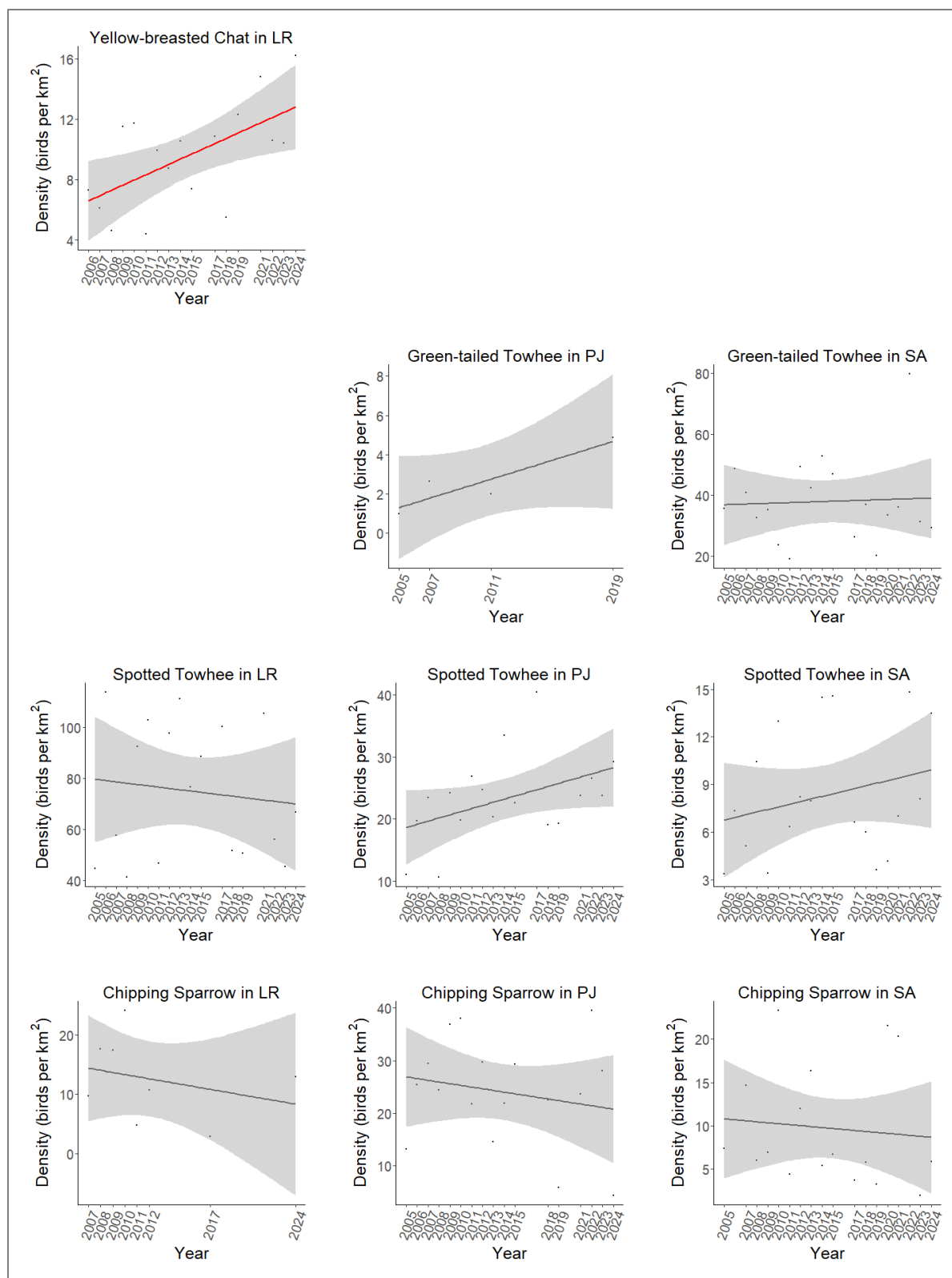


**Figure 15.** Trend lines for yellow-breasted chat, green-tailed towhee, spotted towhee, and chipping sparrow. NPS / TAYLOR SCHMIDT

