



Landbird Monitoring in the Northern Colorado Plateau Network

2017 Field Season

Natural Resource Report NPS/NCPN/NRR—2018/1605



ON THE COVER

Northern waterthrush. ©Kelly Colgan Azar, [some rights reserved](#).

Landbird Monitoring in the Northern Colorado Plateau Network

2017 Field Season

Natural Resource Report NPS/NCPN/NRR—2018/1605

Prepared by

Samuel G. Roberts
Elizabeth L. Tymkiw
Zachary S. Ladin
W. Gregory Shriver

Department of Entomology and Wildlife Ecology
University of Delaware
251 Townsend Hall
Newark, DE 19716

Editing and Design

Alice Wondrak Biel
Northern Colorado Plateau Network
National Park Service
P.O. Box 848
Moab, UT 84532

March 2018

U.S. Department of the Interior
National Park Service
Natural Resource Stewardship and Science
Fort Collins, Colorado

The National Park Service, Natural Resource Stewardship and Science office in Fort Collins, Colorado, publishes a range of reports that address natural resource topics. These reports are of interest and applicability to a broad audience in the National Park Service and others in natural resource management, including scientists, conservation and environmental constituencies, and the public.

The Natural Resource Report Series is used to disseminate comprehensive information and analysis about natural resources and related topics concerning lands managed by the National Park Service. The series supports the advancement of science, informed decision-making, and the achievement of the National Park Service mission. The series also provides a forum for presenting more lengthy results that may not be accepted by publications with page limitations.

All manuscripts in the series receive the appropriate level of peer review to ensure that the information is scientifically credible, technically accurate, appropriately written for the intended audience, and designed and published in a professional manner. This report received informal peer review by subject-matter experts who were not directly involved in the collection, analysis, or reporting of the data.

Views, statements, findings, conclusions, recommendations, and data in this report do not necessarily reflect views and policies of the National Park Service, U.S. Department of the Interior. Mention of trade names or commercial products does not constitute endorsement or recommendation for use by the U.S. Government.

This report is available from the [Northern Colorado Plateau Network](#) website, as well as at the [Natural Resource Publications Management](#) website.

Please cite this publication as:

Roberts, S. G., E. L. Tymkiw, Z. S. Ladin, and W. G. Shriver. 2018. Landbird monitoring in the Northern Colorado Plateau Network: 2017 field season. Natural Resource Report NPS/NCPN/NRR—2018/1605. National Park Service, Fort Collins, Colorado.

NPS 960/143008, March 2018

Contents

Figures v

Tables vii

Executive Summary ix

1 Introduction 1

2 Methods.....3

 2.1 Study area and sampling design 3

 2.2 Field methods.....3

 2.3 Data analysis.....7

3 Results.....9

 3.1 Habitat-based density trends 9

 3.2 Pipe Spring National Monument 9

4 Discussion 15

5 References 17

Appendix A. Individual Species Density by Habitat.....19

Figures

Main Report

Figure 2-1. Northern Colorado Plateau Network parks where landbirds are monitored.....	3
Figure 2-2. Transect locations by habitat, Utah units.....	4
Figure 2-3. Transect locations by habitat, Colorado units.....	5
Figure 2-4. Transect locations, Fossil Butte National Monument.	6
Figure 2-5. Point-count and area-search locations, Pipe Spring National Monument.....	6

Appendix A

Figure A-1. Density trends for mourning dove, white-throated swift, black-chinned hummingbird, and broad-tailed hummingbird.....	19
Figure A-2. Density trends for hairy woodpecker, northern flicker, western wood-pewee, and gray flycatcher.	20
Figure A-3. Density trends for dusky flycatcher, black phoebe, Say's phoebe, and ash-throated flycatcher.....	21
Figure A-4. Density trends for gray vireo, plumbeous vireo, warbling vireo, and pinyon jay.....	22
Figure A-5. Density trends for Woodhouse's scrub-jay, black-billed magpie, common raven, and horned lark.	23
Figure A-6. Density trends for violet-green swallow, cliff swallow, mountain chickadee, and juniper titmouse.....	24
Figure A-7. Density trends for bushtit, white-breasted nuthatch, rock wren, and canyon wren. ...	25
Figure A-8. Density trends for house wren, Bewick's wren, blue-gray gnatcatcher, and mountain bluebird.	26
Figure A-9. Density trends for American robin, sage thrasher, European starling, and Virginia's warbler.	27
Figure A-10. Density trends for common yellowthroat, yellow warbler, Grace's warbler, and black-throated gray warbler.....	28
Figure A-11. Density trends for yellow-breasted chat, green-tailed towhee, spotted towhee, and chipping sparrow.	29
Figure A-12. Density trends for Brewer's sparrow, vesper sparrow, lark sparrow, and black-throated sparrow.....	30
Figure A-13. Density trends for sagebrush sparrow, song sparrow, western tanager, and black-headed grosbeak.....	31
Figure A-14. Density trends for blue grosbeak, lazuli bunting, western meadowlark, and Brewer's blackbird.....	32
Figure A-15. Density trends for brown-headed cowbird, Bullock's oriole, house finch, and lesser goldfinch.....	33

Tables

Table 2-1. Annual number of points surveyed within each habitat.....	3
Table 3-1. Population-density trend slope, R^2 values, and sample size of estimated annual densities for individual species in pinyon-juniper, low-elevation riparian, and sagebrush shrubland habitats in the Northern Colorado Plateau Network, 2005–2017...	10
Table 3-2. Number of individuals detected during point counts and area searches in Pipe Spring National Monument, 2009–2017.....	12

Executive Summary

In 2017, the University of Delaware, in cooperation the National Park Service (NPS), completed the twelfth 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. This population information is useful for land managers and supports the National Park Service's goal of long-term monitoring of biological indicators for network parks.

In 2017, university biologists surveyed 45 survey locations within 11 NPS units. Fifteen transects were located 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 12 years of data collection, 12,974 point-count surveys have been conducted in 11 NCPN units, detecting 166 unique species. During the 2017 field season, 660 point-count surveys were conducted, detecting 116 unique species. One new species was detected for this monitoring program: a northern waterthrush, during a low-elevation riparian transect survey in Arches National Park. This was the first record of that species for the park.

In total, 113 population-density trends were estimated across the three habitats. Twenty of the estimated density trends were significant (p -value < 0.05), with black-chinned hummingbird in PJ as the only significant positive trend. There were sufficient sample sizes to estimate the densities of 60 species in at least one of the three habitats surveyed. Observers estimated densities for 26 bird species of conservation or management concern throughout the Northern Colorado Plateau Network.

Using a modified monitoring design, landbird monitoring surveys were conducted in Pipe Spring National Monument for the eighth year since 2009. A total of 57 individuals of 29 species were recorded. Three species not previously detected by this monitoring program were detected: Wilson's warbler, chipping sparrow, and western meadowlark. While all three of these species have been detected within the park outside of monitoring efforts, they are rare visitors during the breeding season in this location. Sample sizes were too low for density trends to be estimated for Pipe Spring National Monument.

1 Introduction

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

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

In the 2016 Partners in Flight Landbird Conservation Plan, Rosenberg and others (2016) recounted dramatic declines in North American landbird populations, citing an overall reduction of over one billion individual landbirds 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 sage 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 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.

In 2017, the University of Delaware, in cooperation with the National Park Service (NPS), completed the twelfth year of a habitat-based landbird monitoring program in NPS units of the Northern Colorado Plateau Network (NCPN). 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.

The 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 sage shrubland. Using modified methods, monitoring is also conducted at Pipe Spring National Monument, in Arizona.

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. In future analyses, we will evaluate the driving landscape and climate variables affecting long-term, transect-level bird population trends of the species in greatest decline.

2 Methods

2.1 Study area and sampling design

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

The NPS and BCR used GIS and the Southwest Regional Re-GAP Analysis Project to randomly select PJ and SA transect locations (Lowry et al. 2005). Within those habitats, they excluded areas with >50% slope to ensure 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. Transects were groundtruthed and re-assigned if necessary.

Since 2005, all 45 transects have remained in place and are the annually scheduled surveys for this program. From 2005 to 2013, field teams surveyed each transect twice annually. Starting in 2014, survey effort was reduced to one visit per year. The number of completed surveys varied by year, with >75% of planned surveys completed annually (Table 2-1).

In 2009, Pipe Spring National Monument was added to the monitoring program. However, due to the park's small size, only four point-count locations were established, each at least 250 meters apart (Figure 2-5). These point-count locations were placed in a mixture of pinyon-juniper, low-elevation riparian, and semi-desert shrubland habitats. In 2011, to increase bird monitoring efforts in the park, a 1,200-meter area-search transect was added to the program.

2.2 Field methods

Each year, field technicians attend a week-long training session to practice bird and

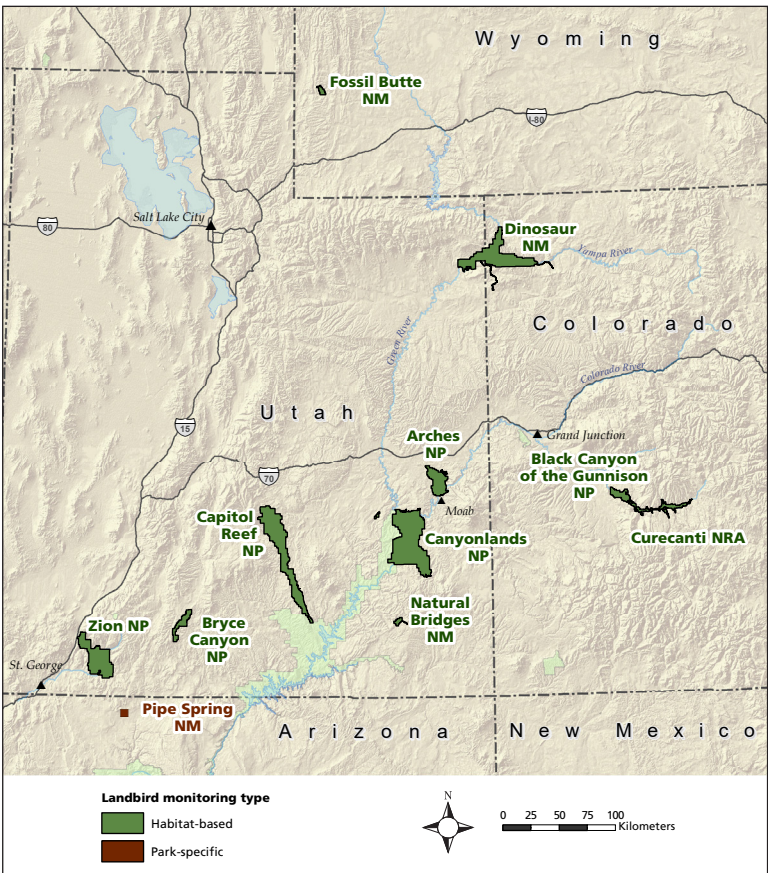


Figure 2-1. Northern Colorado Plateau Network parks where landbirds are monitored.

Table 2-1. Annual number of points surveyed within each habitat.

