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Trends in Abundance and Habitat Associations of Forest Birds on Southern National Forests, 1992–2017

Elizabeth A. Matseur, Thomas W. Bonnot, and Frank R. Thompson III

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ABSTRACT

The USDA Forest Service has a legislative mandate to maintain species and community diversity on National Forest System lands and uses monitoring to determine whether national forests are meeting this goal. The Southern Region of the Forest Service adopted the Southern National Forest's Migrant and Resident Landbird Conservation Strategy in 1996 to address conservation concerns arising from long-term population declines in many birds. The strategy implemented a regionwide program to improve monitoring, research, and management of avian populations and their habitats. Monitoring is conducted by 10-minute point counts from early April to late June across 15 national forest units. Our objective was to analyze 26 years of monitoring data collected by this program from 1992 through 2017 to assess population trends and habitat associations of birds. We used time-removal models within a hierarchical Bayesian model framework to estimate species abundance by year, population trends, and abundance related to forest type and successional class. There were 82,367 point counts completed and 1,104,423 birds detected. We determined population trends for a total of 152 species and between 58 and 117 species per national forest. Seventy-five species had a majority of positive annual trends and 68 species had a majority of negative annual trends across all national forests. We estimated abundance in relation to forest type and successional class for 101 individual bird species. Thirteen species generally had greater abundances in late-successional classes and 29 species in early-successional classes. Twenty-one species were generally more abundant in specific forest types, and abundances of 38 species were more mixed or variable among forest types. This represents the first comprehensive effort to analyze this 26-year dataset, and these results can help inform management and conservation of migrant and resident birds in the Southern Region. We suggest that additional analyses are possible to investigate causal factors for the patterns reported here and further inform management efforts.

Quality Assurance

This publication conforms to the Northern Research Station's Quality Assurance Implementation Plan which requires technical and policy review for all scientific publications produced or funded by the Station. The process included a blind technical review by at least two reviewers, who were selected by the Assistant Director for Research and unknown to the authors. This review policy promotes the Forest Service guiding principles of using the best scientific knowledge, striving for quality and excellence, maintaining high ethical and professional standards, and being responsible and accountable for what we do.

COVER ART: Prairie warbler (T. Johnson, Field Guides Birding Tours, used with permission); **insets, from top:** eastern bluebird (E. Matseur, New Jersey Audubon, used with permission), eastern towhee (M. Roach, New Jersey Audubon Cape May Bird Observatory, used with permission), summer tanager (T. Johnson, Field Guides Birding Tours, used with permission), biologist conducting point count (A. Heltzel, University of Missouri, used with permission).

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INTRODUCTION

The USDA Forest Service (hereafter, Forest Service) has a legislative mandate to maintain species and community diversity on National Forest System lands (USDA Forest Service, n.d.). Land management agencies such as the Forest Service use monitoring to evaluate the success of management activities in meeting legal, regulatory, and policy objectives, including sustaining populations of native and desired nonnative species (Lambert et al. 2009, Manley et al. 2006). Birds are often the focus of monitoring effort for several reasons. They are mostly diurnal and detectable by song and sight. A substantial body of literature describes approaches to monitoring birds (e.g., Hamel et al. 1996, Johnson 2008, Lambert et al. 2009, Manley et al. 2006, Ralph et al. 1995, Rosenstock et al. 2002, Verner 1985). Monitoring also focuses on birds due to vast interest in bird conservation; many are management indicator species or are threatened, endangered, or sensitive species. Bird monitoring can determine changes in occurrence, abundance, or vital rates over time and in response to management or environmental change, which can inform designation of conservation status and provide feedback within an adaptive management framework (Lambert et al. 2009).

The Southern Region of the Forest Service adopted the Southern National Forest's Migrant and Resident Landbird Conservation Strategy in 1996 to improve monitoring, research, and management programs affecting forest birds and their habitats (Gaines and Morris 1996). The strategy includes a regionwide monitoring program based on annual breeding-season point counts of birds. The objective of the monitoring effort is twofold: to develop and implement a standardized bird monitoring program to measure success in achieving population and habitat objectives at the district, forest, and regional level; and to contribute data toward greater understanding of the trends and status of Neotropical migratory birds and other forest birds (Gaines and Morris 1996). La Sorte et al. (2007) summarized relative abundances and annual change in abundances for 144 species based on these surveys from 1992 through 2004. We report some initial results of this monitoring effort on southern national forests from 1992 through 2017. Our objective was (1) to estimate annual abundances and population trends of birds in the Southern Region for 13 national forests, and Land Between the Lakes National Recreation Area and Savannah River Site, both of which are managed by the Southern Region; and (2) to estimate abundance by forest type and successional class in the region. This is the first comprehensive effort to analyze the data from this 26-year monitoring effort and will enable managers for any national forest in the region to quickly assess abundances of species over time or by vegetation types. It is a valuable first step in addressing the original goals of the program to determine and monitor trends of birds on these national forests and their response to habitat management.

METHODS

Study Region and National Forests

We analyzed data from bird point-count surveys that were part of the Southern National Forest's Migratory and Resident Landbird Conservation Strategy (Gaines and Morris 1996). The Southern Region of the Forest Service encompasses 13 states from Texas to Virginia, and Puerto Rico. It includes 14 national forest units and 2 special units: Land Between the Lakes National Recreation Area and Savannah River Site. The bird monitoring program was implemented on 13 of the national forests and 2 special sites (hereafter collectively referred to as national forests; Fig. 1). El Yunque National Forest was the only forest in the region that was not included in the program. Several national forests are named after the state they occur in (e.g., National Forests in Alabama) but are nonetheless a single national forest and not a grouping of national forests created solely for this analysis. We focused our analysis at the scale of the national forest for three reasons. The Southern Region requested that scale of analysis, it is the primary level at which land management planning occurs, and there were sufficient bird detections to analyze abundances of a large number of species at this scale.

The Southern Region includes 244 million acres of forest, of which greater than 13 million acres are owned by the Forest Service, 211 million acres are privately owned, and 20 million acres are owned by other public landowners. National forests in the region are composed of 44 percent oak-hickory (*Quercus* spp.-*Carya* spp.), 24 percent loblolly pine-shortleaf pine (*Pinus taeda-P. echinata*), 16 percent hardwood-pine, 8 percent longleaf pine-slash pine (*P. palustris-P. elliotti*), and 4 percent oak-gum-cypress (*Quercus* spp.-*Liquidambar styraciflua-Taxodium* spp.) forest.

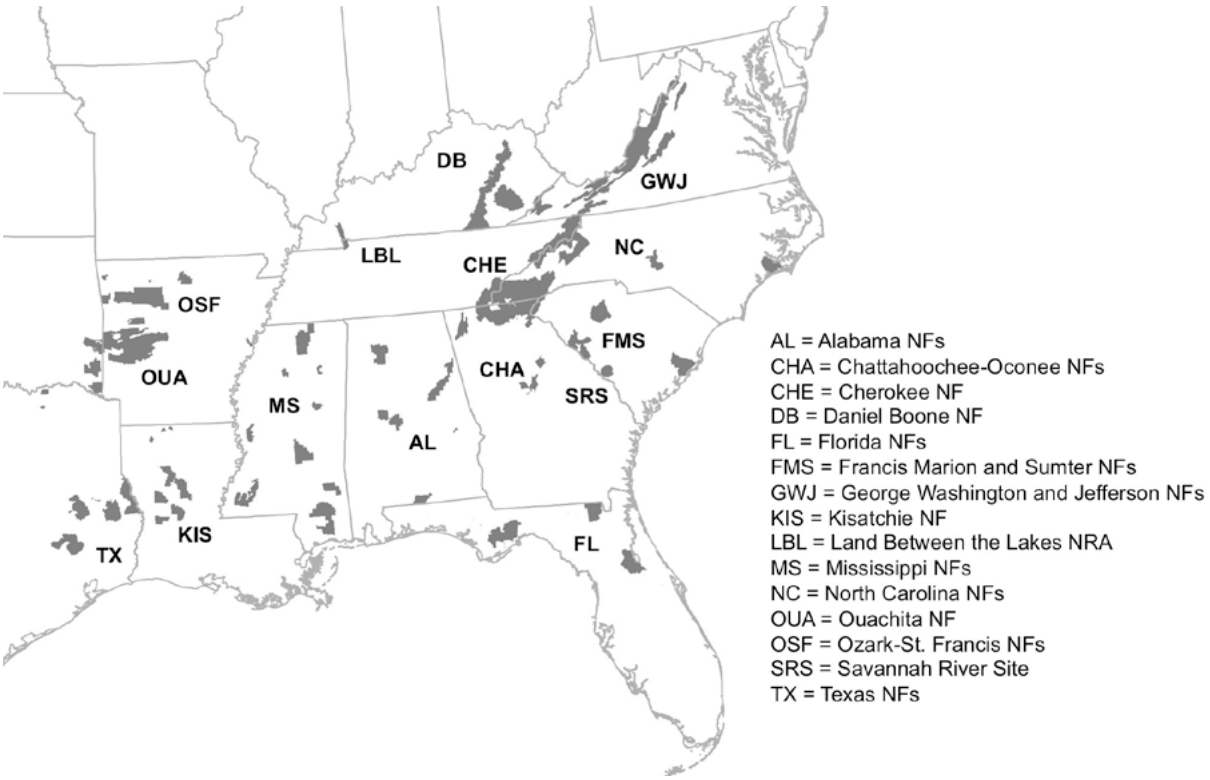

Figure 1.—Location of 13 national forests (NFs), a national recreation area (NRA), and a special site in the Southern Region of the USDA Forest Service.

Sampling Design and Point-count Surveys

Our data comprised bird point-count surveys from 1992 through 2017. Some national forests began point-count surveys in 1992, but most started after the adoption of the conservation strategy in 1996. Each national forest monitored a fixed set of points once annually during the breeding season. The program required a sampling strategy that would both measure changes in species abundance over time on the forest and assess that abundance across a representative sample of vegetation types on each forest. Therefore, national forests used a stratified random sampling design that allocated a minimum of 30 points either equally among habitat groups or in proportion to group composition. Managers of national forests within a physiographic region, as defined by the North American Breeding Bird Survey (BBS) (Bystrak 1981, Sauer and Droege 1990, U.S. Geological Survey 2018), agreed on which habitat groups to survey. The survey was also designed to be hierarchical so that results could be obtained at the scale of a national forest, physiographic region, or region.

Some forests increased the number of points over time or in some years could not complete surveys of all points; consequently, the number of points monitored varied (Table 1 on page 8). National forests added or subtracted a limited number of points to rebalance habitats surveyed to be more representative of the forest and to address contemporary management issues. A relatively consistent sample of points was achieved beginning in 2000, when the program was largely fully implemented; on average, 87 percent of the total number of points were surveyed in any given year across the region. Previous analyses demonstrated that the distribution of points surveyed from 2000 through 2004 reasonably reflected the composition of national forest lands by forest type and forest size class (Tables 3 and 4 in La Sorte et al. 2007). Therefore, we believe that the data provide a reasonable estimate of changes in abundance over time for the national forests considered.

Points were at least 250 m (820 feet) apart and 50 m (164 feet) from habitat type edges. Bird surveys were 10-minute point counts that followed the methodology outlined in Hamel et al. (1996). Guidelines recommended conducting surveys between sunrise and 11 a.m. from April 1 through June 30 each year. Each bird heard or seen was recorded along with a time interval and distance interval for the detection. The time intervals were: 0–3, 3–5, and 5–10 minutes. The distance intervals were: 0–25 meters (0–82 feet), 25–50 meters, and more than 50 meters. We included all bird observations from 1992 to 2017 that fell within the time and date guidelines for the breeding bird point-count surveys. We deleted bird detections that were not detected between sunrise and 11 a.m. or between April 1 and June 30, or that did not include the time interval for the detection.

Vegetation conditions were measured at each point at various times throughout the project and we included two measures in our habitat analysis: forest type and successional class. Forest type was recorded using standard Forest Service vegetation codes, which describe the makeup of the overstory by major tree species. Successional class was categorized as grass and forb, shrub and seedling, sapling and pole, sawtimber, and late successional.

Abundance and Population Trend Analysis

The use of point counts as a survey method has increased greatly since interest in bird conservation and monitoring began to grow starting in the early 1990s. Survey methods and analytical approaches have also changed over time. Early guidelines for monitoring emphasized design-based methods that minimized bias and variability among counts and focused on analyses of relative abundance based on summaries of counts (Hamel et al. 1996, Ralph et al. 1995, Verner 1985). However, there was growing concern that unaccounted-for variability in species detectability could confound interpretation of abundance and trends, which led to greater interest in approaches that empirically estimate detection probability (Rosenstock et al. 2002, Thompson 2002). Initial approaches to analyzing point count data with models that accounted for detection probability were based on distance sampling (Buckland et al. 2001), but now there are a plethora of approaches. These approaches include double-observer sampling (Nichols et al. 2000), time-of-detection sampling, and time-removal sampling (Farnsworth et al. 2002), many of which are available in popular software packages (e.g., Unmarked; Fiske and Chandler 2019). The Southern Region avian monitoring program was based on early point-count guidelines that emphasized design-based approaches to analyzing relative abundance. Bird detections were recorded in three distance categories and time intervals, as described in the preceding section, for easier comparison of results among other common survey protocols in use at that time. Nevertheless, we were able to use this information to empirically estimate detection probability in a contemporary model-based approach.

We modeled abundance and trends of individual bird species at points over time, by national forest, using time-removal models within a hierarchical Bayesian framework. Models included both detection (observation) and abundance (ecological) processes as well as trend estimates. This approach allowed us to empirically estimate species detectability to account for individuals present but not detected, and thus estimate the overall number of individuals present at a point. This distinction is important because Thompson and La Sorte (2008) demonstrated that failure to account for detection probability could result in incorrect conclusions about trends, based on data from the Southern Region avian monitoring program. We fit models using Markov chain Monte Carlo analysis in JAGS (Plummer 2003) via the package jagsUI 1.5.0 in R version 3.6.0 (R Core Team 2019). The Bayesian approach allowed us to incorporate needed random effects and specify a model for some of the unique aspects of the data, such as unequal time intervals. We used a conditional, multinomial (three-part) model (Kéry and Royle 2016). We treated the counts of individuals detected in three time intervals as a multinomial observation process integrated with a binomial availability process that ultimately stemmed from a Poisson abundance (ecological) process. Thus, the model was expressed by the following three component models:

$$y_{i,j} \mid n_{i,j} \sim Multinomial(n_{i,j}, \pi_i^c),$$

$$n_{i,j} \sim Binomial(N_{i,j}, 1 - \pi_0)$$

$$N_{i,j} \sim Poisson(\lambda_j),$$

where $y_{i,j}$ was the individual counts of birds detected among the time intervals with probabilities π_i^c based on the length of the intervals and the detection rate at the i^{th} point, $n_{i,j}$ was the total number of birds actually detected at the point, and $N_{i,j}$ was the latent number of birds estimated at the i^{th} point in year j.

We modeled year-specific abundance for each species within each site by allowing $N_{i,j}$ to follow a Poisson distribution with a mean abundance λ_j that varied across years. We used a noninformative gamma prior for λ_j (Kéry and Schaub 2012). We modeled detection probability based on day of year because bird singing and calling varies seasonally and can affect detectability. We incorporated a random effect for year into the detection probability to account for nonindependence within years and variation among observers and other factors that varied across years. We used vague normal priors for both detection effects. The point counts had an unlimited detection radius and therefore no fixed area was sampled, so abundance represents the number of birds at a point but cannot be converted to a density.

We estimated species trends in the same model as year-specific abundance by calculating the geometric mean of the changes in estimated abundance from one year to the next across the entire time period. This estimate is a true population trend and is analogous to the geometric mean trend estimate from hierarchical models now reported for the BBS (Sauer and Link 2011). Although annual trend estimates may be more variable, they stem directly from the estimated annual abundances and provide a realistic idea of the year-to-year changes that managers would observe for a species on their national forest. Another common method of estimating trends is based on a linear regression through annual abundance estimates (Sauer and Link 2011), so we calculated this as well. The linear trend is not a true estimate of growth and is less representative of the variation in abundance from year to year. However, it can provide a conservative estimate of the general trend of a species in a national forest over the long term. Thus, while our results focus primarily on species' annual trends, we also report linear trends to provide some sense of growth or decline when uncertainty exists in the former. All trend estimates are reported as the mean annual percent change.

We attempted to fit abundance and trend models for all species on a national forest. However, due to sample size limitation for some species, we report only results from models that converged and, hence, for which valid estimates were available. We simulated 3 chains of 10,000 samples. We used a burn-in of 4,000 samples and a thinning rate of 2. We required an effective posterior sample size greater than 30 and the Gelman-Rubin diagnostic near 1 for model convergence. If convergence did not occur after the first 10,000 samples, we updated the chains with another 30,000 samples.

For each national forest (listed alphabetically) we provide a table reporting the number of bird detections, the mean annual trend and linear trend and their credible intervals for each species, and the mean abundance for the period; a summary chart showing the mean annual trends and linear trends for the species with significant trends, and graphs for each species showing mean abundance plus and minus 95-percent credible intervals over time. The lower (LCI) and upper (UCI) bounds of the 95-percent credible intervals were the 2.5 and 97.5 percentiles of the posterior distribution of the estimates. In addition, we flagged species abundances in the tables for each national forest that were based on fewer than 50 bird detections or that had wide credible intervals relative to the size of the estimate. We suggest either not interpreting them or using extreme caution in interpretation. Small sample sizes and low abundances can compromise model fitting and could yield results that are inaccurate or imprecise. In the text we highlighted some of the most abundant and least abundant species that were based on more than 50 detections or that had good precision and identified species with the largest population trends supported by 95-percent credible intervals that excluded 0.

Regional Habitat Association Analysis

We used the same time-removal model in a hierarchical Bayesian approach to determine species abundances in relation to forest type and successional class at the regional scale, while accounting for detection. We used the two-part marginal formulation from Kéry and Royle (2016) to facilitate model convergence and the estimation of covariate effects. Counts within the time intervals were treated as independent Poisson counts with a mean equal to the product of the realized abundance λ'_i and the probability of detection π_i^c within the c^{th} time interval at the i^{th} point:

$$y_{p,i} \sim Poisson(\lambda'_i * \pi_i^c),$$

$$\lambda'_{i_i,j} = \lambda_i z_i,$$

$$z_i \sim Bernoulli(\psi_i).$$

The realized abundance accounts for the large-scale patterns in distribution of a species across the region and over time through a latent occurrence process, z_i modeled as a Bernoulli draw with a mean of ψ_i.

We modeled abundance at each point (λ_i) as the log-linear relationship with an interaction between forest type and successional class at the point. To simplify model estimation, we combined forest types into eight forest-type groups based on classifications for the Forest Service's Forest Inventory and Analysis database (USDA Forest Service 2008). Vegetation data were recorded periodically at sample points. Therefore, we excluded from the analysis points for which forest type and successional class data were recorded more than 5 years from the time of the sample. Occurrence (ψ_i) was modeled as the logit of a random intercept for each national forest and year from a vague normal distribution. Similar to the trend models, we modeled detection probability based on day of year and a random effect for year. We used vague normal priors for all effects.

We attempted abundance models for all species using points from all national forests. However, due to a limited number of detections for some species, we report only results from models that converged and for which valid estimates were available. We simulated 3 chains of 10,000 samples. We used a burn-in of 2,000 samples and a thinning rate of 4. We required an effective posterior sample size greater than 30 and the Gelman-Rubin diagnostic near 1 for model convergence. Abundances are reported as the mean number of birds per point. We report bar charts showing abundances plus or minus 95-percent credible intervals for successional classes within forest types for species with strong relationships between abundance and forest type and successional class. We defined strong relationships as those having 95-percent credible intervals that did not overlap 0 based on 145 or more detections.

RESULTS

Abundance and Population Trends

We analyzed 82,367 point counts from 15 national forests spanning 1992 through 2017. The total number of points per site ranged from 14,945 in Mississippi National Forests to 513 points in Savannah River Site. The average number of points per site was 5,491 points. The total number of points sampled per year ranged from 4,282 points in 2004 to 617 points in 1992. The average number of points sampled per year was 3,168 points (Fig. 1, Table 1). The point surveys were distributed across all successional classes and dominant forest types, and effort by forest type reflected the ranking of dominant forest types on national forest lands (Fig. 2).

We included all 1,104,423 bird detections representing 250 species across 15 national forest sites and 26 years (scientific names of all bird species detected in the monitoring effort can be found in Table 2). Red-eyed vireo (95,631), American crow (59,040), eastern tufted titmouse (53,795), indigo bunting (49,018), and pine warbler (47,767) had the most detections. Species with the fewest detections included in the analysis were peregrine falcon (5), bald eagle (14), common ground-dove (17), Bewick's wren (28), and boat-tailed grackle (38). The average number of detections per species was 4,418 (Table 2).

We estimated abundances and population trends for 152 species. The number of species successfully modeled per national forest ranged from 117 species in North Carolina National Forests to 58 species in Savannah River Site. Red-eyed vireo, American crow, northern cardinal, indigo bunting, pine warbler, and ovenbird frequently had the highest average abundances across all national forests. Some species with the lowest average abundances were green heron, chuck-will's-widow, cerulean warbler, sharp-shinned hawk, northern mockingbird, and northern rough-winged swallow.

Of the 152 species modeled, 75 species showed a majority of positive annual trends and 68 species had a majority of negative annual trends across all national forests. Northern parula, yellow-throated vireo, black-throated green warbler, blue-gray gnatcatcher, and blue-headed vireo were among the species that frequently had large positive annual trends. American crow, blue jay, summer tanager, northern bobwhite, and Kentucky warbler often had large negative annual trends across the national forests.

Table 1.—Number of point counts conducted annually in 13 national forests (NFs), a national recreation area (NRA), and a special site in the Southern Region of the USDA Forest Service, by year

Forest	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Subtotal
Alabama NFs	0	0	0	0	0	64	179	222	273	261	322	300	316	**1,937**
Chattahoochee-Oconee NFs	460	527	310	416	190	197	180	186	156	162	190	187	185	**3,346**
Cherokee NF	157	192	91	180	185	236	189	221	221	227	195	204	223	**2,521**
Daniel Boone NF	0	0	0	0	0	188	172	189	188	188	175	152	174	**1,426**
Florida NFs	0	0	0	0	0	0	0	20	30	30	90	89	135	**394**
Francis Marion and Sumter NFs	0	1	316	285	233	317	318	267	288	276	275	277	264	**3,117**
George Washington and Jefferson NFs	0	15	260	343	407	771	755	753	794	796	666	771	786	**7,117**
Kisatchie NF	0	0	0	0	0	0	129	127	129	98	127	128	128	**866**
Land Between the Lakes NRA	0	205	138	186	107	183	171	170	171	203	202	191	201	**2,128**
Mississippi NFs	0	0	210	213	215	0	39	593	753	810	803	767	827	**5,230**
North Carolina NFs	0	0	0	0	0	329	343	341	339	338	242	274	326	**2,532**
Ouachita NF	0	0	0	0	0	244	255	259	257	254	302	292	302	**2,165**
Ozark-St. Francis NFs	0	0	0	0	0	217	235	234	235	235	235	235	235	**1,861**
Savannah River Site	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Texas NFs	0	0	0	0	0	0	180	180	179	179	180	178	180	**1,256**
Total	**617**	**940**	**1,325**	**1,623**	**1,337**	**2,746**	**3,145**	**3,762**	**4,013**	**4,057**	**4,004**	**4,045**	**4,282**	**35,896**

Forest	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Total
Alabama NFs	349	365	360	359	359	357	336	380	266	373	353	275	328	**6,397**
Chattahoochee-Oconee NFs	208	191	188	160	127	158	165	180	185	180	182	183	179	**5,632**
Cherokee NF	211	220	198	227	213	133	225	229	203	223	224	194	228	**5,249**
Daniel Boone NF	157	163	1	182	185	187	183	186	187	185	183	183	176	**3,584**
Florida NFs	135	134	123	96	133	144	177	92	0	21	0	6	0	**1,455**
Francis Marion and Sumter NFs	255	56	330	329	288	264	280	260	223	186	132	112	107	**5,939**
George Washington and Jefferson NFs	380	341	266	433	375	421	399	416	389	261	261	146	154	**11,359**
Kisatchie NF	130	130	111	128	111	127	128	126	128	128	114	12	0	**2,239**
Land Between the Lakes NRA	199	193	201	213	207	154	133	160	158	156	154	157	158	**4,371**
Mississippi NFs	835	746	840	764	728	829	799	824	818	786	799	721	226	**14,945**
North Carolina NFs	311	243	330	328	231	346	330	326	304	225	241	298	240	**6,285**
Ouachita NF	302	314	307	306	306	306	300	304	268	171	226	149	291	**5715**
Ozark-St. Francis NFs	235	245	244	244	236	235	228	222	220	222	233	219	235	**4,879**
Savannah River Site	0	0	0	0	0	0	81	85	86	86	86	60	29	**513**
Texas NFs	180	180	180	180	200	228	228	228	228	179	180	179	179	**3,805**
Total	**3,887**	**3,521**	**3,679**	**3,949**	**3,699**	**3,889**	**3,992**	**4,018**	**3,663**	**3,382**	**3,368**	**2,894**	**2,530**	**82,367**

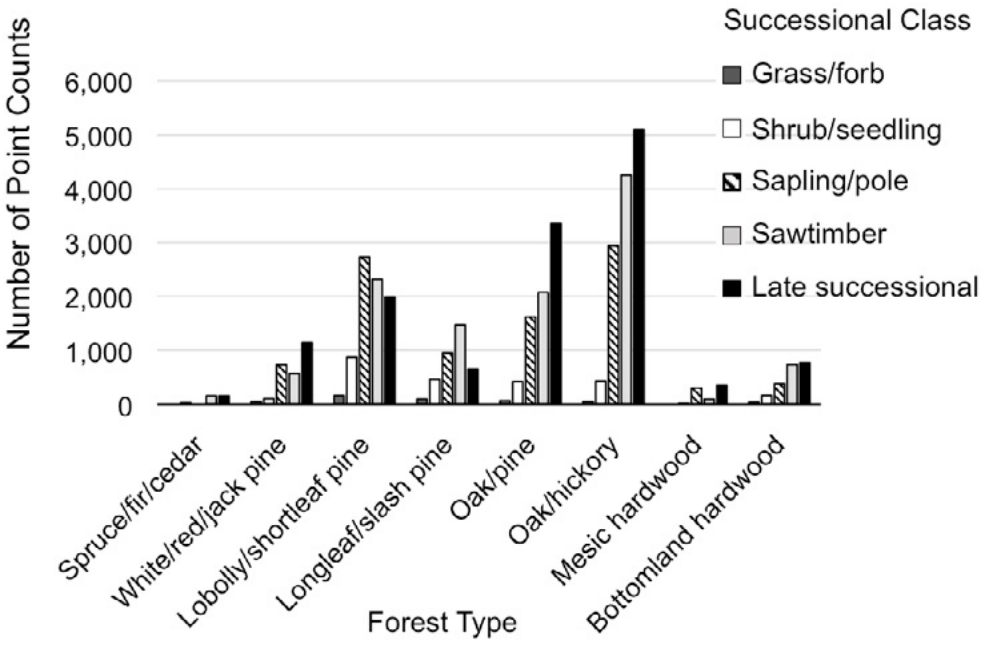

Figure 2.—The number of point-count surveys conducted in the Southern Region of the USDA Forest Service from 1992 through 2017 by forest type and successional class. Forest types were spruce/fir/cedar (*Picea* spp./*Abies* spp./*Juniperus* spp.), white/red/jack pine (*Pinus strobus/P. resinosa/P. banksiana*), loblolly/shortleaf pine (*Pinus taeda/P. echinata*), longleaf/slash pine (*Pinus palustris/P. elliottii*), oak/pine (*Quercus* spp./*Pinus* spp.), oak/hickory (*Quercus* spp./*Carya* spp.), mesic hardwood, and bottomland hardwood.