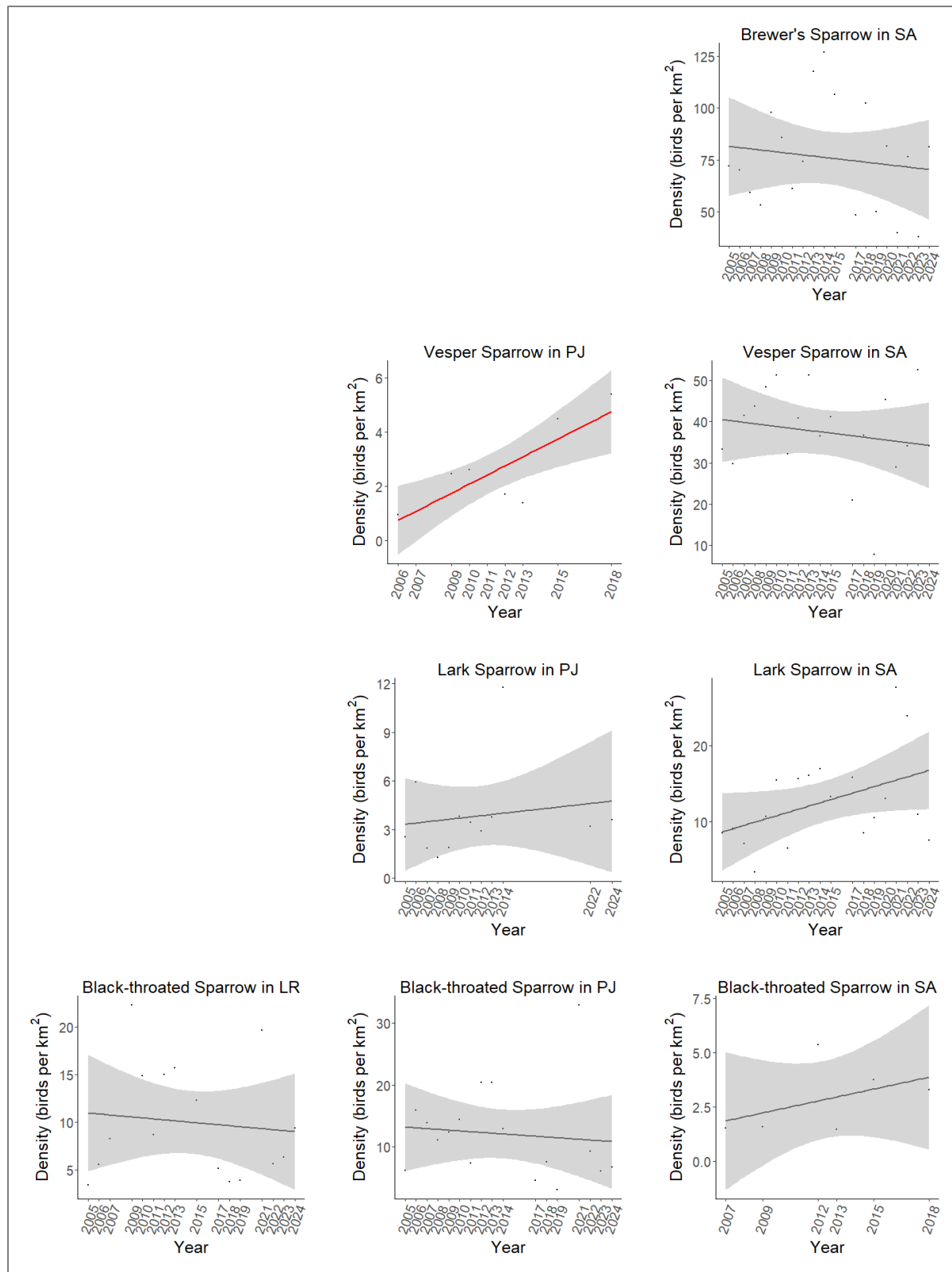


**Figure 16.** Trend lines for Brewer's sparrow, vesper sparrow, lark sparrow, and black-throated sparrow.  
NPS / TAYLOR SCHMIDT