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

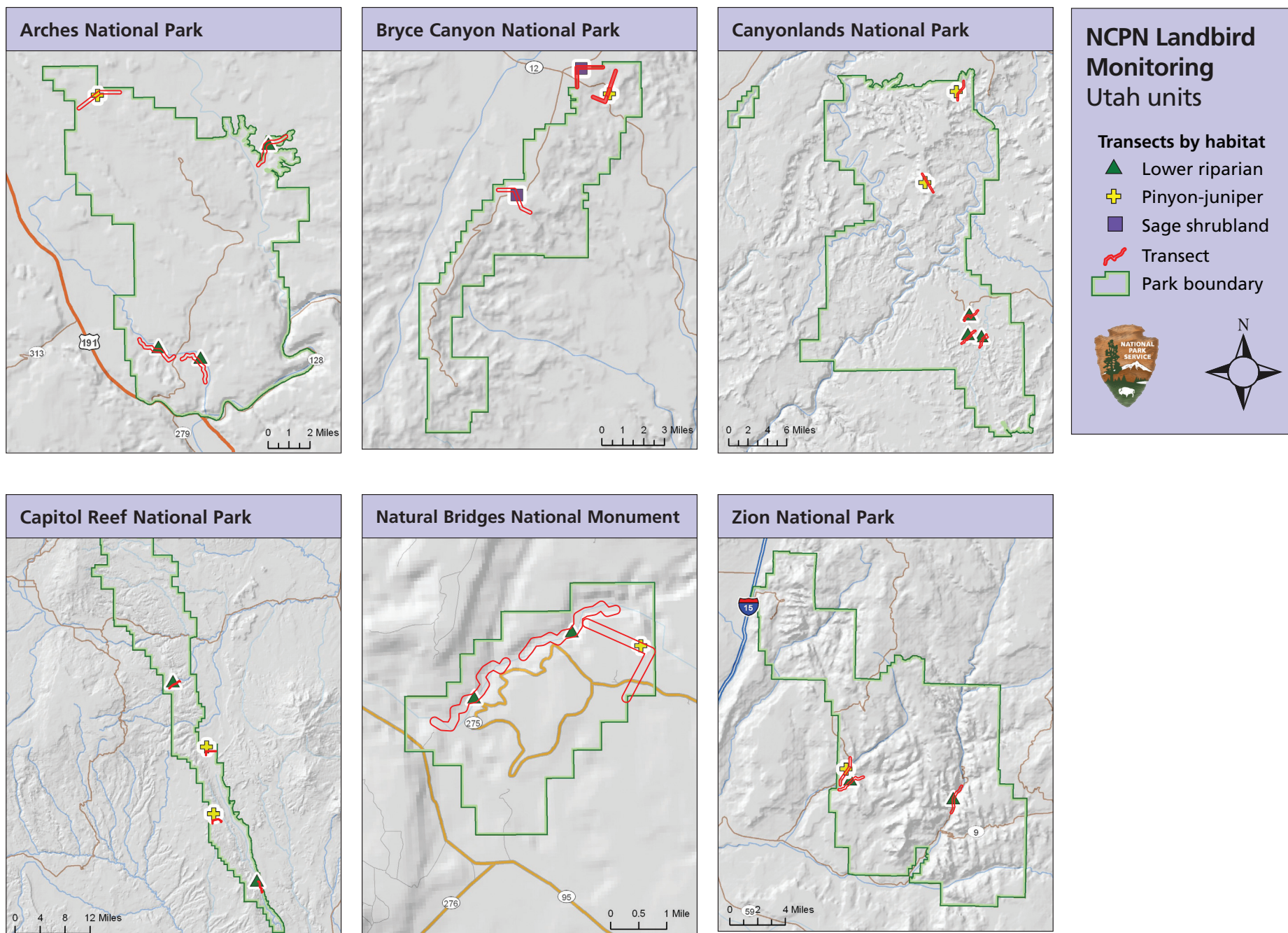


Figure 2-2. Transect locations by habitat, Utah units.

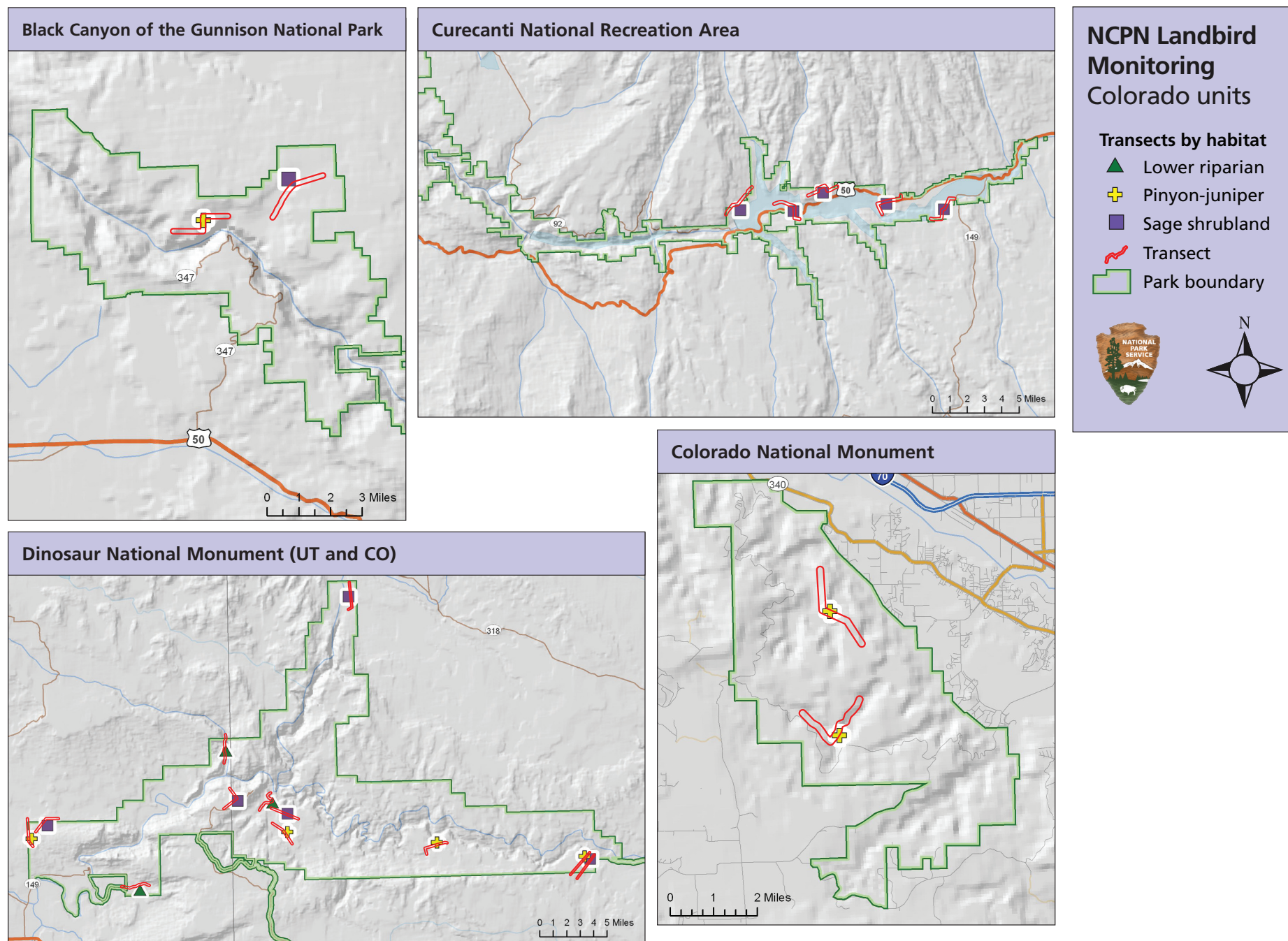


Figure 2-3. Transect locations by habitat, Colorado units.

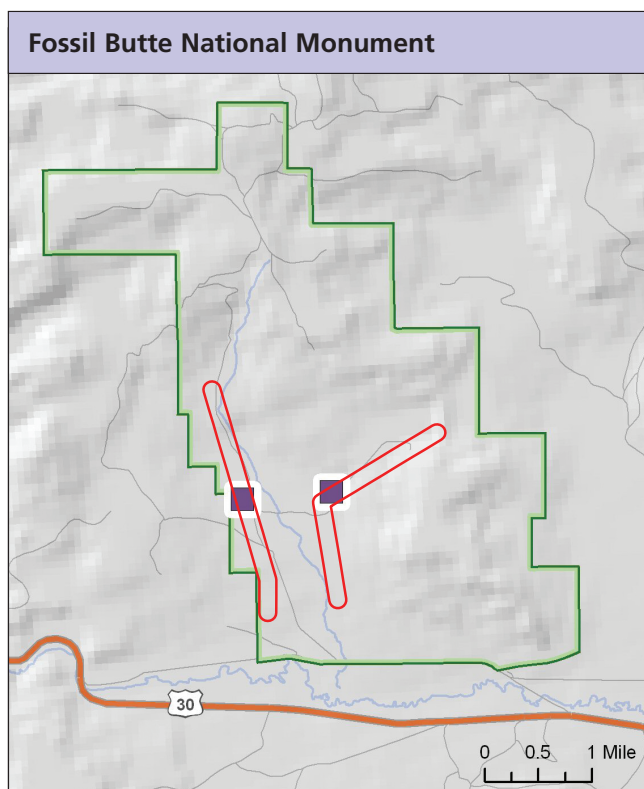


Figure 2-4. Transect locations, Fossil Butte National Monument.

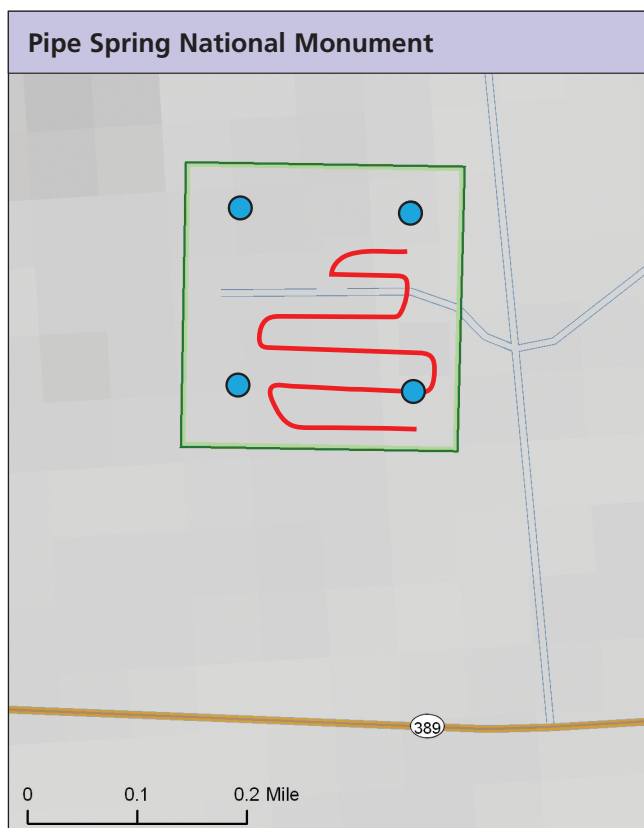
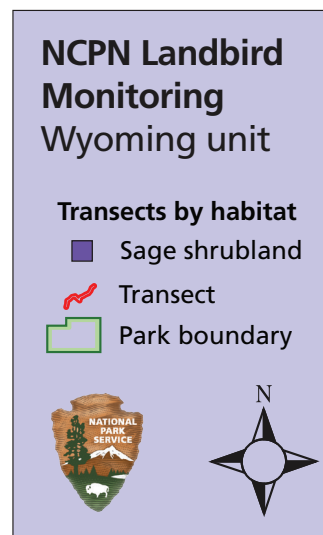
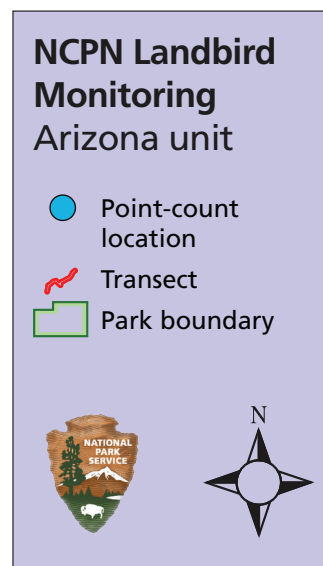


Figure 2-5. Point-count and area-search locations, Pipe Spring National Monument.



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

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

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

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

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

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

Habitat assessments and point counts at Pipe Spring NM follow the methods described above. In addition, observers continuously walk the 1,200-meter area-search transect during the time remaining after completing the point counts, recording the same data for all bird detections as are collected during point counts.

For more detailed information about survey protocols, refer to Daw and others (2017) and BCR's Northern Colorado Plateau Network Point Transect Protocol on the Rocky Mountain Avian Data Center website, <http://rmbo.org/v3/avian/DataCollection.aspx>. Links to past and current protocols and data sheets may also be found at that site.

2.3 Data analysis

2.3.1 Distance sampling

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

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

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

2.3.2 *Habitat-based density trends*

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

To ensure sufficient sample sizes, we only estimated densities of species for which there were at least 80 independent detections within a habitat across all years within the distance cut-off. For each eligible species within a habitat each year, we fit a series of five pre-selected detection function models to the distribution of distances observed:

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

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

3 Results

Over 12 years of data collection, 12,974 point-count surveys have been conducted in 11 NCPN units (see Table 2-1), detecting 166 unique species. Of those 166 species, 151 were within 125 meters of the observer, the established distance cut-off for our analyses (see Section 2.3.2). In 2017, between May 1 and June 16, field technicians completed 44 of 45 planned habitat-based transects, for a total of 660 point-count surveys. A total of 4,917 individual birds of 116 unique species were recorded. One new species was detected for this monitoring program: a northern waterthrush, during a low-elevation riparian transect survey in Arches National Park. This was the first record of that species for the park.

3.1 Habitat-based density trends

In total, 113 population-density trends were estimated across the three habitats. Twenty of the estimated density trends were significant (p -value < 0.05), with black-chinned hummingbird in PJ as the only significant positive trend. There were sufficient sample sizes to estimate the densities of 60 species

in at least one of the three habitats surveyed (Table 3-1).