Table 2.—Number of detections for 250 bird species in 13 national forests, a national recreation area, and a special site in the Southern Region of the USDA Forest Service, 1992–2017

Common name	Scientific name	Detections
Red-eyed vireo	*Vireo olivaceus*	95,631
American cow	*Corvus brachyrhynchos*	59,040
Eastern tufted titmouse	*Baeolophus bicolor*	53,795
Indigo bunting	*Passerina cyanea*	49,018
Pine warbler	*Setophaga pinus*	47,767
Northern cardinal	*Cardinalis cardinalis*	47,610
Carolina wren	*Thryothorus ludovicianus*	39,955
Hooded warbler	*Setophaga citrina*	35,913
Ovenbird	*Seiurus aurocapilla*	34,645
Eastern towhee	*Pipilo erythrophthalmus*	32,479
Blue jay	*Cyanocitta cristata*	30,857
Yellow-breasted chat	*Icteria virens*	26,691
Pileated woodpecker	*Dryocopus pileatus*	26,494
Yellow-billed cuckoo	*Coccyzus americanus*	25,466
Red-bellied woodpecker	*Melanerpes carolinus*	25,141
Carolina chickadee	*Poecile carolinensis*	23,915
Scarlet tanager	*Piranga olivacea*	23,574
Acadian flycatcher	*Empidonax virescens*	23,152
Summer tanager	*Piranga rubra*	23,044
Great crested flycatcher	*Myiarchus crinitus*	21,360
White-eyed vireo	*Vireo griseus*	20,128
Blue-gray gnatcatcher	*Polioptila caerulea*	18,612
Eastern wood-pewee	*Contopus virens*	17,757
Wood thrush	*Hylocichla mustelina*	17,412
Mourning dove	*Zenaida macroura*	17,188
Black-and-white warbler	*Mniotilta varia*	13,843
Prairie warbler	*Setophaga discolor*	13,815
Northern parula	*Setophaga americana*	13,226
Worm-eating warbler	*Helmitheros vermivorum*	12,998
Black-throated green warbler	*Setophaga virens*	11,787
White-breasted nuthatch	*Sitta carolinensis*	10,261
Common yellowthroat	*Geothlypis trichas*	9,984
Downy woodpecker	*Dryobates pubescens*	8,951
Kentucky warbler	*Geothlypis formosa*	7,672
Brown-headed cowbird	*Molothrus ater*	7,144
Blue-headed vireo	*Vireo solitarius*	7,001
Dark-eyed junco	*Junco hyemalis*	6,903
American goldfinch	*Spinus tristis*	6,229
Yellow-throated vireo	*Vireo flavifrons*	6,144
Chestnut-sided warbler	*Setophaga pensylvanica*	5,920
Red-headed woodpecker	*Melanerpes erythrocephalus*	5,262
Northern bobwhite	*Colinus virginianus*	5,119
Veery	*Catharus fuscescens*	4,927
Northern flicker	*Colaptes auratus*	4,464
Black-throated blue warbler	*Setophaga caerulescens*	4,222
Brown-headed nuthatch	*Sitta pusilla*	4,203
Yellow-throated warbler	*Setophaga dominica*	4,194
American robin	*Turdus migratorius*	3,738
Bachman's sparrow	*Peucaea aestivalis*	3,602
Chipping sparrow	*Spizella passerina*	3,445
Prothonotary warbler	*Protonotaria citrea*	3,424
Hairy woodpecker	*Dryobates villosus*	3,311
Cedar waxwing	*Bombycilla cedrorum*	3,091
Chimney swift	*Chaetura pelagica*	2,920
Field sparrow	*Spizella pusilla*	2,897
Louisiana waterthrush	*Parkesia motacilla*	2,803
Ruby-throated hummingbird	*Archilochus colubris*	2,719
American redstart	*Setophaga ruticilla*	2,650
Gray catbird	*Dumetella carolinensis*	2,638
Red-shouldered hawk	*Buteo lineatus*	2,559
Rose-breasted grosbeak	*Pheucticus ludovicianus*	2,389
Wild turkey	*Meleagris gallopavo*	2,029
Brown thrasher	*Toxostoma rufum*	2,005
Blue grosbeak	*Passerina caerulea*	1,777
Canada warbler	*Cardellina canadensis*	1,765
Eastern bluebird	*Sialia sialis*	1,723
Turkey vulture	*Cathartes aura*	1,713
Eastern phoebe	*Sayornis phoebe*	1,703
Golden-crowned kinglet	*Regulus satrapa*	1,642
Red-cockaded woodpecker	*Dryobates borealis*	1,609
Common grackle	*Quiscalus quiscula*	1,517
Common raven	*Corvus corax*	1,490
Blue-winged warbler	*Vermivora cyanoptera*	1,303
Barred owl	*Strix varia*	1,286
Winter wren	*Troglodytes hiemalis*	1,279
Black-capped chickadee	*Poecile atricapillus*	1,221
Fish crow	*Corvus ossifragus*	1,190
Red-breasted nuthatch	*Sitta canadensis*	1,071
Broad-winged hawk	*Buteo platypterus*	1,001
Song sparrow	*Melospiza melodia*	948
Purple martin	*Progne subis*	927
Barn swallow	*Hirundo rustica*	904
Red-winged blackbird	*Agelaius phoeniceus*	898
Northern mockingbird	*Mimus polyglottos*	890

(continued on next page)

(Table 2 continued)

Common name	Scientific name	Detections
Swainson's warbler	*Limnothlypis swainsonii*	881
Orchard oriole	*Icterus spurius*	865
Red-tailed hawk	*Buteo jamaicensis*	865
Cerulean warbler	*Setophaga cerulea*	859
Blackburnian warbler	*Setophaga fusca*	836
Canada goose	*Branta canadensis*	836
Great blue heron	*Ardea herodias*	814
Yellow warbler	*Setophaga petechia*	797
Dickcissel	*Spiza americana*	783
Eastern kingbird	*Tyrannus tyrannus*	718
Painted bunting	*Passerina ciris*	577
Ruffed grouse	*Bonasa umbellus*	560
Cattle egret	*Bubulcus ibis*	554
Wood duck	*Aix sponsa*	487
Black vulture	*Coragyps atratus*	434
Great egret	*Ardea alba*	404
Chuck-will's-widow	*Antrostomus carolinensis*	370
White ibis	*Eudocimus albus*	339
Eastern meadowlark	*Sturnella magna*	314
Least flycatcher	*Empidonax minimus*	307
Brown creeper	*Certhia americana*	293
Hermit thrush	*Catharus guttatus*	287
Whip-poor-will	*Antrostomus vociferus*	264
Swainson's thrush	*Catharus ustulatus*	250
Pine siskin	*Spinus pinus*	248
Black-billed cuckoo	*Coccyzus erythropthalmus*	241
Belted kingfisher	*Megaceryle alcyon*	238
Common nighthawk	*Chordeiles minor*	214
Alder flycatcher	*Empidonax alnorum*	185
Red crossbill	*Loxia curvirostra*	183
American kestrel	*Falco sparverius*	173
Magnolia warbler	*Setophaga magnolia*	172
Northern rough-winged swallow	*Stelgidopteryx serripennis*	159
Laughing gull	*Leucophaeus atricilla*	157
Little blue heron	*Egretta caerulea*	149
Yellow-bellied sapsucker	*Sphyrapicus varius*	145
Warbling vireo	*Vireo gilvus*	142
Green heron	*Butorides virescens*	127
Cooper's hawk	*Accipiter cooperii*	125
Golden-winged warbler	*Vermivora chrysoptera*	117
Tree swallow	*Tachycineta bicolor*	117
American coot	*Fulica americana*	111
Snowy egret	*Egretta thula*	110
Mississippi kite	*Ictinia mississippiensis*	107
Great horned owl	*Bubo virginianus*	106
House wren	*Troglodytes aedon*	101
Mallard	*Anas platyrhynchos*	98
Sharp-shinned hawk	*Accipiter striatus*	97
Yellow-rumped warbler	*Setophaga coronata*	95
Eastern screech-owl	*Megascops asio*	91
Scissor-tailed flycatcher	*Tyrannus forficatus*	88
Palm warbler	*Setophaga palmarum*	74
Northern waterthrush	*Parkesia noveboracensis*	71
Sandhill crane	*Antigone canadensis*	67
Yellow-crowned night-heron	*Nyctanassa violacea*	62
Bobolink	*Dolichonyx oryzivorus*	53
Killdeer	*Charadrius vociferus*	53
Willow flycatcher	*Empidonax traillii*	53
European starling	*Sturnus vulgaris*	52
Ruby-crowned kinglet	*Regulus calendula*	52
Bachman's warbler	*Vermivora bachmanii*	51
Osprey	*Pandion haliaetus*	51
Pied-billed grebe	*Podilymbus podiceps*	51
Tennessee warbler	*Oreothlypis peregrina*	50
Baltimore oriole	*Icterus galbula*	49
Bell's vireo	*Vireo bellii*	45
Bronzed cowbird	*Molothrus aeneus*	40
Barn owl	*Tyto alba*	39
Boat-tailed grackle	*Quiscalus major*	38
Grasshopper sparrow	*Ammodramus savannarum*	37
Great-tailed grackle	*Quiscalus mexicanus*	37
Wood stork	*Mycteria americana*	37
Vesper sparrow	*Pooecetes gramineus*	35
White-winged dove	*Zenaida asiatica*	35
Greater roadrunner	*Geococcyx californianus*	34
Cliff swallow	*Petrochelidon pyrrhonota*	30
Bewick's wren	*Thryomanes bewickii*	28
Spotted sandpiper	*Actitis macularius*	27
House finch	*Haemorhous mexicanus*	26
Florida scrub-jay	*Aphelocoma coerulescens*	25
House sparrow	*Passer domesticus*	25
Bank swallow	*Riparia riparia*	23
White-throated sparrow	*Zonotrichia albicollis*	23
Swallow-tailed kite	*Elanoides forficatus*	22

(continued on next page)

(Table 2 continued)

Common name	Scientific name	Detections
Black-throated gray warbler	*Setophaga nigrescens*	21
American woodcock	*Scolopax minor*	19
Common ground-dove	*Columbina passerina*	17
Loggerhead shrike	*Lanius ludovicianus*	17
Crested caracara	*Caracara cheriway*	15
Eurasian collared-dove	*Streptopelia decaocto*	15
Nashville warbler	*Oreothlypis ruficapilla*	15
Bald eagle	*Haliaeetus leucocephalus*	14
Double-crested cormorant	*Phalacrocorax auritus*	13
Lark sparrow	*Chondestes grammacus*	13
White-rumped sandpiper	*Calidris fuscicollis*	11
Anhinga	*Anhinga anhinga*	10
Bay-breasted warbler	*Setophaga castanea*	10
Black-bellied whistling-duck	*Dendrocygna autumnalis*	10
Evening grosbeak	*Coccothraustes vespertinus*	10
Mourning warbler	*Geothlypis philadelphia*	10
Lesser yellowlegs	*Tringa flavipes*	8
Olive-sided flycatcher	*Contopus cooperi*	8
Rufous hummingbird	*Selasphorus rufus*	8
Spotted towhee	*Pipilo maculatus*	8
Swamp sparrow	*Melospiza georgiana*	8
Black-crowned night-heron	*Nycticorax nycticorax*	7
Black-headed grosbeak	*Pheucticus melanocephalus*	7
Gray kingbird	*Tyrannus dominicensis*	7
Hooded merganser	*Lophodytes cucullatus*	7
Least tern	*Sternula antillarum*	7
Western kingbird	*Tyrannus verticalis*	7
Wilson's warbler	*Cardellina pusilla*	7
Least bittern	*Ixobrychus exilis*	6
Northern pintail	*Anas acuta*	6
Purple finch	*Haemorhous purpureus*	6
Reddish egret	*Egretta rufescens*	6
American tree sparrow	*Spizelloides arborea*	5
American wigeon	*Mareca americana*	5
Northern gannet	*Morus bassanus*	5
Peregrine falcon	*Falco peregrinus*	5
Rufous-crowned sparrow	*Aimophila ruficeps*	5
American bittern	*Botaurus lentiginosus*	4
Blue-winged teal	*Spatula discors*	4
Lincoln's sparrow	*Melospiza lincolnii*	4
Rock pigeon	*Columba livia*	4

Common name	Scientific name	Detections
Savannah sparrow	*Passerculus sandwichensis*	4
Sedge wren	*Cistothorus platensis*	4
Black-necked stilt	*Himantopus mexicanus*	3
Brown-crested flycatcher	*Myiarchus tyrannulus*	3
Common gallinule	*Gallinula galeata*	3
Merlin	*Falco columbarius*	3
Northern harrier	*Circus hudsonius*	3
Philadelphia vireo	*Vireo philadelphicus*	3
Sora	*Porzana carolina*	3
White-winged crossbill	*Loxia leucoptera*	3
Black rail	*Laterallus jamaicensis*	2
Black-chinned hummingbird	*Archilochus alexandri*	2
Brewer's blackbird	*Euphagus cyanocephalus*	2
Fox sparrow	*Passerella iliaca*	2
Gray-cheeked thrush	*Catharus minimus*	2
Greater yellowlegs	*Tringa melanoleuca*	2
Limpkin	*Aramus guarauna*	2
Sharp-tailed sparrow	*Ammodramus caudacutus*	2
White-faced ibis	*Plegadis chihi*	2
White-tailed kite	*Elanus leucurus*	2
Wilson's snipe	*Gallinago delicata*	2
Black tern	*Chlidonias niger*	1
Black-crested titmouse	*Baeolophus atricristatus*	1
Black-whiskered vireo	*Vireo altiloquus*	1
Cape May warbler	*Setophaga tigrina*	1
Clay-colored sparrow	*Spizella pallida*	1
Glossy ibis	*Plegadis falcinellus*	1
Golden eagle	*Aquila chrysaetos*	1
Harris's sparrow	*Zonotrichia querula*	1
Ring-necked pheasant	*Phasianus colchicus*	1
Rough-legged hawk	*Buteo lagopus*	1
Semipalmated sandpiper	*Calidris pusilla*	1
Short-eared owl	*Asio flammeus*	1
Short-tailed hawk	*Buteo brachyurus*	1
Swainson's hawk	*Buteo swainsoni*	1
Tricolored heron	*Egretta tricolor*	1
Upland sandpiper	*Bartramia longicauda*	1
Virginia rail	*Rallus limicola*	1
Western meadowlark	*Sturnella neglecta*	1
White-crowned sparrow	*Zonotrichia leucophrys*	1
Yellow rail	*Coturnicops noveboracensis*	1

Alabama National Forests

Alabama National Forests completed 6,397 point counts between 1997 and 2017. The number of points surveyed ranged from 380 in 2012 to 64 in 1997. We estimated abundances and population trends for 90 species (Table 3). Red-eyed vireo (1.03 birds/point), indigo bunting (0.75 bird/point), and pine warbler (0.69 bird/point) had the highest average abundances, whereas chuck-will's-widow (0.01 bird/point), cerulean warbler (0.01 bird/point), and sharp-shinned hawk (0.01 bird/point) had the lowest average abundances. More species showed more positive than negative annual trends; 24 species had significant positive annual trends and 6 species had significant negative annual trends (Figs. 3, 4). Yellow-throated warbler had the largest increase in abundance per year (16.93 percent), followed by eastern phoebe (14.40 percent) and brown-headed nuthatch (12.75 percent). Other woodland-breeding species with large positive annual trends included great crested flycatcher (10.60 percent), Acadian flycatcher (10.38 percent), worm-eating warbler (10.27 percent), yellow-throated vireo (10.10 percent), and black-throated green warbler (9.77 percent). Some early-successional, scrub-breeding species such as northern cardinal (5.81 percent), Carolina wren (4.56 percent), white-eyed vireo (3.52 percent), and prairie warbler (2.51 percent) had small positive annual trends. Pine warbler and red-eyed vireo had some of the highest average abundances and also experienced increases in abundance of 8.13 percent and 2.93 percent per year, respectively. Among species that showed significant declines, common grackle had the greatest annual decline (-29.10 percent), followed by turkey vulture (-13.00 percent). Other species with moderate negative annual trends included hairy woodpecker (-8.33 percent), downy woodpecker (-4.84 percent), and ovenbird (-3.68 percent). Despite having one of the highest average abundances, indigo bunting declined by 2.18 percent per year. Overall, linear trends followed annual trends and were smaller (Fig. 3).

Table 3.—Number of detections, annual trend, linear trend, 95-percent credible interval defined by LCI and UCI, and average abundance for 90 bird species in Alabama National Forests, 1997–2017; caution should be used in interpreting species abundances marked with Δ because they are based on fewer than 50 detections or had wide credible intervals and may be inaccurate or imprecise

		Annual trend			Linear trend			
Species name	Detections	Trend	LCI	UCI	Trend	LCI	UCI	Abundance (birds/point)
		percent						
Acadian flycatcher	1,160	10.38	3.75	22.44	3.95	1.32	6.59	0.19
American crow	2,895	5.23	2.52	8.54	2.05	0.18	3.91	0.47
American goldfinch	311	8.07	-2.87	30.62	4.59	1.62	7.56	0.09
American kestrel	3	-0.01	-9.49	11.23	-0.05	-0.35	0.26	1.39 Δ
American redstart	33	0.01	-5.51	6.46	-0.16	-0.94	0.61	1.69 Δ
American robin	54	10.87	-6.76	69.21	2.45	-2.54	7.43	0.02 Δ
Bachman's sparrow	349	5.40	-7.75	27.96	0.57	-3.64	4.77	0.10
Barred owl	40	-0.54	-8.41	5.52	-0.21	-0.85	0.43	3.06 Δ
Belted kingfisher	33	-0.51	-19.30	17.44	-0.06	-0.55	0.42	2.52 Δ
Black vulture	29	0.74	-11.91	18.49	-0.54	-1.03	-0.05	0.87 Δ
Black-and-white warbler	535	1.89	-2.82	8.66	0.36	-1.97	2.70	0.13
Black-capped chickadee	28	-0.86	-60.52	152.01	-0.40	-3.96	3.16	0.05 Δ
Black-throated green warbler	1,091	9.77	4.06	19.08	6.64	4.36	8.93	0.17
Blue grosbeak	242	10.73	-0.32	37.07	3.78	1.18	6.38	0.05
Blue jay	2,033	1.10	-1.05	3.43	2.38	1.31	3.44	0.36
Blue-gray gnatcatcher	1,192	7.76	2.98	14.71	4.73	2.61	6.86	0.19

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(Table 3 continued)

Species name	Detections	Annual trend			Linear trend			Abundance (birds/point)
		Trend	LCI	UCI	Trend	LCI	UCI	
		percent						
Blue-headed vireo	191	13.10	-0.01	52.56	4.21	-1.52	9.94	0.05
Blue-winged warbler	217	9.91	-2.03	44.52	5.80	0.37	11.23	0.04
Broad-winged hawk	84	0.99	-7.74	15.13	3.60	-0.86	8.06	0.02 Δ
Brown thrasher	171	8.07	-5.81	39.75	2.23	-1.53	6.00	0.04 Δ
Brown-headed cowbird	350	3.39	-2.57	11.57	5.78	3.28	8.28	0.07
Brown-headed nuthatch	456	12.75	3.37	33.57	6.80	3.91	9.68	0.08
Canada goose	25	-6.29	-72.93	192.14	-0.27	-3.33	2.80	0.02 Δ
Carolina chickadee	1,435	-1.38	-3.41	0.91	1.22	-0.69	3.14	0.25
Carolina wren	2,066	4.56	1.69	7.98	3.63	1.89	5.36	0.35
Cedar waxwing	42	16.65	-7.13	345.92	-1.29	-6.70	4.11	0.05 Δ
Cerulean warbler	25	-13.17	-52.40	52.47	-8.78	-13.91	-3.64	0.01 Δ
Chimney swift	496	-4.37	-9.07	1.33	-4.35	-7.96	-0.75	0.14
Chipping sparrow	796	7.98	2.46	15.95	10.08	6.68	13.48	0.13
Chuck-will's-widow	47	-8.69	-50.88	69.65	2.32	-3.44	8.08	0.01 Δ
Common grackle	64	-29.10	-64.50	-5.97	-10.60	-15.91	-5.29	0.05 Δ
Common nighthawk	4	-0.04	-14.22	17.08	-0.18	-0.49	0.13	1.43 Δ
Common yellowthroat	450	4.94	-0.54	13.21	3.33	0.46	6.21	0.08
Downy woodpecker	569	-4.84	-7.88	-1.42	1.85	-0.62	4.32	0.12
Eastern bluebird	219	9.35	-0.09	22.55	7.89	4.35	11.43	0.08
Eastern kingbird	47	0.17	-4.19	5.34	0.01	-0.79	0.80	1.89 Δ
Eastern phoebe	139	14.40	0.76	57.38	2.77	-1.57	7.11	0.03 Δ
Eastern towhee	2,258	0.23	-1.74	2.37	2.74	1.43	4.06	0.37
Eastern tufted titmouse	2,985	5.00	2.46	7.99	3.98	2.53	5.42	0.49
Eastern wood-pewee	993	6.96	2.87	12.66	9.79	7.97	11.60	0.15
Field sparrow	586	1.70	-2.01	5.58	2.95	-0.96	6.86	0.12
Fish crow	15	1.42	-9.84	130.65	0.51	0.07	0.95	1.06 Δ
Gray catbird	102	-6.73	-16.20	5.14	-7.41	-12.70	-2.13	0.03 Δ
Great blue heron	17	-1.17	-7.62	5.10	-0.77	-1.48	-0.05	0.95 Δ
Great crested flycatcher	2,166	10.60	5.65	17.72	5.78	3.63	7.92	0.37
Great horned owl	6	0.05	-59.49	137.85	-0.07	-0.43	0.29	0.83 Δ
Hairy woodpecker	241	-8.33	-14.13	-0.60	-2.51	-5.98	0.96	0.08
Hooded warbler	2,150	7.86	3.96	13.01	5.75	4.02	7.48	0.35
Indigo bunting	4,504	-2.18	-3.45	-0.87	0.05	-1.08	1.18	0.75
Kentucky warbler	690	7.26	1.05	17.06	6.03	3.18	8.89	0.11
Louisiana waterthrush	274	7.17	-3.14	32.02	6.84	4.76	8.92	0.06
Mourning dove	1,723	1.46	-0.91	4.28	3.86	2.63	5.09	0.29
Northern bobwhite	466	0.21	-4.08	5.01	1.52	-1.93	4.96	0.16

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(Table 3 continued)

