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

2023 Field Season



California gull (*Larus californicus*), Utah's state bird.
NPS/WILL ELDER

Status and trends of landbird populations in the Northern Colorado Plateau Network: 2023 field season

Science Report NPS/SR—2024/138

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Abstract

In 2023, the University of Delaware, in cooperation with the National Park Service (NPS), completed the eighteenth year of a habitat-based landbird monitoring program in park 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 population information is useful for land managers and supports the NPS's goal of long-term monitoring of biological indicators for network parks.

University biologists surveyed 42 out of 45 survey locations within 11 NPS units in 2023. Fifteen transects were located in each of the three habitats of interest: low-elevation riparian, pinyon-juniper, and sagebrush shrubland. Each location was surveyed once. In addition to the habitat-based surveys, four point-count surveys and an area search were conducted at Pipe Spring National Monument using a modified monitoring design.

Over 18 years of data collection, 16,159 point-count surveys were conducted in 11 NCPN units, detecting 176 unique species. During the 2023 field season, 599 point-count surveys were conducted, detecting 118 unique species. In addition, since 2009, a modified protocol that includes four point counts and an area search has been conducted at Pipe Spring National Monument.

Using data from 2005 to 2023, 118 population-density trends were estimated across the three habitats. Fourteen of the estimated density trends were significant (p-value <0.05). Six negative trends were observed: mourning dove (*Zenaida macroura*) and white-throated swift (*Aeronautes saxatalis*) in low-elevation riparian, and mourning dove, white-throated swift, Bewick's wren (*Thryomanes bewickii*), and mountain bluebird (*Sialia currucoides*) in pinyon-juniper areas. Additionally, eight positive trends were found: hairy woodpecker (*Leuconotopicus villosus*) 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 habitats; and western tanager, Grace's warbler (*Setophaga graciae)* and lark sparrow (*Chondestes grammacus*) in sagebrush shrubland. There were sufficient sample sizes to estimate the densities of 61 species in at least one of the three habitats surveyed.

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).

Rosenberg and others (2019) estimated a loss of nearly three billion birds across North America since 1970. As bird populations decline, establishing and continuing long-term population monitoring is essential to identifying causes and developing 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 (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 US 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 (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 2023, the University of Delaware, in cooperation with the National Park Service (NPS), completed the eighteenth year of a habitat-based landbird monitoring program in NCPN units. 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, pinyon-juniper, and sagebrush shrubland. 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 and Figure 1). Each transect consists of 15 point-count locations, spaced 250 meters apart (Figures 2–4).

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

Park	Low-elevation riparian	Pinyon-juniper	Sagebrush shrubland
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

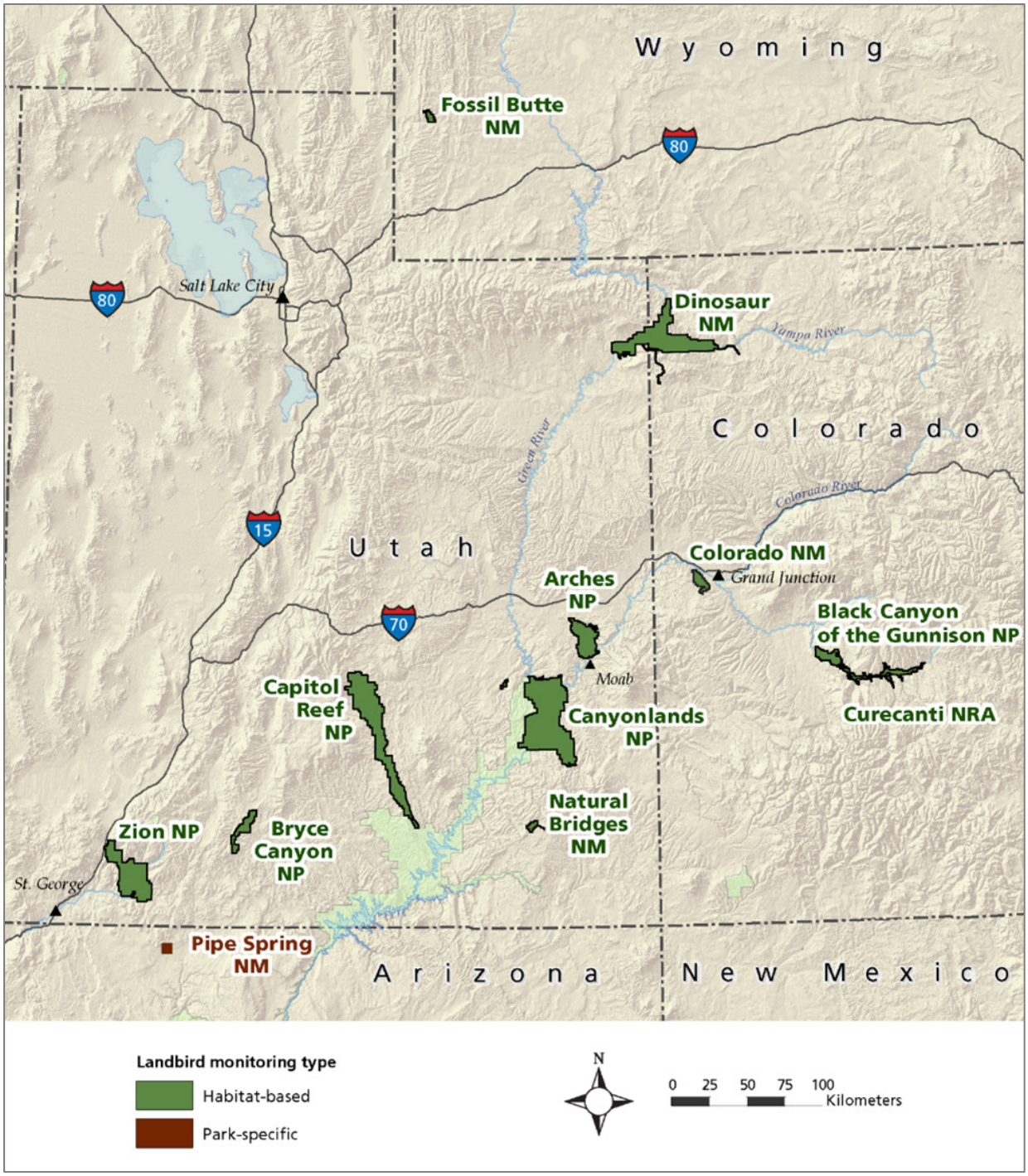


Figure 1. NCPN areas where landbirds are monitored.

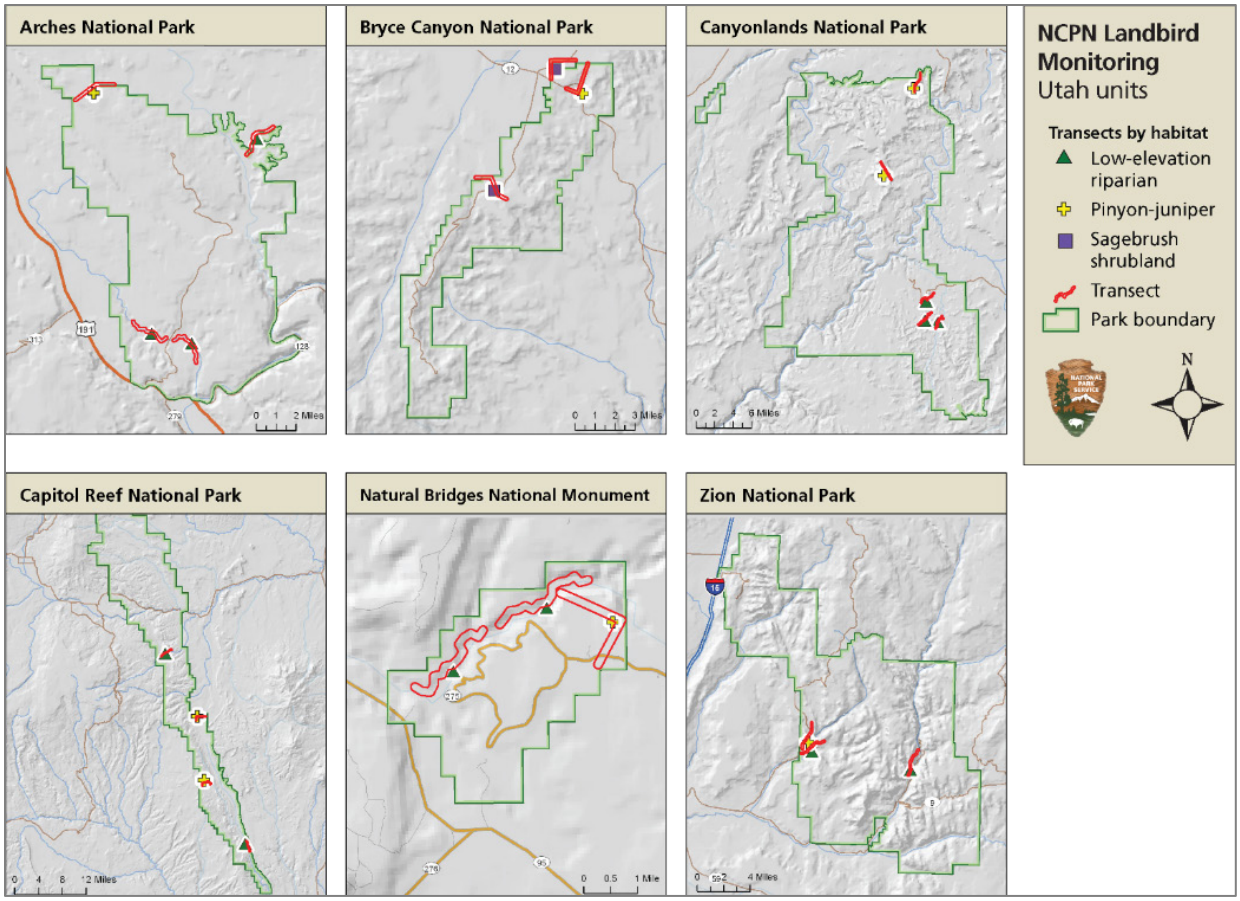


Figure 2. Transect locations by habitat, Utah units.