3.2 Pipe Spring National Monument

Using a modified monitoring design, land-bird monitoring surveys were conducted in Pipe Spring National Monument (NM) for the eighth year since 2009. Because of differences in data collection methods, data from this small park are excluded from all other analyses and only summarized in this report.

In 2017, field technicians completed four planned point-count surveys and the area search at Pipe Spring NM. A total of 57 individuals of 29 species were detected during surveys (Table 3-2). Three species not previously detected by this monitoring program were recorded: Wilson's warbler, chipping sparrow, and western meadowlark. While all three of these species have been detected within the park outside of monitoring efforts, they are rare visitors during the breeding season in this location. Sample sizes were too low for density trends to be estimated for Pipe Spring National Monument.

Table 3-1. Population-density trend slope, R² values, and sample size of estimated annual densities for individual species in pinyon-juniper, low-elevation riparian, and sagebrush shrubland habitats in the Northern Colorado Plateau Network, 2005–2015 and 2017.

Common name	Low-elevation riparian			Pinyon-juniper			Sagebrush shrubland		
	Slope	R ²	Sample size*	Slope	R ²	Sample size*	Slope	R ²	Sample size*
Mourning dove	-2.91 ^b	0.71	10	-4.24 ^b	0.54	12	-0.16	0.02	12
White-throated swift	-3.71 ^a	0.56	10	-0.25 ^b	0.65	11	2.11	0.06	8
Black-chinned hummingbird	-0.87	0	9	31.80 ^a	0.47	11	NA	NA	–
Broad-tailed hummingbird	2.43	0.12	6	-10.60	0.32	8	-0.44	0.01	9
Hairy woodpecker	-0.12	0.04	7	NA	NA	–	NA	NA	–
Northern flicker	0.09	0.15	7	-0.47	0.54	5	0.01	0	10
Western wood-pewee	-0.82	0.43	9	NA	NA	–	NA	NA	–
Gray flycatcher	NA	NA	–	-2.94	0.31	12	-0.01	0	7
Dusky flycatcher	NA	NA	–	0.44	0.02	10	-0.08	0	11
Black phoebe	-0.71	0.07	7	NA	NA	–	NA	NA	–
Say's phoebe	-0.65 ^a	0.41	10	-0.15	0.34	8	-0.06	0.01	9
Ash-throated flycatcher	-2.84 ^a	0.53	11	-1.49 ^a	0.45	12	-0.32	0.03	4
Gray vireo	NA	NA	–	-0.36	0.03	11	NA	NA	–
Plumbeous vireo	-1.90 ^a	0.38	11	-0.47	0.12	12	NA	NA	–
Warbling vireo	-0.34	0.05	9	NA	NA	–	-0.34 ^b	0.9	6
Pinyon jay	NA	NA	–	-0.42	0.23	10	NA	NA	–
Woodhouse's scrub-jay	-0.22	0.04	10	0.18	0.01	9	0.00	0	7
Black-billed magpie	NA	NA	–	NA	NA	–	-0.39	0.33	10
Common raven	-2	0.32	8	NA	NA	–	0.26	0.15	5
Horned lark	NA	NA	–	NA	NA	–	-0.32	0.18	11
Violet-green swallow	-10.30	0.39	10	-13.10	0.09	10	0.31	0.06	10
Cliff swallow	NA	NA	–	NA	NA	–	-1.17	0.15	9
Mountain chickadee	NA	NA	–	-0.06	0	9	NA	NA	–
Juniper titmouse	-1.58 ^a	0.45	11	-0.90	0.02	11	NA	NA	–
Bushtit	-0.81	0.12	7	-9.40 ^a	0.49	9	NA	NA	–
White-breasted nuthatch	NA	NA	–	-0.59	0.19	10	NA	NA	–
Rock wren	-1.22 ^b	0.6	10	-0.60	0.16	11	-0.37	0.18	11
Canyon wren	-0.09	0.06	7	-0.26	0.95	3	NA	NA	–
House wren	0.00	0	9	NA	NA	–	0.16	0.16	7
Bewick's wren	-1.34	0.26	11	-2.73 ^a	0.49	11	NA	NA	–
Blue-gray gnatcatcher	-3.42	0.03	11	-2.72	0.05	12	-3.20	0.21	11
Mountain bluebird	NA	NA	–	-1.27 ^a	0.58	10	-0.51	0.14	12
American robin	1.42	0.09	11	NA	NA	–	-0.31	0.08	10
Sage thrasher	NA	NA	–	NA	NA	–	-0.73	0.2	11
European starling	NA	NA	–	NA	NA	–	-0.49	0.39	5
Virginia's warbler	-1.12	0.37	9	0.20	0.02	10	0.05	0.04	9
Common yellowthroat	-0.98	0.03	9	NA	NA	–	NA	NA	–
Yellow warbler	-4.82	0.15	11	NA	NA	–	0.05	0.02	5
Grace's warbler	NA	NA	–	-0.12	0.03	5	NA	NA	–
Black-throated gray warbler	-1.1	0.2	11	-11.60 ^c	0.87	12	-0.59	0.45	7
Yellow-breasted chat	-1.58	0.27	11	NA	NA	–	NA	NA	–
Green-tailed towhee	NA	NA	–	0.54	0.27	7	-3.38	0.31	12

Table 3-1. Population-density trend slope, R^2 values, and sample size of estimated annual densities for individual species in pinyon-juniper, low-elevation riparian, and sagebrush shrubland habitats in the Northern Colorado Plateau Network, 2005–2015 and 2017.

Common name	Low-elevation riparian			Pinyon-juniper			Sagebrush shrubland		
	Slope	R^2	Sample size*	Slope	R^2	Sample size*	Slope	R^2	Sample size*
Spotted towhee	-1.85	0.02	11	0.22	0.01	12	0.04	0	11
Chipping sparrow	NA	NA	–	-2.41	0.24	12	-1.88	0.22	12
Brewer's sparrow	NA	NA	–	NA	NA	–	-3.32	0.08	12
Vesper sparrow	NA	NA	–	0.65	0.59	3	3.54	0.27	12
Lark sparrow	NA	NA	–	-0.38	0.24	10	0.68	0.09	10
Black-throated sparrow	0.41	0.01	9	-0.93	0.09	11	-0.07	0.03	5
Sagebrush sparrow	NA	NA	–	NA	NA	–	-0.44^b	0.77	7
Song sparrow	-3.01^b	0.66	9	NA	NA	–	NA	NA	–
Western tanager	-0.27	0.19	9	0.79	0.32	10	NA	NA	–
Black-headed grosbeak	-0.50	0.32	10	1.05	0.38	6	NA	NA	–
Blue grosbeak	-0.30	0.04	8	NA	NA	–	NA	NA	–
Lazuli bunting	-10.10^b	0.71	10	NA	NA	–	0.06	0	6
Western meadowlark	NA	NA	–	NA	NA	–	-0.82	0.32	12
Brewer's blackbird	NA	NA	–	NA	NA	–	0.02	0	8
Brown-headed cowbird	-1.55^b	0.81	8	0.28	0.05	8	-0.22	0.09	9
Bullock's oriole	-0.17	0.03	9	NA	NA	–	NA	NA	–
House finch	-4.74	0.73	11	-0.60	0.04	11	0.03	0	10
Lesser goldfinch	-3.93	0.35	11	NA	NA	–	NA	NA	–

Bolded values represent significant trends (^ap-value less than or equal to 0.05; ^bp-value less than or equal to 0.01; ^cp-value less than or equal to 0.001).

*Due to low sample size detections in certain years, models could not be fit for each species/habitat combination for all years. Sample sizes of estimated annual densities are provided.

Table 3-2. Number of individuals detected during point counts and area searches in Pipe Spring National Monument, 2009–2017.

Species	Point counts		Area searches		Total
	2009–2015	2017	2011–2015	2017	
Mallard	0	0	1	0	1
Mallard (domestic)	0	0	10	0	10
Gambel's quail	42	3	34	1	80
Black-crowned night-heron	1	0	11	0	12
Cooper's hawk	1	0	1	0	2
Red-tailed hawk	0	1	1	0	2
Eurasian collared-dove	48	2	82	0	132
Mourning dove	20	0	37	0	57
Great horned owl	0	0	1	0	1
Common poorwill	0	0	3	0	3
White-throated swift	20	0	3	0	23
Black-chinned hummingbird	2	0	0	0	2
Broad-tailed hummingbird	0	0	4	0	4
Downy woodpecker	1	0	0	0	1
Hairy woodpecker	0	0	1	0	1
American kestrel	5	0	11	0	16
Peregrine falcon	5	0	0	0	5
Prairie falcon	1	0	0	0	1
Western wood-pewee	3	0	7	0	10
Gray flycatcher	1	0	1	0	2
Black phoebe	6	0	18	0	24
Say's phoebe	23	1	24	0	48
Ash-throated flycatcher	25	0	18	0	43
Cassin's kingbird	54	1	35	0	90
Western kingbird	36	1	34	0	71
Gray vireo	3	2	0	0	5
Warbling vireo	0	0	4	0	4
Pinyon jay	1	0	0	0	1
Woodhouse's scrub-jay	2	1	6	0	9
Common raven	37	1	24	0	62
Violet-green swallow	13	1	53	0	67
Northern rough-winged swallow	9	0	4	0	13
Cliff swallow	0	0	1	0	1
Barn swallow	2	0	0	0	2
Juniper titmouse	6	0	1	0	7
Rock wren	19	2	1	0	22
Canyon wren	2	0	0	0	2
House wren	1	0	0	0	1
Bewick's wren	12	3	25	1	41
Blue-gray gnatcatcher	4	2	1	0	7
American robin	3	0	0	0	3
Northern mockingbird	27	2	4	0	33
Sage thrasher	1	0	0	0	1

Table 3-2. Number of individuals detected during point counts and area searches in Pipe Spring National Monument, 2009–2017, cont.

Species	Point counts		Area searches		Total
	2009–2015	2017	2011–2015	2017	
European starling	22	0	84	1	107
Cedar waxwing	0	0	1	1	2
Orange-crowned warbler	0	0	1	0	1
Macgillivray's warbler	1	0	0	0	1
Yellow warbler	10	0	42	1	53
Yellow-rumped warbler	1	0	2	1	4
Black-throated gray warbler	4	0	1	0	5
Wilson's warbler	0	0	0	1	1
Yellow-breasted chat	0	0	1	0	1
Green-tailed towhee	1	0	3	0	4
Spotted towhee	6	0	0	0	6
Chipping sparrow	0	1	0	1	2
Brewer's sparrow	2	0	0	0	2
Lark sparrow	1	0	21	0	22
Black-throated sparrow	87	4	41	0	132
White-crowned sparrow	12	2	36	2	52
Summer tanager	1	0	0	0	1
Western tanager	2	0	6	0	8
Black-headed grosbeak	6	0	6	1	13
Blue grosbeak	4	1	5	0	10
Lazuli bunting	0	2	6	0	8
Red-winged blackbird	1	0	0	0	1
Western meadowlark	0	1	0	0	1
Yellow-headed blackbird	1	0	1	0	2
Brown-headed cowbird	14	2	16	0	32
Bullock's oriole	24	4	25	0	53
House finch	98	5	89	1	193
Pine siskin	2	0	29	0	31
Lesser goldfinch	10	0	9	0	19
House sparrow	8	0	53	0	61
Total	754	45	939	12	1,750

4 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. The focal habitats of this study are dominant throughout the western U.S., and are among the most likely to change. With gradual changes affecting habitat integrity for bird populations, such as pinyon-juniper encroachment on sage 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 12-year population-density trends within low-elevation riparian, pinyon-juniper, and sage shrubland habitats for 60 species (a total of 113 species/habitat combinations; Appendix B). The majority of density trend estimates were non-significant, indicating the potential for stable populations for many species.

Of the 113 trend estimates, 20 were significant. Among these, we found an overall negative trend across all three habitats, with only one positive trend: black-chinned hummingbird in pinyon-juniper. While this study does not explore specific factors linked to the declining bird populations in the NCPN, we provide evidence of long-term regional declines 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 should be noted that because of the nature of low-elevation riparian, pinyon-juniper, and sage 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 sage 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. For example, although warbling vireos showed a significant negative trend in sage shrubland habitat, detections of warbling vireos in sage shrubland are likely picked up from adjacent riparian habitat.

Future studies using these data will seek to estimate population density trends for individual species at the transect level. Transect-level estimates will provide a finer-scale view of population trends to complement the regionwide analyses presented in this report. Using land-cover and climate variables, we will evaluate the drivers of density trends for individual species, allowing us to identify prominent threats to declining species and estimate causes of variance in these trends across the NCPN. We also plan to compare trend estimates within NCPN units to those of bird populations outside park boundaries using Breeding Bird Survey data.