Species name	Detections	Annual trend			Linear trend			Abundance (birds/point)
		Trend	LCI	UCI	Trend	LCI	UCI	
		percent						
Northern cardinal	3,409	5.81	2.88	9.38	3.64	1.93	5.35	0.55
Northern flicker	374	11.13	-2.44	45.10	-4.47	-11.39	2.46	0.14
Northern mockingbird	91	0.83	-4.52	17.45	0.41	-0.63	1.44	1.28 Δ
Northern parula	820	-0.14	-3.70	3.96	2.92	1.20	4.65	0.15
Northern rough-winged swallow	12	-0.16	-5.18	5.12	0.08	-0.37	0.53	2.04 Δ
Orchard oriole	44	-0.38	-6.19	5.43	-0.25	-1.00	0.51	1.75 Δ
Ovenbird	1,073	-3.68	-6.18	-0.91	-3.48	-4.89	-2.07	0.19
Pileated woodpecker	1,516	3.26	0.16	6.97	3.49	1.97	5.01	0.27
Pine warbler	4,380	8.13	5.32	11.70	3.83	1.83	5.82	0.69
Prairie warbler	3,624	2.51	0.79	4.47	2.95	1.76	4.14	0.57
Purple martin	32	-0.50	-9.38	6.31	0.02	-0.59	0.64	1.81 Δ
Red-bellied woodpecker	1,807	2.28	-0.39	5.40	2.66	1.61	3.72	0.32
Red-breasted nuthatch	41	-3.75	-47.30	62.52	-1.15	-3.85	1.55	0.05 Δ
Red-cockaded woodpecker	103	13.62	-0.54	50.39	3.76	-1.02	8.55	0.04 Δ
Red-eyed vireo	6,453	2.93	1.49	4.46	1.50	0.69	2.30	1.03
Red-headed woodpecker	620	-1.88	-5.18	1.78	1.88	-0.54	4.31	0.12
Red-shouldered hawk	155	-0.08	-4.36	4.68	0.81	-0.27	1.90	2.12 Δ
Red-tailed hawk	73	-1.50	-9.65	2.76	-1.20	-1.85	-0.56	2.24 Δ
Red-winged blackbird	13	-0.05	-11.77	11.20	0.20	-0.38	0.79	1.10 Δ
Ruby-throated hummingbird	159	-0.56	-9.24	13.06	2.77	-1.66	7.19	0.03
Scarlet tanager	1,099	0.34	-2.00	3.18	-1.11	-3.76	1.53	0.19
Sharp-shinned hawk	8	-11.99	-88.56	548.54	-3.82	-9.39	1.75	0.01 Δ
Song sparrow	7	-2.31	-19.92	11.10	-0.26	-0.62	0.09	0.45 Δ
Summer tanager	2,404	1.59	-0.41	3.84	4.00	2.31	5.69	0.39
Swainson's warbler	34	-0.88	-22.06	14.81	0.54	-0.17	1.24	1.23 Δ
Turkey vulture	182	-13.00	-19.08	-6.92	-6.02	-12.79	0.74	0.05 Δ
Whip-poor-will	19	-0.23	-6.40	5.89	0.04	-0.54	0.62	1.84 Δ
White-breasted nuthatch	1,081	4.57	1.22	8.75	2.01	0.46	3.55	0.19
White-eyed vireo	1,245	3.52	0.10	7.86	4.71	3.67	5.75	0.20
Wild turkey	139	2.10	-7.79	15.77	-0.84	-4.83	3.14	0.05 Δ
Wood thrush	797	-1.65	-4.60	1.71	-0.92	-2.76	0.92	0.14
Worm-eating warbler	717	10.27	2.19	27.10	4.90	1.59	8.20	0.12
Yellow warbler	148	-7.44	-36.22	34.23	-2.13	-9.21	4.95	0.03 Δ
Yellow-billed cuckoo	1,936	5.25	2.06	9.38	1.51	-0.55	3.57	0.35
Yellow-breasted chat	3,586	-1.20	-2.59	0.32	-0.46	-1.65	0.73	0.59
Yellow-throated vireo	708	10.10	1.99	27.43	8.37	6.21	10.54	0.12
Yellow-throated warbler	458	16.93	6.89	41.86	10.33	7.54	13.12	0.08

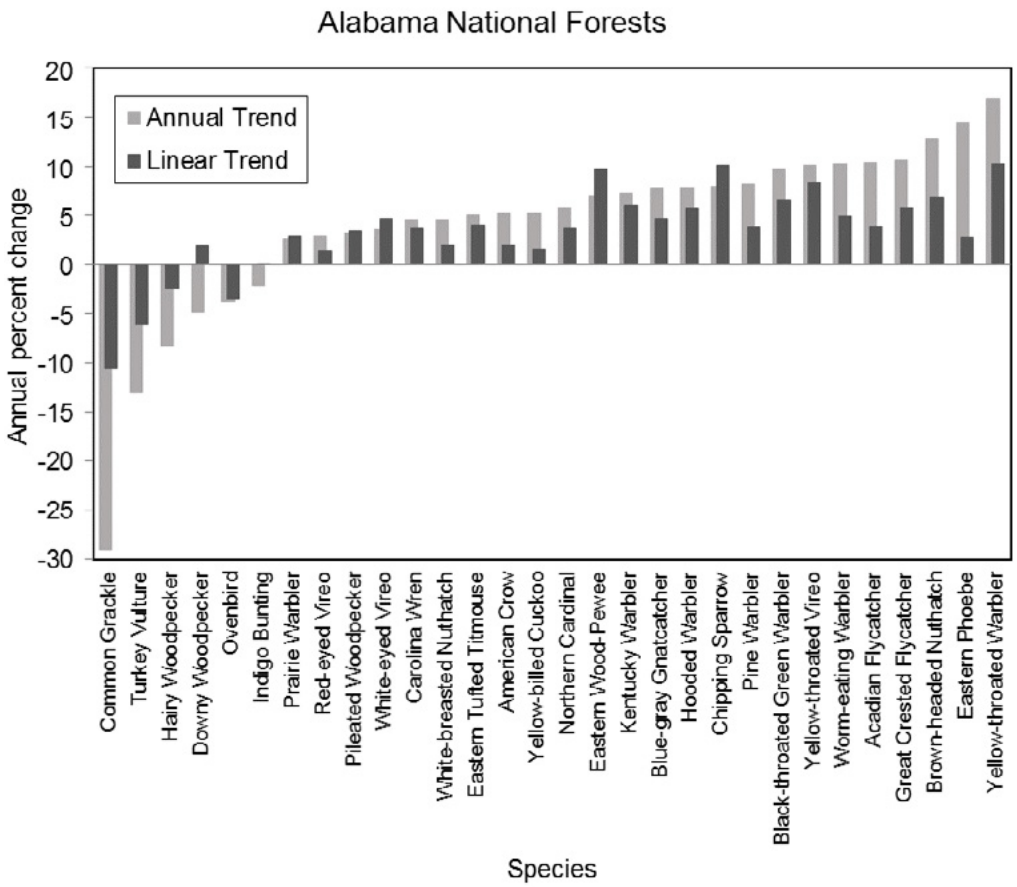


Figure 3.—Significant (based on 95-percent credible interval) positive and negative annual and linear trends for bird species in Alabama National Forests, 1997–2017.

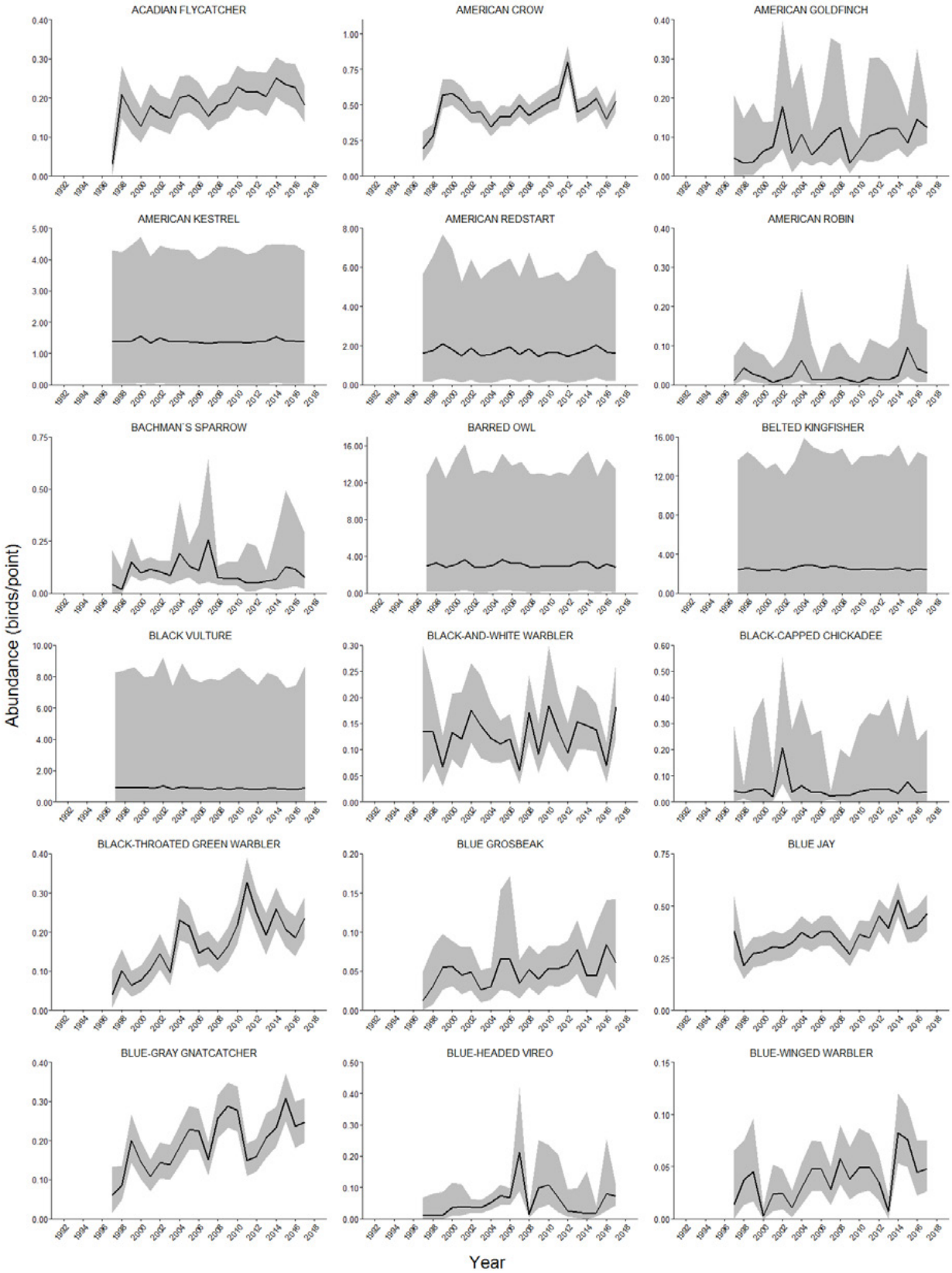
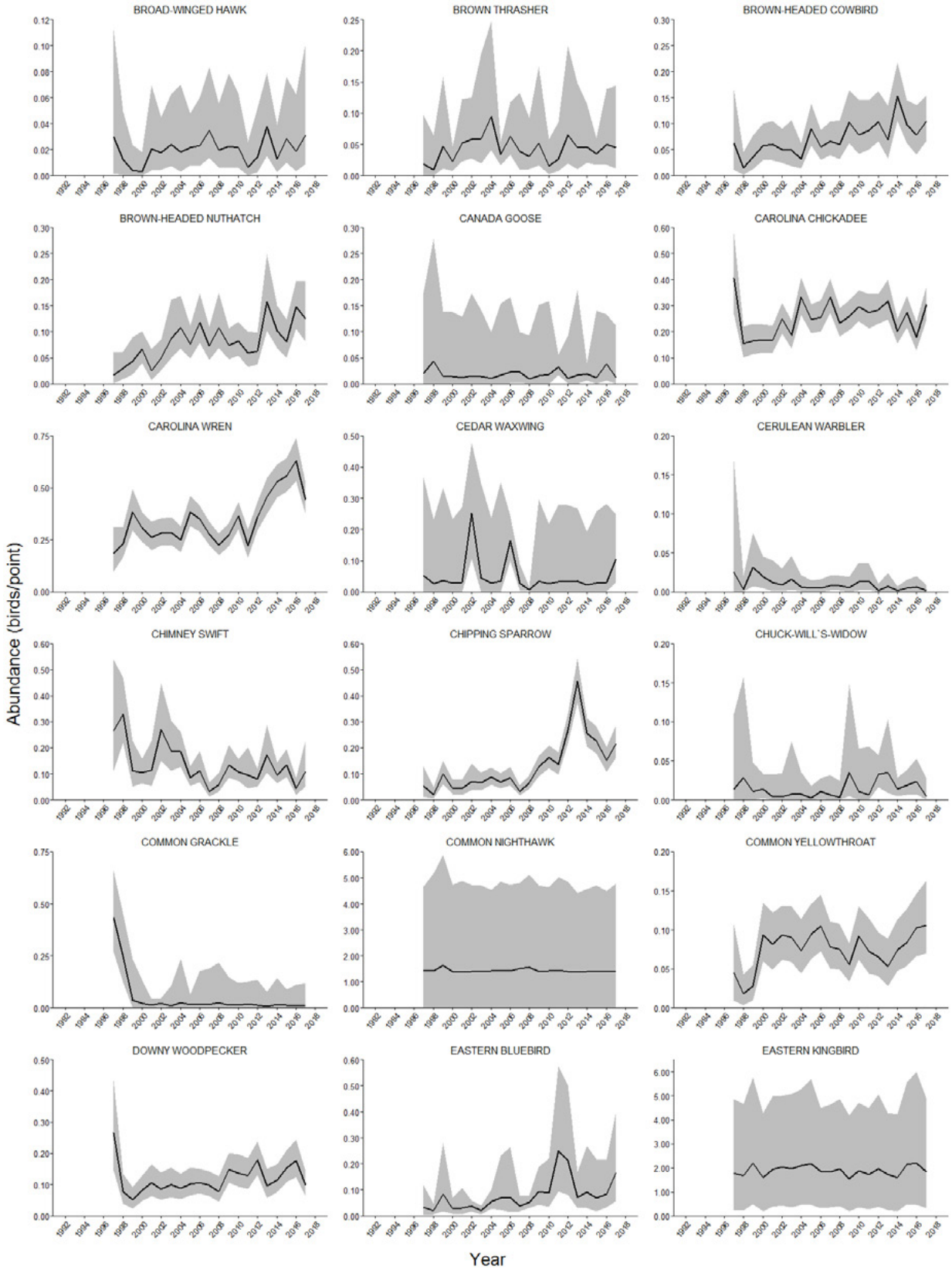


Figure 4. (page 1 of 5)—Estimated abundances and 95-percent credible intervals (shaded areas) for 90 bird species in Alabama National Forests, by year. The scale of the abundance axes may vary among species to best illustrate patterns in abundance.



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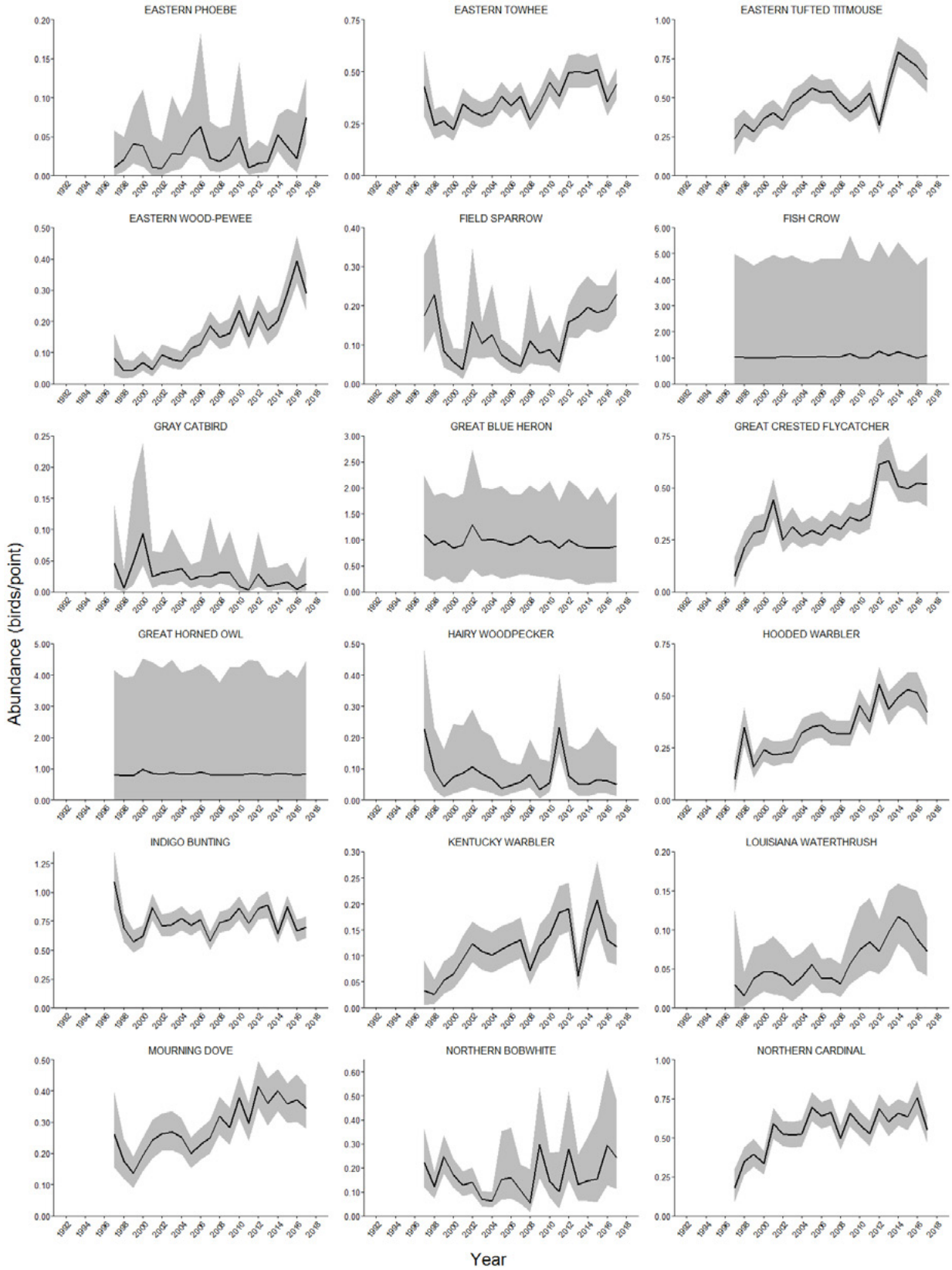

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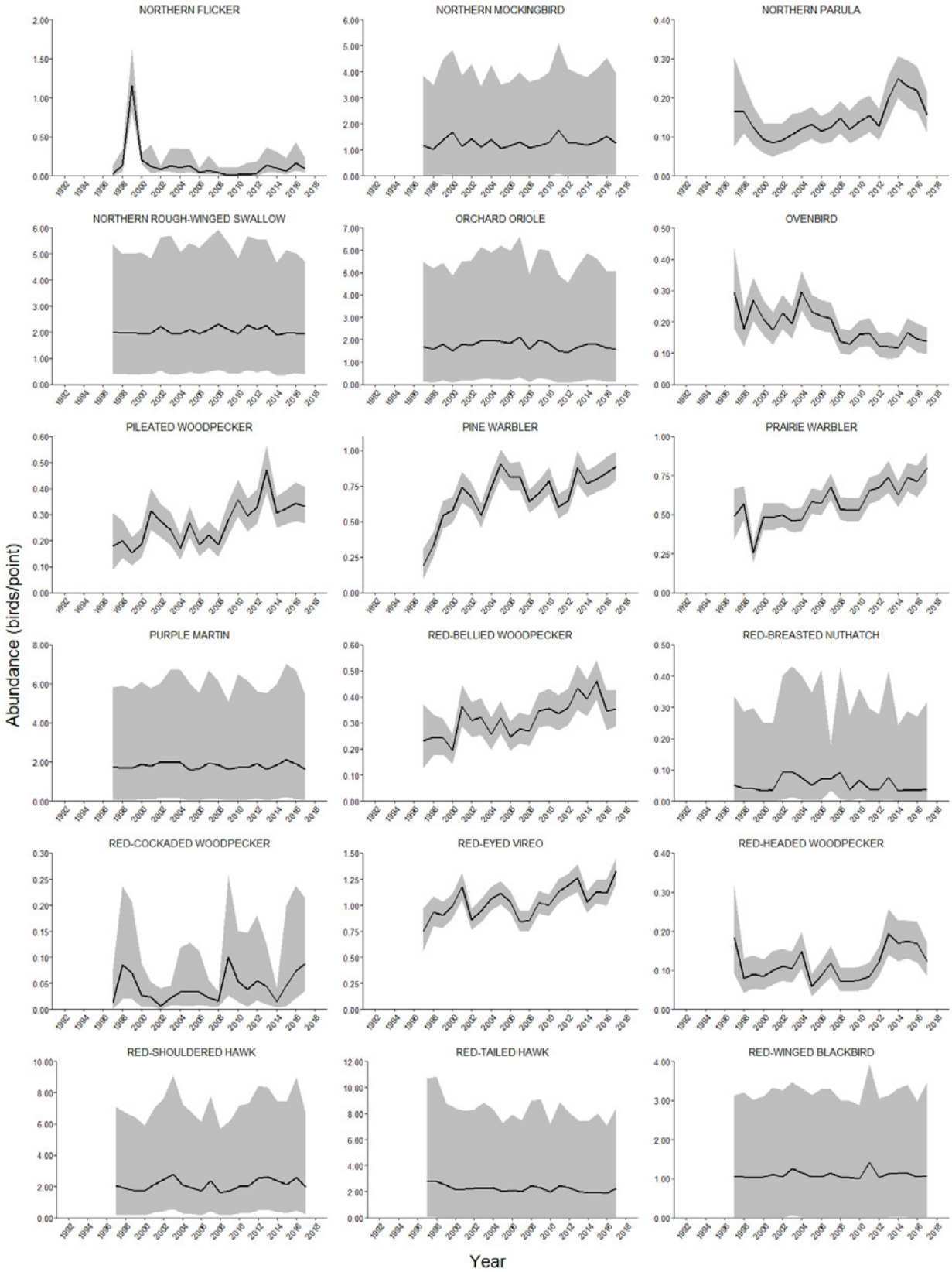

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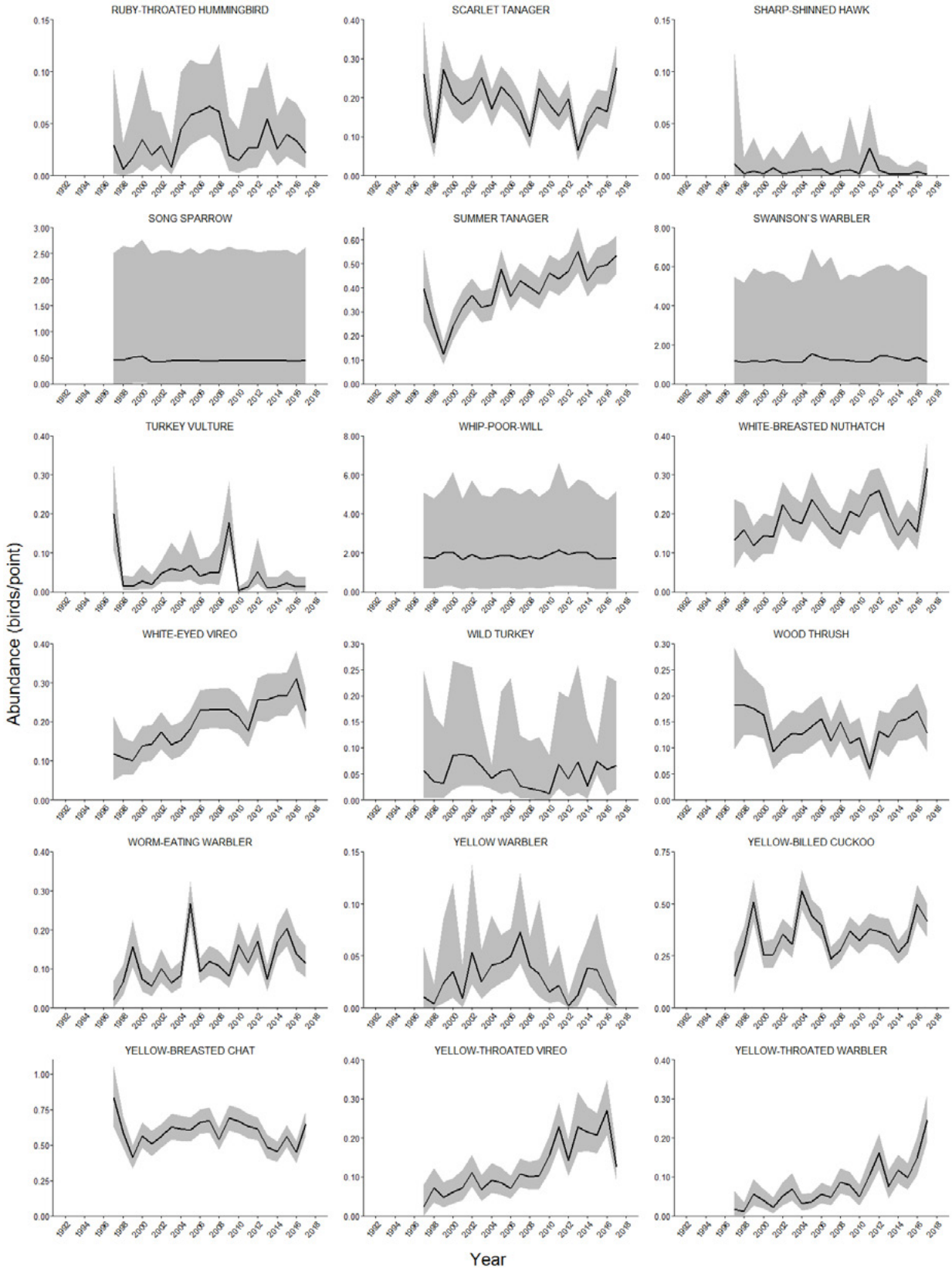

Figure 4 (page 5 of 5)

Chattahoochee-Oconee National Forests

Chattahoochee-Oconee National Forests completed 5,632 point counts between 1992 and 2017. The number of points surveyed ranged from 527 points in 1993 to 127 points in 2009. We estimated abundances and population trends for 104 species (Table 4). Red-eyed vireo had the highest average abundance (1.37 birds/point), followed by American crow (1.07 birds/point) and indigo bunting (0.66 bird/point). Species that had the lowest average abundances were rose-breasted grosbeak (0.03 bird/point), cerulean warbler (0.02 bird/point), and green heron (0.02 bird/point). Although a similar number of species had positive and negative trends, 10 species showed significant annual growth and 15 species showed significant annual declines (Figs. 5, 6). Blackburnian warbler had the highest positive annual trend and increased 20.53 percent per year. Blue-headed vireo and yellow-billed cuckoo also had large positive annual trends: 11.34 percent and 6.79 percent per year, respectively. Additional woodland-breeding species with positive annual trends included white-breasted nuthatch (4.23 percent), yellow-throated warbler (3.75 percent), scarlet tanager (1.39 percent), and eastern tufted titmouse (1.24 percent). Chestnut-sided warbler was the only early-successional, scrub-breeding species with a positive annual trend and increased 5.04 percent annually. Several early-successional, scrub-breeding species had significant negative annual trends, including field sparrow (-6.29 percent), blue-winged warbler (-4.71 percent), prairie warbler (-2.52 percent), eastern towhee (-1.80 percent), northern cardinal (-1.42 percent), and Carolina wren (-1.21 percent). Some woodland-breeding species also had significant negative annual trends: northern flicker (-5.79 percent), dark-eyed junco (-5.68 percent), and red-bellied woodpecker (-3.21 percent). Chipping sparrow had the greatest negative annual trend (-8.92 percent). Most linear trends followed annual trends, but the direction of linear trends differed from that of annual trends for some species (Fig. 5).