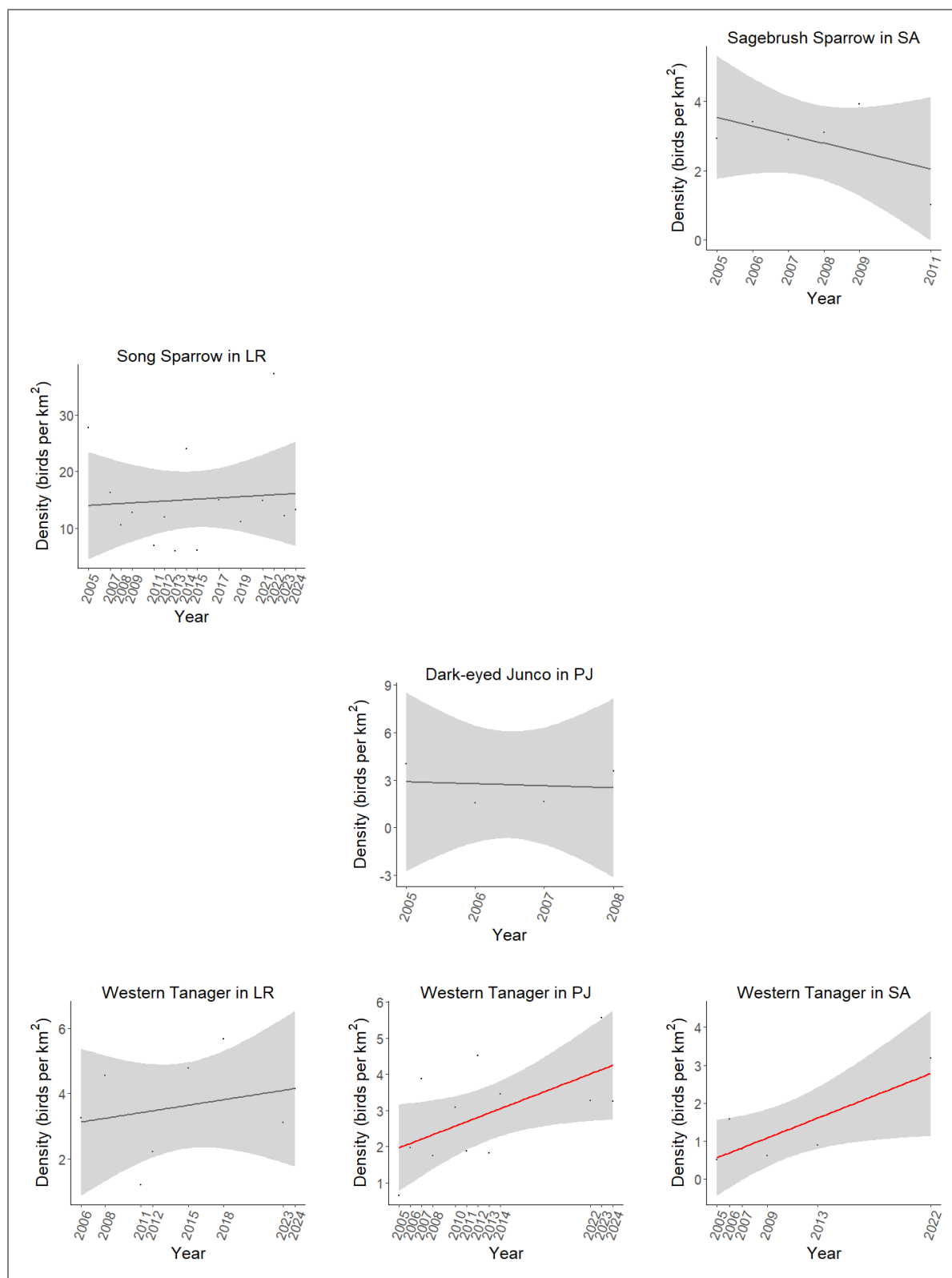


**Figure 17.** Trend lines for sagebrush sparrow, song sparrow, dark-eyed junco, and western tanager. NPS / TAYLOR SCHMIDT