5 References

- Baruch-Mordo, S., J. S. Evans, J. P. Severson, D. E. Naugle, J. D. Maestas, J. M. Kiesecker, M. J. Falkowski, C. A. Hagen, and K. P. Reese. 2013. Saving sage-grouse from the trees: A proactive solution to reducing a key threat to a candidate species. *Biological Conservation* 167:233–241.
- Breshears, D. D., N. S. Cobb, P. M. Rich, K. P. Price, C. D. Allen, R. G. Balice, W. H. Romme, J. H. Kastens, M. L. Floyd, J. Belnap, J. J. Anderson, O. B. Myers, and C. W. Meyer. 2005. Regional vegetation die-off in response to global-change-type drought. *Proceedings of the National Academy of Sciences of the United States of America* 102:15144–15148.
- Browder, S. F., D. H. Johnson, and I. J. Ball. 2002. Assemblages of breeding birds as indicators of grassland condition. *Ecological Indicators* 2:257–270.
- Burnham, K. P., and D. R. Anderson. 2002. Model selection and multimodel inference: A practical information-theoretic approach. 2nd edition. New York: Springer.
- Canterbury, G. E., T. E. Martin, D. R. Petit, L. J. Petit, and D. F. Bradford. 2000. Bird communities and habitat as ecological indicators of forest condition in regional monitoring. *Conservation Biology* 14:544–558.
- Daw, S., M. Beer, and S. L. Garman. 2017. Landbird monitoring protocol narrative for park units in the Northern Colorado Plateau Network: Version 1.03. Natural Resource Report NPS/NCPN/NRR—2017/1428. National Park Service, Fort Collins, Colorado.
- Fleischner, T. L. 1994. Ecological costs of livestock grazing in western North America. *Conservation Biology* 8:629–644.
- Gardali, T., and A. L. Holmes. 2011. Maximizing benefits from riparian revegetation efforts: Local- and landscape-level determinants of avian response. *Environmental Management* 48:28–37.
- Gardali, T., A. L. Holmes, S. L. Small, N. Nur, G. R. Geupel, and G. H. Golet. 2006. Abundance patterns of landbirds in restored and remnant riparian forests on the Sacramento River, California, U.S.A. *Restoration Ecology* 14:391–403.
- Gregory, R. D., P. Vorisek, A. Van Strien, A. W. Gmelig Meyling, F. Jiguet, L. Fornasari, J. Reif, P. Chylarecki, and I. J. Burfield. 2007. Population trends of widespread woodland birds in Europe. *Ibis* 149:78–97.
- Lowry, J., R. Ramsey, K. Boykin, D. Bradford, P. Comer, S. Falzarano, W. Kepner, J. Kirby, L. Langs, J. Prior-Magee, G. Manis, L. O'Brien, T. Sajwaj, K. Thomas, W. Rieth, S. Schrader, D. Schrupp, K. Schulz, B. Thompson, C. Velasquez, C. Wallace, E. Waller, and B. Wolk. 2005. Southwest Regional Gap Analysis Project: Final report on land cover mapping methods. Logan, Utah. <http://swregap.nmsu.edu/report/swregap%20final%20report.pdf>.
- Miller, R. F., and P. E. Wigand. 1994. Holocene changes in semiarid pinyon-juniper woodlands. *BioScience* 44:465–474.
- R Core Team, 2014. R: A language and environment for statistical computing. Foundation for Statistical Computing, Vienna, Austria.
- Rosenberg, K. V., J. A. Kennedy, R. Dettmers, R. P. Ford, D. Reynolds, J. D. Alexander, C. J. Beardmore, P. J. Blancher, R. E. Bogart, G. S. Butcher, A. F. Camfield, A. Couturier, D. W. Demarest, W. E. Easton, J. J. Giocomo, R. H. Keller, A. E. Min, A. O. Panjabi, D. N. Pashley, T. D. Rich, J. M. Ruth, H. Stabins, J. Stanton, and T. Will. 2016. Partners in Flight landbird conservation plan: 2016 revision for Canada and continental United States. Partners in Flight Science Committee. <http://www.partnersinflight.org/wp-content/uploads/2016/08/pif-continental-plan-final-spread-single.pdf>.
- Sauer, J. R., J. E. Fallon, and R. Johnson. 2003. Use of North American Breeding

Bird Survey data to estimate population change for bird conservation regions. *The Journal of Wildlife Management* 67:372–389.

Thomas, L., S. T. Buckland, E. A. Rexstad, J. L. Laake, S. Strindberg, S. L. Hedley,

J. R. Bishop, T. A. Marques, and K. P. Burnham. 2010. Distance software: Design and analysis of distance sampling surveys for estimating population size. *Journal of Applied Ecology* 47:5–14.

Appendix A. Individual Species Density by Habitat

Red lines indicate trends from a simple linear regression model (LR = Low-elevation Riparian, PJ = Pinyon-juniper, SA = Sage Shrubland).

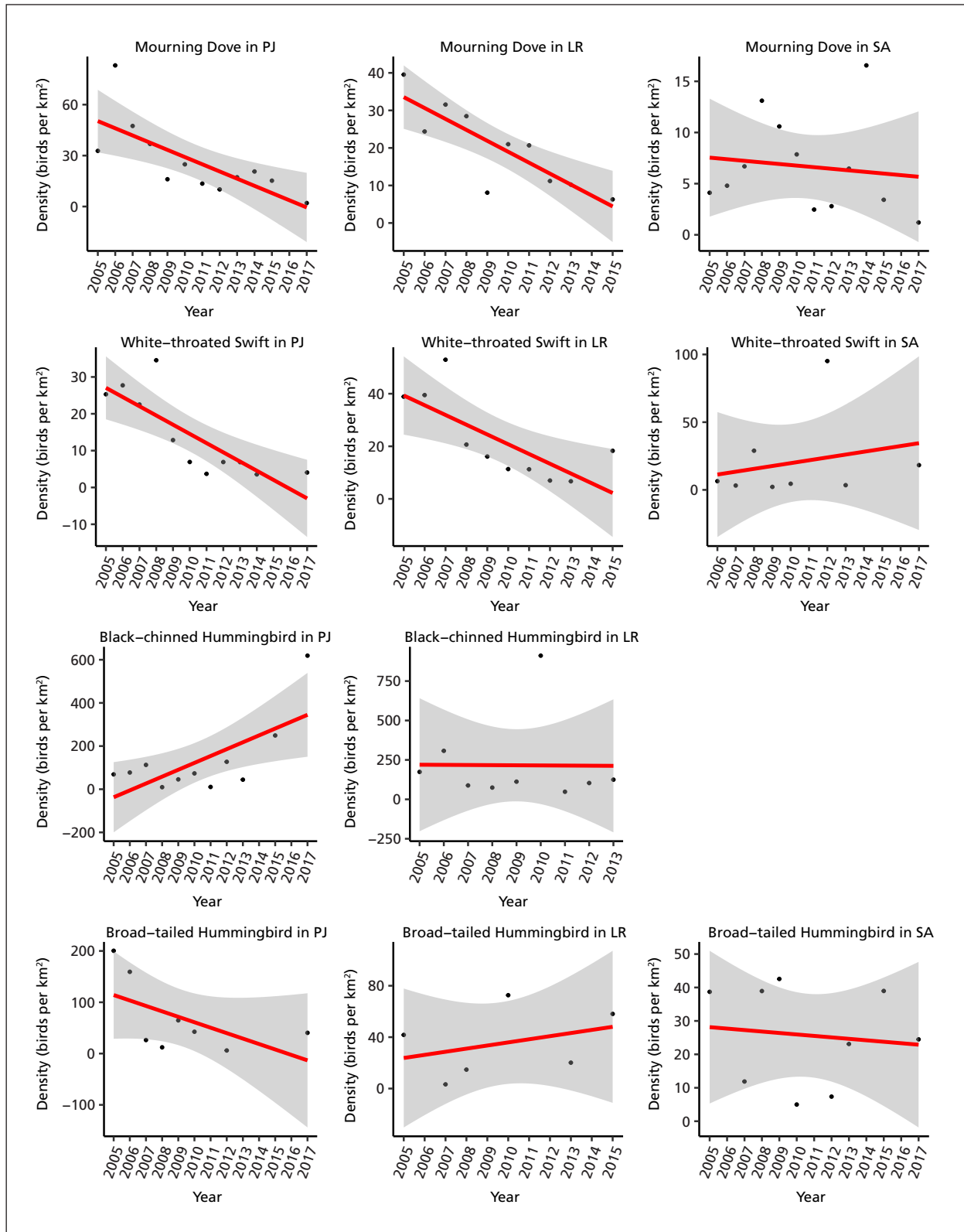


Figure A-1. Density trends for mourning dove, white-throated swift, black-chinned hummingbird, and broad-tailed hummingbird.

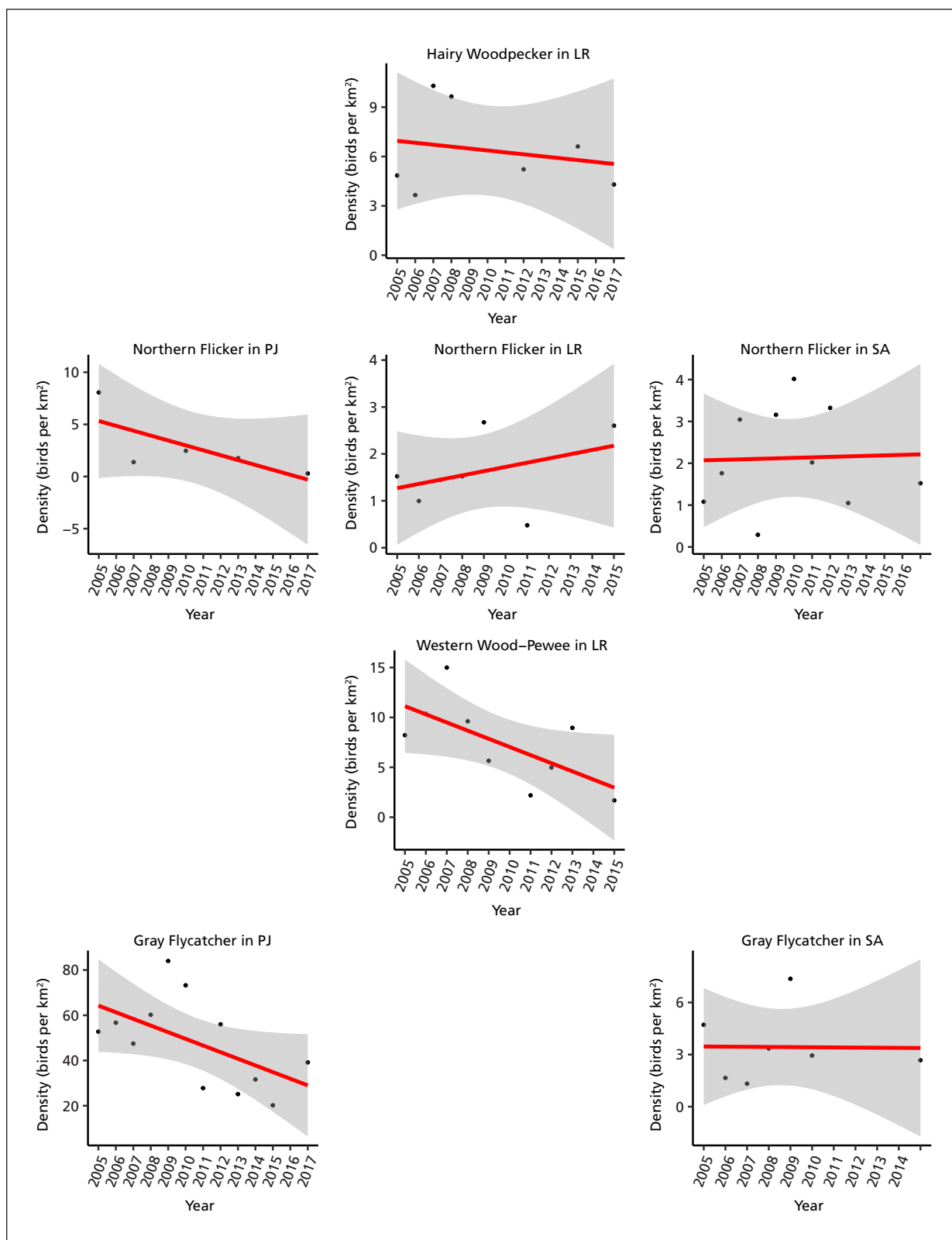


Figure A-2. Density trends for hairy woodpecker, northern flicker, western wood-pewee, and gray flycatcher.