Table 4.—Number of detections, annual trend, linear trend, 95-percent credible interval defined by LCI and UCI, and average abundance for 104 bird species in Chattahoochee-Oconee National Forests, 1992–2017; caution should be used in interpreting species abundances marked with Δ because they are based on fewer than 50 detections or had wide credible intervals and may be inaccurate or imprecise

		Annual trend			Linear trend			
Species name	Detections	Trend	LCI	UCI	Trend	LCI	UCI	Abundance (birds/point)
		percent						
Acadian flycatcher	1,236	-0.40	-1.98	1.10	-0.28	-1.11	0.56	0.23
American crow	5,715	-0.26	-0.95	0.43	-0.43	-0.89	0.03	1.07
American goldfinch	575	1.31	-2.75	4.68	3.06	1.03	5.09	0.16
American redstart	54	0.03	-4.32	5.01	0.28	-0.05	0.61	3.13 Δ
American robin	117	-1.17	-5.80	2.52	-0.06	-0.79	0.67	1.13 Δ
Barn swallow	45	-3.75	-29.00	11.43	0.47	-1.01	1.94	0.09 Δ
Barred owl	61	0.77	-2.35	4.94	0.63	0.20	1.05	3.05 Δ
Belted kingfisher	34	-0.40	-3.84	2.83	-0.20	-0.52	0.12	4.20 Δ
Black vulture	74	0.66	-3.15	19.88	0.38	0.13	0.62	2.23 Δ
Black-and-white warbler	744	0.77	-1.21	2.81	1.07	-0.50	2.64	0.18
Blackburnian warbler	69	20.53	0.15	58.26	5.24	1.77	8.70	0.04 Δ
Black-capped chickadee	91	1.03	-24.53	35.13	0.41	-3.48	4.30	0.05 Δ
Black-throated blue warbler	517	-0.72	-4.25	2.30	-2.15	-4.05	-0.24	0.11
Black-throated green warbler	1,896	-1.24	-2.63	0.07	0.01	-1.09	1.11	0.39
Blue grosbeak	62	1.58	-2.58	8.68	0.75	0.03	1.47	1.42 Δ
Blue jay	2,295	-0.54	-1.61	0.50	1.23	0.11	2.36	0.46

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(Table 4 continued)

Species name	Detections	Annual trend			Linear trend			Abundance (birds/point)
		Trend	LCI	UCI	Trend	LCI	UCI	
		percent						
Blue-gray gnatcatcher	1,268	-2.49	-4.05	-1.00	2.18	0.19	4.17	0.24
Blue-headed vireo	636	11.34	3.40	18.12	5.03	3.24	6.81	0.17
Blue-winged warbler	383	-4.71	-8.03	-1.30	-2.88	-5.27	-0.49	0.09
Broad-winged hawk	156	1.61	-3.44	7.17	2.51	-0.15	5.17	0.05
Brown thrasher	181	2.00	-2.92	6.61	2.55	1.25	3.86	0.05
Brown-headed cowbird	338	0.32	-3.14	4.01	1.50	-1.34	4.34	0.09
Brown-headed nuthatch	171	3.42	-0.92	7.80	8.39	4.80	11.97	0.05 Δ
Canada goose	37	-1.54	-12.02	7.84	1.32	-1.81	4.46	0.03 Δ
Canada warbler	41	0.57	-3.86	7.02	0.21	-0.30	0.71	3.02 Δ
Carolina chickadee	2,308	-1.31	-2.29	-0.34	0.04	-1.13	1.22	0.43
Carolina wren	2,048	-1.21	-2.43	-0.03	0.80	-0.49	2.09	0.40
Cedar waxwing	36	0.04	-3.65	4.06	0.30	0.13	0.46	3.62 Δ
Cerulean warbler	20	-13.77	-73.54	8.70	0.18	-1.38	1.75	0.02 Δ
Chestnut-sided warbler	519	5.04	1.08	9.36	0.15	-2.78	3.07	0.11
Chimney swift	270	3.91	0.56	7.64	4.43	1.20	7.67	0.08
Chipping sparrow	188	-8.92	-17.01	-1.97	-0.03	-3.33	3.28	0.05
Common grackle	132	-4.14	-14.09	5.55	-1.39	-4.87	2.08	0.05 Δ
Common raven	15	-0.20	-5.19	4.66	0.31	0.00	0.62	1.70 Δ
Common yellowthroat	129	-1.66	-8.29	5.87	1.54	-1.26	4.33	0.03
Cooper's hawk	26	-0.17	-8.18	5.13	0.14	-0.35	0.62	1.40 Δ
Dark-eyed junco	169	-5.68	-12.12	-0.23	1.20	-1.84	4.25	0.05
Downy woodpecker	923	-0.74	-2.58	1.01	1.53	0.44	2.62	0.20
Eastern bluebird	125	7.59	-1.00	19.24	3.12	-0.07	6.32	0.03
Eastern kingbird	44	-2.19	-32.50	18.29	3.10	0.37	5.82	0.04 Δ
Eastern meadowlark	19	-0.81	-5.48	3.00	-0.30	-0.69	0.08	1.51 Δ
Eastern phoebe	279	-3.39	-7.75	0.96	2.29	-0.29	4.88	0.07
Eastern towhee	2,531	-1.80	-2.97	-0.66	-1.42	-2.51	-0.34	0.50
Eastern tufted titmouse	3,354	1.24	0.37	2.12	1.61	0.89	2.33	0.66
Eastern wood-pewee	522	-0.50	-2.63	1.49	2.49	-0.30	5.28	0.11
Field sparrow	196	-6.29	-12.29	-0.84	-1.31	-4.26	1.65	0.05
Gray catbird	140	-0.82	-4.04	2.03	-0.25	-0.88	0.37	1.89 Δ
Great blue heron	144	0.76	-15.12	16.74	5.17	-0.53	10.87	0.10 Δ
Great crested flycatcher	1,304	-1.19	-2.57	0.17	0.47	-0.75	1.69	0.25
Great egret	15	27.98	-6.53	480.66	-1.51	-6.81	3.78	0.03 Δ
Great horned owl	11	-1.05	-17.52	3.52	-0.16	-0.48	0.15	1.78 Δ
Green heron	20	-4.50	-15.11	4.44	0.63	-1.70	2.95	0.02 Δ
Hairy woodpecker	344	-0.80	-4.13	2.66	-0.96	-2.97	1.04	0.08
Hooded warbler	2,616	0.51	-0.54	1.55	0.15	-0.64	0.95	0.51
Indigo bunting	3,496	-0.67	-1.70	0.37	-1.87	-2.85	-0.88	0.66
Kentucky warbler	331	-1.32	-5.52	2.22	0.43	-1.55	2.41	0.08
Killdeer	8	-0.51	-13.71	5.70	-0.21	-0.48	0.06	1.30 Δ
Louisiana waterthrush	230	2.03	-4.33	7.88	2.33	-0.05	4.72	0.07
Mourning dove	1,458	3.03	1.62	4.40	3.67	2.80	4.54	0.31
Northern bobwhite	274	1.87	-1.03	4.67	0.82	-1.62	3.26	0.06

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(Table 4 continued)

Species name	Detections	Annual trend			Linear trend			Abundance (birds/point)
		Trend	LCI	UCI	Trend	LCI	UCI	
		percent						
Northern cardinal	2,624	-1.42	-2.46	-0.39	0.31	-0.76	1.38	0.50
Northern flicker	401	-5.79	-9.63	-2.30	-2.11	-4.30	0.09	0.09
Northern mockingbird	77	0.75	-10.23	11.77	3.69	0.66	6.71	0.03 Δ
Northern parula	774	-2.89	-4.84	-1.07	1.39	-0.52	3.30	0.16
Northern rough-winged swallow	50	0.49	-30.87	50.56	1.61	-0.35	3.56	0.05 Δ
Orchard oriole	19	0.51	-2.84	5.17	0.10	-0.17	0.37	2.53 Δ
Ovenbird	3,425	0.51	-0.35	1.38	-0.21	-0.80	0.38	0.65
Palm warbler	29	0.67	-33.80	60.61	-0.28	-0.71	0.15	0.60 Δ
Pileated woodpecker	2,689	-0.09	-1.18	0.97	-0.33	-1.02	0.35	0.55
Pine warbler	2,383	-1.79	-2.71	-0.89	1.89	0.17	3.60	0.45
Prairie warbler	1,305	-2.52	-4.01	-1.08	-2.00	-3.34	-0.67	0.23
Prothonotary warbler	53	13.72	-7.32	72.12	5.46	1.85	9.07	0.03 Δ
Purple martin	42	12.71	-8.60	84.81	3.35	0.61	6.09	0.03 Δ
Red-bellied woodpecker	1,313	-3.21	-5.04	-1.55	1.60	-0.51	3.71	0.33
Red-breasted nuthatch	42	0.13	-8.77	10.11	0.68	0.21	1.16	1.12 Δ
Red-cockaded woodpecker	40	11.53	-0.58	21.89	7.41	4.75	10.06	0.03 Δ
Red-eyed vireo	7,566	-0.06	-0.67	0.53	-0.25	-0.64	0.14	1.37
Red-headed woodpecker	173	3.73	-2.51	10.36	2.76	0.17	5.34	0.06
Red-shouldered hawk	144	2.53	-3.95	8.58	5.12	2.36	7.88	0.04
Red-tailed hawk	180	3.08	-1.50	7.28	2.83	-1.04	6.71	0.05
Red-winged blackbird	79	13.28	-4.72	49.58	5.83	3.08	8.58	0.05 Δ
Rose-breasted grosbeak	86	1.55	-4.64	8.45	-1.98	-5.05	1.10	0.03 Δ
Ruby-throated hummingbird	188	5.01	-0.81	10.86	6.13	3.40	8.85	0.06
Ruffed grouse	21	-1.95	-19.23	5.52	-0.50	-1.01	0.02	0.79 Δ
Scarlet tanager	2,495	1.39	0.26	2.49	1.34	0.42	2.26	0.51
Sharp-shinned hawk	11	0.29	-3.62	4.62	-0.10	-0.37	0.17	2.43 Δ
Song sparrow	42	-0.43	-4.95	3.00	-0.42	-0.85	0.00	2.57 Δ
Summer tanager	990	-0.09	-2.02	1.67	0.27	-1.27	1.81	0.19
Swainson's warbler	24	7.80	-7.81	77.28	1.17	0.32	2.02	0.17 Δ
Turkey vulture	137	4.13	-0.58	8.83	2.28	-1.03	5.58	0.06 Δ
Veery	53	8.87	-2.67	53.30	1.43	0.65	2.22	0.37 Δ
Whip-poor-will	12	-2.06	-32.50	4.02	-0.02	-0.42	0.38	0.82 Δ
White-breasted nuthatch	871	4.23	1.65	6.51	4.54	3.12	5.97	0.22
White-eyed vireo	531	-0.76	-3.34	1.98	1.23	-0.23	2.70	0.12
Wild turkey	133	2.11	-3.42	7.68	2.61	0.19	5.03	0.05
Winter wren	11	0.28	-6.34	10.00	0.01	-0.35	0.37	5.99 Δ
Wood duck	72	19.99	-6.39	188.60	-0.78	-7.12	5.56	0.10 Δ
Wood thrush	1,636	0.81	-0.31	1.93	1.03	-0.05	2.12	0.30
Worm-eating warbler	671	-1.95	-3.72	-0.20	0.22	-1.28	1.73	0.13
Yellow warbler	121	-1.78	-8.49	3.87	1.11	-2.49	4.72	0.03
Yellow-billed cuckoo	1,470	6.79	4.01	9.93	1.68	-0.75	4.11	0.32
Yellow-breasted chat	1,299	-1.36	-3.52	0.65	-3.79	-5.46	-2.12	0.24
Yellow-throated vireo	148	3.51	-3.33	10.51	3.55	0.57	6.54	0.04
Yellow-throated warbler	314	3.75	1.33	6.34	5.98	4.00	7.96	0.07

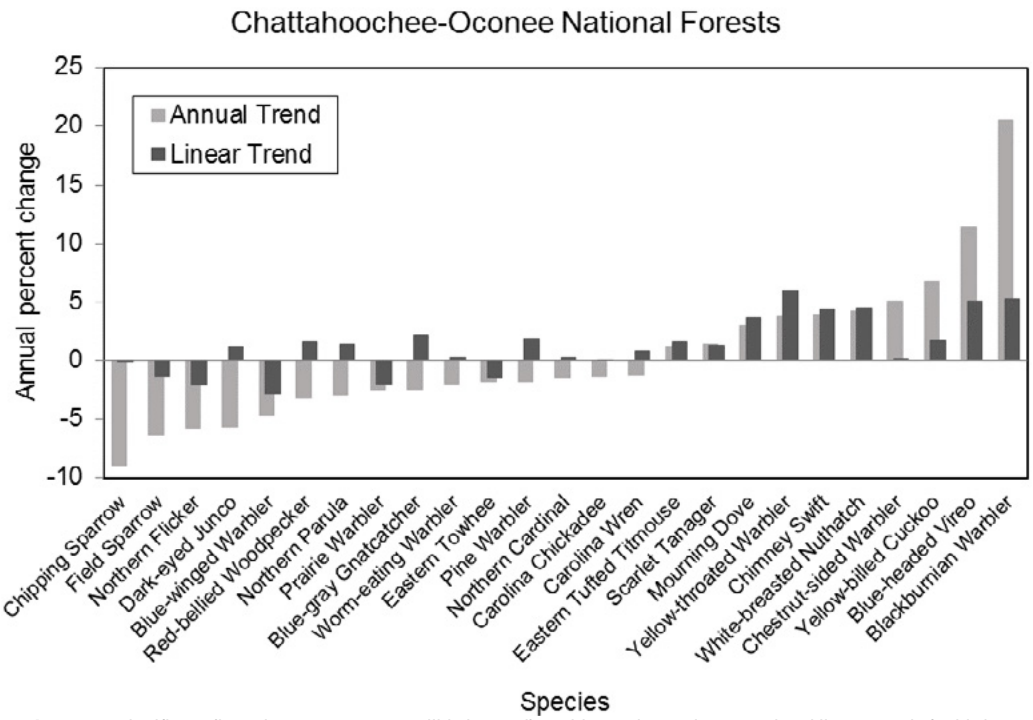


Figure 5.—Significant (based on 95-percent credible interval) positive and negative annual and linear trends for bird species in Chattahoochee-Oconee National Forests, 1992–2017.

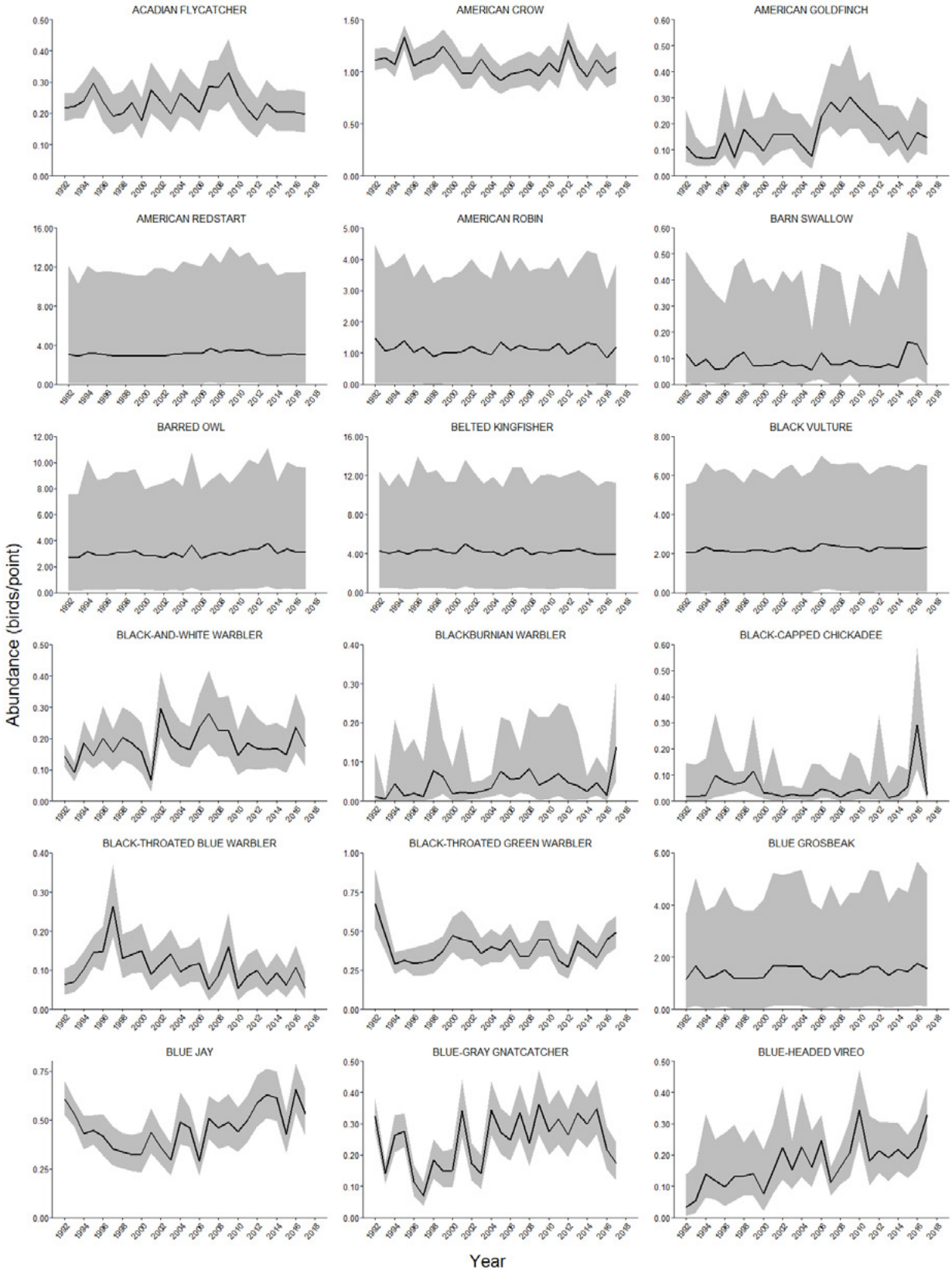
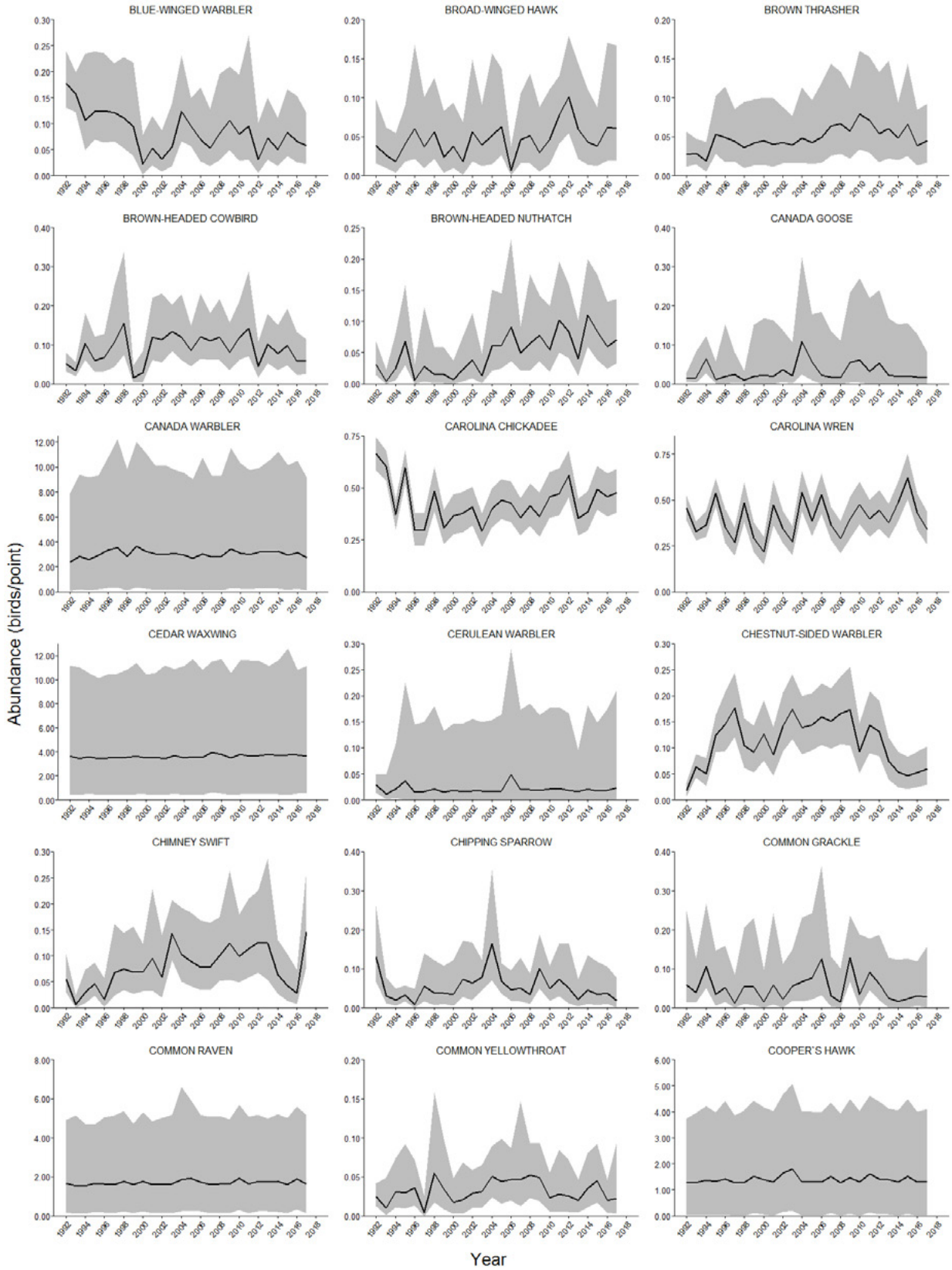


Figure 6. (page 1 of 6)—Estimated abundances and 95-percent credible intervals (shaded areas) for 104 bird species in Chattahoochee-Oconee National Forests, by year. The scale of the abundance axes may vary among species to best illustrate patterns in abundance.