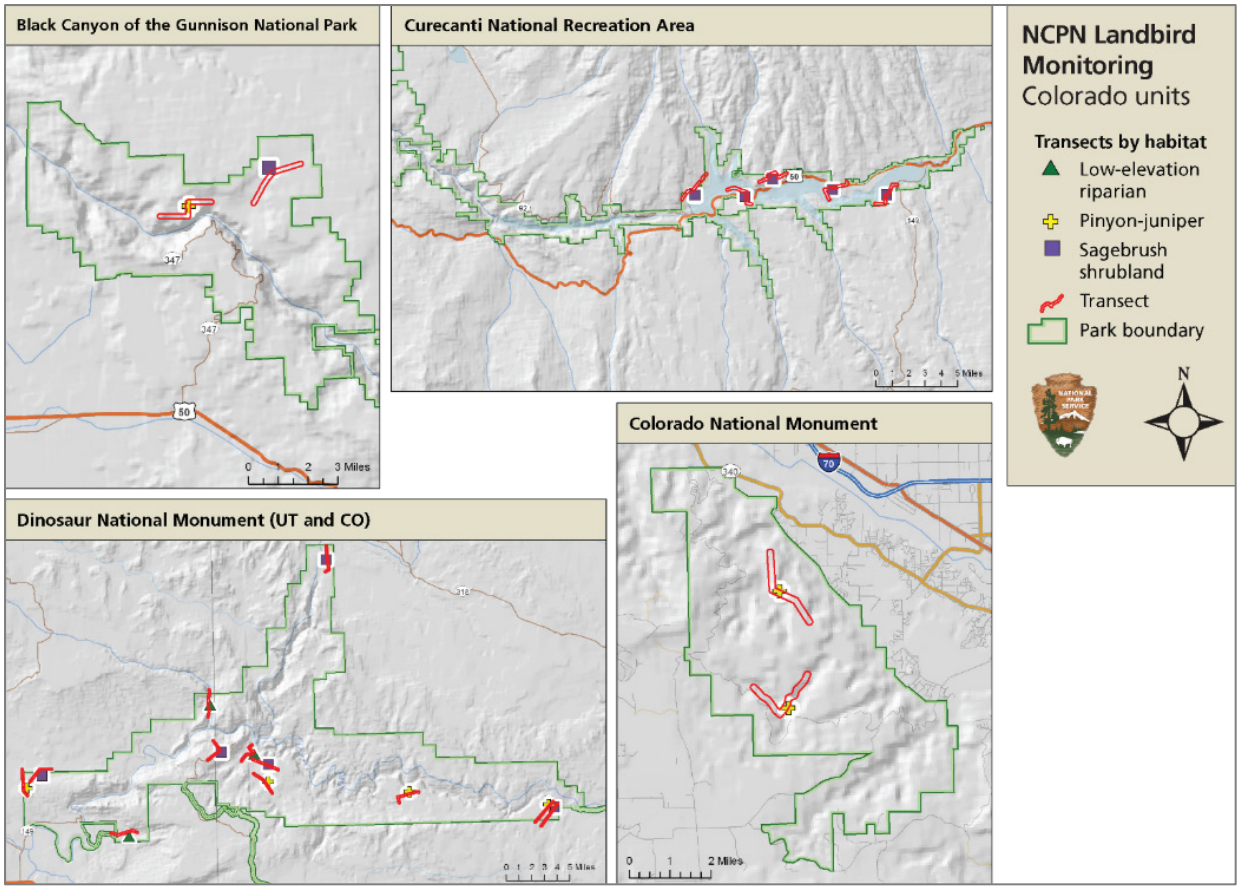


Figure 3. Transect locations by habitat, Colorado units.

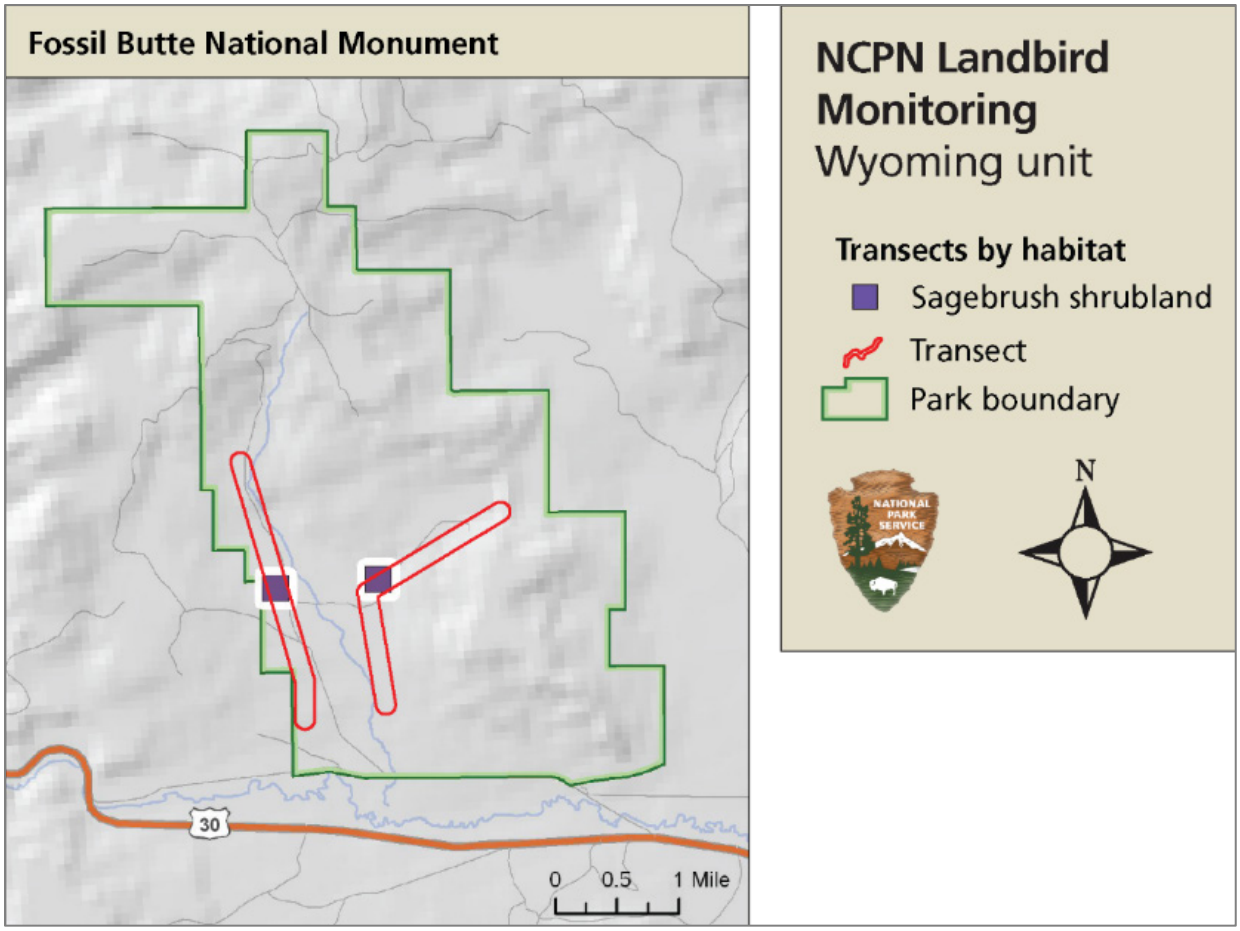


Figure 4. Transect locations, Fossil Butte National Monument.

The NPS and BCR used GIS and the Southwest Regional Re-GAP Analysis Project to randomly select pinyon-juniper and sagebrush shrubland 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. Due to the scarcity of riparian habitat in the NCPN, low-elevation riparian transect locations were manually selected. Sites with crossable streams were chosen, excluding the Colorado, Green, Gunnison, and Virgin rivers. Transects were ground-truthed and reassigned 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. Beginning in 2014, the 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).

Table 2. The annual number of point visits within each habitat.

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

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. All transects are completed during the breeding season, which occurs between May 1 and July 15, depending on the transit 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 daily, 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 mph or precipitation is heavier than 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 additional, non-dominant habitat types are also recorded.

During the five-minute point count, observers record all bird detections, regardless of the 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 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 (2017) and the NCPN website. Links to past and current protocols and annual reports may also be found at that site.

Data Analysis

Distance Sampling

- We used the Distance package in program R [version 3.1.3; R Core Team (2014)], which uses 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: All objects at the sampling location are detected.
- Objects are stationary or detected before movement occurs.
- 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 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 cutoff 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.
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 fitted 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 that were based on at least 10 detections within the distance cutoff (125 meters). This was done because annual density estimates within a habitat that are based on a low number (<10) of annual detections can lead to inaccurate density estimates (MacKenzie et al. 2006), which are not appropriate to include.

Results

Through 18 years of data collection, 16,378 point-count surveys have been conducted in 11 NCPN units (see Table 1), detecting 176 unique species. Of those 176 species, 165 were within 125 meters of the observer, the established distance cutoff for our analyses. In 2023, between May 11 and June 27, field technicians visited 42 of the 45 planned habitat-based transects and conducted 599 point-count surveys. A total of 4,936 individual birds of 118 unique species were recorded. Three new species were detected for this monitoring program: a northern pygmy owl (*Glaucidium californicum*) in Canyonlands National Park, and a sandhill crane (*Grus canadensis*) and California gull (*Larus californicus*) in Fossil Butte National Monument.

For the first time in this monitoring program, cedar waxwing (*Bombycilla cedrorum*) and peregrine falcon *(Falco peregrinus)* were detected in Arches National Park, Townsend's solitaire (*Myadestes townsendi*) was detected in Canyonlands National Park, Cordilleran flycatcher (*Empidonax occidentalis*) was detected in Colorado National Monument, Savannah sparrow (*Passerculus sandwichensis*) was detected in Curecanti National Recreation Area, osprey (*Pandion haliaetus*) in Dinosaur National Monument, and Virginia's warbler (*Leiothlypis virginiae*) and Brewer's blackbird (*Euphagus cyanocephalus*) in Pipe Spring 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. Fourteen of the estimated density trends were significant (p-value <0.05), including six negative trends and eight positive trends (Tables 3 and 4).

Table 3. Significant density trends for landbird species in the NCPN, 2023. "NA" = not enough data available; "–" = no trend.

	Habitat		
Species	**Low-elevation riparian**	**Pinyon-juniper**	**Sagebrush shrubland**
Mourning dove	↓	↓	–
White-throated swift	↓	↓	–
Hairy woodpecker	↑	NA	NA
Bewick's wren	–	↓	NA
Mountain bluebird	NA	↓	–
Yellow-rumped warbler	–	↑	–
Grace's warbler	NA	–	↑
Vesper sparrow	NA	↑	–
Lark sparrow	NA	–	↑
Western tanager	–	↑	↑
Lazuli bunting	–	↑	–

Table 4. Population-density trend slope, R^2 values, and sample size of estimated annual densities for individual species in low-elevation riparian, pinyon-juniper, and sagebrush shrubland habitats in the NCPN, 2005–2015 and 2017–2023.

	Low-elevation riparian			Pinyon-juniper			Sagebrush shrubland		
Common name	Slope [A]	R^2	Sample size [B]	Slope [A]	R^2	Sample size [B]	Slope [A]	R^2	Sample size [B]
Mourning dove	−0.68[E]	0.59	15	−1.24[D]	0.49	17	−0.13	0.13	11
White-throated swift	−0.82[D]	0.44	17	−0.53[D]	0.43	16	−1	0.12	4
Hairy woodpecker	0.8[C]	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	−0.16	0.01	17	0.01	0.00	9
Dusky flycatcher	NA	NA	NA	−0.21	0.06	15	0.29	0.13	18
Black phoebe	0.16	0.02	7	NA	NA	NA	NA	NA	NA
Say's phoebe	−0.15	0.21	15	−0.13	0.67	4	0.05	0.31	8
Ash-throated flycatcher	−0.12	0.01	17	0.02	0.00	17	−0.13	0.24	5
Gray vireo	0.13	0.38	9	0.13	0.03	17	NA	NA	NA
Plumbeous vireo	−0.07	0.01	17	0.11	0.06	16	0.15	0.29	3
Warbling vireo	0.11	0.02	17	NA	NA	NA	0.1	0.30	7
Pinyon jay	NA	NA	NA	−0.04	0.04	14	NA	NA	NA
Woodhouse's scrub-jay	0.05	0.02	14	0.18	0.04	13	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	−3.95	0.06	15	1.33	0.18	15	0.13	0.12	14
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	−0.74	0.16	16	NA	NA	NA
Bushtit	0.65	0.37	10	−0.44	0.01	13	NA	NA	NA
White-breasted nuthatch	NA	NA	NA	−0.01	0.00	10	NA	NA	NA
Rock wren	−0.09	0.03	17	−0.03	0.00	14	−0.14	0.17	18
Canyon wren	−0.02	0.01	10	NA	NA	NA	NA	NA	NA
House wren	0.39	0.06	17	NA	NA	NA	0.13	0.31	8
Bewick's wren	−0.34	0.14	14	−0.6[C]	0.25	17	NA	NA	NA

[A] 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.

[B] Slope with no asterisks = p-value > 0.05.

[C] p-value ≤ 0.05.

[D] p-value ≤ 0.01.

[E] p-value ≤ 0.001.