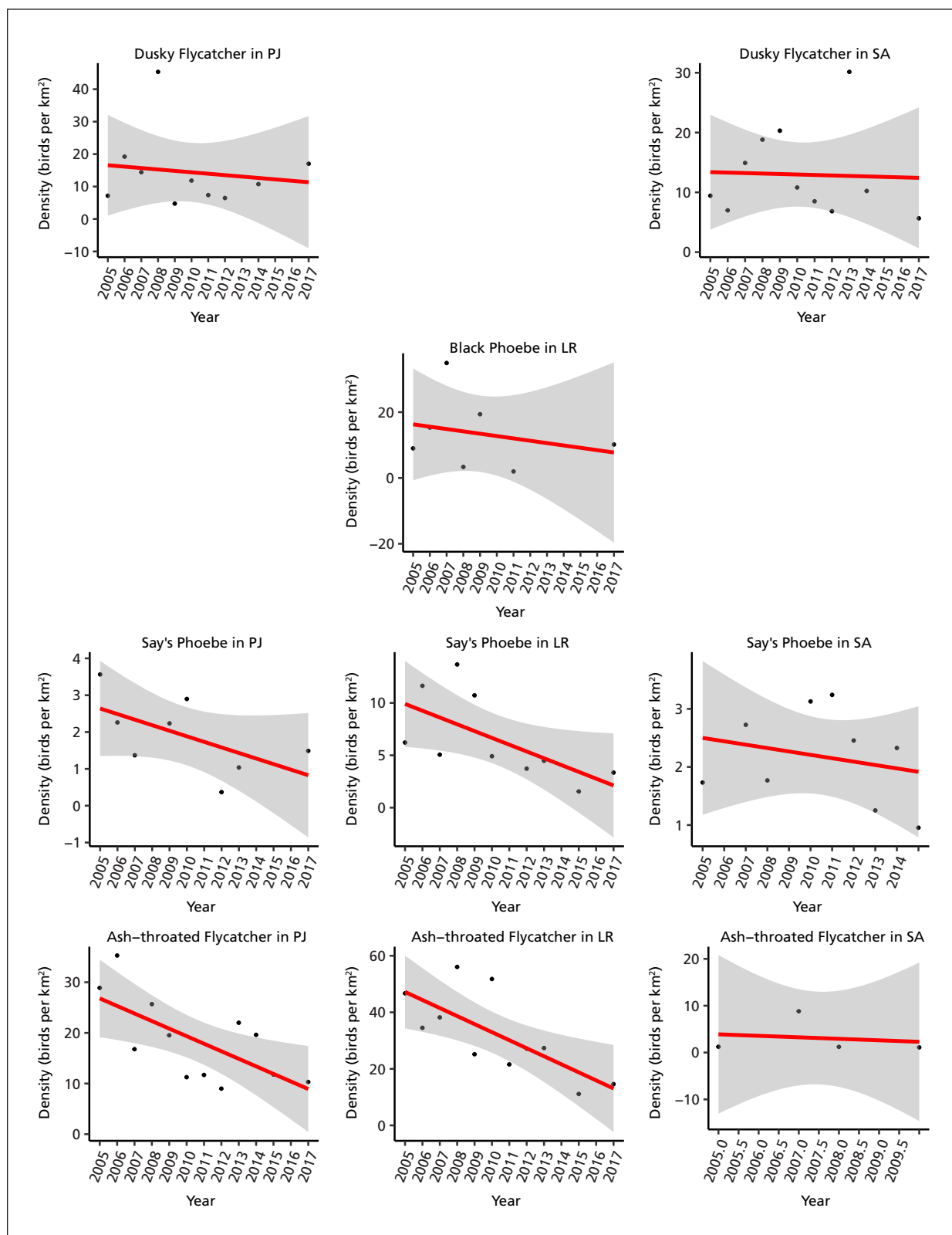


Figure A-3. Density trends for dusky flycatcher, black phoebe, Say's phoebe, and ash-throated flycatcher.

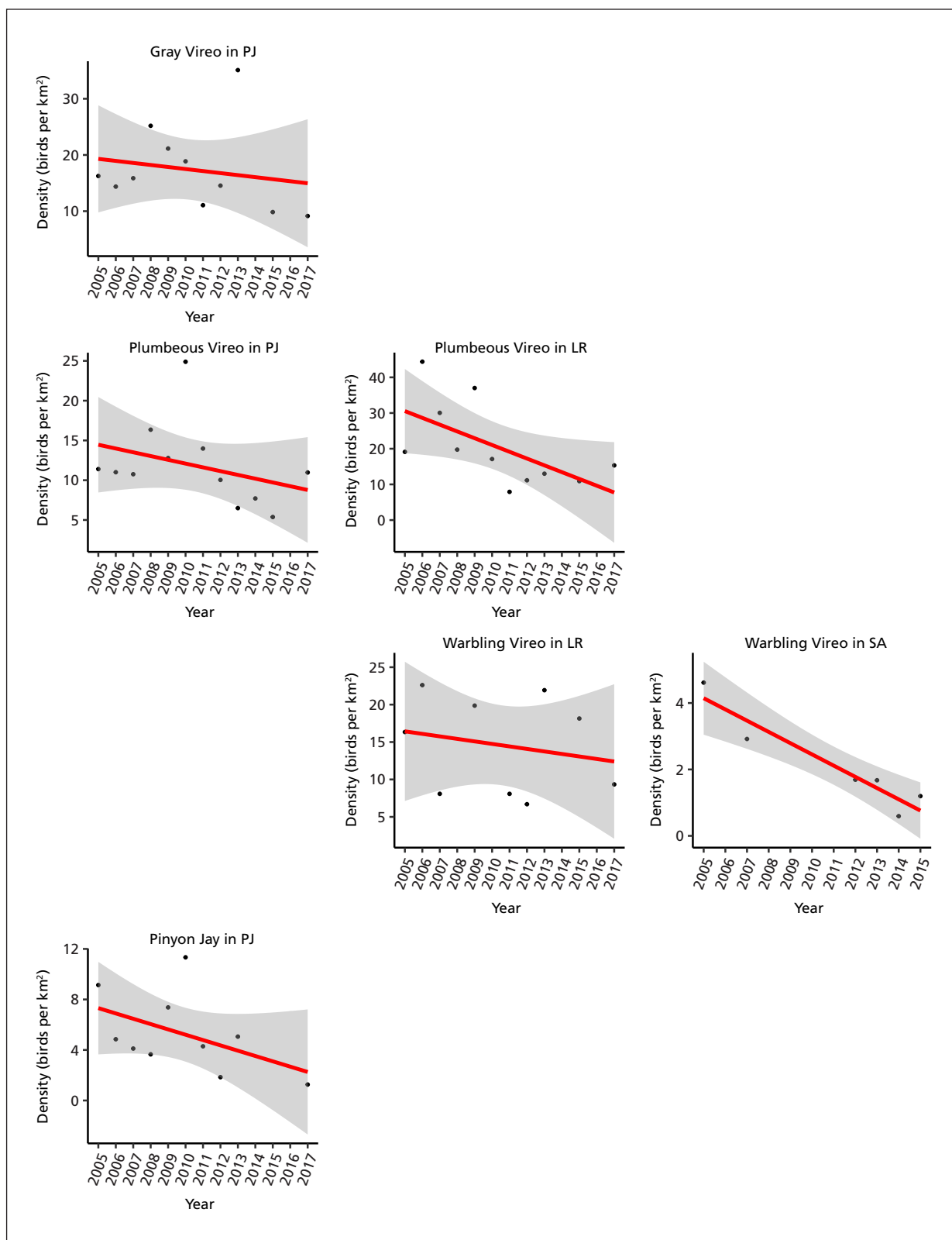


Figure A-4. Density trends for gray vireo, plumbeous vireo, warbling vireo, and pinyon jay.

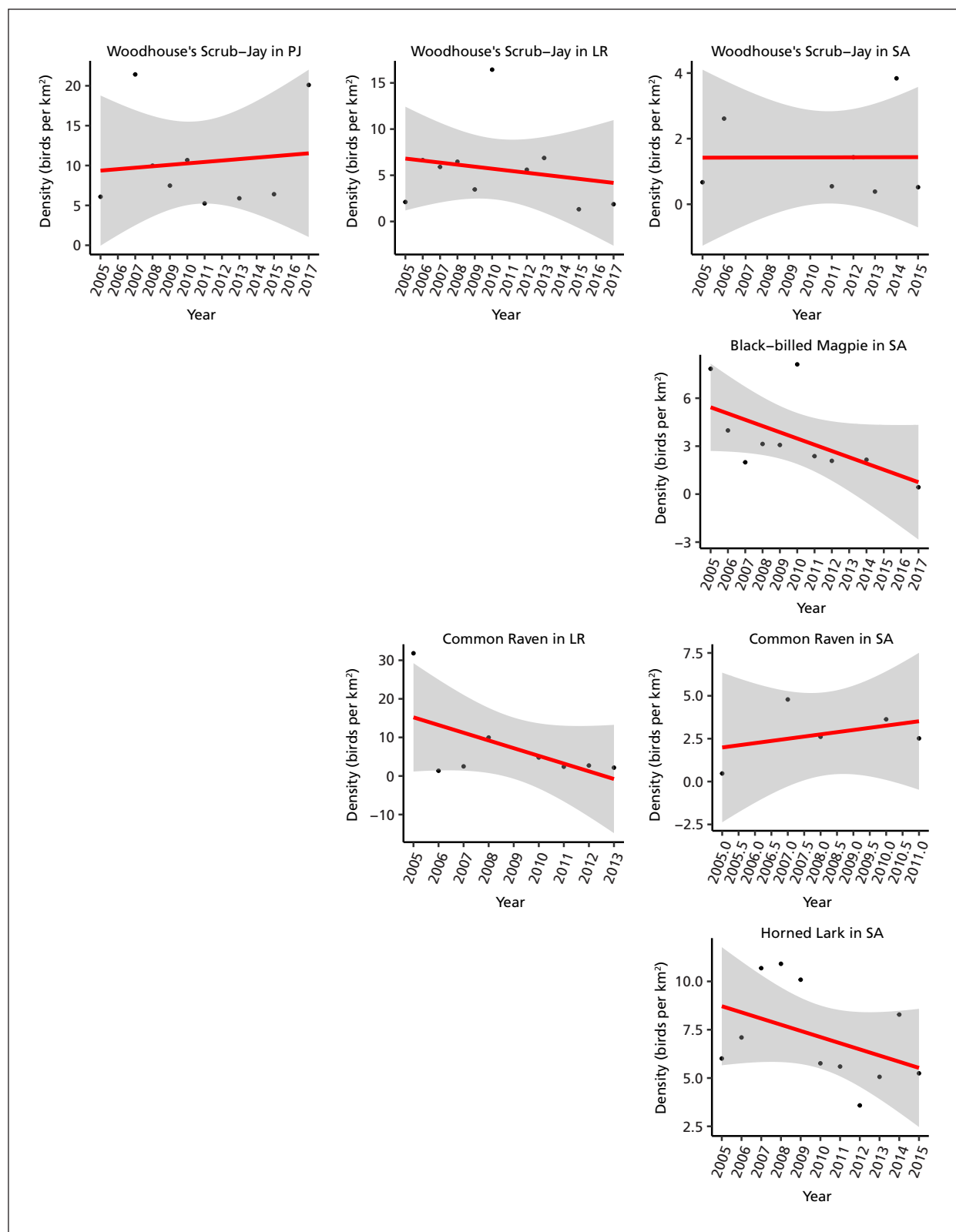


Figure A-5. Density trends for Woodhouse's scrub-jay, black-billed magpie, common raven, and horned lark.