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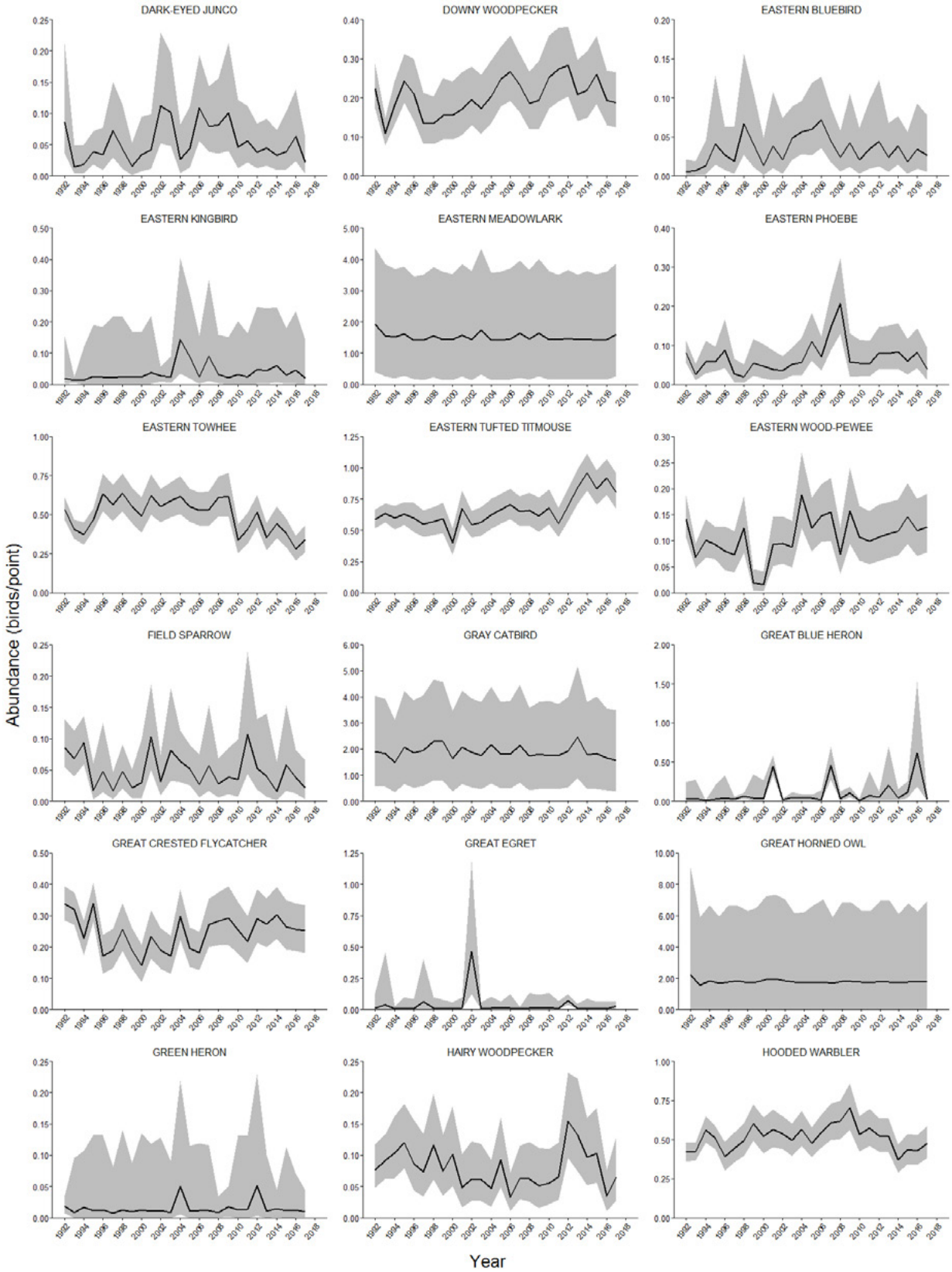

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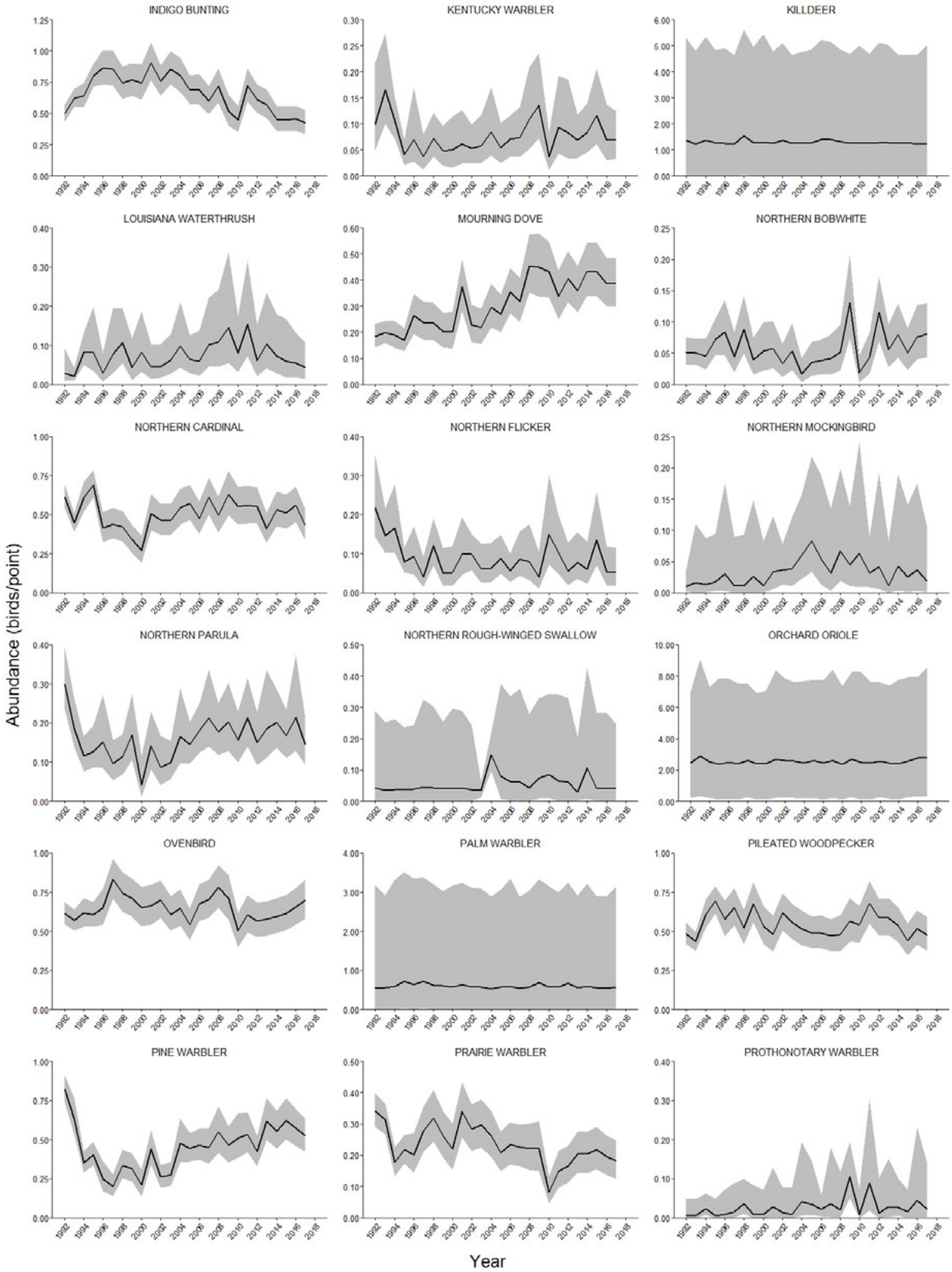

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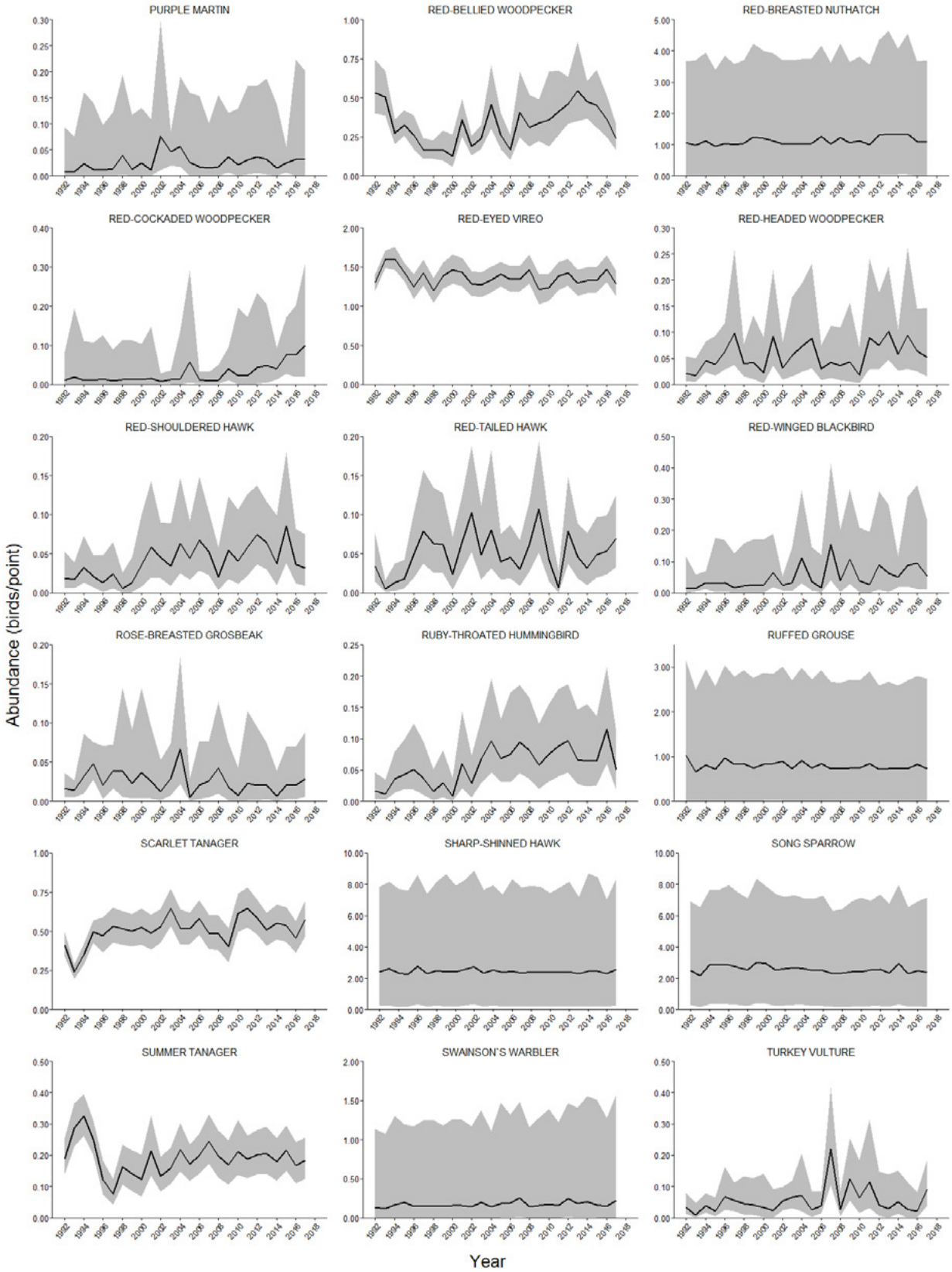

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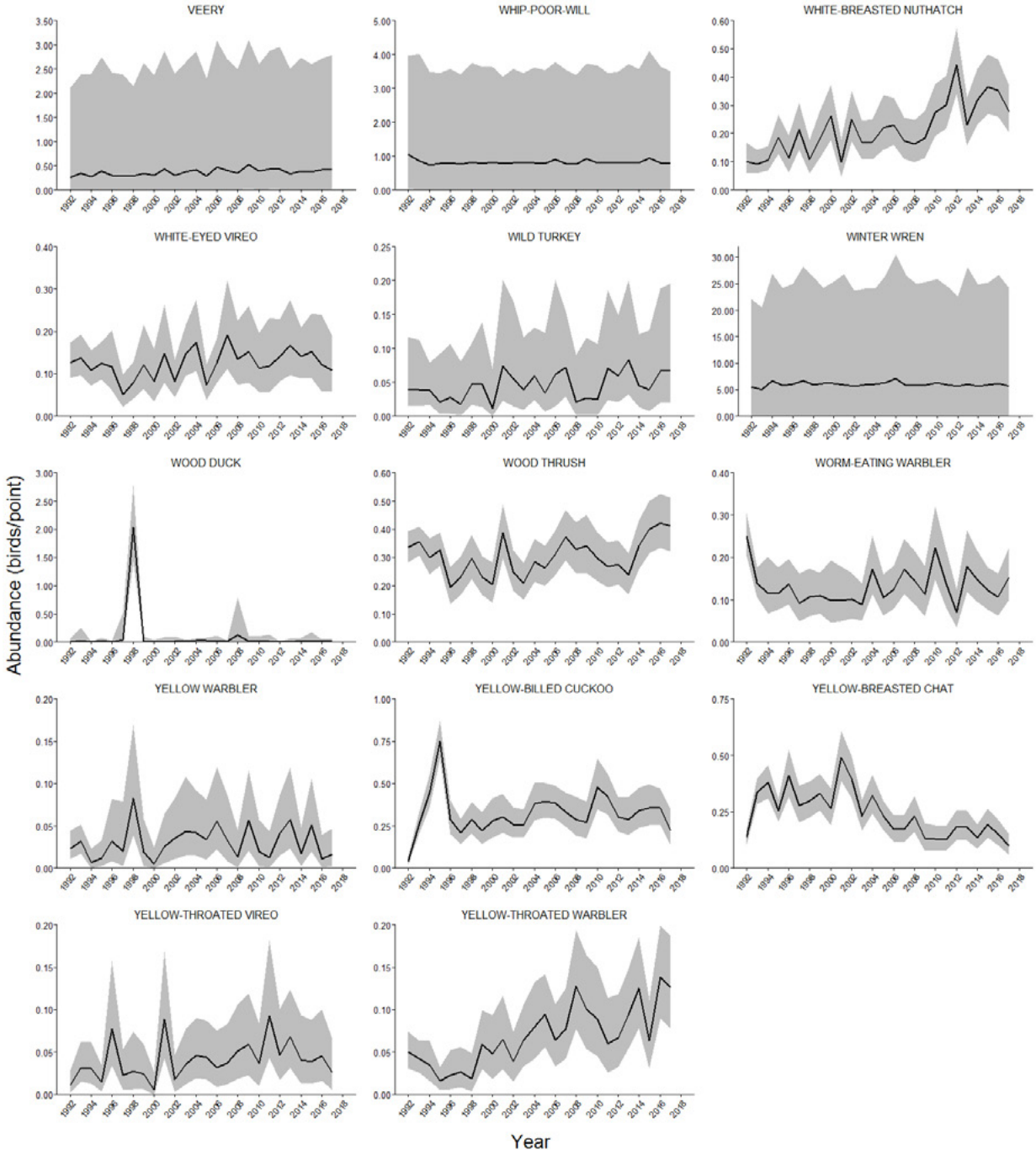

Figure 6 (page 6 of 6)

Cherokee National Forest

Cherokee National Forest completed 5,249 point counts between 1992 and 2017. The number of points surveyed ranged from 236 in 1997 to 91 in 1994. We estimated abundances and population trends for 102 species (Table 5). Species with the highest average abundances included red-eyed vireo (1.44 birds/point), ovenbird (0.80 bird/point), and American crow (0.77 bird/point). Species with the lowest average abundances were great horned owl (0.01 bird/point), green heron (0.01 bird/point), and northern mockingbird (0.01 bird/point). More species had positive than negative annual trends; 25 species had significant positive annual trends and 4 species had significant negative annual trends (Figs. 7, 8). Red-breasted nuthatch had the greatest annual trend (15.97 percent), followed by eastern phoebe (13.15 percent) and American robin (9.19 percent). Some woodland-breeding species with positive annual trends included downy woodpecker (7.78 percent), cedar waxwing (7.60 percent), blue-gray gnatcatcher (6.94 percent), eastern wood-pewee (6.79 percent), red-bellied woodpecker (5.86 percent), northern parula (4.95 percent), eastern tufted titmouse (4.77 percent), and white-breasted nuthatch (4.58 percent). Some early-successional, scrub-breeding species with positive annual trends were Carolina wren (3.43 percent), American goldfinch (3.26 percent), and northern cardinal (2.22 percent). Red-eyed vireo and ovenbird had some of the highest average abundances and had small positive annual trends, 0.45 percent and 0.50 percent, respectively. Of the species with significant negative annual trends, common grackle had the greatest negative trend (-29.27 percent), followed by rose-breasted grosbeak (-6.56 percent) and Canada warbler (-4.55 percent). Chestnut-sided warbler was the only early-successional, scrub-breeding species that had a negative annual trend (-4.18 percent). Linear trends were generally similar to annual trends, but smaller (Fig. 7).

Table 5.—Number of detections, annual trend, linear trend, 95-percent credible interval defined by LCI and UCI, and average abundance for 102 bird species in Cherokee National Forest, 1992–2017; caution should be used in interpreting species abundances marked with Δ because they are based on fewer than 50 detections or had wide credible intervals and may be inaccurate or imprecise

		Annual trend			Linear trend			
Species name	Detections	Trend	LCI	UCI	Trend	LCI	UCI	Abundance (birds/point)
		percent						
Acadian flycatcher	692	2.07	-0.29	4.75	3.10	1.44	4.76	0.14
American crow	3,822	0.49	-0.52	1.54	1.77	0.49	3.06	0.77
American goldfinch	735	3.26	0.56	6.22	1.99	-0.61	4.59	0.18
American redstart	150	0.07	-3.90	4.47	0.92	-3.64	5.49	0.03
American robin	699	9.19	5.02	14.66	7.96	5.46	10.46	0.16
Barn swallow	6	-0.04	-5.92	6.29	0.11	-0.14	0.36	1.61 Δ
Barred owl	55	0.86	-4.74	10.56	0.20	-0.31	0.72	1.25 Δ
Belted kingfisher	23	0.37	-5.04	10.87	0.10	-0.28	0.47	1.74 Δ
Black-and-white warbler	1,532	2.19	0.65	3.84	0.96	-0.09	2.02	0.37
Black-billed cuckoo	21	0.28	-3.67	7.31	0.37	0.06	0.67	2.58 Δ
Blackburnian warbler	123	-1.10	-5.33	3.54	-3.49	-6.76	-0.22	0.04
Black-capped chickadee	38	2.74	-7.49	14.15	0.03	-2.35	2.42	0.04 Δ
Black-throated blue warbler	1,225	-1.02	-2.56	0.53	-1.15	-2.20	-0.10	0.25
Black-throated green warbler	3,127	1.54	0.59	2.51	1.94	0.95	2.94	0.62
Blue jay	1,444	3.98	2.40	5.65	2.32	0.99	3.66	0.31
Blue-gray gnatcatcher	503	6.94	0.95	13.61	1.75	-0.80	4.30	0.15

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(Table 5 continued)

Species name	Detections	Annual trend			Linear trend			Abundance (birds/point)
		Trend	LCI	UCI	Trend	LCI	UCI	
		percent						
Blue-headed vireo	1,413	3.03	1.48	4.59	0.69	-1.33	2.71	0.31
Broad-winged hawk	103	-1.77	-10.37	2.52	0.66	-0.09	1.42	1.76
Brown creeper	39	1.38	-4.67	19.61	0.96	0.31	1.60	0.77 Δ
Brown thrasher	62	0.53	-3.51	6.41	0.18	-0.47	0.83	1.63 Δ
Brown-headed cowbird	95	1.86	-1.07	6.33	0.74	0.23	1.25	3.04 Δ
Canada goose	216	-0.49	-12.85	12.20	-1.14	-2.92	0.63	0.11 Δ
Canada warbler	399	-4.55	-8.23	-1.19	-3.66	-5.89	-1.44	0.09
Carolina chickadee	2,037	1.26	-0.12	2.73	2.02	1.13	2.91	0.43
Carolina wren	1,047	3.43	1.62	5.38	4.66	2.64	6.67	0.22
Cedar waxwing	591	7.60	0.26	14.98	3.08	-0.03	6.19	0.19
Chestnut-sided warbler	1,058	-4.18	-6.45	-1.99	-3.65	-5.06	-2.23	0.22
Chimney swift	253	4.05	-2.66	10.06	1.47	-1.75	4.70	0.07
Chipping sparrow	68	-0.39	-34.67	47.82	3.29	0.96	5.62	0.05 Δ
Common grackle	177	-29.27	-74.72	-4.71	1.29	-7.57	10.14	0.67 Δ
Common raven	68	3.90	-3.12	45.72	0.39	-0.14	0.91	1.25 Δ
Common yellowthroat	31	-0.06	-11.22	12.37	0.11	-0.42	0.64	1.91 Δ
Cooper's hawk	7	-0.03	-7.68	8.82	0.02	-0.23	0.27	3.37 Δ
Dark-eyed junco	1,644	1.73	0.32	3.25	1.19	0.09	2.28	0.35
Downy woodpecker	417	7.78	2.66	13.24	2.90	0.65	5.16	0.13
Eastern bluebird	20	0.42	-3.73	6.68	0.42	0.00	0.84	1.59 Δ
Eastern kingbird	7	0.36	-3.80	7.37	0.15	-0.04	0.35	3.00 Δ
Eastern phoebe	162	13.15	3.21	38.82	5.80	2.49	9.12	0.04
Eastern screech-owl	9	-0.05	-8.08	6.76	-0.06	-0.42	0.30	2.39 Δ
Eastern towhee	2,280	1.10	-0.10	2.40	0.22	-0.97	1.41	0.46
Eastern tufted titmouse	2,468	4.77	3.36	6.31	4.80	3.74	5.85	0.49
Eastern wood-pewee	352	6.79	2.78	12.38	4.44	3.11	5.78	0.07
Field sparrow	88	3.03	-2.82	10.74	4.45	0.86	8.04	0.02
Golden-crowned kinglet	204	10.40	-2.07	31.18	4.71	1.72	7.69	0.09
Golden-winged warbler	20	-1.36	-56.56	113.90	-2.56	-5.47	0.36	0.03 Δ
Gray catbird	270	-0.29	-5.00	4.63	1.09	-1.08	3.25	0.07
Great blue heron	21	9.37	-4.16	110.57	0.78	-0.21	1.76	0.20 Δ
Great crested flycatcher	210	1.09	-2.97	5.53	-1.01	-2.74	0.71	0.07
Great horned owl	14	-0.83	-66.07	196.80	-1.22	-3.85	1.42	0.01 Δ
Green heron	14	18.62	-4.73	165.07	1.58	-2.03	5.18	0.01 Δ
Hairy woodpecker	228	3.59	-1.19	9.41	1.80	-0.64	4.24	0.06
Hooded warbler	3,542	1.06	0.07	2.06	1.16	0.43	1.88	0.71
House wren	8	0.50	-3.81	7.63	0.48	0.27	0.69	2.12 Δ
Indigo bunting	3,452	0.16	-0.91	1.29	-1.09	-2.25	0.08	0.69
Kentucky warbler	30	-12.79	-48.97	6.96	-2.27	-4.78	0.24	0.03 Δ
Least flycatcher	31	9.07	-10.73	105.39	3.23	1.12	5.34	0.04 Δ
Louisiana waterthrush	268	0.58	-2.65	4.16	2.14	-0.18	4.47	0.07
Mallard	52	-0.85	-35.87	54.18	4.96	1.10	8.82	0.04 Δ

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(Table 5 continued)

Species name	Detections	Annual trend			Linear trend			Abundance (birds/point)
		Trend	LCI	UCI	Trend	LCI	UCI	
		percent						
Mourning dove	649	4.50	1.89	7.42	5.76	3.21	8.30	0.14
Northern bobwhite	34	-0.46	-41.88	74.29	-3.36	-7.31	0.59	0.02 Δ
Northern cardinal	1,077	2.22	0.41	4.20	4.94	2.76	7.12	0.23
Northern flicker	332	-1.24	-5.08	2.74	0.90	-1.69	3.48	0.09
Northern mockingbird	10	0.41	-80.92	406.83	2.08	-1.00	5.16	0.01 Δ
Northern parula	629	4.95	2.36	7.94	5.19	3.70	6.68	0.13
Northern rough-winged swallow	35	11.39	-8.47	96.26	0.62	-1.33	2.57	0.03 Δ
Ovenbird	4,027	0.50	-0.42	1.45	-0.03	-0.77	0.71	0.80
Pileated woodpecker	1,653	2.14	0.62	3.72	0.88	-0.36	2.12	0.39
Pine warbler	690	-0.47	-2.55	1.68	2.14	-1.52	5.81	0.14
Prairie warbler	345	3.10	-1.66	8.24	4.43	1.90	6.95	0.09
Red-bellied wodpecker	234	5.86	0.74	10.97	5.04	3.37	6.72	0.06
Red-breasted nuthatch	145	15.97	4.98	46.40	8.25	5.49	11.01	0.04
Red-eyed vireo	7,470	0.45	-0.21	1.11	-0.14	-0.91	0.63	1.44
Red-headed woodpecker	12	0.06	-15.71	17.12	0.26	-0.01	0.53	2.01 Δ
Red-shouldered hawk	53	-0.43	-6.84	6.55	-0.12	-5.29	5.06	0.01 Δ
Red-tailed hawk	17	-0.51	-9.27	4.78	-0.10	-0.41	0.22	2.12 Δ
Red-winged blackbird	6	0.47	-4.84	9.85	-0.07	-0.36	0.23	1.30 Δ
Rose-breasted grosbeak	348	-6.56	-10.17	-3.36	-3.05	-5.21	-0.89	0.08
Ruby-throated hummingbird	158	1.39	-1.72	5.86	0.24	-0.61	1.09	1.57 Δ
Ruffed grouse	72	-1.30	-10.93	4.50	-0.87	-1.63	-0.11	0.79 Δ
Scarlet tanager	2,339	1.78	0.62	3.01	1.07	-0.18	2.33	0.47
Sharp-shinned hawk	9	-0.03	-8.24	8.53	-0.28	-0.66	0.11	1.07 Δ
Song sparrow	89	-1.30	-12.08	11.03	1.13	-2.23	4.49	0.02
Summer tanager	34	0.13	-46.18	83.91	0.36	-2.31	3.03	0.02 Δ
Swainson's thrush	22	-1.73	-26.51	30.24	-0.09	-2.67	2.50	0.06 Δ
Swainson's warbler	80	6.29	-4.31	18.92	2.56	0.38	4.74	0.04 Δ
Tree swallow	22	0.03	-24.92	31.71	0.82	0.12	1.52	0.44 Δ
Turkey vulture	45	11.69	-4.12	67.67	0.98	-2.25	4.20	0.02 Δ
Veery	1,377	0.67	-0.94	2.38	0.07	-0.76	0.90	0.32
Warbling vireo	11	-0.04	-19.34	22.78	0.03	-0.13	0.20	0.94 Δ
Whip-poor-will	29	-0.67	-42.01	68.88	-1.54	-4.45	1.36	0.02 Δ
Winter wren	233	-3.53	-7.55	0.57	-2.90	-5.52	-0.28	0.06
Wood thrush	1,339	2.27	0.60	4.09	0.91	-0.23	2.06	0.27
Worm-eating warbler	1,139	1.54	0.05	3.15	-0.40	-2.31	1.50	0.24
Yellow warbler	48	-10.31	-40.45	4.54	-0.83	-3.44	1.78	0.10 Δ
Yellow-bellied sapsucker	41	14.90	-2.56	83.79	5.07	3.25	6.88	0.06 Δ
Yellow-billed cuckoo	743	1.08	-0.91	3.22	0.21	-4.17	4.60	0.16
Yellow-breasted chat	380	-1.20	-3.89	1.66	-3.22	-5.36	-1.09	0.08
Yellow-throated vireo	114	11.48	-5.40	57.50	4.82	1.15	8.49	0.04 Δ
Yellow-throated warbler	459	0.41	-1.75	2.59	2.84	-0.62	6.30	0.10

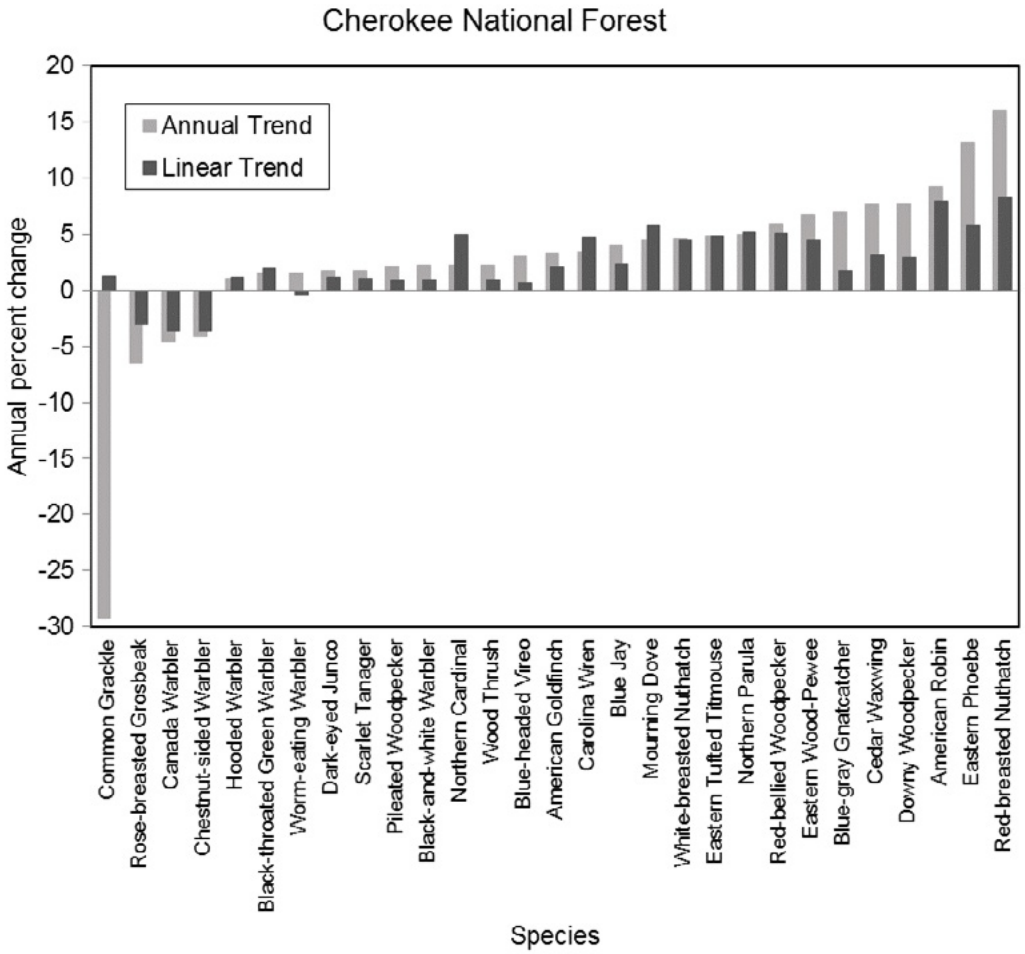


Figure 7.—Significant (based on 95-percent credible interval) positive and negative annual and linear trends for bird species in Cherokee National Forest, 1992–2017.