Table 4 (continued). Population-density trend slope, R^2 values, and sample size of estimated annual densities for individual species in low-elevation riparian, pinyon-juniper, and sagebrush shrubland habitats in the NCPN, 2005–2015 and 2017–2023.

	Low-elevation riparian			Pinyon-juniper			Sagebrush shrubland		
Common name	Slope [A]	R^2	Sample size [B]	Slope [A]	R^2	Sample size [B]	Slope [A]	R^2	Sample size [B]
Blue-gray gnatcatcher	−0.48	0.00	17	−0.97	0.02	17	0.33	0.06	16
Western bluebird	NA	NA	NA	NA	NA	NA	0.25	0.38	3
Mountain bluebird	NA	NA	NA	−0.35[C]	0.36	12	0.18	0.07	16
Hermit thrush	NA	NA	NA	−0.02	0.01	3	NA	NA	NA
American robin	−0.63	0.20	9	0.34	0.24	9	0.87	0.20	14
Sage thrasher	NA	NA	NA	NA	NA	NA	0.01	0.00	17
Lucy's warbler	1.06	0.18	12	NA	NA	NA	NA	NA	NA
Virginia's warbler	−0.18	0.10	12	0.2	0.12	14	0.09	0.15	17
Common yellowthroat	−0.2	0.02	12	NA	NA	NA	NA	NA	NA
Yellow warbler	1.78	0.20	17	NA	NA	NA	0.2	0.19	8
Yellow-rumped warbler	0.11	0.00	6	0.67[D]	0.81	7	0.38	0.27	6
Grace's warbler	NA	NA	NA	0.1	0.04	7	0.14[C]	0.86	5
Black-throated gray warbler	0	0.00	16	−0.25	0.01	17	0	0.00	10
Yellow-breasted chat	0.27	0.24	16	NA	NA	NA	NA	NA	NA
Green-tailed towhee	NA	NA	NA	0.24	0.82	4	0.29	0.01	18
Spotted towhee	−0.44	0.01	17	0.49	0.16	17	0.1	0.02	18
Chipping sparrow	−1.3	0.32	7	0.02	0.00	16	−0.06	0.00	17
Brewer's sparrow	NA	NA	NA	NA	NA	NA	−0.78	0.03	18
Vesper sparrow	NA	NA	NA	0.33[D]	0.69	9	−0.33	0.03	18
Lark sparrow	NA	NA	NA	0.14	0.06	11	0.59[C]	0.32	18
Black-throated sparrow	−0.11	0.01	15	−0.04	0.00	16	0.18	0.21	6
Sagebrush sparrow	NA	NA	NA	NA	NA	NA	−0.25	0.29	6
Song sparrow	0.18	0.01	14	NA	NA	NA	NA	NA	NA
Dark-eyed junco	NA	NA	NA	−0.13	0.02	4	NA	NA	NA
Western tanager	0.06	0.05	7	0.15[C]	0.41	11	0.13[C]	0.67	6
Black-headed grosbeak	−0.08	0.08	12	0.26	0.33	7	−0.02	0.07	3

[A] 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.

[B] Slope with no asterisks = p-value > 0.05.

[C] p-value ≤ 0.05.

[D] p-value ≤ 0.01.

[E] p-value ≤ 0.001.

Table 4 (continued). Population-density trend slope, R^2 values, and sample size of estimated annual densities for individual species in low-elevation riparian, pinyon-juniper, and sagebrush shrubland habitats in the NCPN, 2005–2015 and 2017–2023.

	Low-elevation riparian			Pinyon-juniper			Sagebrush shrubland		
Common name	Slope [A]	R^2	Sample size [B]	Slope [A]	R^2	Sample size [B]	Slope [A]	R^2	Sample size [B]
Blue grosbeak	0.26	0.12	11	NA	NA	NA	NA	NA	NA
Lazuli bunting	−0.07	0.00	16	1.52[C]	0.53	9	0.19	0.08	10
Western meadowlark	NA	NA	NA	−0.45	0.27	6	−0.17	0.18	18
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	0.17	0.18	8	NA	NA	NA	NA	NA	NA
House finch	−0.85	0.22	16	−0.07	0.00	16	0.08	0.08	13
Lesser goldfinch	−0.56	0.06	15	−0.09	0.02	6	NA	NA	NA

[A] 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.

[B] Slope with no asterisks = p-value > 0.05.

[C] p-value ≤ 0.05.

[D] p-value ≤ 0.01.

[E] p-value ≤ 0.001.

With the addition of 2023 density estimates, we saw these trends change: the western tanager and Bewick's wren density trends changed from non-significant to significantly positive in pinyon-juniper; the rock wren, and western meadowlark trends changed from significantly negative to non-significant in sagebrush shrubland; and the house finch trend changed from significantly positive to non-significant in sagebrush shrubland.

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 2023, we completed all four point-count surveys and the area search in Pipe Spring National Monument. We detected 132 individuals of 34 species during surveys in Pipe Spring National Monument (Table 5). Sample sizes were too low for density trends to be estimated for Pipe Spring National Monument.

Table 5. Number of individual birds detected during point counts and area searches in Pipe Spring National Monument, 2009–2023, excluding years 2016 and 2020 when surveys were not conducted.

	Point counts		Area searches		
Species	**2009–2022**	**2023**	**2009–2022**	**2023**	**Total**
Mallard	0	0	1	0	1
Mallard (domestic)	0	0	10	0	10
Gambel's quail	50	0	44	1	95
Black-crowned night-heron	1	0	12	0	13
Cooper's hawk	3	0	3	1	7
Red-tailed hawk	1	0	4	0	5
Eurasian collared-dove	53	0	87	1	141
Mourning dove	32	0	50	4	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	0	24
Black-chinned hummingbird	2	0	2	1	5
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	0	5
Prairie falcon	1	0	1	0	2
Western wood-pewee	3	0	8	2	13
Gray flycatcher	1	0	2	0	3
Black phoebe	6	0	18	0	24
Say's phoebe	33	2	30	1	66
Ash-throated flycatcher	36	1	27	3	67
Cassin's kingbird	62	1	37	1	101
Western kingbird	43	2	42	7	94
Gray vireo	7	1	2	7	17
Warbling vireo	0	0	4	0	4
Pinyon jay	1	0	1	0	2

Table 5 (continued). Number of individual birds detected during point counts and area searches in Pipe Spring National Monument, 2009–2023, excluding years 2016 and 2020 when surveys were not conducted.

Species	Point counts		Area searches		Total
	2009–2022	2023	2009–2022	2023	
Woodhouse's scrub-jay	3	0	7	0	10
Common raven	42	1	30	1	74
Violet-green swallow	30	0	71	1	102
Northern rough-winged swallow	11	0	6	0	17
Cliff swallow	0	0	2	0	2
Barn swallow	2	0	0	0	2
Juniper titmouse	6	0	1	1	8
Bushtit	0	0	1	0	1
Rock wren	26	3	6	0	35
Canyon wren	2	0	1	0	3
House wren	2	0	2	0	4
Bewick's wren	24	0	35	1	60
Blue-gray gnatcatcher	8	0	5	1	14
Ruby-crowned kinglet	0	0	1	0	1
American robin	3	0	0	0	3
Northern mockingbird	29	0	5	3	37
Sage thrasher	1	0	0	0	1
European starling	27	1	92	0	120
Cedar waxwing	0	1	3	0	4
Northern waterthrush	0	0	1	0	1
Orange-crowned warbler	0	0	2	0	2
MacGillivray's warbler	2	0	0	0	2
Virginia's warbler	0	0	0	1	1
Common yellowthroat	2	0	8	1	11
Yellow warbler	15	0	80	6	101
Yellow-rumped warbler	2	0	4	1	7
Black-throated gray warbler	5	0	2	0	7
Wilson's warbler	0	0	8	0	8
Yellow-breasted chat	0	0	2	0	2
Green-tailed towhee	3	0	8	3	14
Spotted towhee	6	0	0	0	6
Chipping sparrow	1	0	1	0	2
Brewer's sparrow	5	1	3	0	9
Lark sparrow	1	0	22	1	24

Table 5 (continued). Number of individual birds detected during point counts and area searches in Pipe Spring National Monument, 2009–2023, excluding years 2016 and 2020 when surveys were not conducted.

Species	Point counts		Area searches		Total
	2009–2022	2023	2009–2022	2023	
Black-throated sparrow	101	5	50	4	160
Lincoln's sparrow	0	0	1	0	1
White-crowned sparrow	26	2	70	31	129
Summer tanager	1	0	0	0	1
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	8	3	13
Red-winged blackbird	1	0	0	0	1
Western meadowlark	2	0	1	0	3
Yellow-headed blackbird	1	0	1	0	2
Brown-headed cowbird	16	0	18	5	39
Brewer's blackbird	0	0	0	2	2
Bullock's oriole	33	2	31	1	67
House finch	141	10	107	3	261
Pine siskin	2	0	31	0	33
Lesser goldfinch	10	0	11	0	21
House sparrow	8	0	53	0	61
Total	985	33	1,224	99	2,341

Discussion

As the western landscape continues to change due to anthropogenic land use and climate change, bird populations that cannot adapt are at risk of 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 18-year population-density trends within low-elevation riparian, pinyon-juniper, and sagebrush shrubland habitats for 61 species (118 species/habitat combinations: Appendix A). Most density trend estimates were non-significant, indicating the potential for stable populations for many species.

Of the 118 trend estimates, 14 were significant (p-value <0.05), including six negative trends (mourning dove and white-throated swift in low-elevation riparian; and mourning dove, white-throated swift, Bewick's wren, and mountain bluebird in pinyon-juniper) and eight positive trends (hairy woodpecker in low-elevation riparian; lazuli bunting, yellow-rumped warbler, vesper sparrow, western tanager, and lazuli bunting in pinyon-juniper; and western tanager, Grace's warbler and lark sparrow). 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 estimated 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 is crucial for obtaining 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 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 region-wide 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.

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Appendix A. Individual Species Habitat-based Density Trends by Habitat

Red lines indicate significant trends from a simple linear regression model in low-elevation riparian (LR), pinyon-juniper (PJ), and sagebrush shrubland (SA) habitats for individual species in Figures 5 through 20.