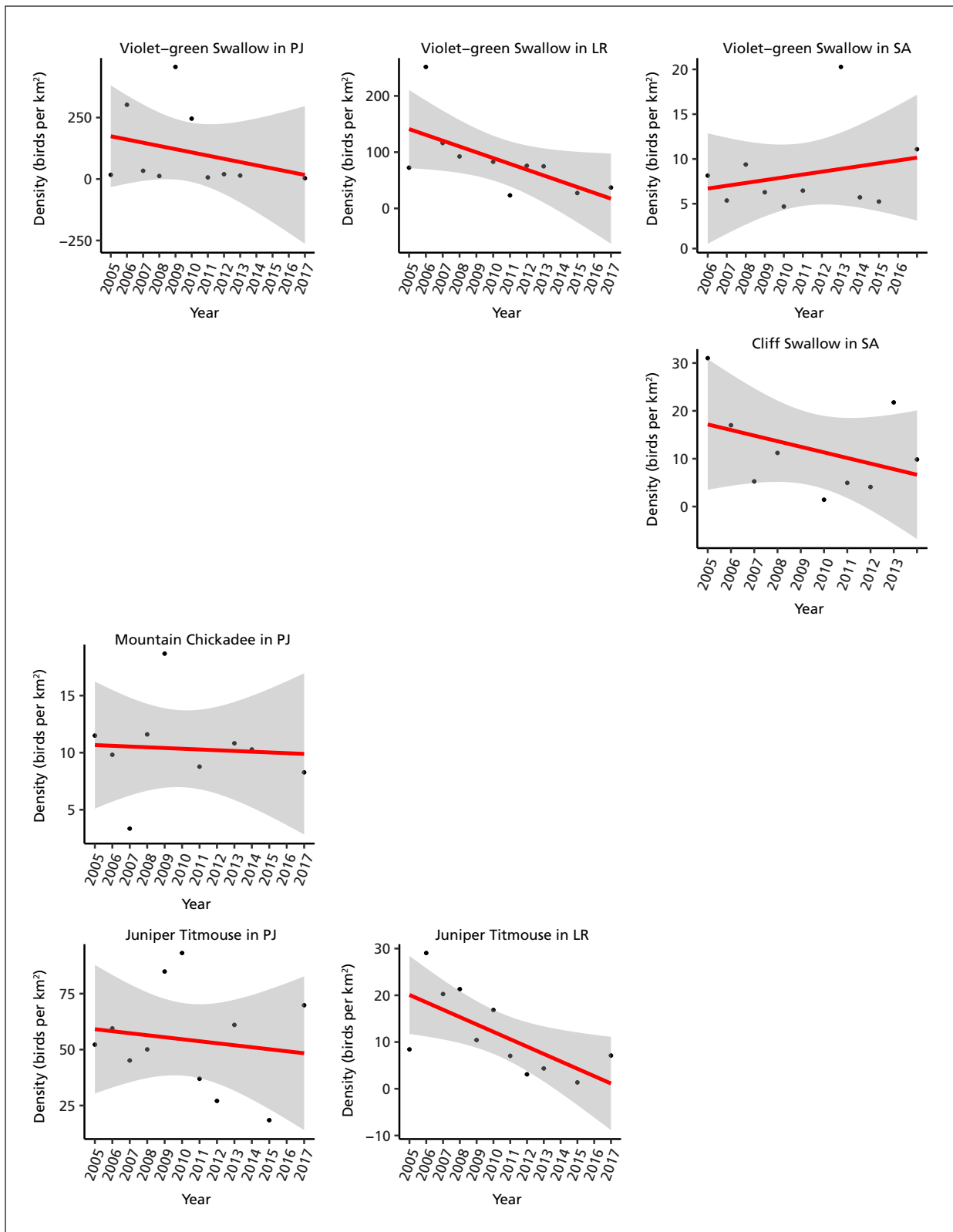


Figure A-6. Density trends for violet-green swallow, cliff swallow, mountain chickadee, and juniper titmouse.

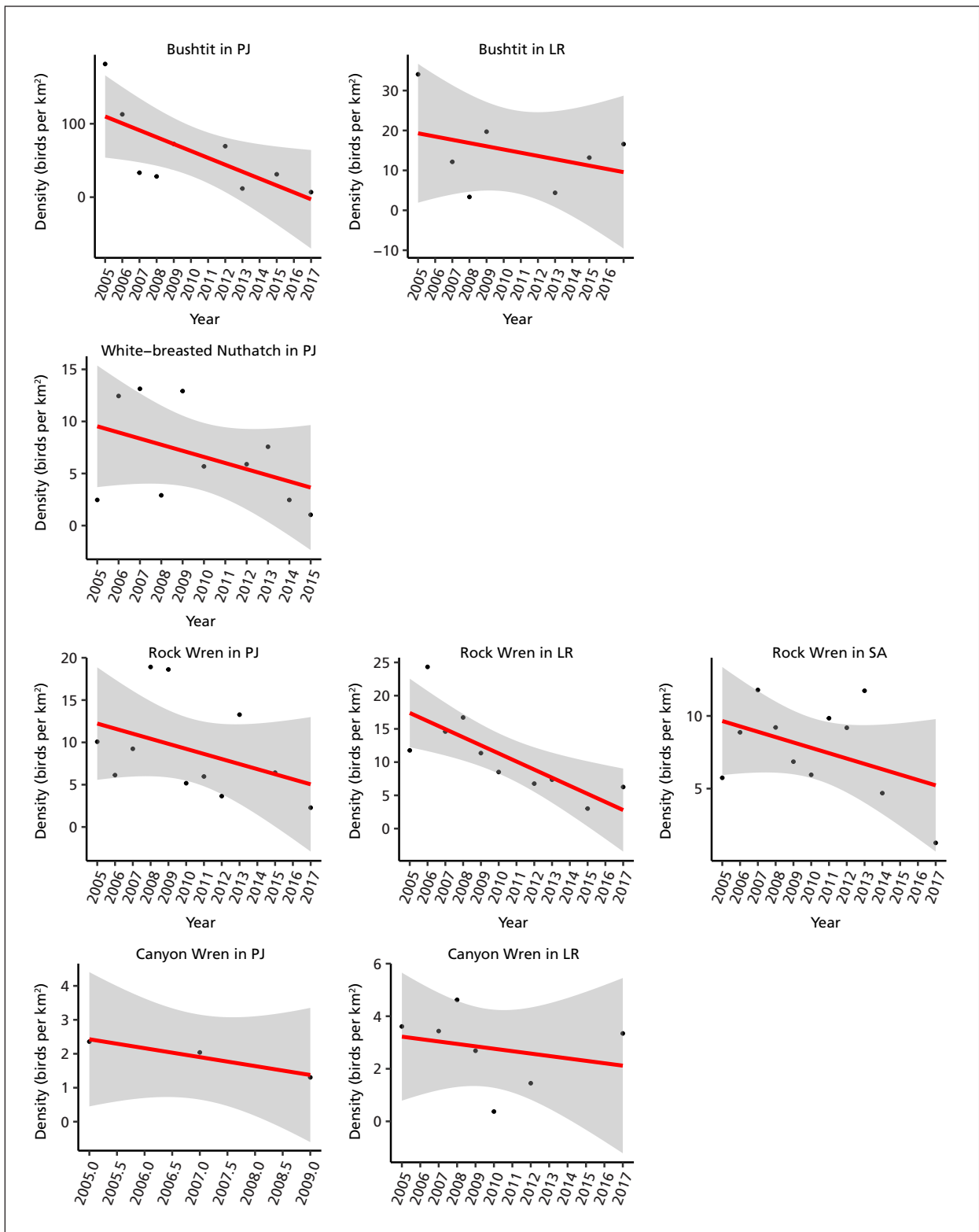


Figure A-7. Density trends for bushtit, white-breasted nuthatch, rock wren, and canyon wren.

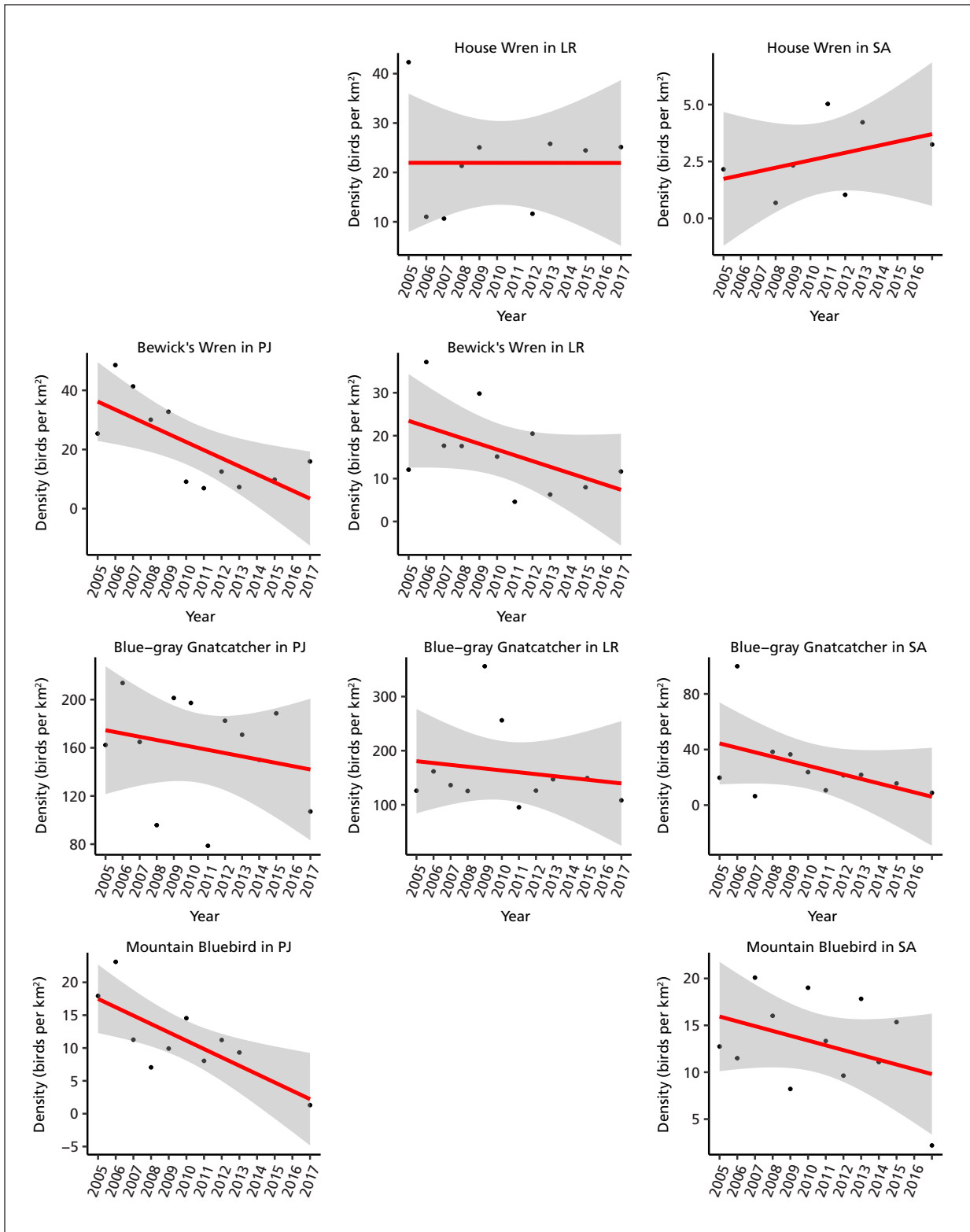


Figure A-8. Density trends for house wren, Bewick's wren, blue-gray gnatcatcher, and mountain bluebird.

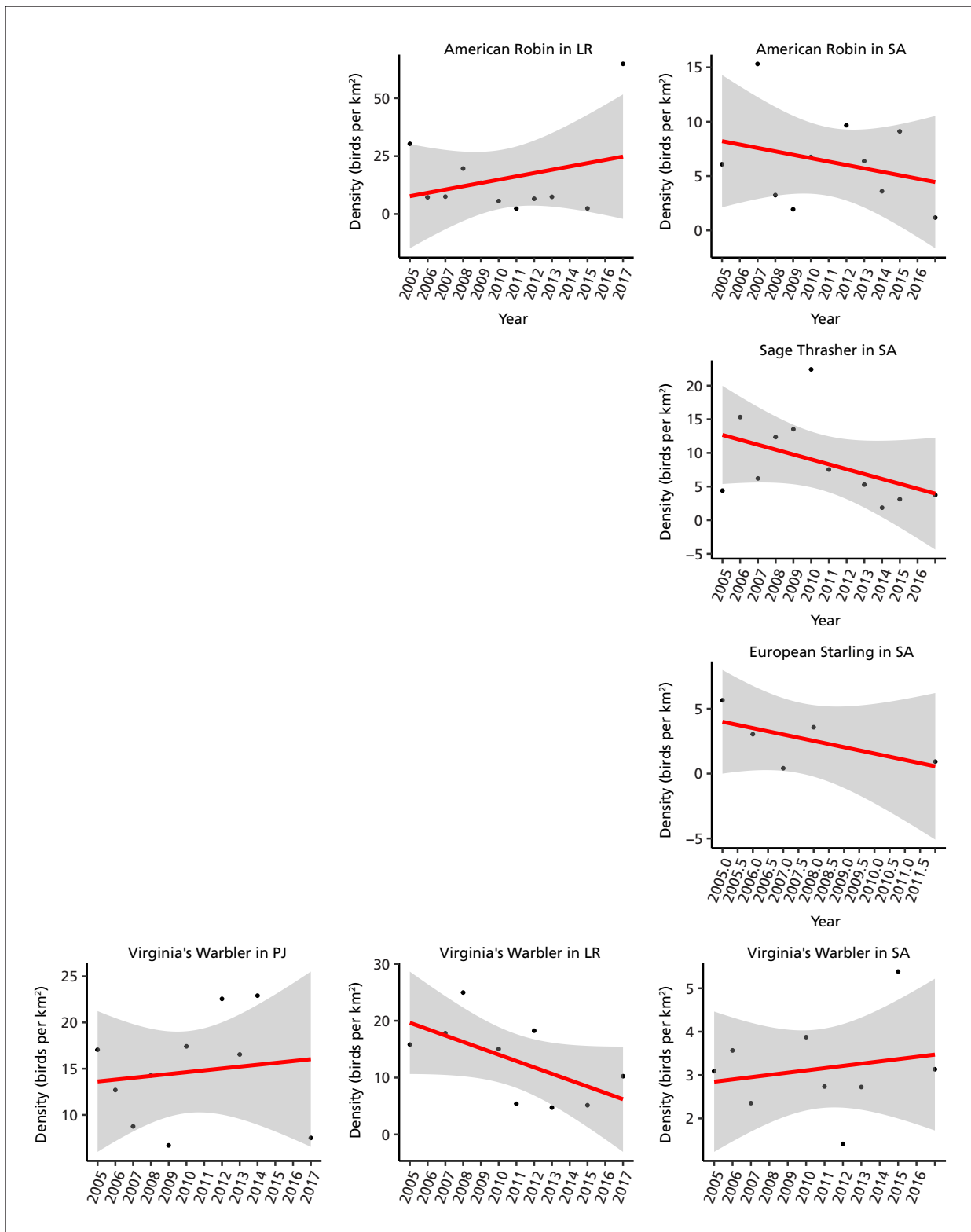


Figure A-9. Density trends for American robin, sage thrasher, European starling, and Virginia's warbler.