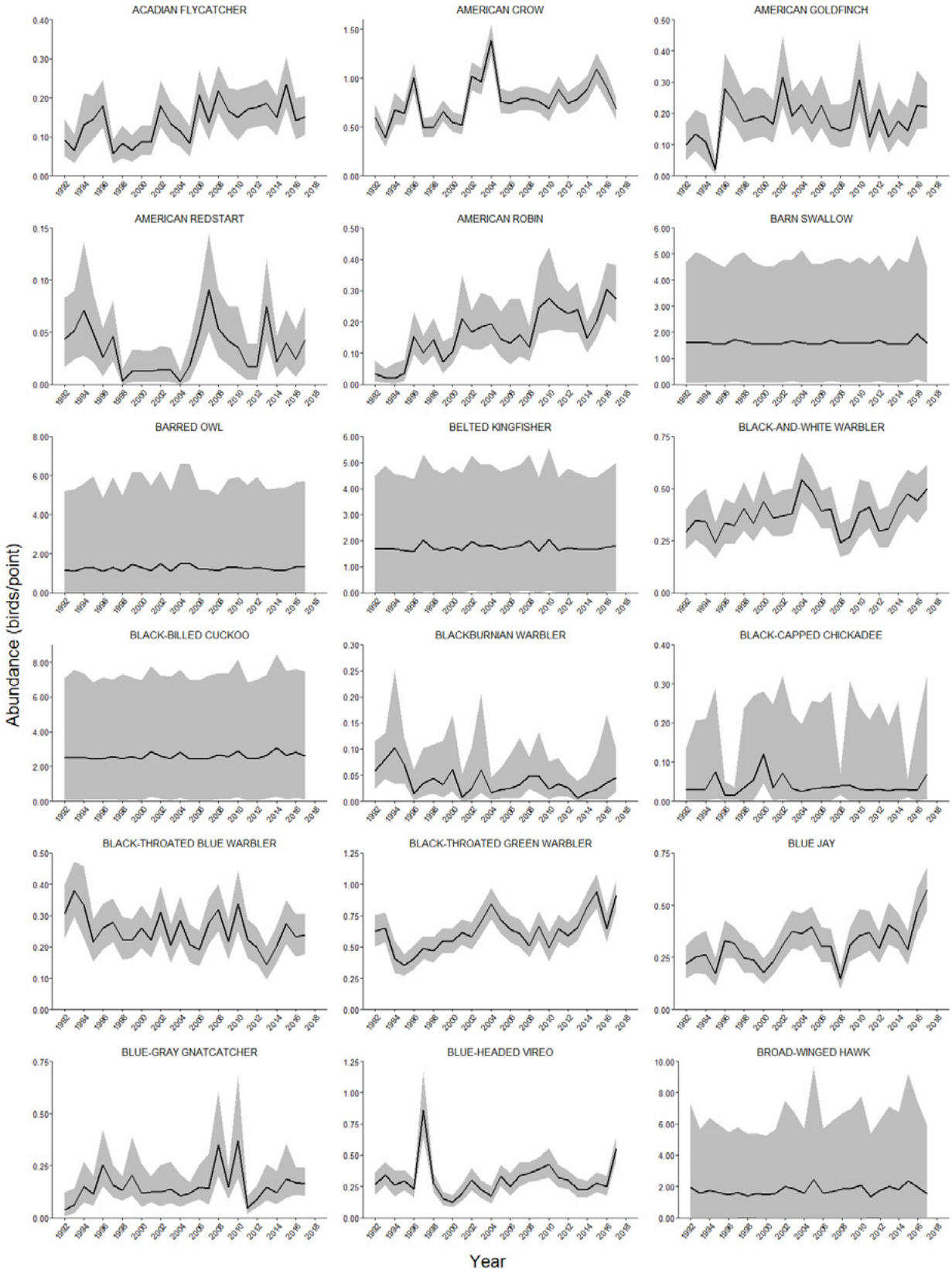


Figure 8. (page 1 of 6)—Estimated abundances and 95-percent credible intervals (shaded areas) for 102 bird species in Cherokee National Forest, by year. The scale of the abundance axes may vary among species to best illustrate patterns in abundance.

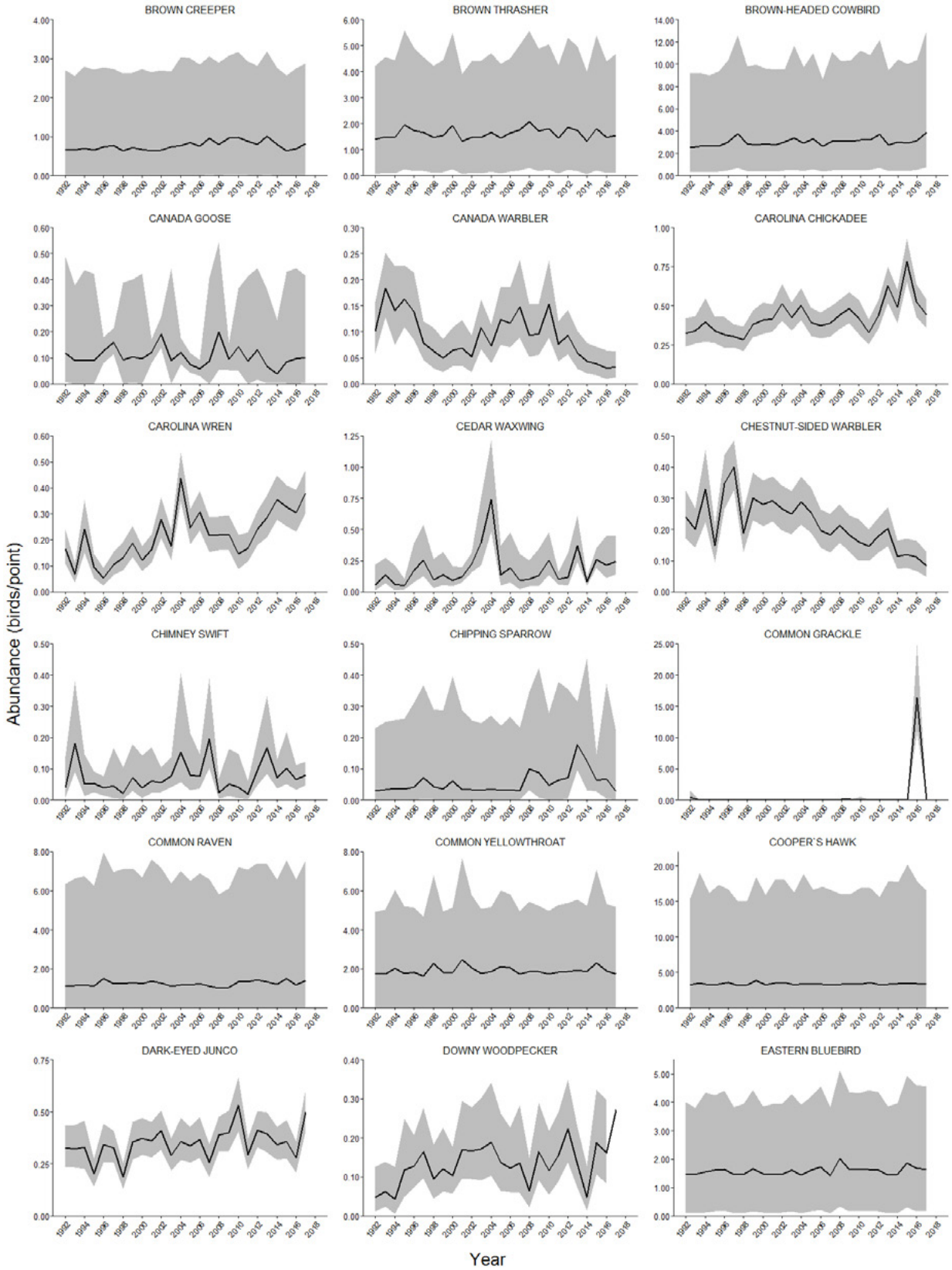
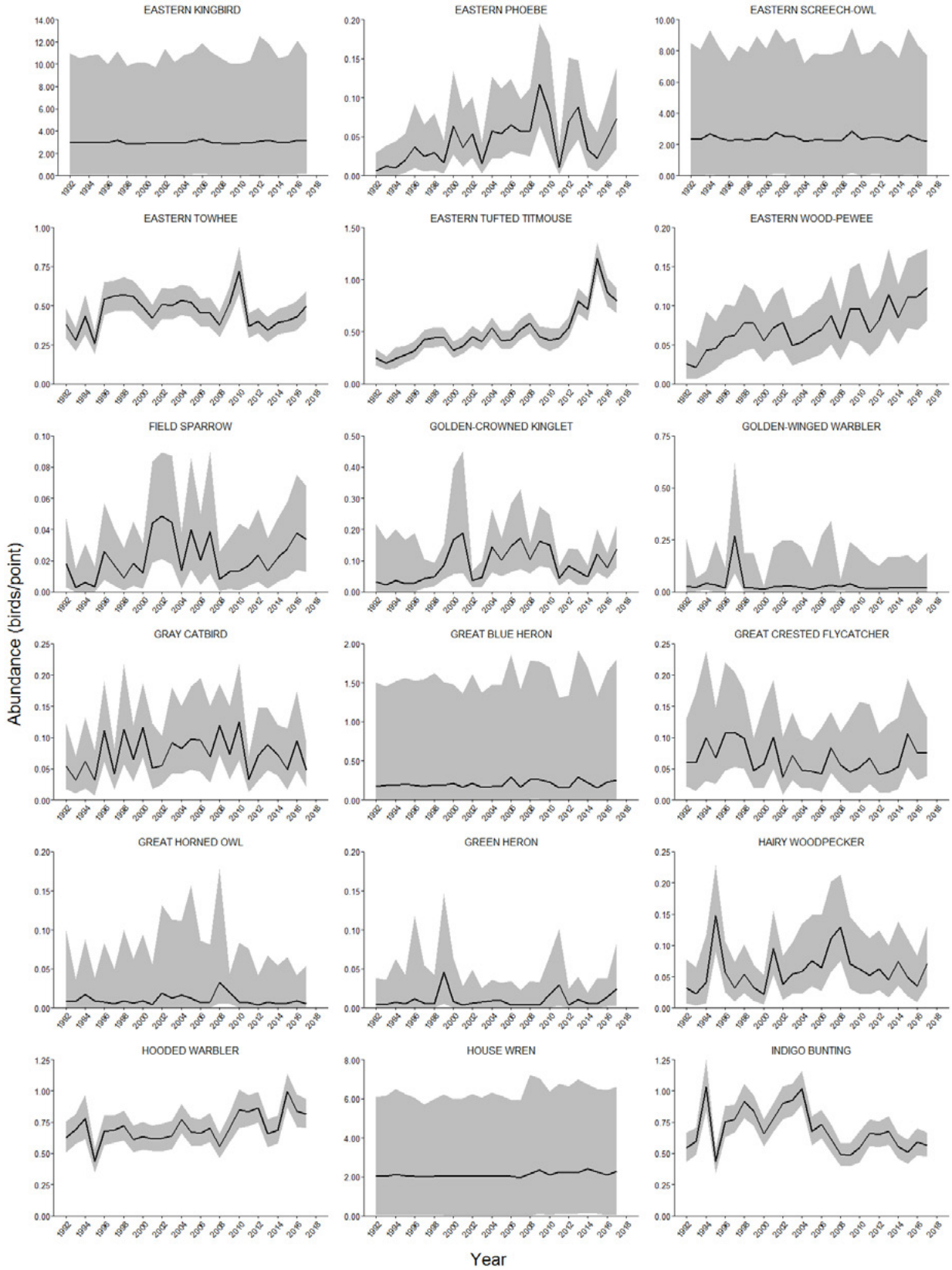


Figure 8 (page 2 of 6)



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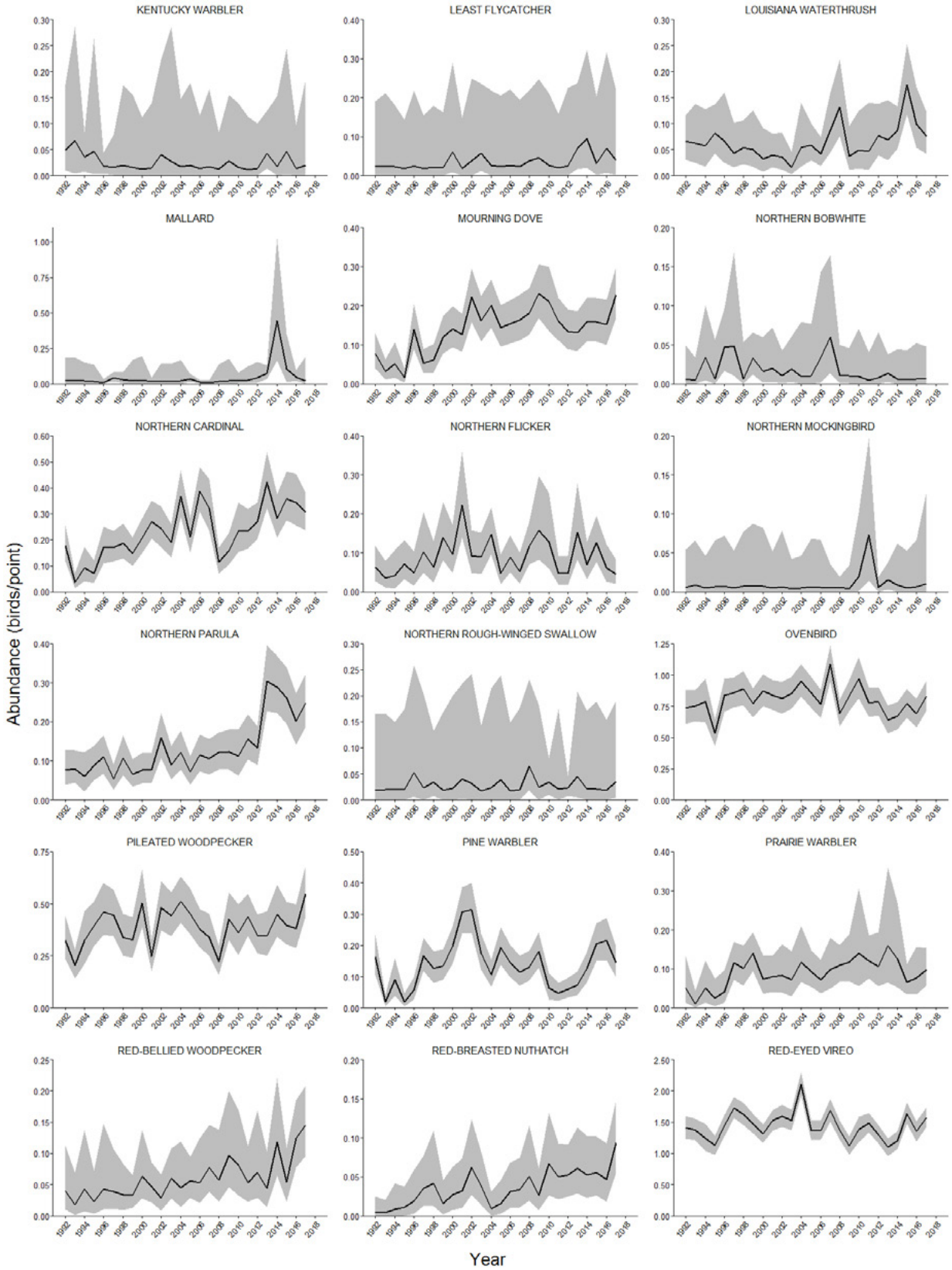

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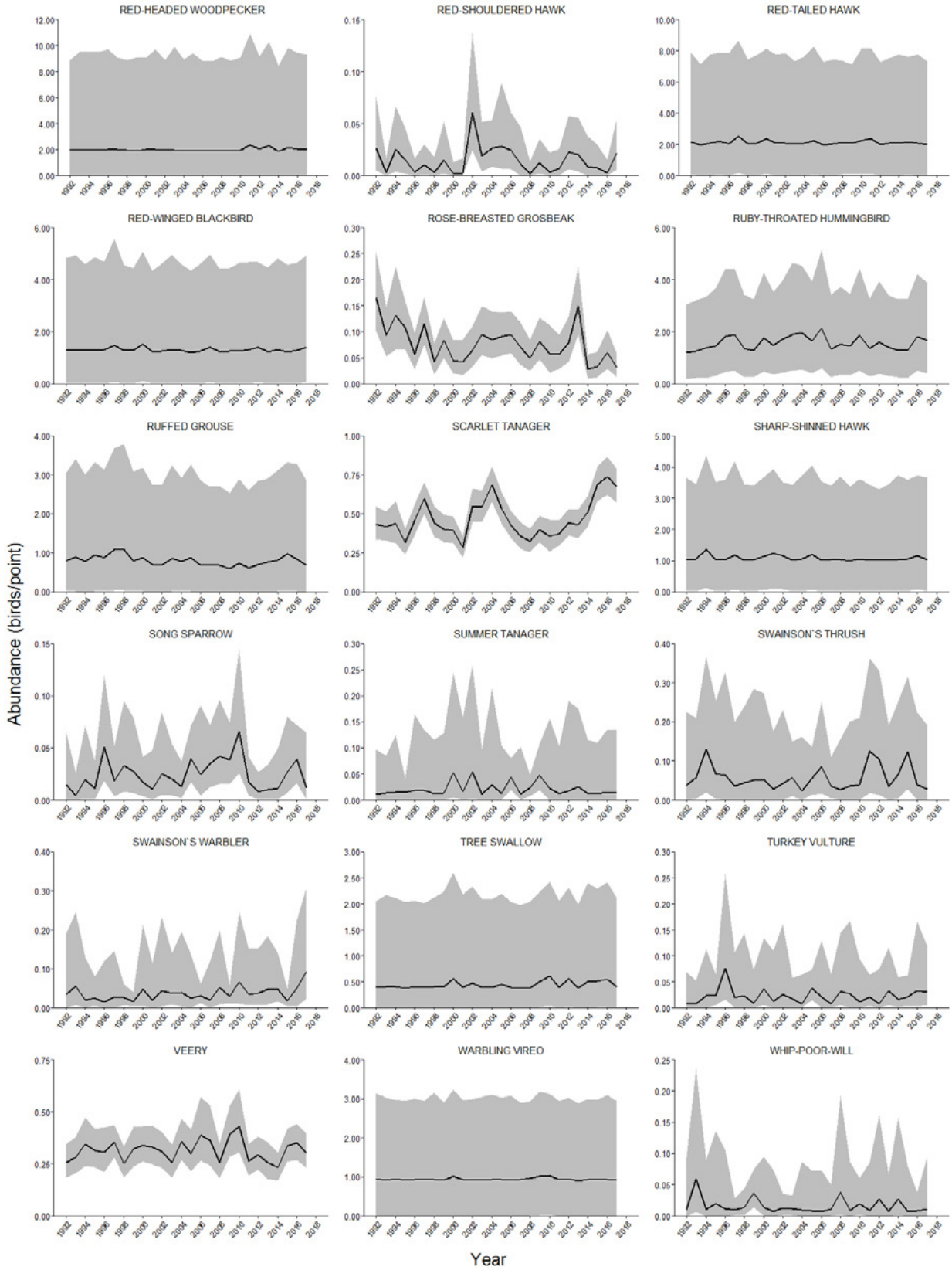

Figure 8 (page 5 of 6)

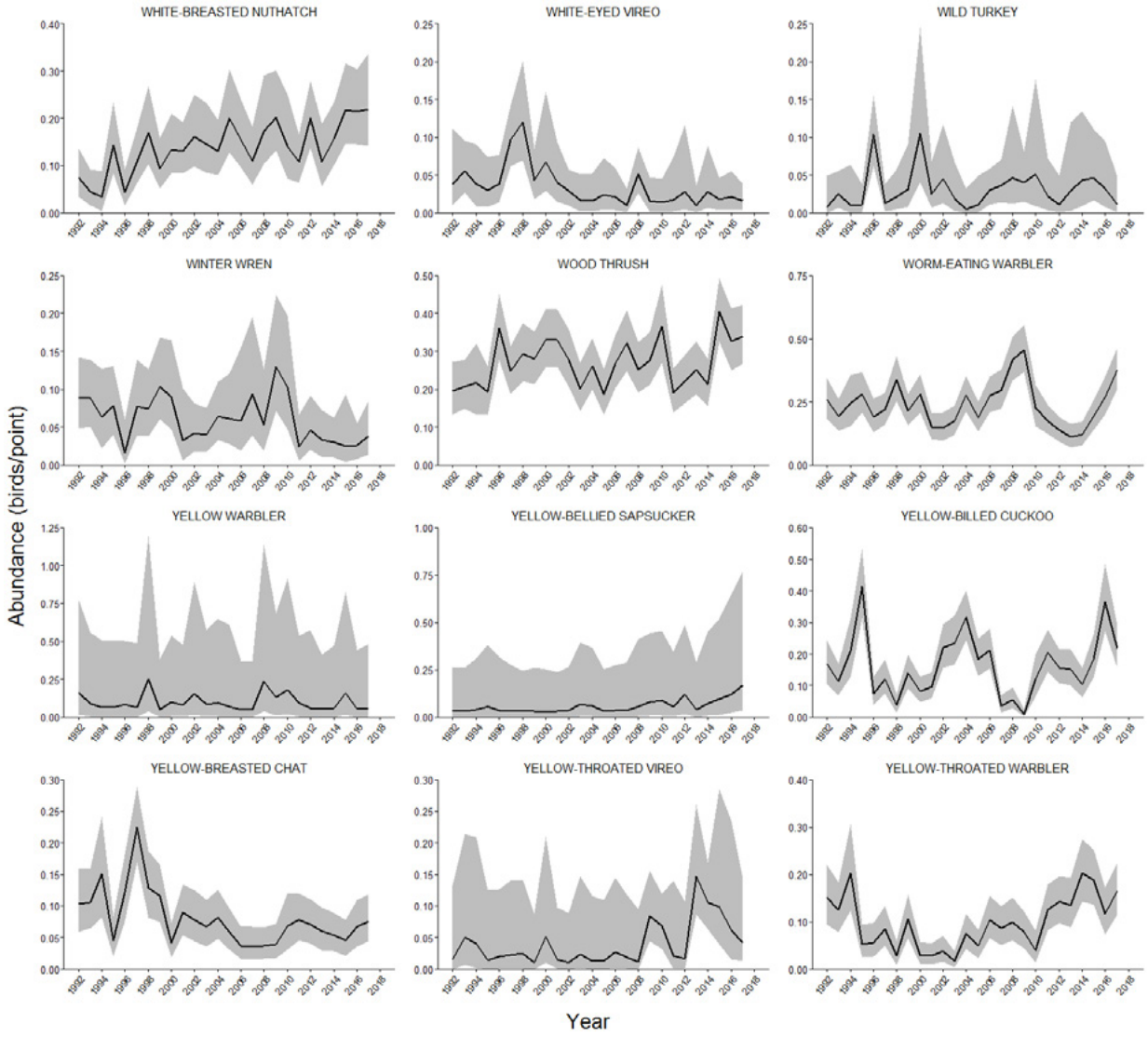

Figure 8 (page 6 of 6)

Daniel Boone National Forest

Daniel Boone National Forest completed 3,584 point counts between 1997 and 2017. The number of points surveyed ranged from 189 in 1999 to 152 in 2003, excluding the 1 point surveyed in 2007. We estimated abundances and population trends for 90 species (Table 6). Red-eyed vireo (1.61 birds/point), ovenbird (1.23 birds/point), and hooded warbler (0.96 bird/point) had the highest average abundances. Northern mockingbird (0.01 bird/point), northern rough-winged swallow (0.01 bird/point), and mallard (0.01 bird/point) had the lowest average abundances. Overall, more species had positive than negative annual trends; 16 species had significant positive annual trends and 3 species had significant negative annual trends (Figs. 9, 10). Yellow-throated vireo had the highest positive annual trend (6.29 percent), followed by yellow-throated warbler (6.23 percent) and blue-headed vireo (5.19 percent). Other woodland-breeding species that had positive trends included yellow-billed cuckoo (3.95 percent), eastern tufted titmouse (3.85 percent), black-throated green warbler (3.84 percent), northern parula (3.77 percent), eastern wood-pewee (3.67 percent), and scarlet tanager (3.10 percent). The three species with the highest average abundances also had small positive trends: red-eyed vireo (1.50 percent), ovenbird (1.59 percent), and hooded warbler (2.22 percent). Some early-successional, scrub-breeding species had significant negative annual trends: yellow-breasted chat (-2.63 percent) and indigo bunting (-1.89 percent). Pileated woodpecker was the only woodland-breeding species with a significant negative annual trend (-2.23 percent). All linear trends, except for yellow-billed cuckoo, were similar to annual trends (Fig. 9).