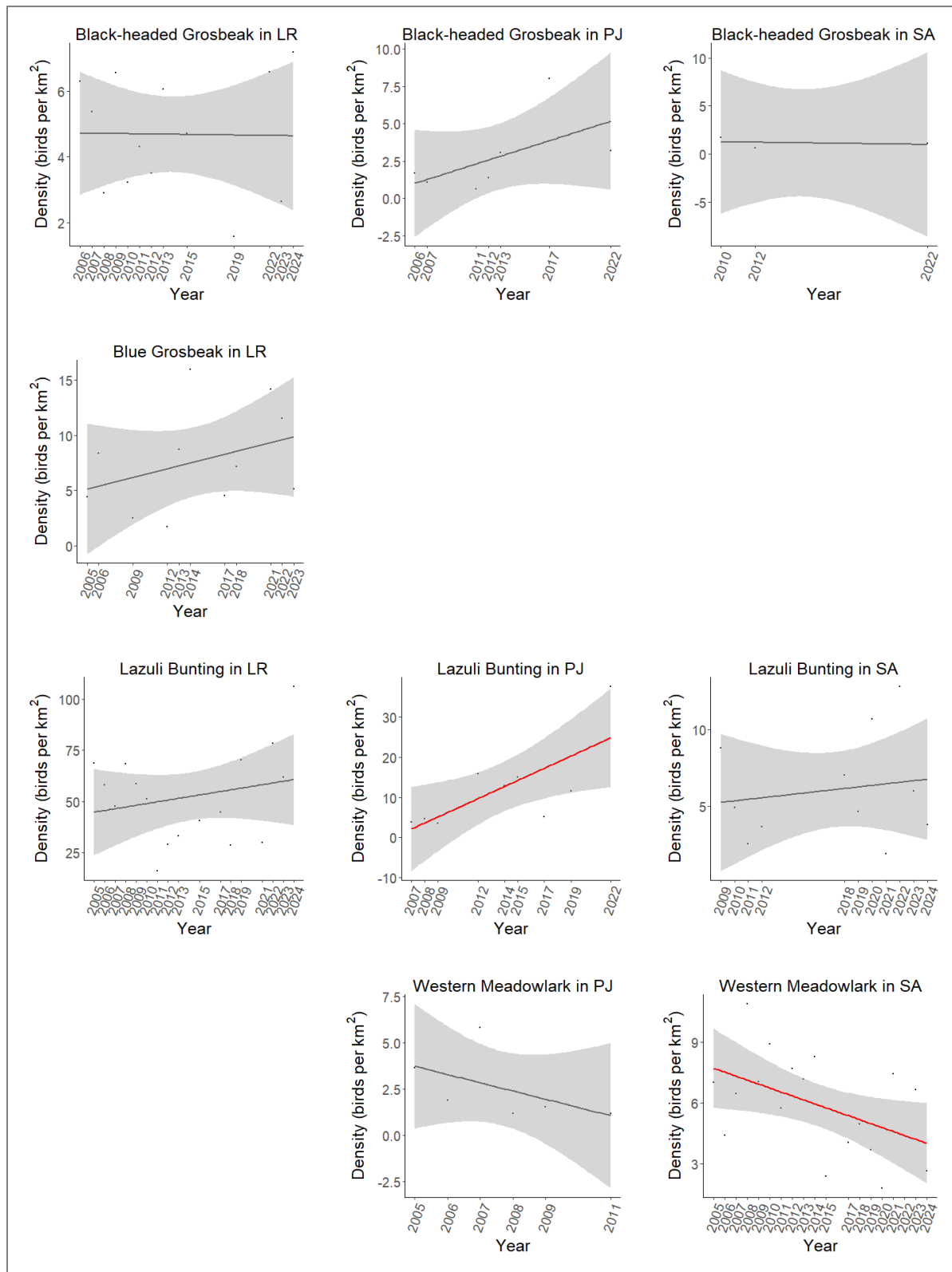


**Figure 18.** Trend lines for black-headed grosbeak, blue grosbeak, lazuli bunting, and western meadowlark. NPS / TAYLOR SCHMIDT