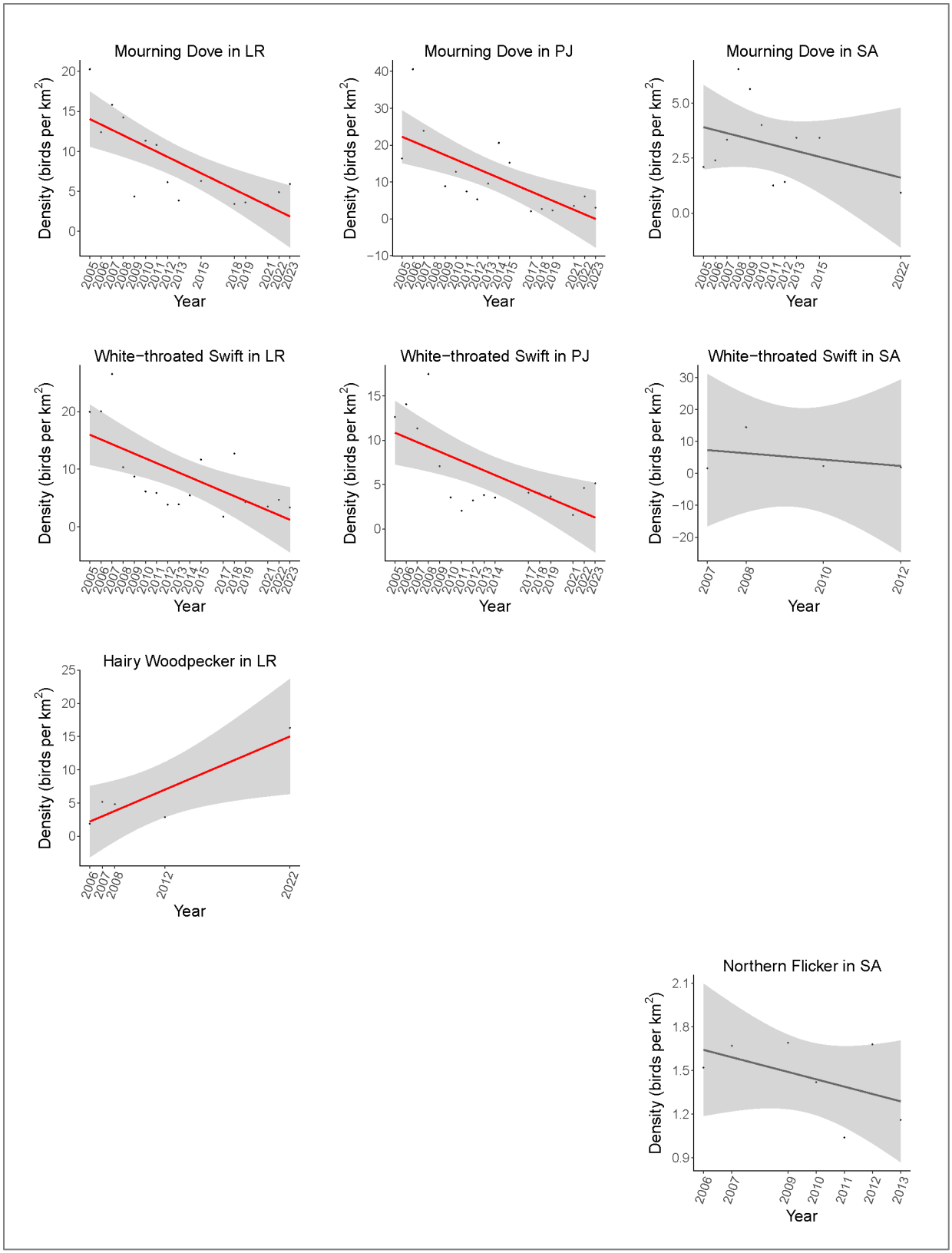


Figure 5. Trend lines in habitats for mourning dove, white-throated swift, hairy woodpecker, and northern flicker.

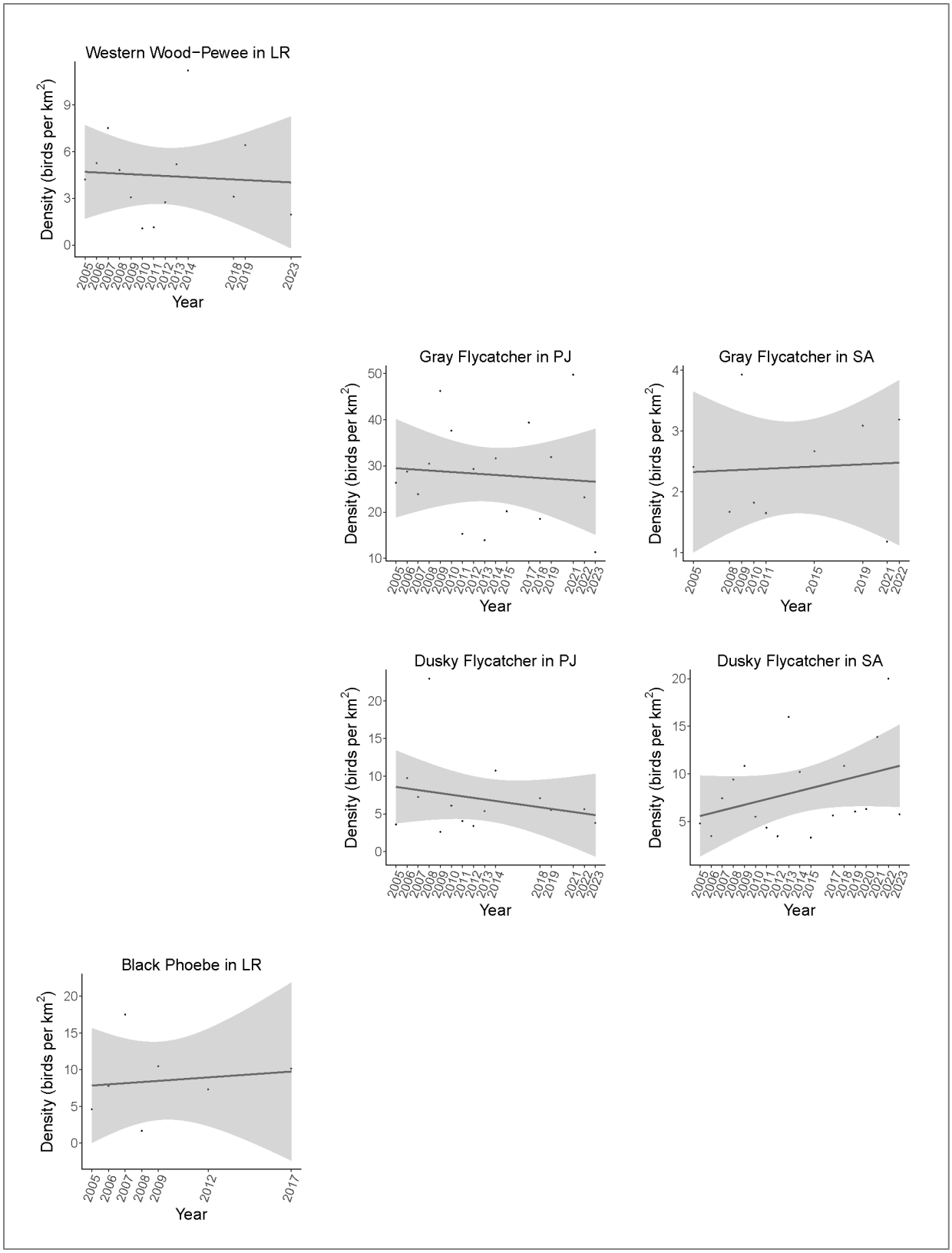


Figure 6. Trend lines for western wood-pewee, gray flycatcher, dusky flycatcher, and black phoebe.

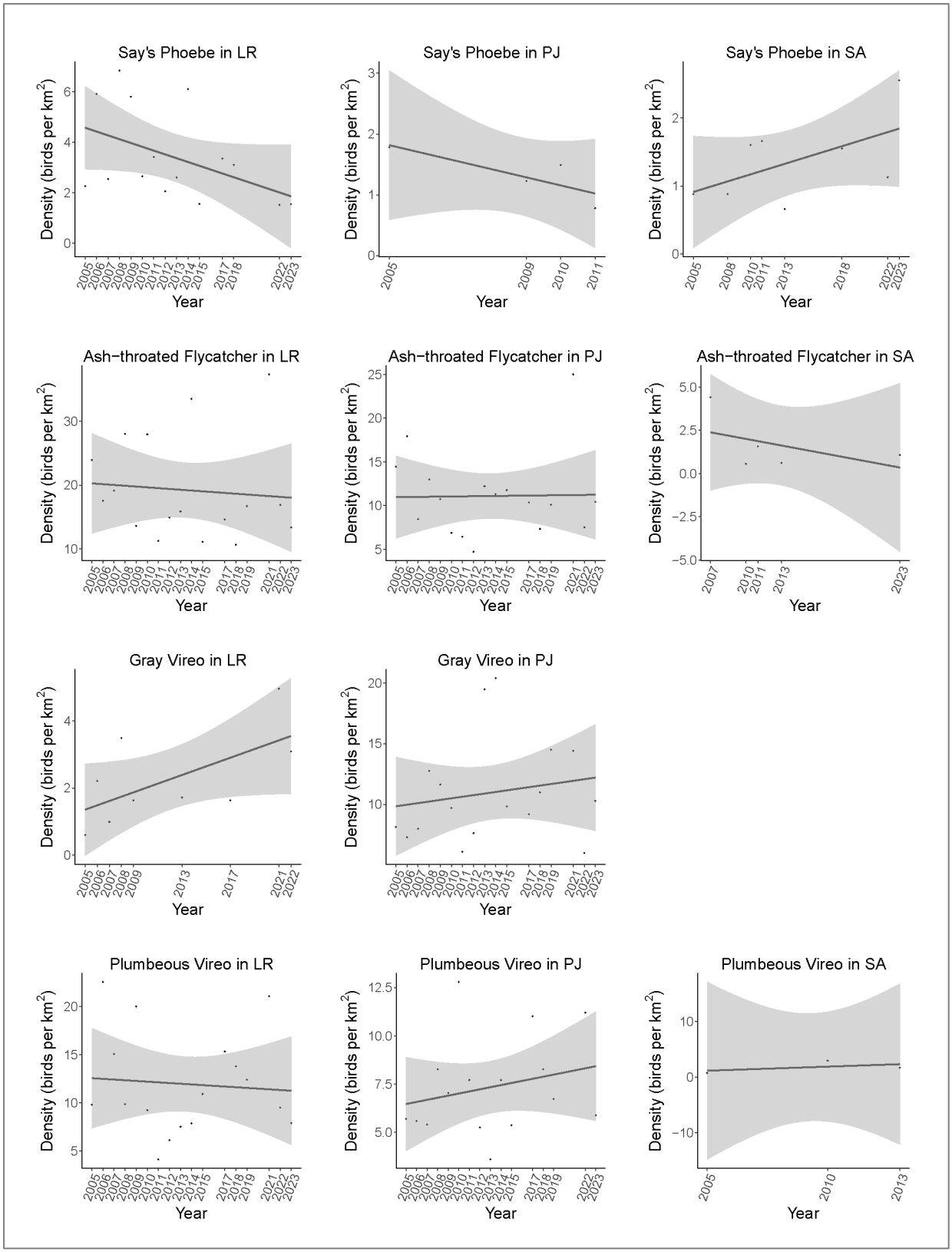


Figure 7. Trend lines for Say's phoebe, ash-throated flycatcher, gray vireo, and plumbeous vireo.