Table 6.—Number of detections, annual trend, linear trend, 95-percent credible interval defined by LCI and UCI, and average abundance for 90 bird species in Daniel Boone National Forest, 1997–2017; caution should be used in interpreting species abundances marked with Δ because they are based on fewer than 50 detections or had wide credible intervals and may be inaccurate or imprecise

		Annual trend			Linear trend			
Species name	Detections	Trend	LCI	UCI	Trend	LCI	UCI	Abundance (birds/point)
		percent						
Acadian flycatcher	1,235	2.08	0.29	3.87	2.29	1.14	3.43	0.36
American crow	2,988	-0.14	-1.29	1.03	-0.55	-1.53	0.43	0.88
American goldfinch	370	-1.76	-5.72	2.20	-2.64	-5.14	-0.14	0.12
American redstart	175	4.08	-1.66	10.68	1.38	-1.38	4.14	0.06
American robin	116	-2.42	-10.95	6.19	-3.65	-7.06	-0.24	0.05
Barred owl	22	-0.17	-11.47	11.51	0.47	-0.40	1.35	1.10 Δ
Belted kingfisher	15	-0.68	-5.82	3.80	-0.07	-0.48	0.33	2.78 Δ
Black-and-white warbler	1,255	3.05	0.93	5.17	1.78	0.86	2.71	0.39
Black-billed cuckoo	16	3.47	-58.53	143.27	1.50	-2.80	5.81	0.03 Δ
Black-throated green warbler	1,197	3.84	1.92	5.93	4.17	2.78	5.55	0.35
Blue grosbeak	15	-1.61	-60.59	132.13	0.30	-2.17	2.76	0.03 Δ
Blue jay	836	1.94	-0.43	4.44	1.89	0.54	3.24	0.27
Blue-gray gnatcatcher	751	0.02	-2.49	2.50	0.73	-1.75	3.22	0.23
Blue-headed vireo	351	5.19	0.88	10.40	7.22	4.06	10.39	0.11
Blue-winged warbler	176	1.78	-2.25	6.02	6.98	1.62	12.34	0.06
Broad-winged hawk	21	-1.79	-26.63	4.01	0.07	-0.52	0.67	1.33 Δ
Brown thrasher	47	0.26	-3.70	4.42	0.17	-0.52	0.85	7.67 Δ
Brown-headed cowbird	335	-2.42	-5.73	0.86	-4.96	-6.79	-3.14	0.14
Canada goose	41	6.07	-8.98	24.86	1.24	-3.27	5.76	0.05 Δ
Carolina chickadee	795	0.17	-1.78	2.15	-0.84	-3.20	1.52	0.26

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(Table 6 continued)

Species name	Detections	Annual trend			Linear trend			Abundance (birds/point)
		Trend	LCI	UCI	Trend	LCI	UCI	
		percent						
Carolina wren	953	0.10	-2.46	2.68	-1.23	-3.66	1.19	0.29
Cedar waxwing	218	5.77	-20.03	102.65	4.81	-5.58	15.20	0.53 Δ
Cerulean warbler	424	2.70	-0.08	5.65	2.20	-0.20	4.61	0.13
Chestnut-sided warbler	10	-6.51	-20.98	10.46	-2.40	-5.48	0.68	0.02 Δ
Chimney swift	26	-13.22	-50.33	5.23	-2.71	-5.81	0.38	0.04 Δ
Chipping sparrow	177	-1.61	-6.45	3.56	-4.33	-9.16	0.50	0.07
Common grackle	12	-0.49	-42.35	67.00	-0.63	-1.20	-0.07	0.35 Δ
Common yellowthroat	251	-2.70	-6.49	0.97	-1.08	-3.22	1.05	0.08
Cooper's hawk	7	0.00	-31.37	51.89	-0.06	-0.39	0.27	2.61 Δ
Downy woodpecker	330	-0.24	-5.76	5.85	-2.66	-5.49	0.17	0.17
Eastern bluebird	43	-0.86	-6.42	3.50	-0.29	-0.94	0.36	2.66 Δ
Eastern towhee	702	-0.06	-2.44	2.41	0.24	-1.48	1.97	0.22
Eastern tufted titmouse	2,104	3.85	2.44	5.29	2.49	1.39	3.58	0.63
Eastern wood-pewee	1,040	3.67	1.90	5.52	4.62	3.42	5.83	0.30
European starling	7	-0.02	-21.50	28.59	-0.81	-1.43	-0.19	2.19 Δ
Field sparrow	173	-1.68	-7.23	4.77	-3.08	-6.16	0.00	0.06
Gray catbird	46	-0.17	-4.00	3.80	-0.06	-0.72	0.60	5.59 Δ
Great blue heron	16	1.59	-50.48	109.70	-0.75	-3.50	1.99	0.02 Δ
Great crested flycatcher	194	0.24	-4.69	5.38	-0.59	-5.58	4.40	0.07
Green heron	15	2.97	-59.58	149.51	1.37	-3.78	6.53	0.02 Δ
Hairy woodpecker	228	-3.10	-8.80	2.68	-0.98	-4.25	2.29	0.09
Hooded warbler	3,306	2.22	1.16	3.29	2.19	1.50	2.88	0.96
Indigo bunting	1,719	-1.89	-3.47	-0.33	-2.70	-3.74	-1.65	0.51
Kentucky warbler	449	-1.62	-4.26	1.00	-2.17	-4.75	0.42	0.14
Least flycatcher	8	0.08	-9.16	5.63	0.23	-0.30	0.76	3.95 Δ
Louisiana waterthrush	157	7.01	-1.91	17.53	2.04	-0.62	4.70	0.07
Mallard	12	-20.83	-78.67	6.61	-4.93	-11.46	1.61	0.01 Δ
Mourning dove	601	4.32	1.20	7.78	1.39	-0.69	3.47	0.20
Northern bobwhite	39	-1.22	-22.66	3.80	-0.67	-1.08	-0.26	2.90 Δ
Northern cardinal	1,132	1.17	-0.77	3.15	1.68	-0.57	3.94	0.36
Northern flicker	269	-0.21	-4.34	4.74	3.05	-1.02	7.11	0.11
Northern mockingbird	9	15.26	-12.18	266.33	-0.55	-6.32	5.22	0.01 Δ
Northern parula	531	3.77	1.26	6.51	4.06	2.25	5.87	0.18
Northern rough-winged swallow	14	4.09	-66.76	212.12	-0.38	-7.51	6.74	0.01 Δ
Orchard oriole	10	0.53	-4.30	6.97	-0.03	-0.54	0.47	3.66 Δ
Ovenbird	4,294	1.59	0.58	2.59	0.86	0.11	1.62	1.23
Pileated woodpecker	1,262	-2.23	-4.40	-0.12	-0.77	-2.33	0.79	0.43
Pine warbler	550	-0.49	-2.97	2.15	-2.68	-5.37	0.02	0.19
Prairie warbler	584	0.14	-1.94	2.28	0.68	-2.92	4.27	0.18
Prothonotary warbler	7	-0.51	-13.16	7.89	-0.05	-0.29	0.19	1.46 Δ
Red-bellied woodpecker	878	2.06	-1.36	5.49	0.48	-1.85	2.80	0.35
Red-tailed hawk	46	-0.32	-5.08	4.34	-0.36	-1.14	0.43	2.49 Δ
Red-winged blackbird	227	4.41	-1.78	11.27	3.50	-1.47	8.47	0.11
Rose-breasted grosbeak	8	0.82	-6.08	40.84	-0.02	-0.42	0.38	1.64 Δ
Ruby-throated hummingbird	138	-4.11	-12.54	3.38	-4.29	-7.76	-0.82	0.05
Ruffed grouse	11	-1.84	-49.53	13.12	-0.59	-1.07	-0.12	0.84 Δ
Scarlet tanager	1,879	3.10	1.59	4.69	1.84	0.72	2.96	0.57
Song sparrow	35	0.17	-4.52	5.29	-0.23	-0.79	0.32	2.07 Δ

(continued on next page)

(Table 6 continued)

Species name	Detections	Annual trend			Linear trend			Abundance (birds/point)
		Trend	LCI	UCI	Trend	LCI	UCI	
		percent						
Summer tanager	168	-2.28	-9.15	3.98	-2.93	-7.69	1.83	0.07
Swainson's thrush	13	-3.31	-38.33	46.54	1.09	-0.87	3.04	0.07 Δ
Swainson's warbler	49	2.40	-6.89	12.76	-2.13	-6.65	2.40	0.03 Δ
Tree swallow	30	24.63	-2.07	159.81	3.43	-1.42	8.29	0.03 Δ
Turkey vulture	63	-8.78	-20.40	2.15	-5.49	-9.19	-1.79	0.03 Δ
Whip-poor-will	6	0.56	-4.53	8.73	-0.07	-0.47	0.33	1.49 Δ
White-breasted nuthatch	964	0.27	-1.70	2.31	-1.01	-2.80	0.78	0.30
White-eyed vireo	715	1.36	-1.12	3.95	-0.07	-2.27	2.14	0.22
Wild turkey	157	1.14	-7.68	9.82	0.82	-3.36	4.99	0.10
Wood thrush	1,446	1.42	-0.20	3.03	-0.01	-1.04	1.02	0.42
Worm-eating warbler	1,409	1.93	0.40	3.57	0.16	-1.22	1.54	0.42
Yellow warbler	114	-2.89	-13.48	4.24	-0.77	-1.85	0.30	0.80 Δ
Yellow-billed cuckoo	1,384	3.95	1.87	6.04	-0.79	-3.45	1.87	0.47
Yellow-breasted chat	933	-2.63	-4.57	-0.70	-2.05	-3.34	-0.77	0.28
Yellow-throated vireo	378	6.29	1.99	10.85	3.18	1.05	5.30	0.13
Yellow-throated warbler	630	6.23	3.72	9.05	2.77	0.71	4.84	0.19

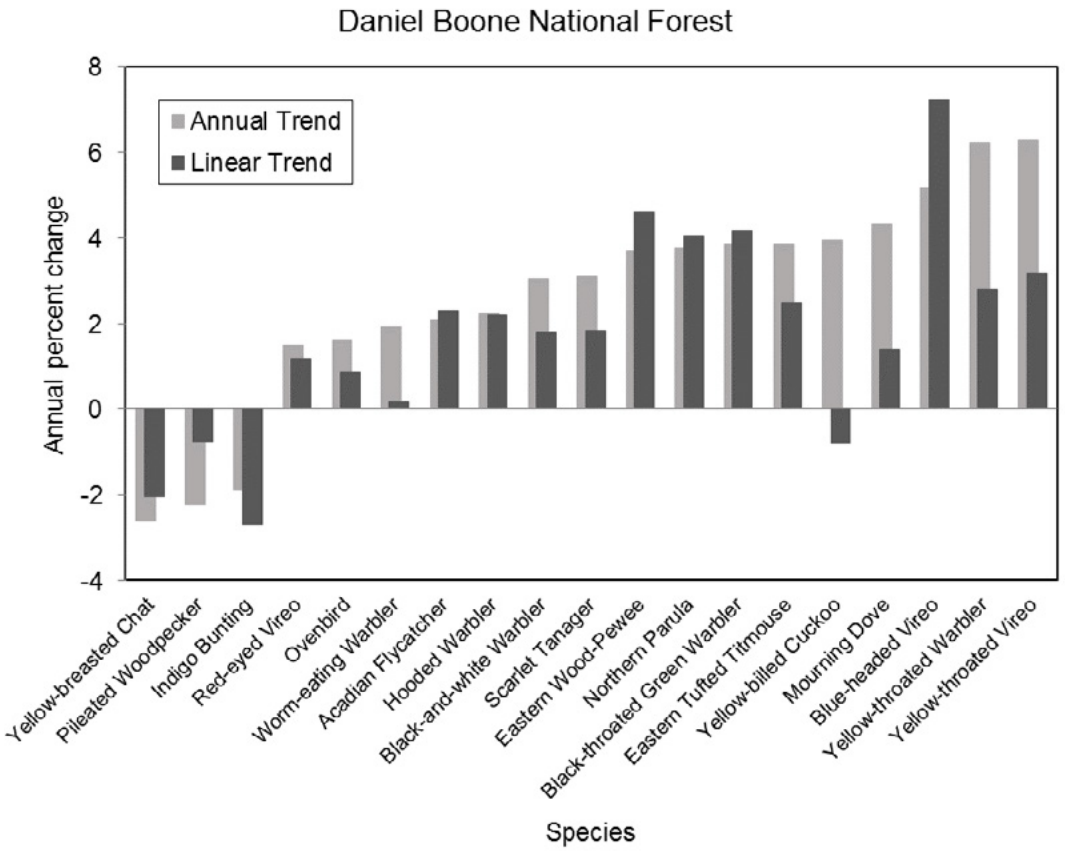


Figure 9.—Significant (based on 95-percent credible interval) positive and negative annual and linear trends for bird species in Daniel Boone National Forest, 1997–2017.

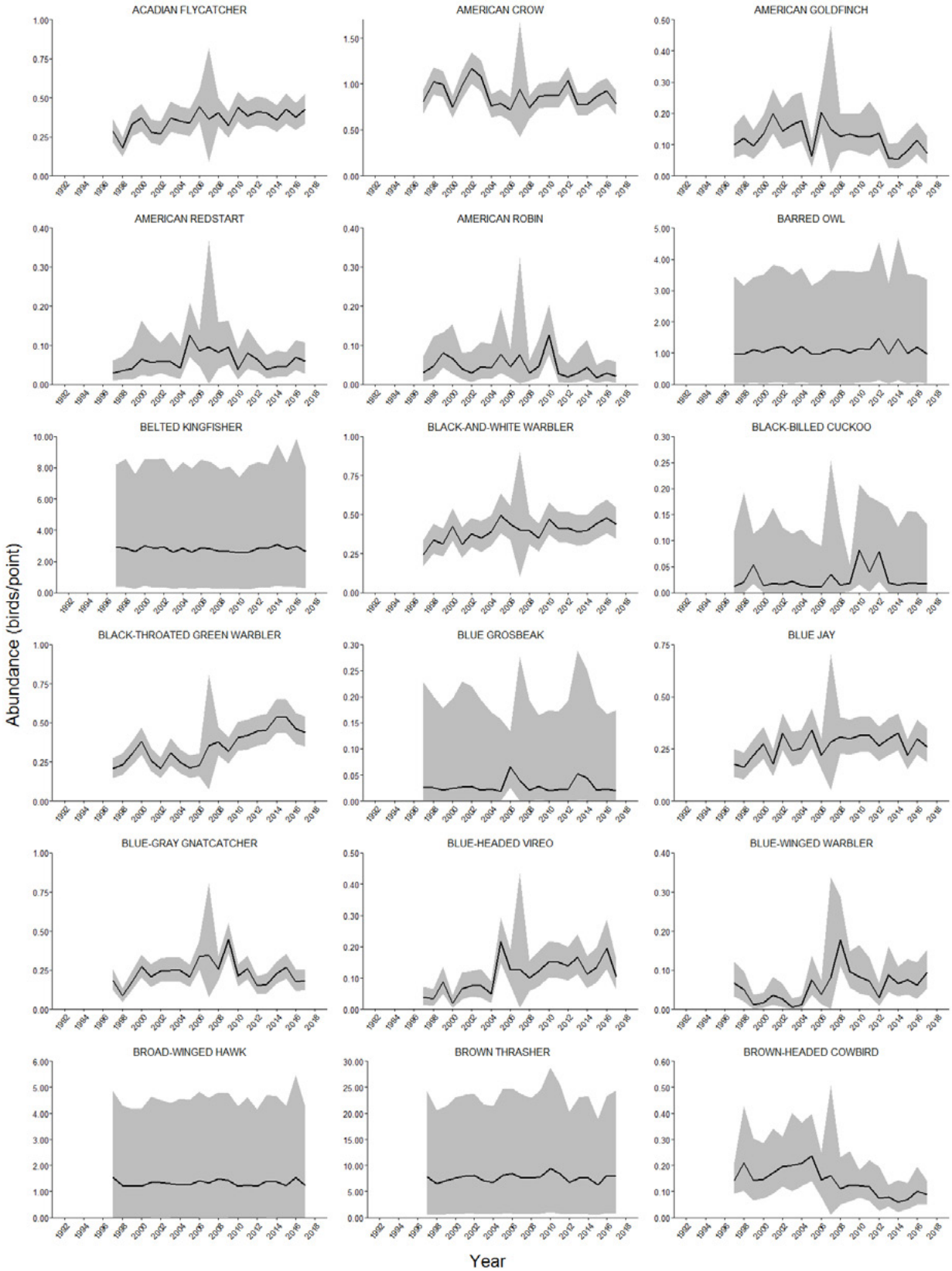


Figure 10. (page 1 of 5)—Estimated abundances and 95-percent credible intervals (shaded areas) for 90 bird species in Daniel Boone National Forest, by year. The scale of the abundance axes may vary among species to best illustrate patterns in abundance.

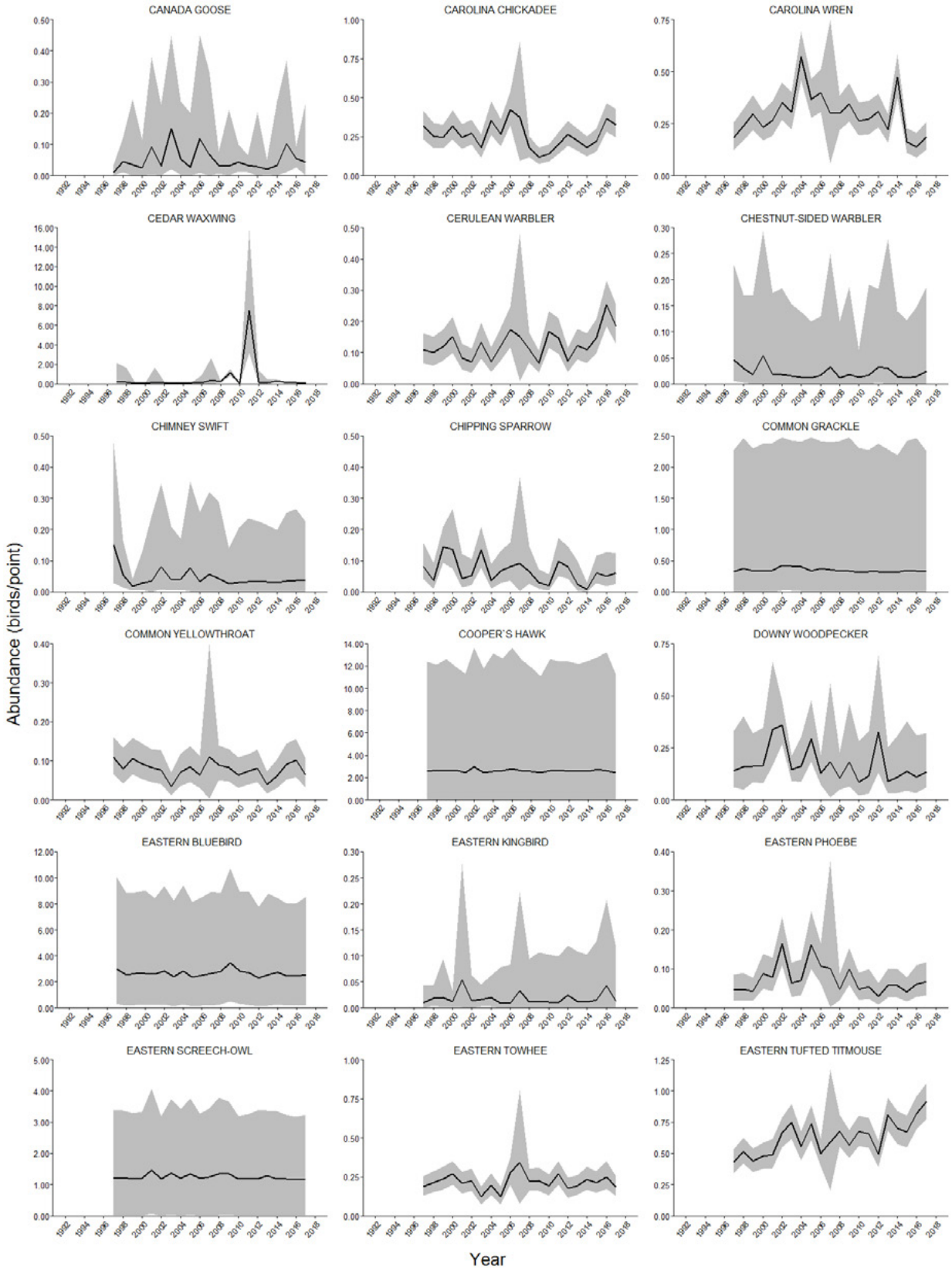


Figure 10 (page 2 of 5)

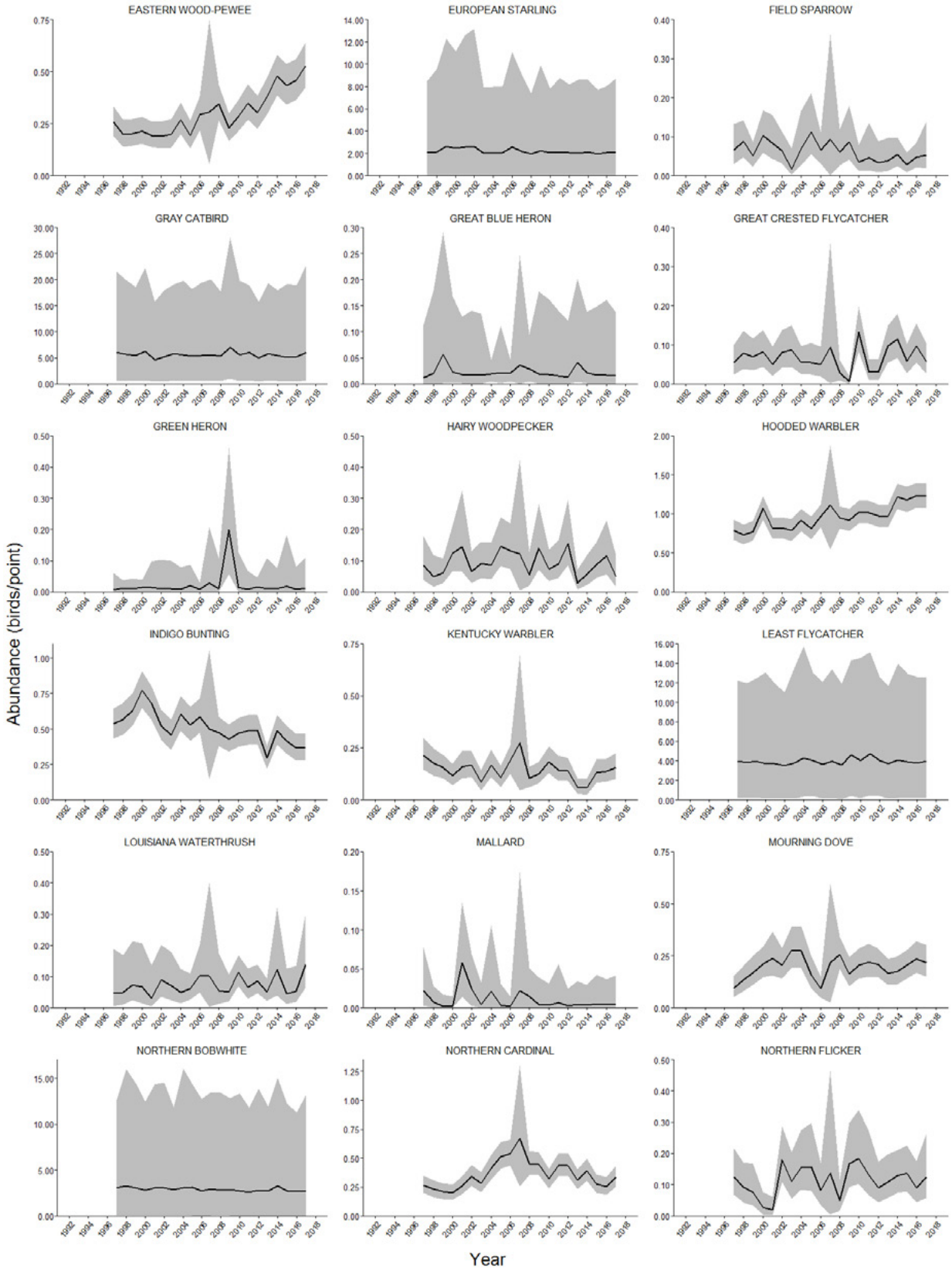
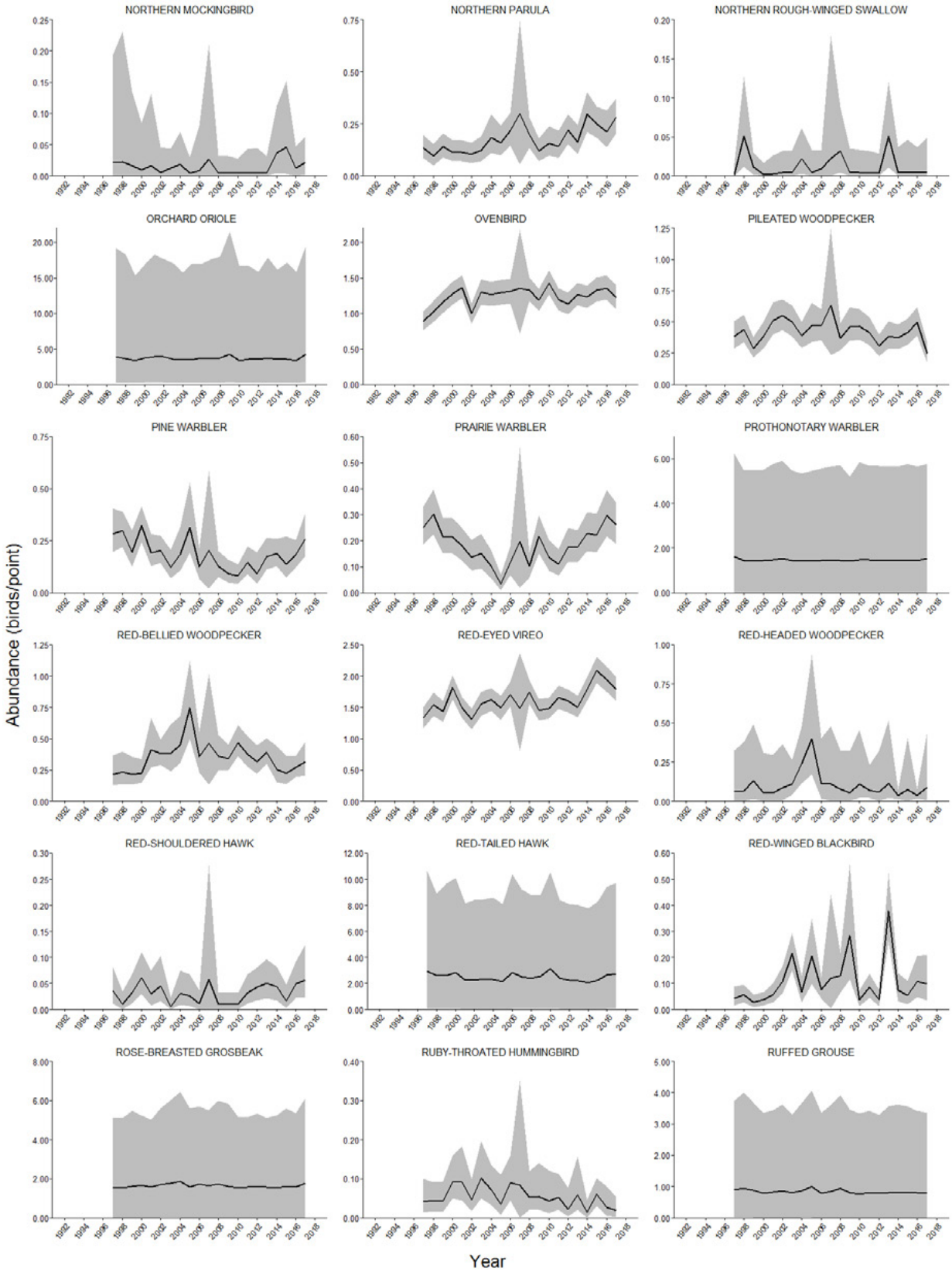