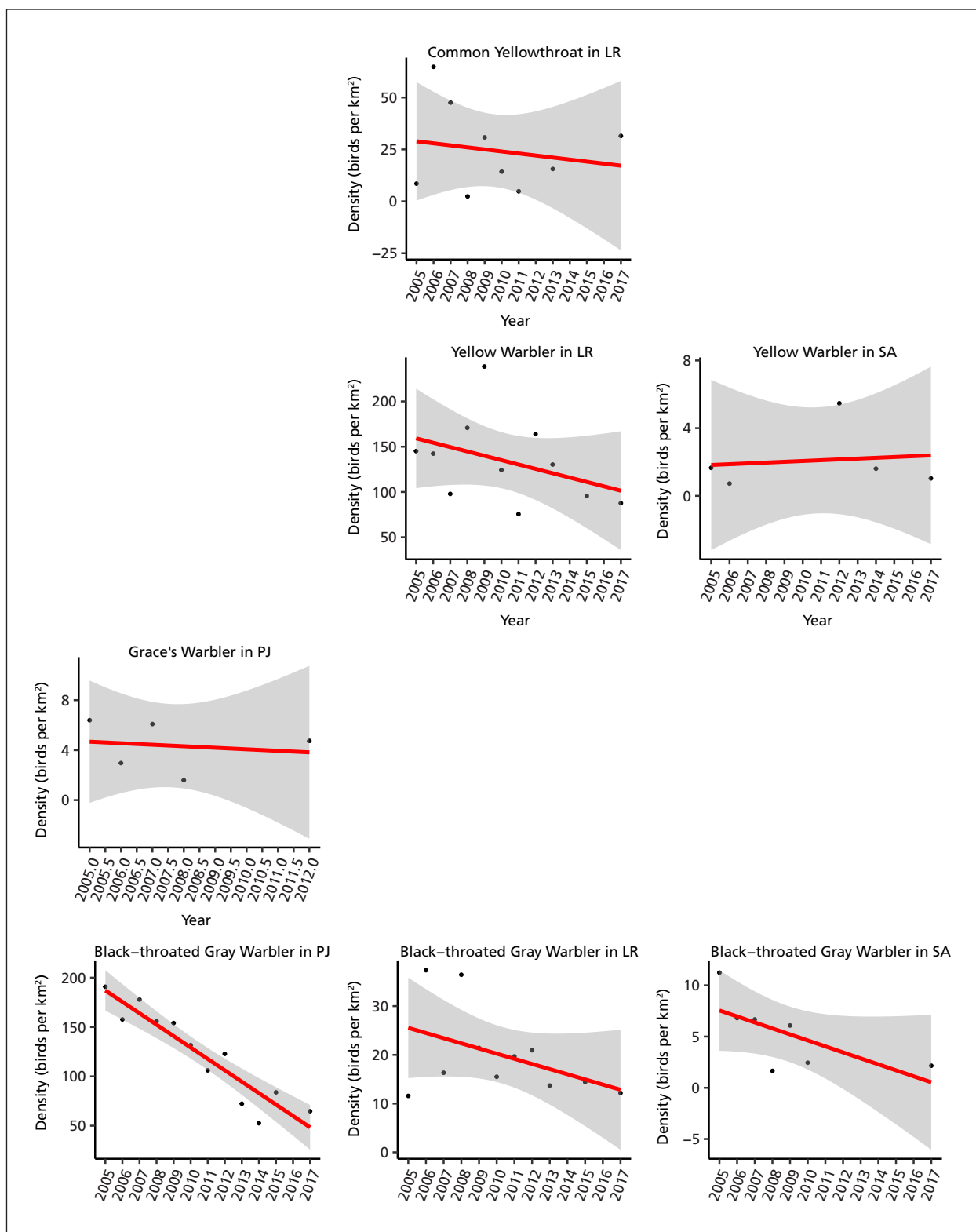


Figure A-10. Density trends for common yellowthroat, yellow warbler, Grace's warbler, and black-throated gray warbler.

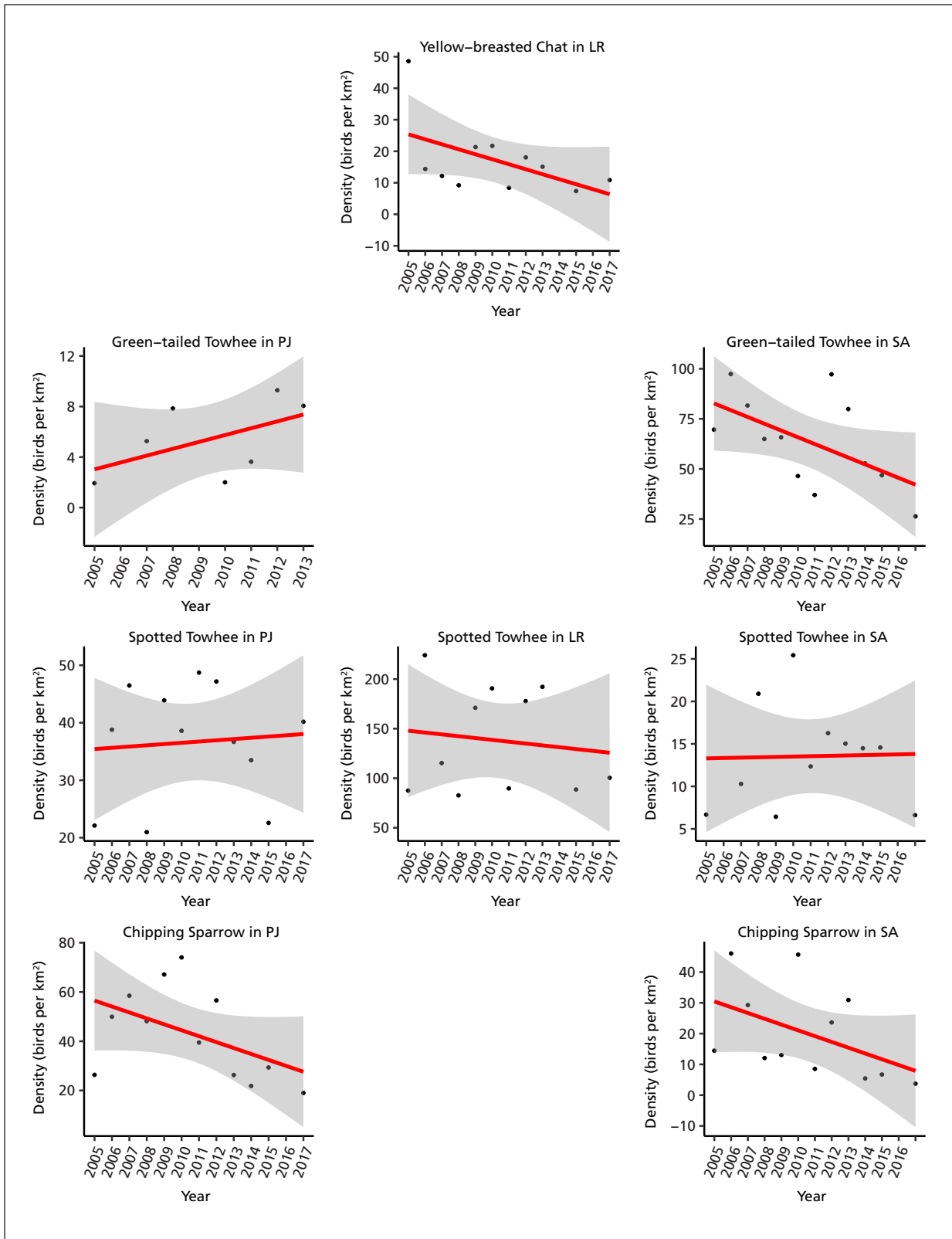


Figure A-11. Density trends for yellow-breasted chat, green-tailed towhee, spotted towhee, and chipping sparrow.

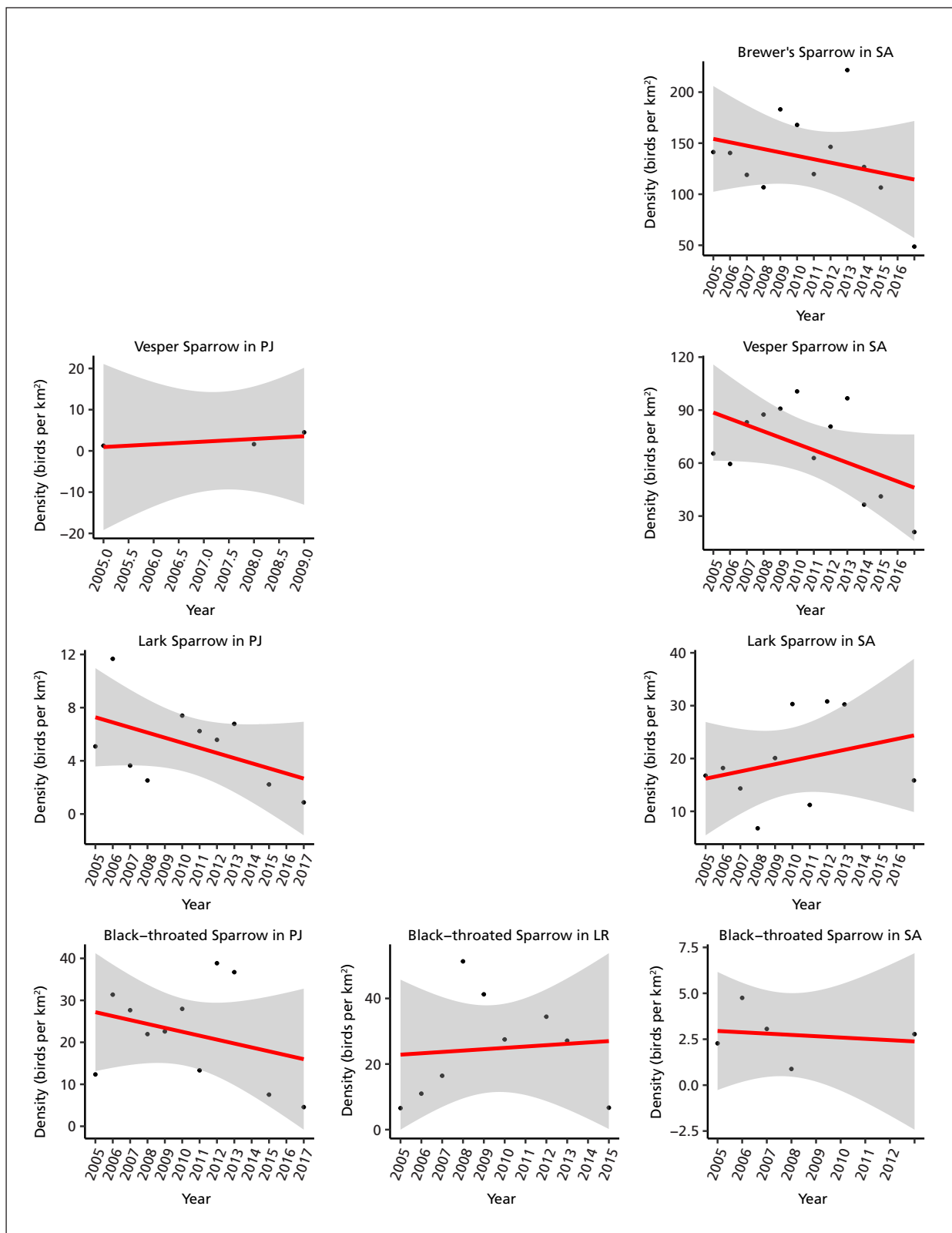


Figure A-12. Density trends for Brewer's sparrow, vesper sparrow, lark sparrow, and black-throated sparrow.