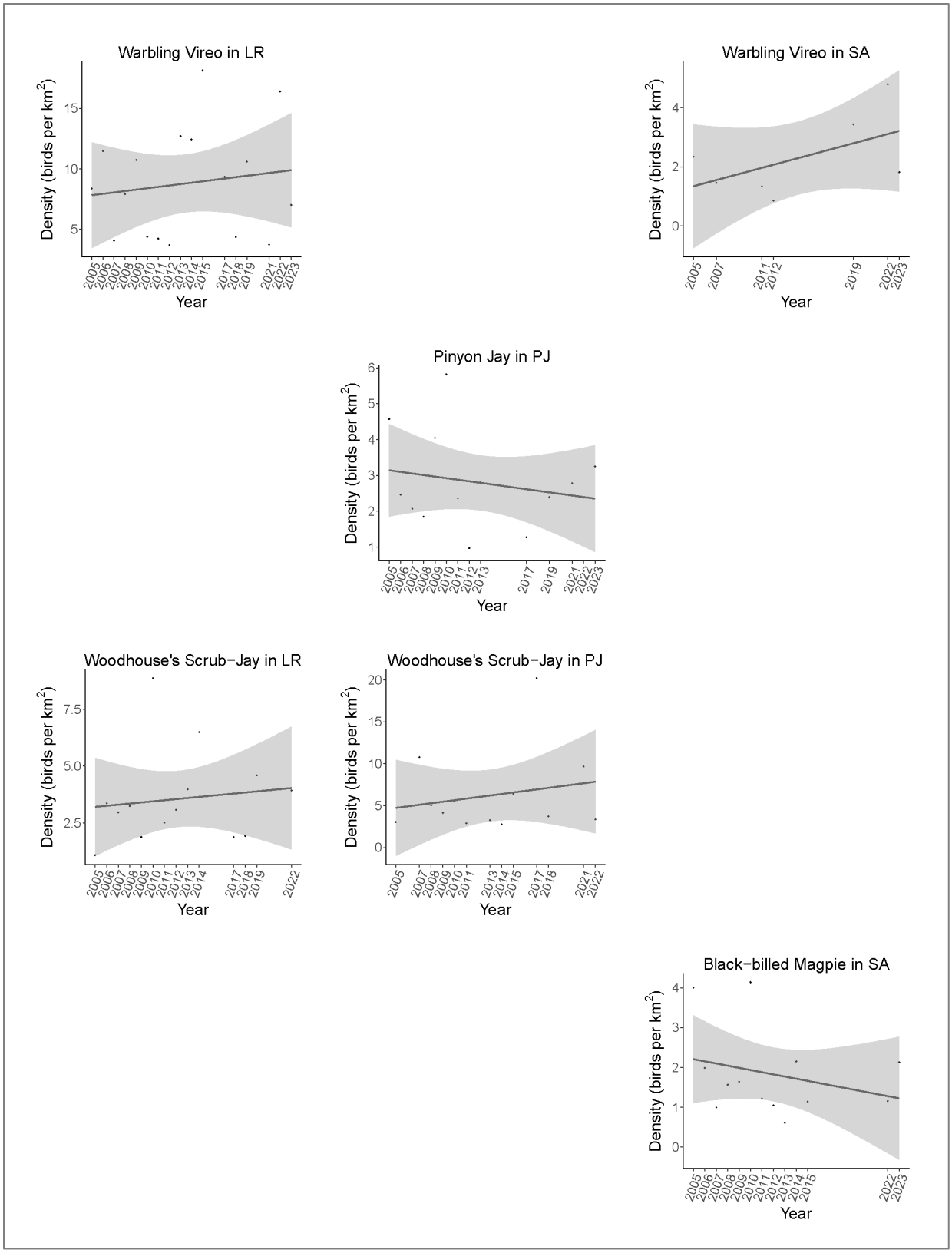


Figure 8. Trend lines for warbling vireo, pinyon jay, Woodhouse's scrub-jay, black-billed magpie.

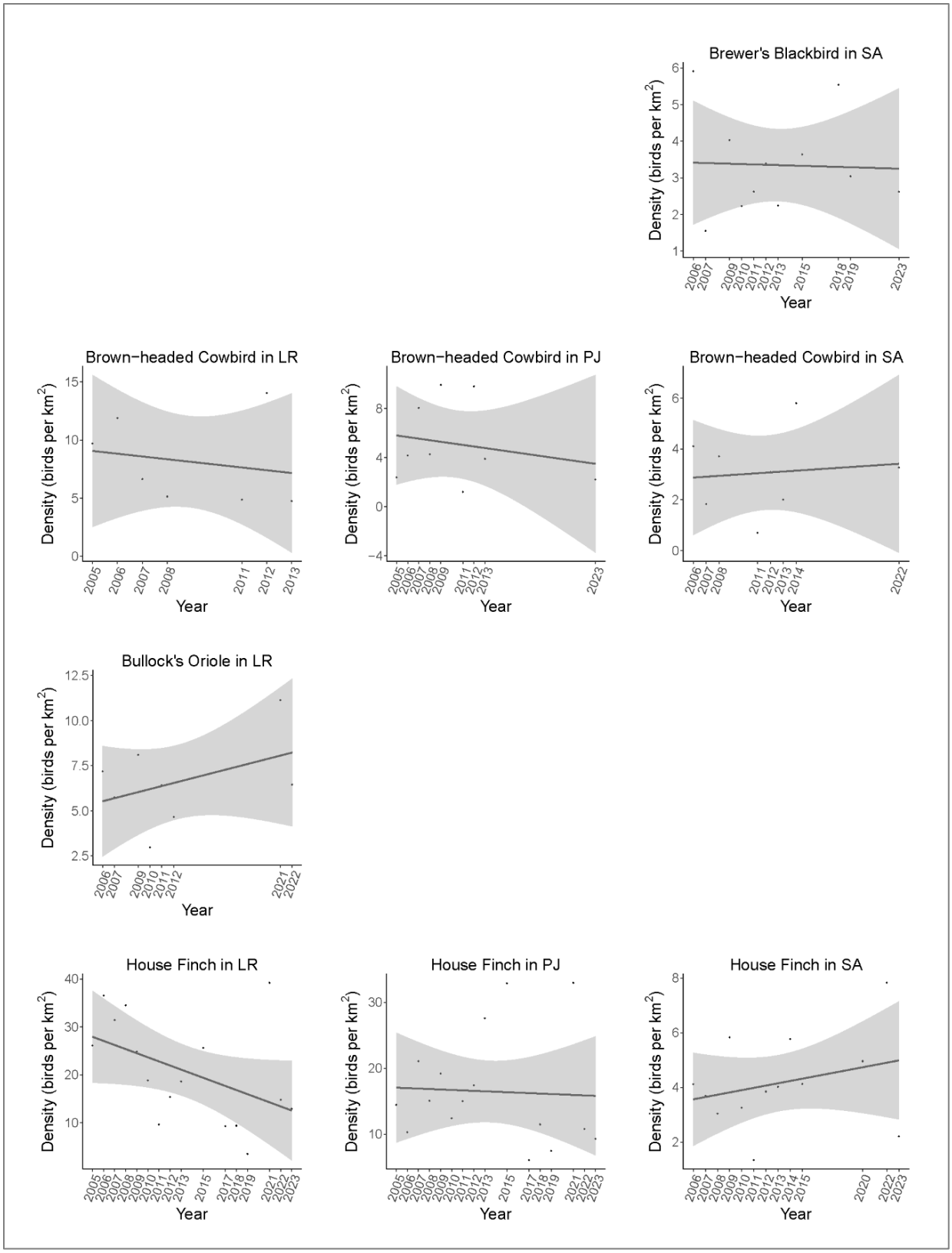


Figure 9. Trend lines for Brewer's blackbird, brown-headed cowbird, Bullock's oriole, and house finch.

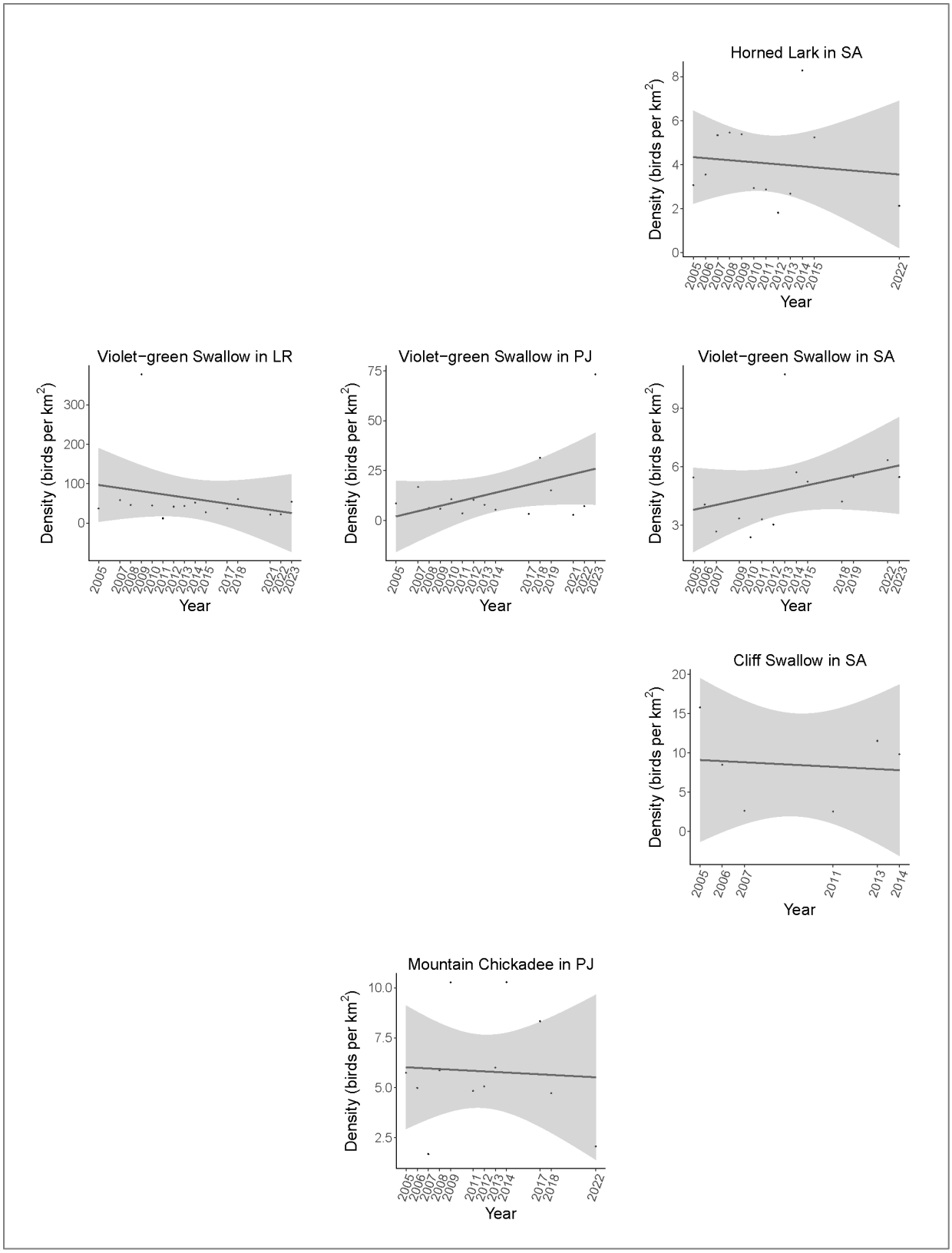


Figure 10. Trend lines for horned lark, violet-green swallow, cliff swallow, and mountain chickadee.