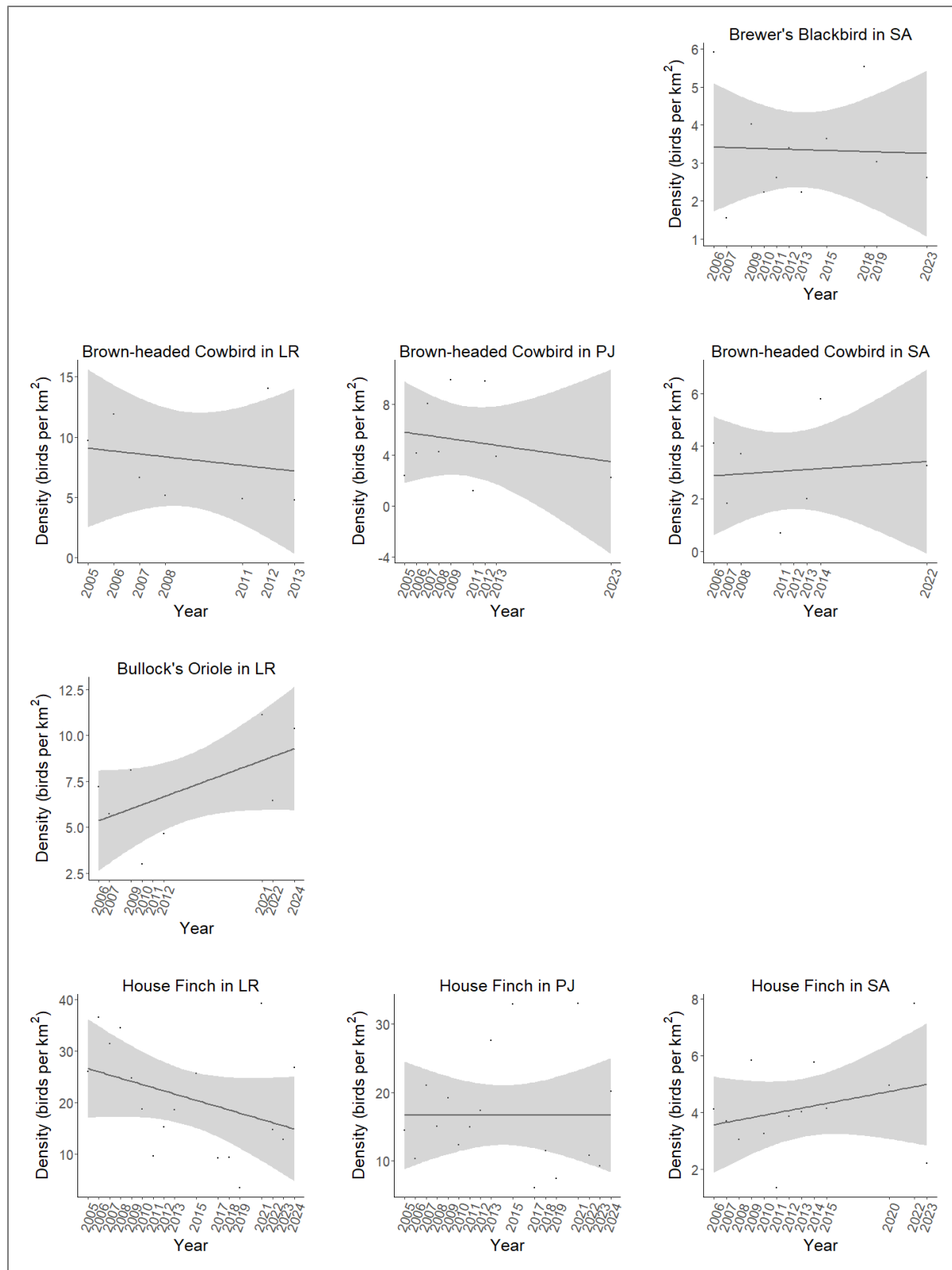


**Figure 19.** Trend lines for Brewer's blackbird, brown-headed cowbird, Bullock's oriole, and house finch.  
NPS / TAYLOR SCHMIDT

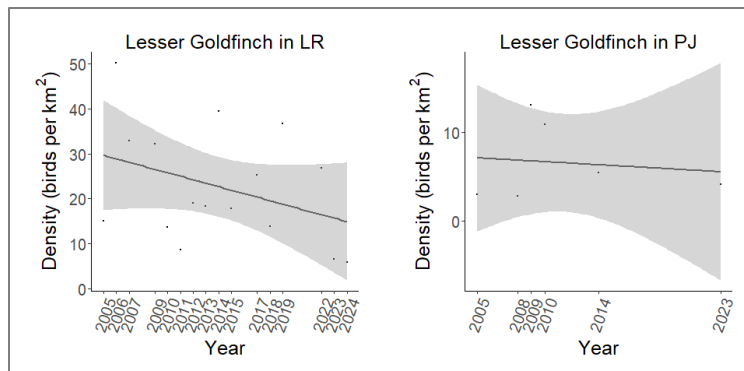


**Figure 20.** Trend lines for lesser goldfinch. NPS / TAYLOR SCHMIDT

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