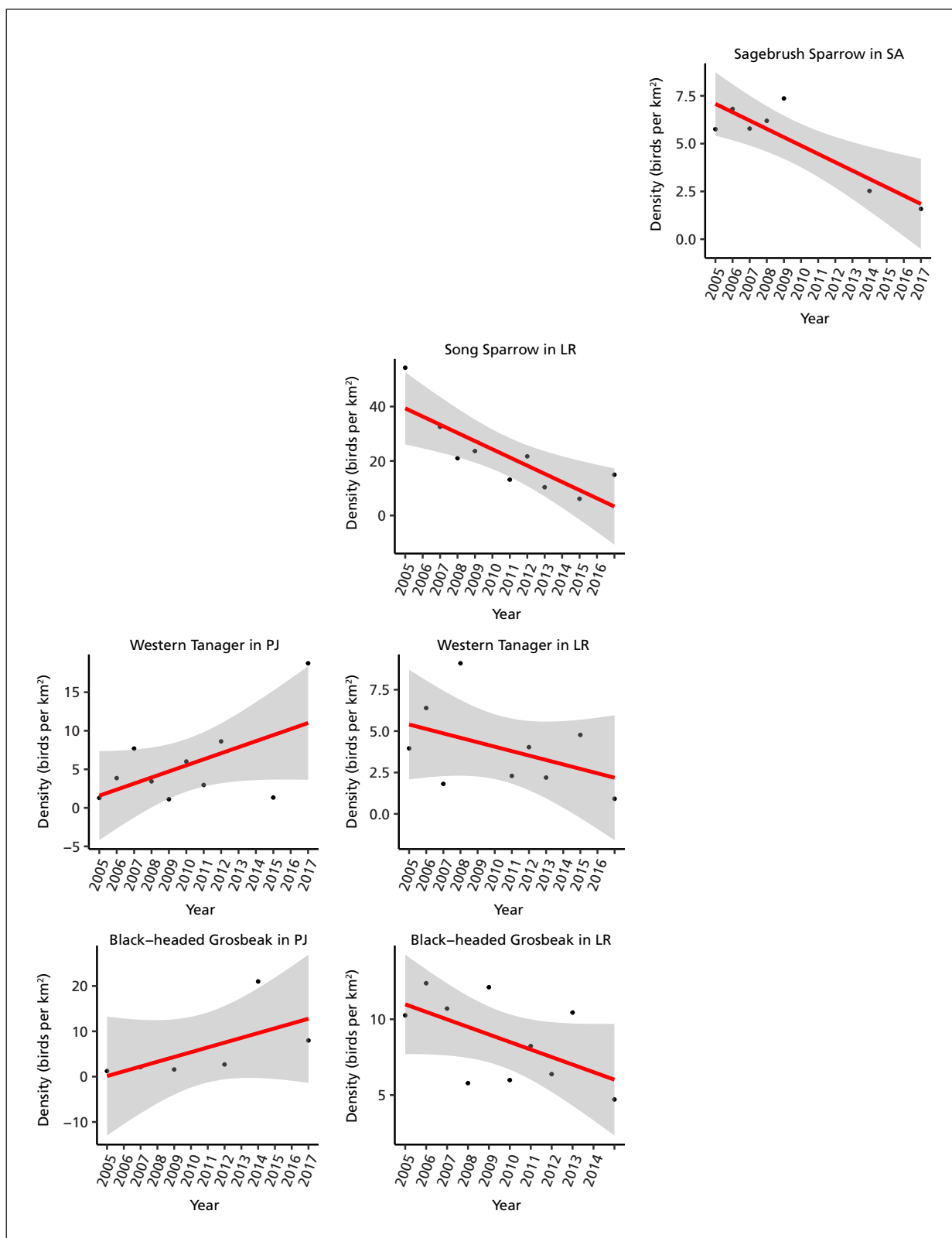


Figure A-13. Density trends for sagebrush sparrow, song sparrow, western tanager, and black-headed grosbeak.

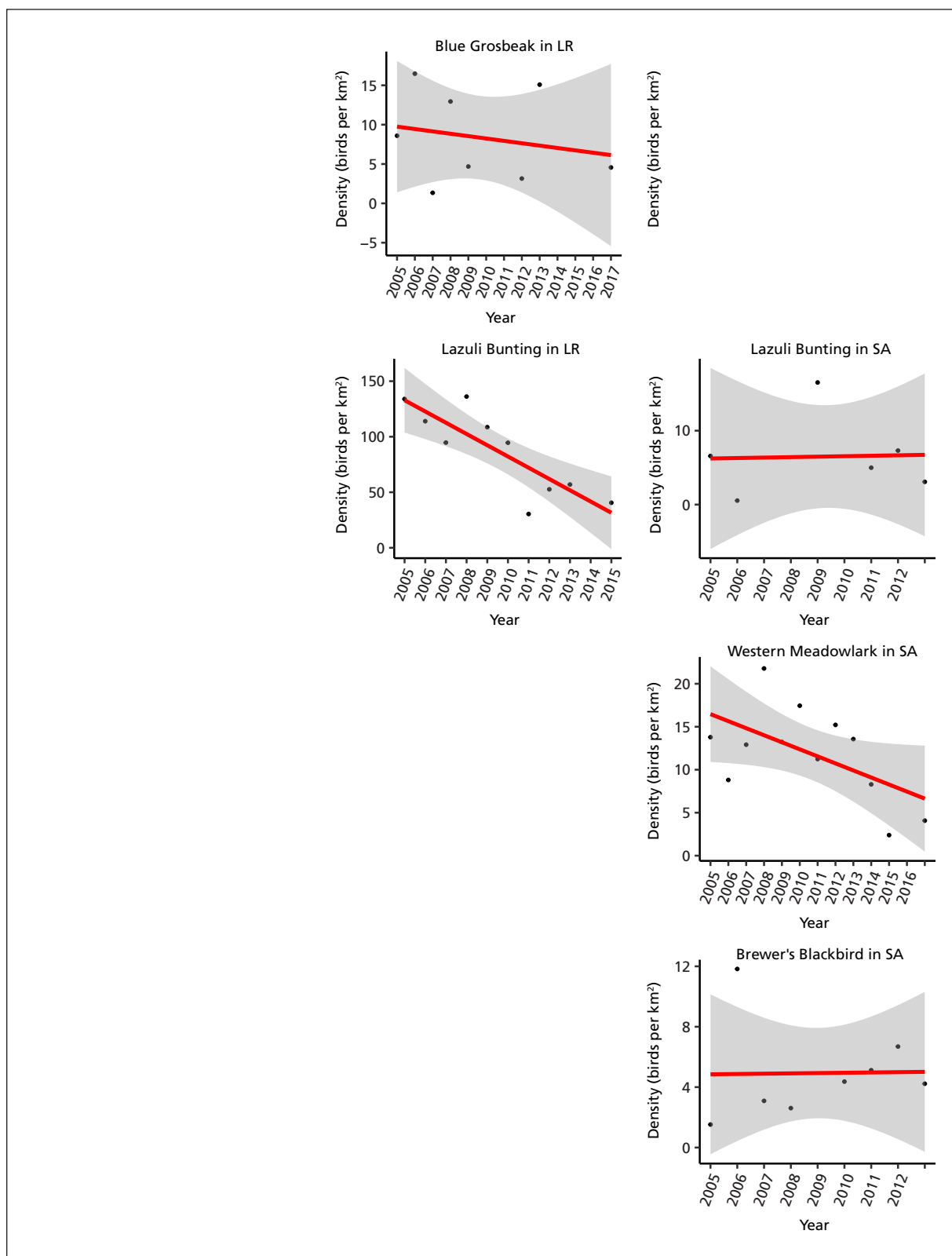


Figure A-14. Density trends for blue grosbeak, lazuli bunting, western meadowlark, and Brewer's blackbird.

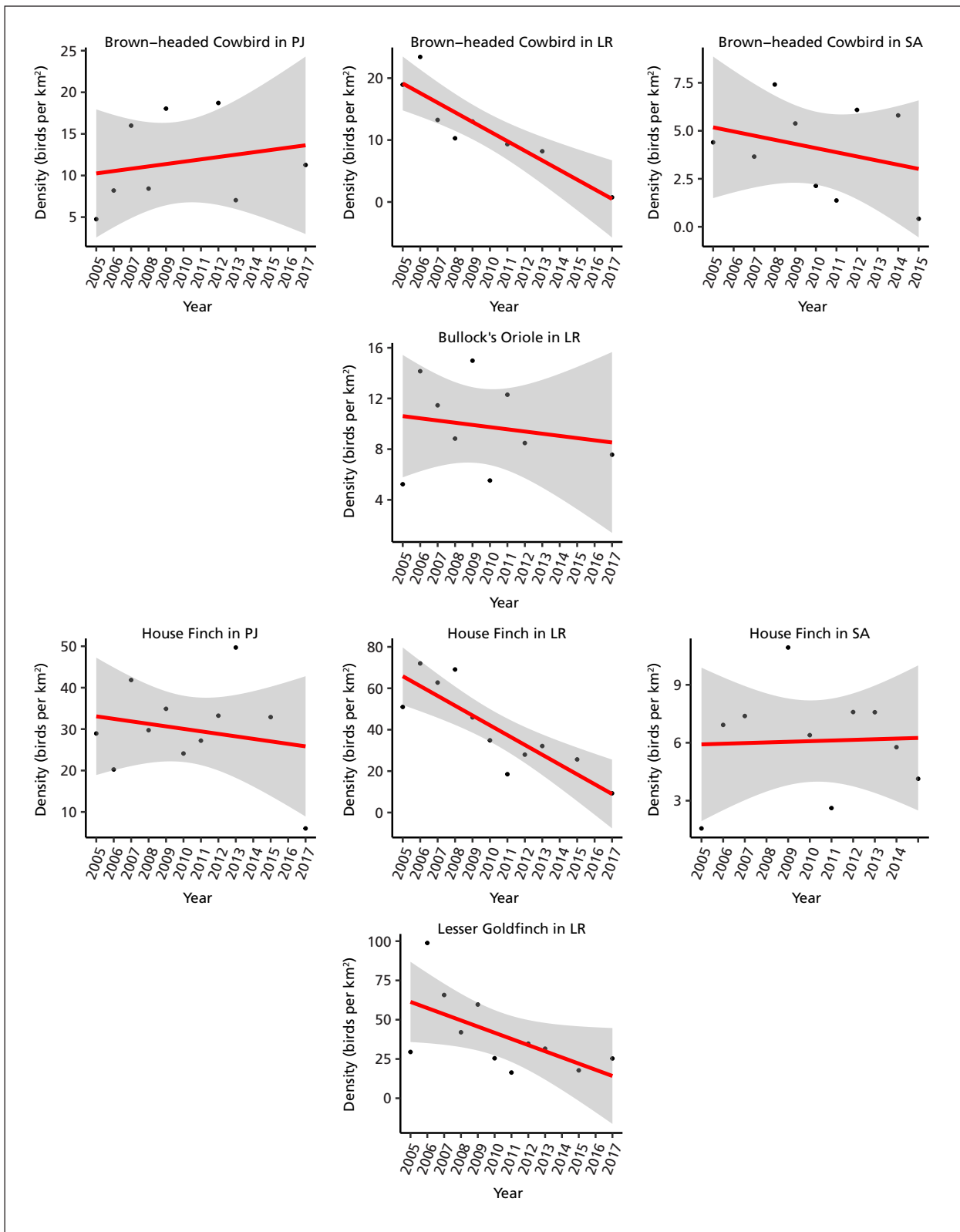


Figure A-15. Density trends for brown-headed cowbird, Bullock's oriole, house finch, and lesser goldfinch.

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

National Park Service
U.S. Department of the Interior



Natural Resource Stewardship and Science

1201 Oak Ridge Drive, Suite 150
Fort Collins, Colorado 80525

www.nature.nps.gov

EXPERIENCE YOUR AMERICA™