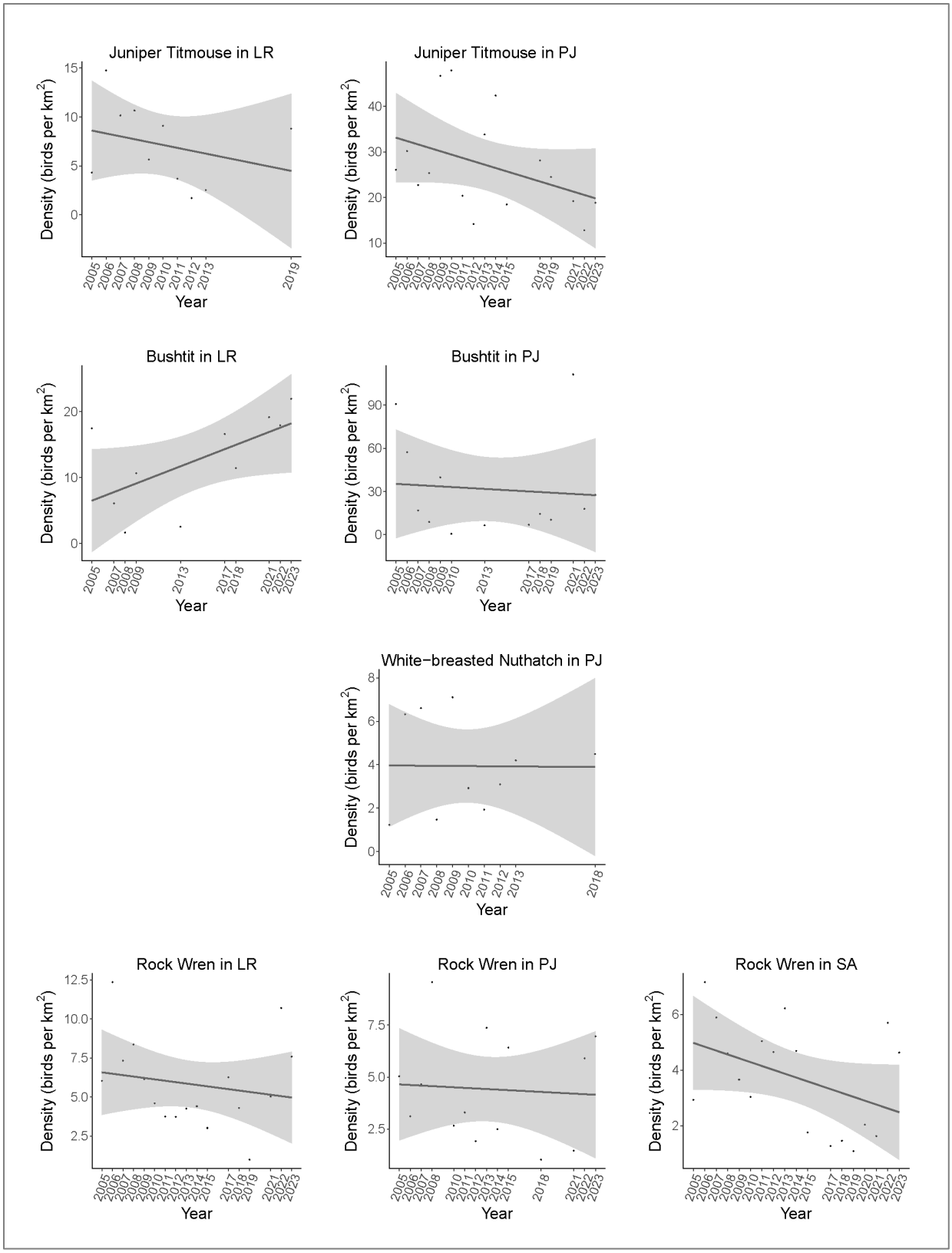


Figure 11. Trend lines for juniper titmouse, bushtit, white-breasted nuthatch, and rock wren.

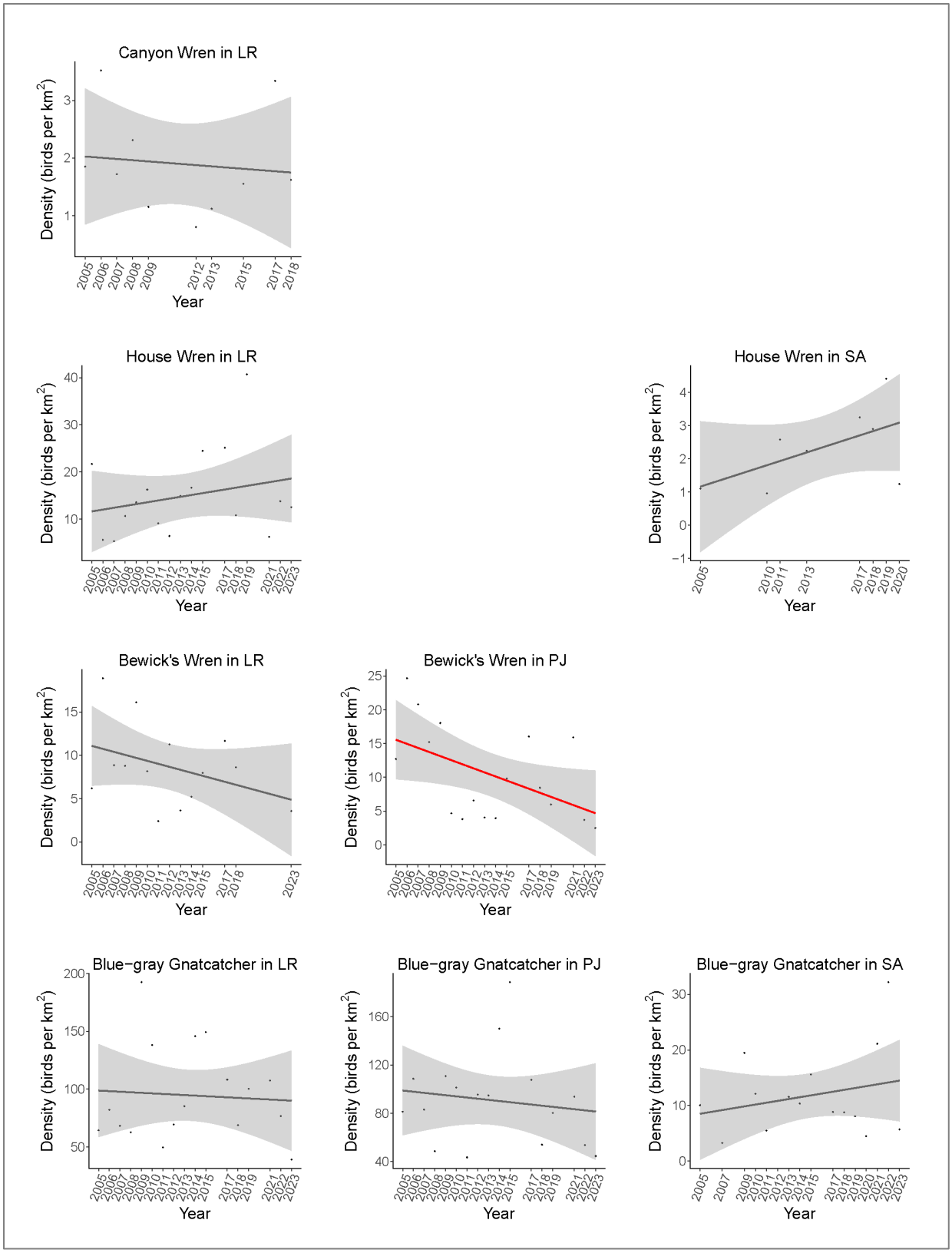


Figure 12. Trend lines for canyon wren, house wren, Bewick's wren, blue-gray gnatcatcher.

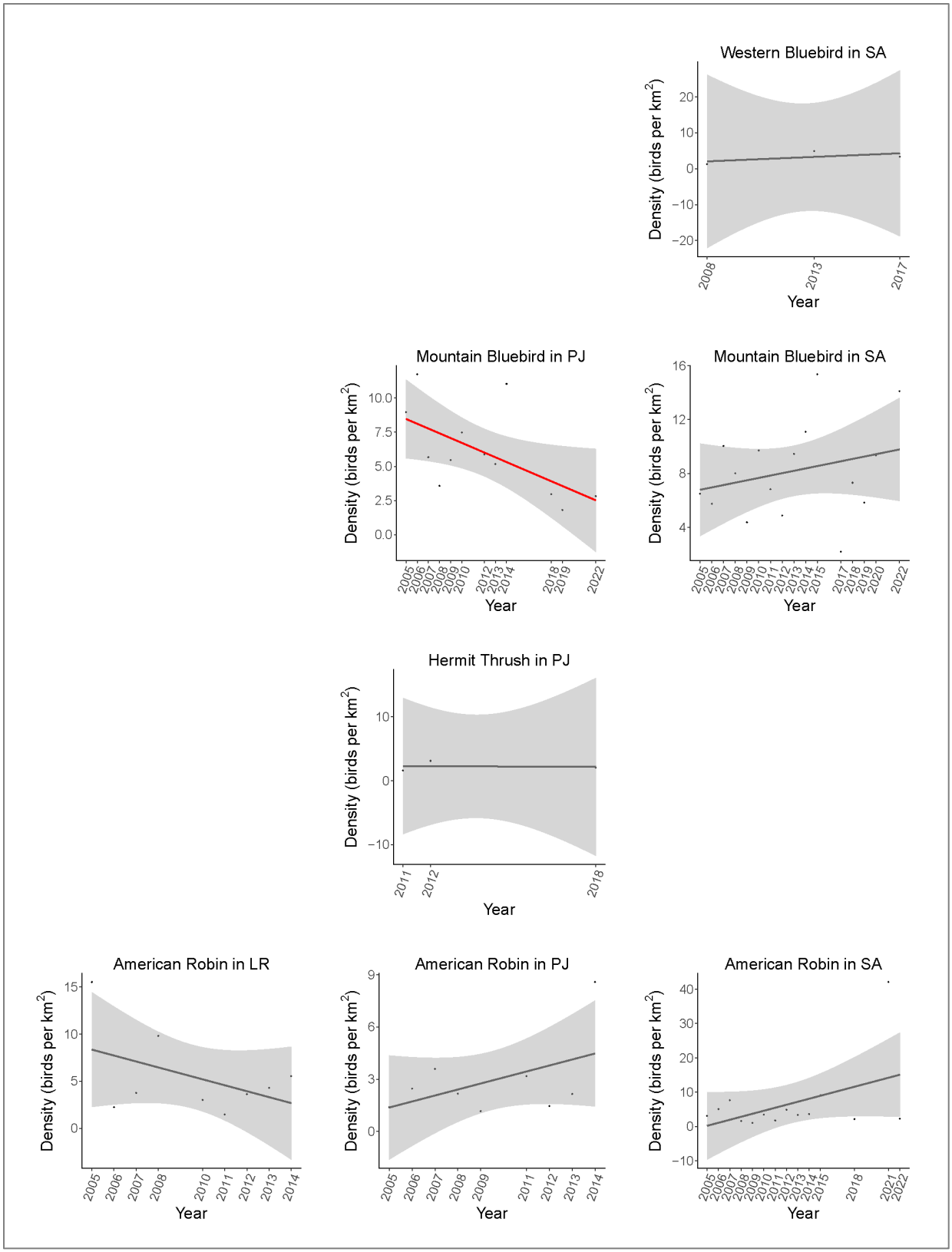


Figure 13. Trend lines for western bluebird, mountain bluebird, hermit thrush, and American robin.

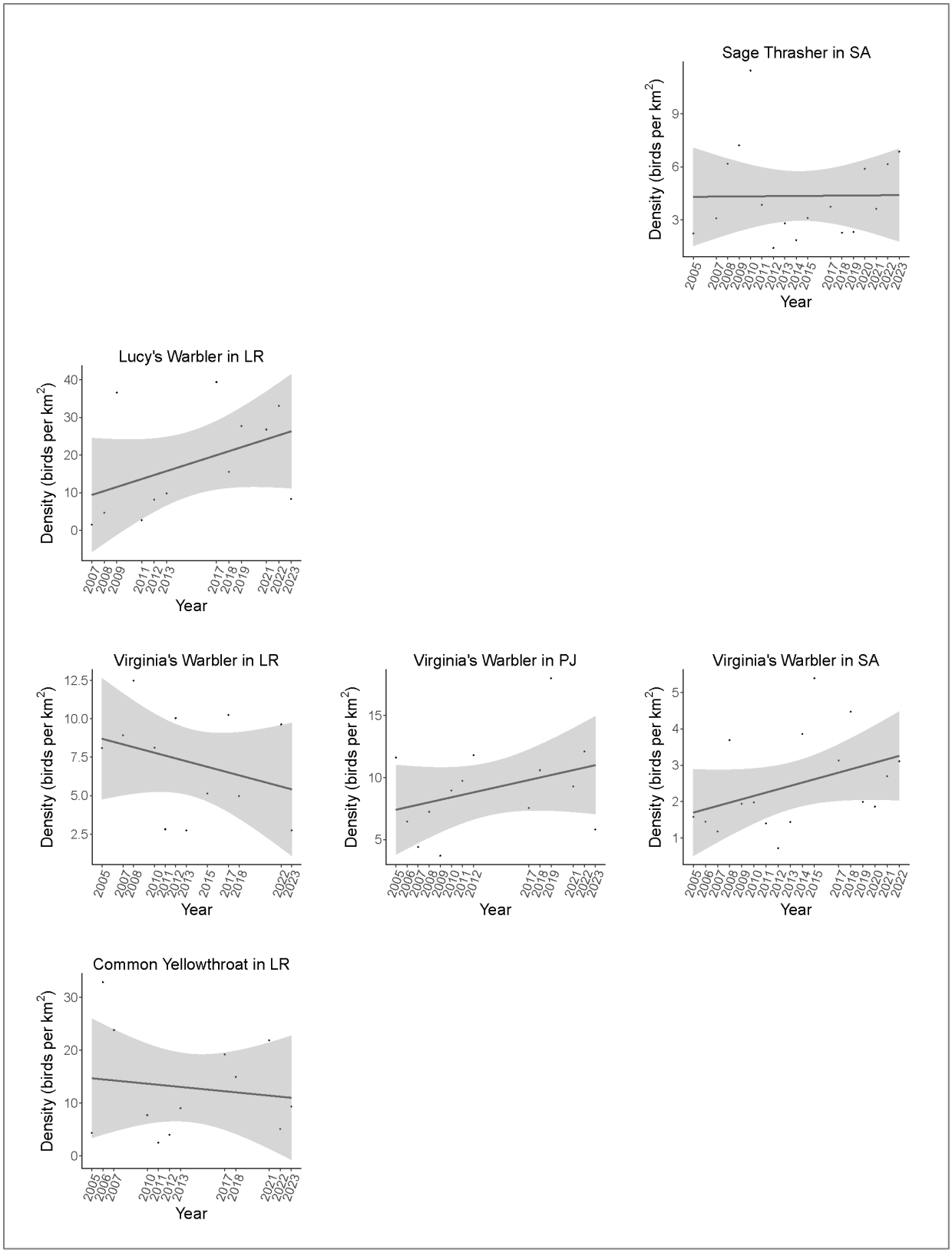


Figure 14. Trend lines for sage thrasher, Lucy's warbler, Virginia's warbler, common yellowthroat.

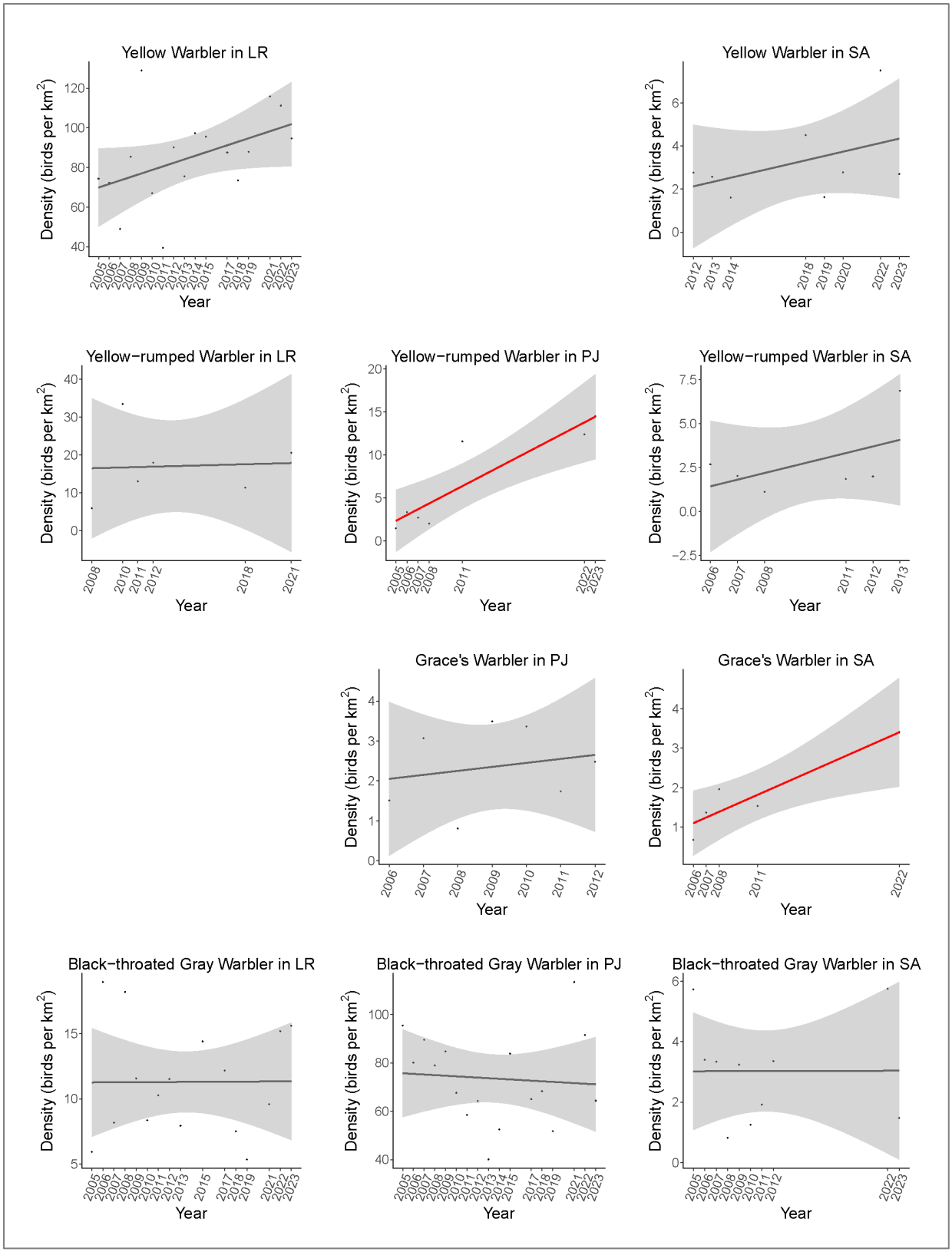


Figure 15. Trend lines for yellow warbler, yellow-rumped warbler, Grace's warbler, and black-throated gray warbler.

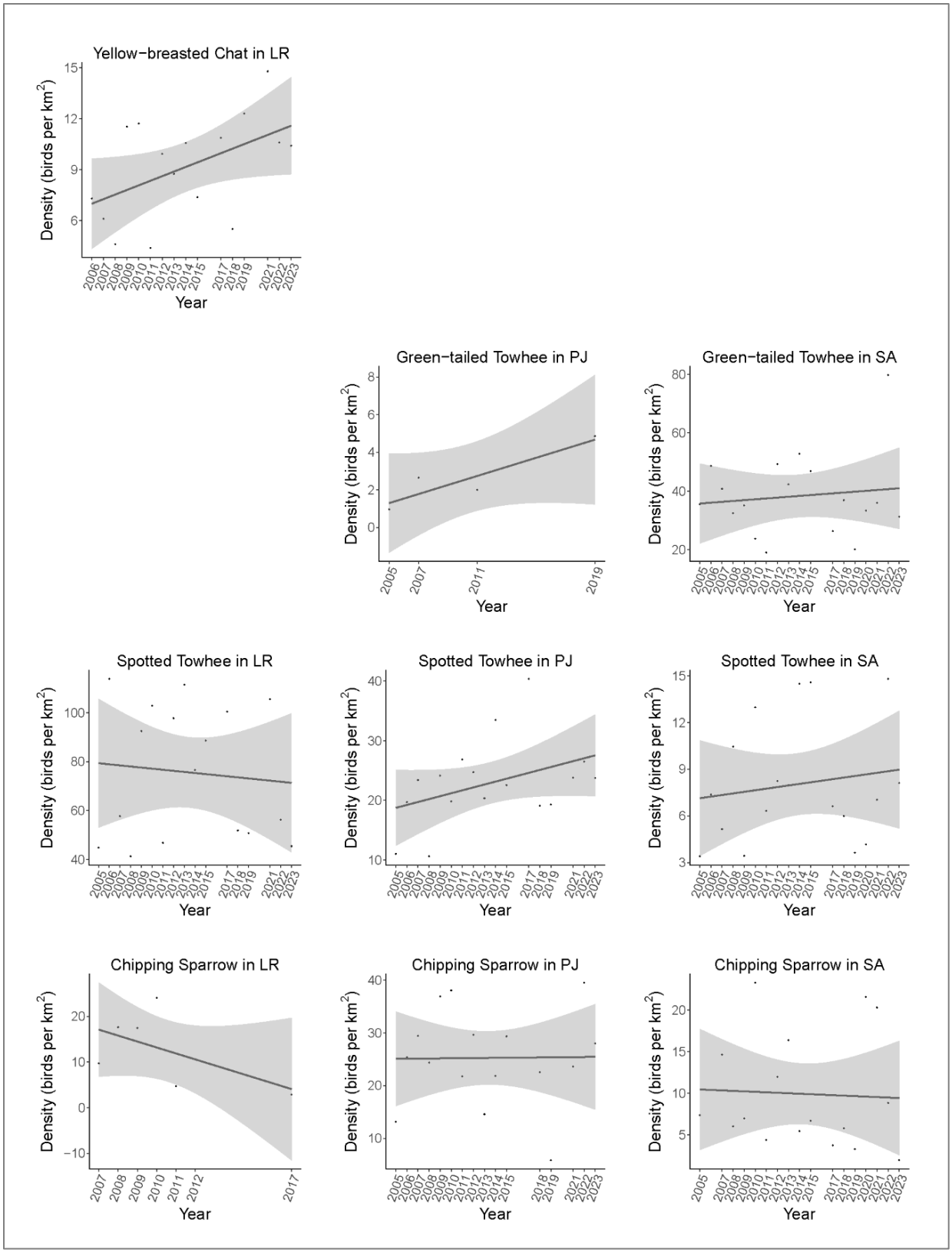


Figure 16. Trend lines for yellow-breasted chat, green-tailed towhee, spotted towhee, and chipping sparrow.

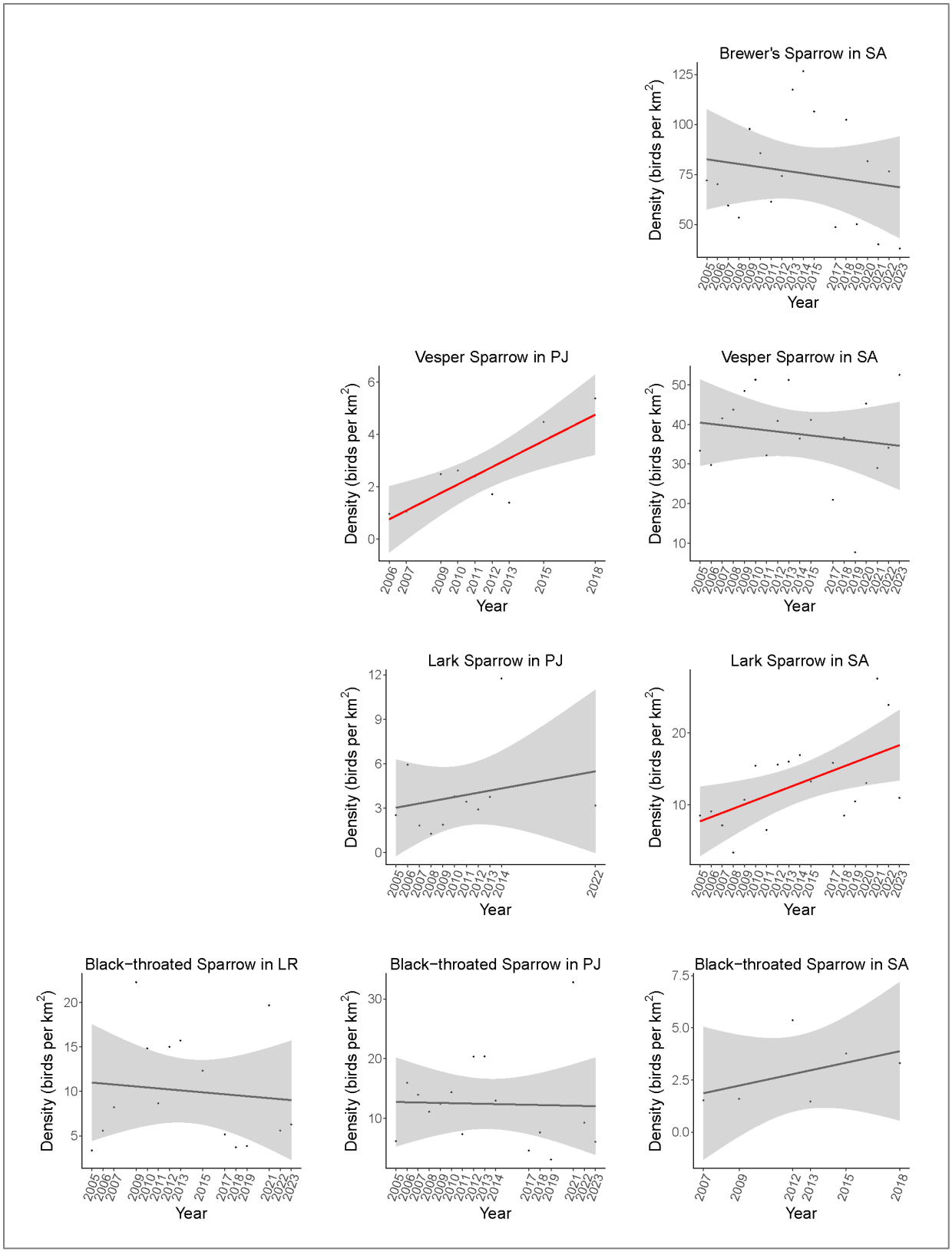


Figure 17. Trend lines for Brewer's sparrow, vesper sparrow, lark sparrow, and black-throated sparrow.

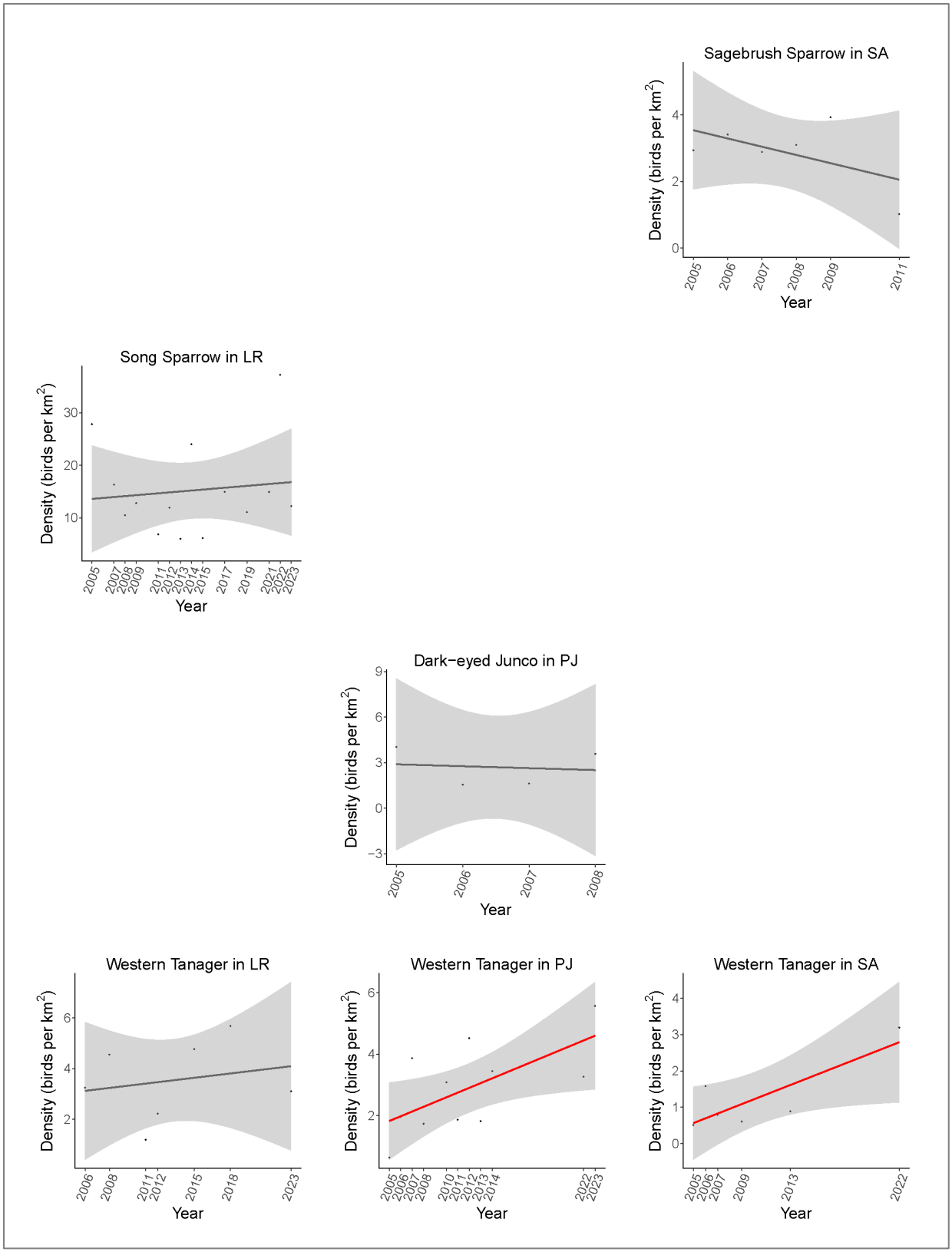


Figure 18. Trend lines for sagebrush sparrow, song sparrow, dark-eyed junco, and western tanager.

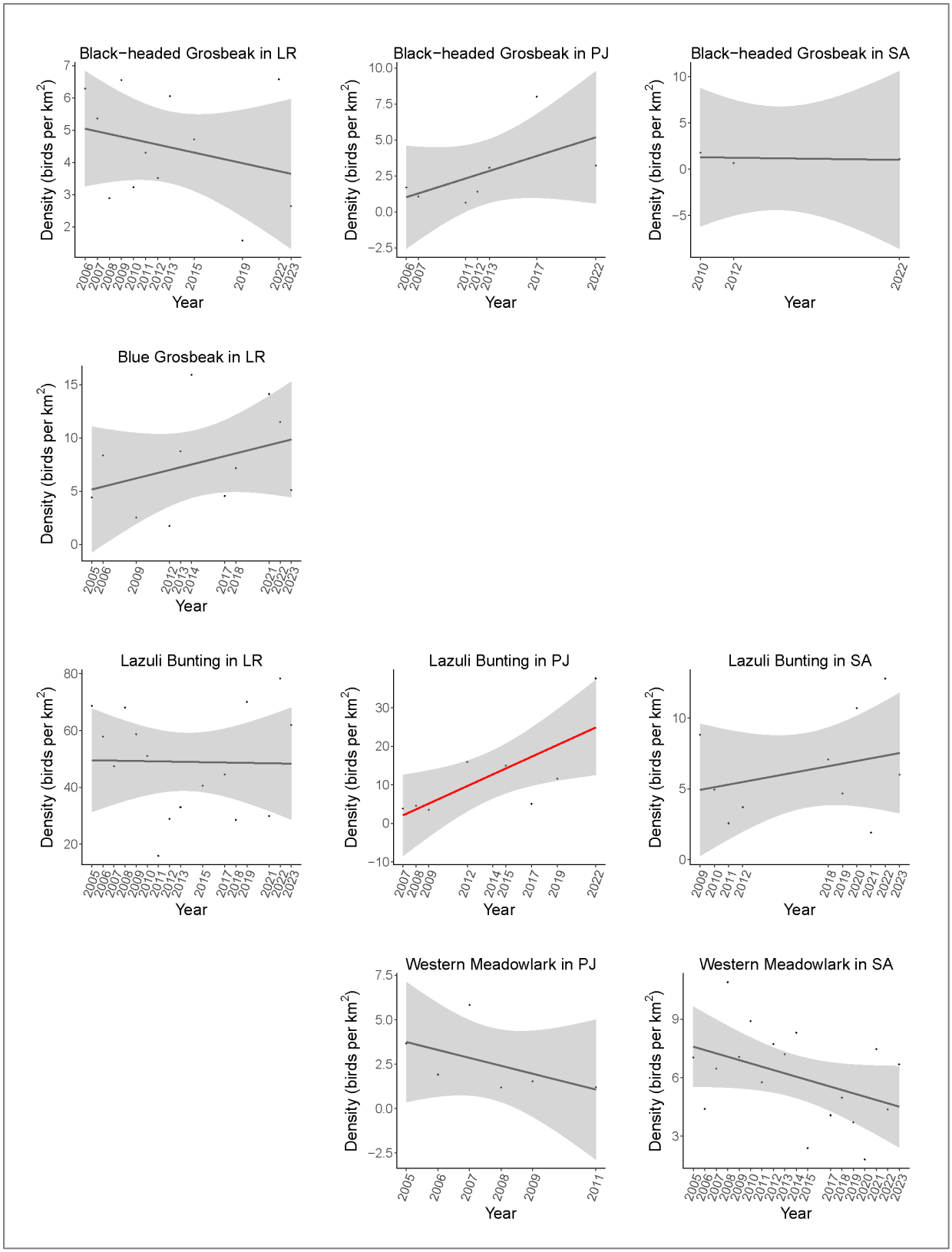


Figure 19. Trend lines for black-headed grosbeak, blue grosbeak, lazuli bunting, western meadowlark.

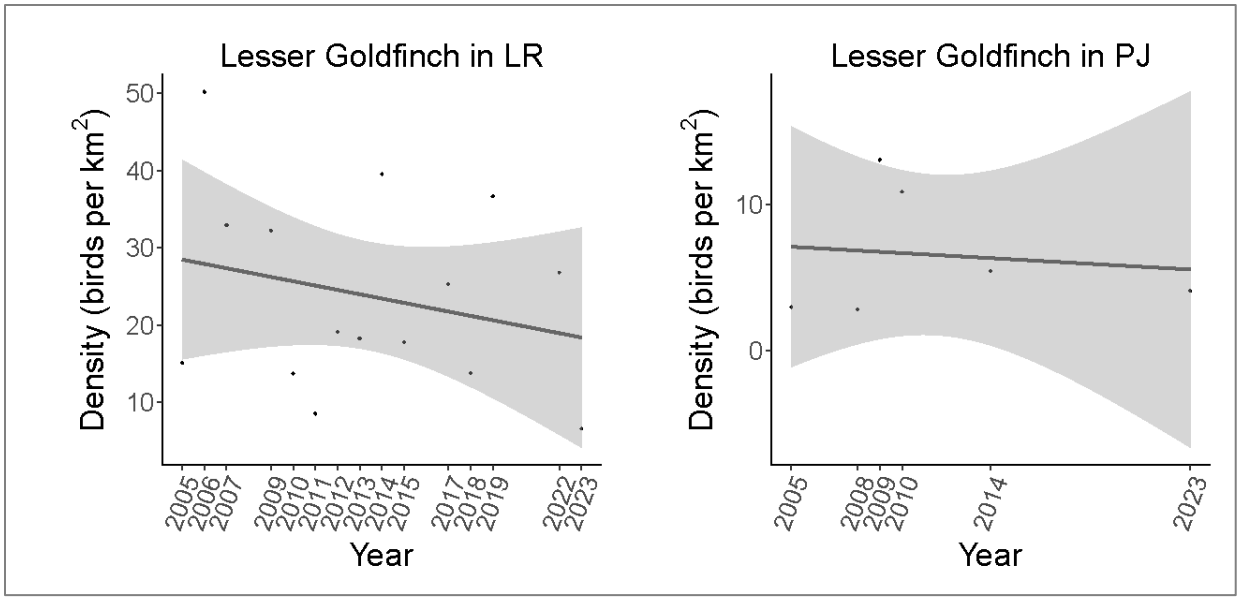


Figure 20. Trend lines for lesser goldfinch.

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