Figure 10 (page 3 of 5)



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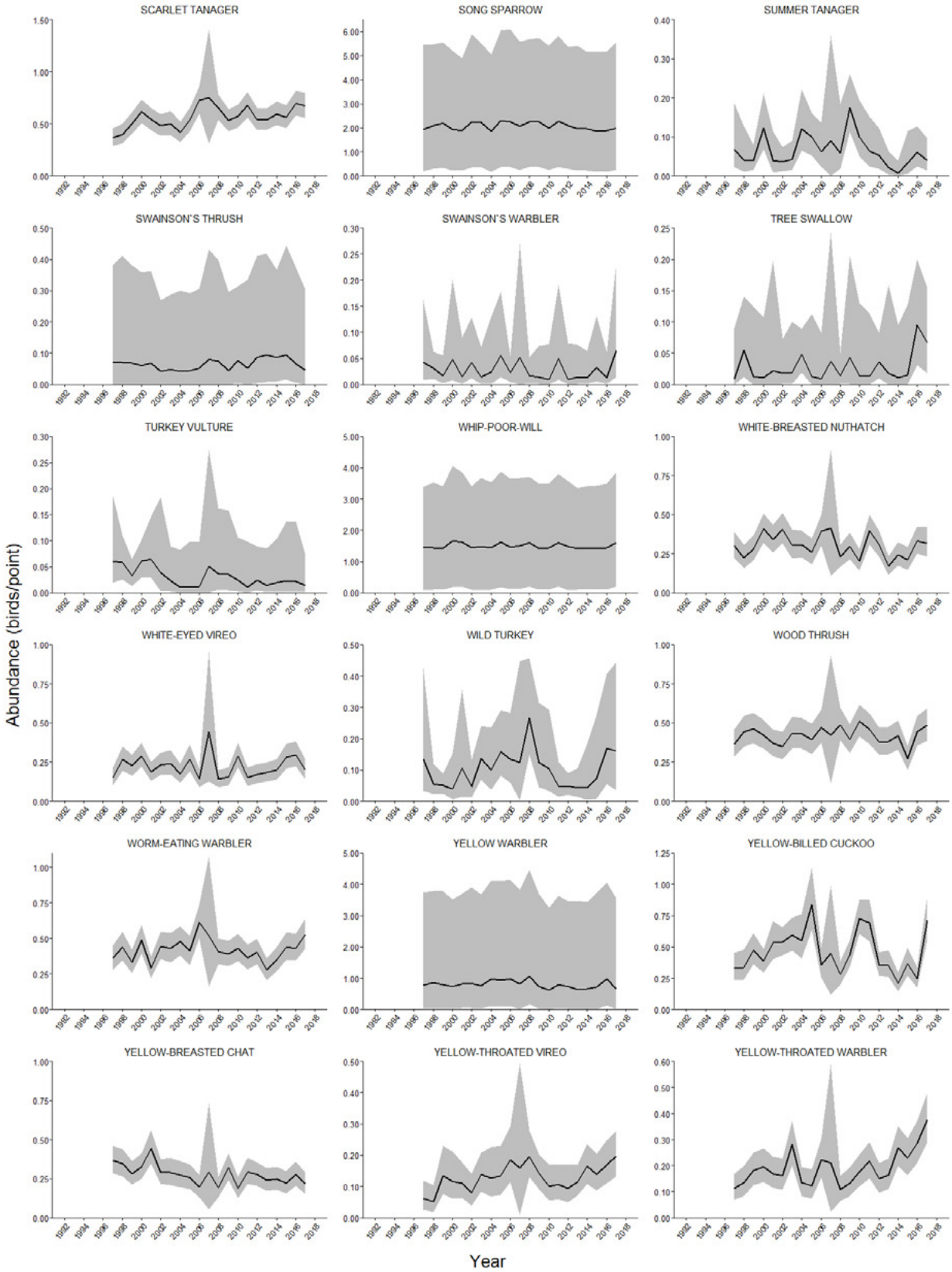

Figure 10 (page 5 of 5)

Florida National Forests

Florida National Forests completed 1,455 point counts between 1999 and 2016. The number of points surveyed ranged from 177 points in 2011 to 6 points in 2016. We estimated abundances and population trends for 66 species (Table 7). Species with the highest average abundances included great crested flycatcher (1.52 birds/point), pine warbler (1.33 birds/point), and eastern towhee (1.30 birds/point). Prairie warbler (0.03 bird/point), wood duck (0.03 bird/point), and American goldfinch (0.01 bird/point) had the lowest average abundances. Four species had significant positive trends and nine species had significant negative trends (Figs. 11, 12). Species with the highest positive annual trends were brown-headed nuthatch (9.84 percent) and red-headed woodpecker (8.70 percent). Early-successional, scrub-breeding species with positive annual trends were common yellowthroat (5.89 percent) and Carolina wren (4.54 percent). Of the species with significant negative annual trends, American crow had the greatest negative trend (-12.95 percent). Three other woodland-breeding species also had substantial negative trends: yellow-throated vireo (-10.80 percent), eastern tufted titmouse (-10.56 percent), and northern parula (-10.16 percent). Other woodland-breeding species such as summer tanager and Bachman's sparrow showed declines of about 8 percent per year. Two species with high average abundances also declined: pine warbler (-8.05 percent) and great crested flycatcher (-2.79 percent). Linear trends were in the same direction but smaller than annual trends, except for mourning dove (Fig. 11).

Table 7.—Number of detections, annual trend, linear trend, 95-percent credible interval defined by LCI and UCI, and average abundance for 66 bird species in Florida National Forests, 1999–2016; caution should be used in interpreting species abundances marked with Δ because they are based on fewer than 50 detections or had wide credible intervals and may be inaccurate or imprecise

		Annual trend			Linear trend			
Species name	Detections	Trend	LCI	UCI	Trend	LCI	UCI	Abundance (birds/point)
		percent						
Acadian flycatcher	63	1.02	-15.50	33.30	-3.15	-7.58	1.28	0.08
American crow	480	-12.95	-21.11	-7.72	-6.75	-14.45	0.94	0.62
American goldfinch	9	-6.44	-73.91	438.57	-3.36	-14.69	7.97	0.01 Δ
American kestrel	13	-1.04	-9.41	5.14	-0.03	-0.69	0.63	1.90 Δ
American redstart	3	-0.10	-11.01	12.45	-0.13	-0.41	0.16	7.27 Δ
Bachman's sparrow	987	-7.76	-11.48	-4.71	-5.61	-9.49	-1.73	0.76
Barn swallow	32	7.24	-19.62	108.78	0.97	-2.20	4.15	0.08 Δ
Barred owl	14	0.07	-10.24	15.66	-0.29	-0.99	0.41	1.89 Δ
Blue grosbeak	60	8.22	-16.93	94.02	0.29	-5.76	6.33	0.08 Δ
Blue jay	527	-2.82	-8.53	2.24	-2.96	-6.87	0.96	0.44
Blue-gray gnatcatcher	306	-4.51	-10.95	1.43	-2.28	-6.44	1.87	0.28
Brown thrasher	232	-4.05	-12.03	3.63	2.08	-1.88	6.04	0.18
Brown-headed cowbird	120	-4.54	-14.69	5.15	-5.16	-9.83	-0.49	0.14
Brown-headed nuthatch	517	9.84	1.45	23.72	2.88	-2.61	8.38	0.39
Carolina chickadee	177	-0.01	-12.18	14.98	-5.14	-12.98	2.70	0.14
Carolina wren	1,698	4.54	1.33	8.32	2.41	0.56	4.26	1.25
Chimney swift	30	3.00	-24.19	79.89	-3.81	-10.51	2.88	0.05 Δ
Chuck-will's-widow	24	0.21	-30.39	58.92	-2.19	-7.99	3.61	0.07 Δ
Common grackle	169	3.56	-10.13	29.72	4.30	-0.61	9.22	0.17
Common ground-dove	7	0.20	-15.18	33.30	0.17	-0.09	0.44	4.02 Δ
Common nighthawk	114	-8.44	-20.18	1.14	-3.38	-9.79	3.03	0.09

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(Table 7 continued)

Species name	Detections	Annual trend			Linear trend			Abundance (birds/point)
		Trend	LCI	UCI	Trend	LCI	UCI	
		percent						
Common yellowthroat	1,157	5.89	1.99	10.49	3.29	1.05	5.53	0.84
Downy woodpecker	159	0.08	-8.45	10.46	1.72	-2.73	6.18	0.13
Eastern bluebird	112	7.85	-8.77	42.59	0.70	-6.66	8.05	0.10
Eastern kingbird	33	2.79	-17.58	56.19	-2.48	-6.26	1.29	0.13 Δ
Eastern meadowlark	149	1.42	-11.84	25.27	-0.05	-5.26	5.16	0.14
Eastern towhee	1,759	-2.40	-4.83	0.07	-3.20	-7.48	1.08	1.30
Eastern tufted titmouse	681	-10.56	-16.66	-6.37	-2.64	-9.56	4.28	0.75
Eastern wood-pewee	67	2.99	-14.47	38.99	-4.01	-10.75	2.73	0.08
Gray catbird	29	2.73	-23.55	85.75	0.28	-4.94	5.50	0.09 Δ
Great blue heron	9	-0.12	-6.70	7.41	-0.20	-0.67	0.27	2.79 Δ
Great crested flycatcher	2,071	-2.79	-5.13	-0.51	-2.42	-4.23	-0.62	1.52
Great egret	20	-0.73	-25.68	31.90	-0.67	-1.44	0.09	1.12 Δ
Great horned owl	6	-1.06	-26.60	6.67	-0.23	-0.68	0.23	1.83 Δ
Hairy woodpecker	18	-1.35	-28.08	8.21	-0.04	-0.59	0.51	1.60 Δ
Hooded warbler	93	13.28	-0.50	46.40	4.45	0.64	8.26	0.08
Indigo bunting	25	-2.22	-28.15	60.84	-4.40	-12.00	3.20	0.04 Δ
Little blue heron	5	0.11	-24.25	95.91	0.06	-0.30	0.42	1.27 Δ
Mourning dove	804	-5.39	-10.04	-1.41	0.34	-4.08	4.77	0.57
Northern bobwhite	417	-3.82	-11.22	3.22	-3.21	-8.43	2.01	0.33
Northern cardinal	1,197	-0.04	-3.29	3.44	-0.63	-2.81	1.55	0.91
Northern flicker	88	-3.26	-17.83	12.96	-3.91	-10.90	3.08	0.10
Northern mockingbird	83	5.61	-12.27	43.54	-0.73	-7.32	5.86	0.07
Northern parula	311	-10.16	-17.25	-4.98	-0.05	-6.24	6.14	0.26
Pileated woodpecker	450	1.55	-4.04	8.49	2.87	0.41	5.33	0.36
Pine warbler	1,656	-8.05	-11.46	-5.40	-4.47	-7.95	-0.99	1.33
Prairie warbler	25	-1.43	-64.84	252.85	-2.31	-9.55	4.94	0.03 Δ
Purple martin	8	-4.98	-61.59	191.80	-3.82	-8.02	0.38	0.04 Δ
Red-bellied woodpecker	1,796	-0.41	-3.00	2.27	1.24	-0.67	3.15	1.29
Red-cockaded woodpecker	255	5.98	-5.00	23.24	0.74	-2.85	4.34	0.18
Red-eyed vireo	67	-6.34	-20.74	6.69	-3.42	-8.57	1.74	0.07
Red-headed woodpecker	620	8.70	0.23	22.52	3.05	-2.62	8.72	0.49
Red-shouldered hawk	83	-2.06	-15.20	13.46	-0.36	-4.58	3.87	0.09
Red-tailed hawk	7	-0.10	-7.33	8.09	-0.05	-0.69	0.59	3.20 Δ
Red-winged blackbird	44	-3.11	-22.12	37.48	2.91	-4.50	10.33	0.10 Δ
Sandhill crane	65	-8.52	-23.54	1.63	3.84	-1.73	9.41	0.09 Δ
Summer tanager	378	-8.40	-14.78	-3.02	-3.23	-8.76	2.29	0.37
Swallow-tailed kite	10	-0.32	-14.62	12.00	-0.05	-0.60	0.50	2.20 Δ
Turkey vulture	31	1.59	-17.96	46.33	-0.23	-3.82	3.36	0.07 Δ
White-eyed vireo	376	-3.28	-8.99	2.48	0.33	-2.80	3.45	0.27
Wild turkey	39	0.89	-5.46	15.06	0.86	-0.04	1.75	1.78 Δ
Wood duck	11	-2.05	-63.28	232.53	1.12	-1.43	3.68	0.03 Δ
Yellow-billed cuckoo	228	4.71	-4.85	20.60	-1.71	-6.30	2.88	0.24
Yellow-breasted chat	7	3.66	-39.89	324.01	0.14	-1.25	1.52	0.15 Δ
Yellow-throated vireo	158	-10.80	-17.22	-4.80	-2.15	-9.40	5.10	0.26
Yellow-throated warbler	41	-7.11	-34.91	47.16	-6.52	-13.37	0.33	0.05 Δ

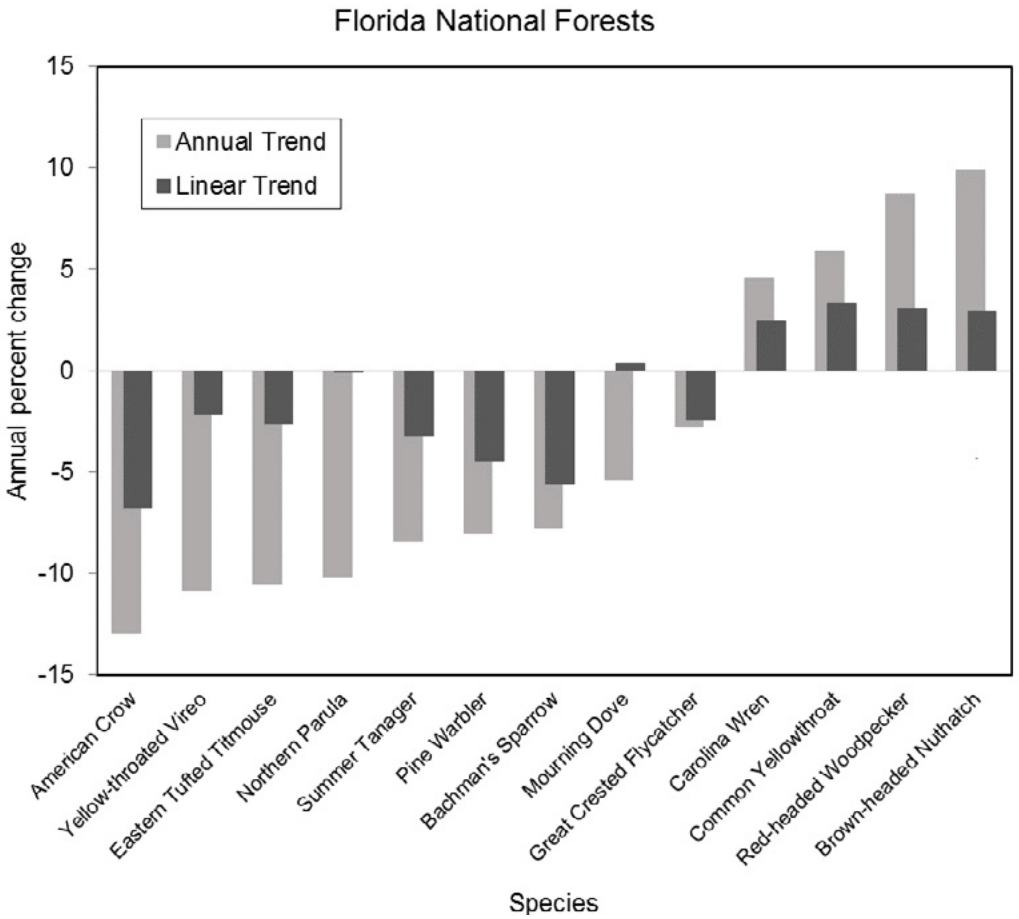

Figure 11.—Significant (based on 95-percent credible interval) positive and negative annual and linear trends for bird species in Florida National Forests, 1999–2016.

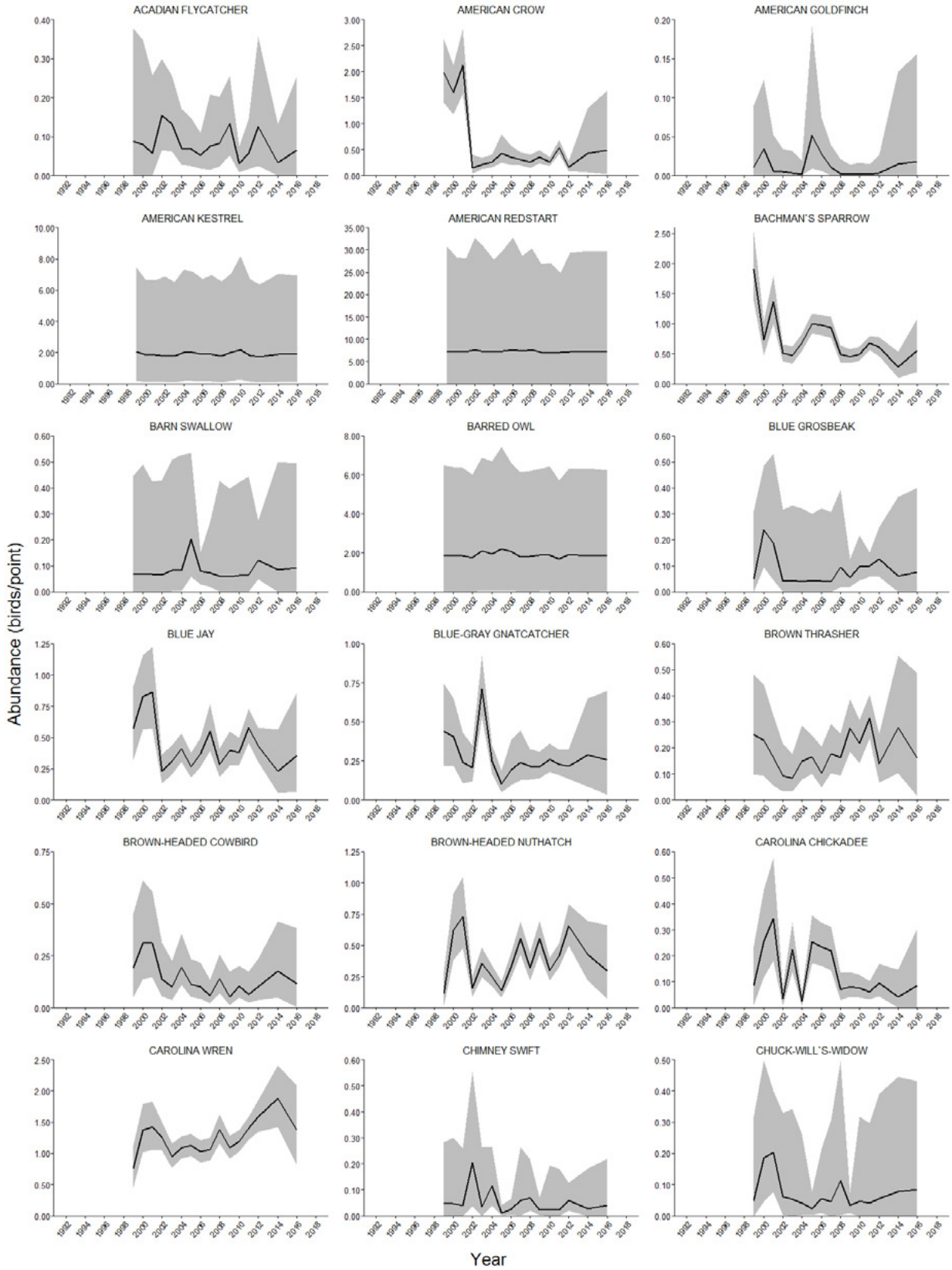

Figure 12. (page 1 of 4)—Estimated abundances and 95-percent credible intervals (shaded areas) for 66 bird species in Florida National Forests, by year. The scale of the abundance axes may vary among species to best illustrate patterns in abundance.

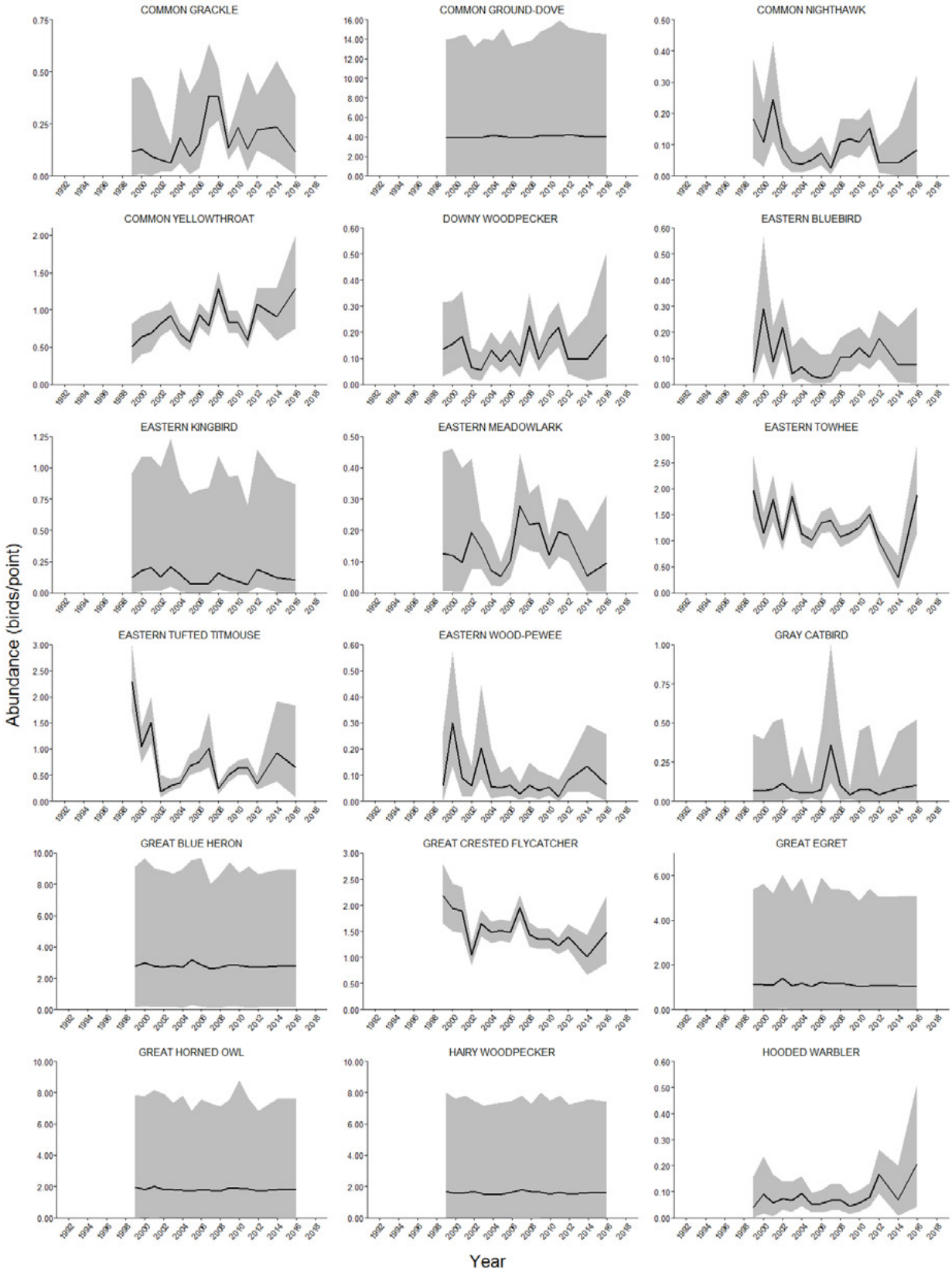

Figure 12 (page 2 of 4)

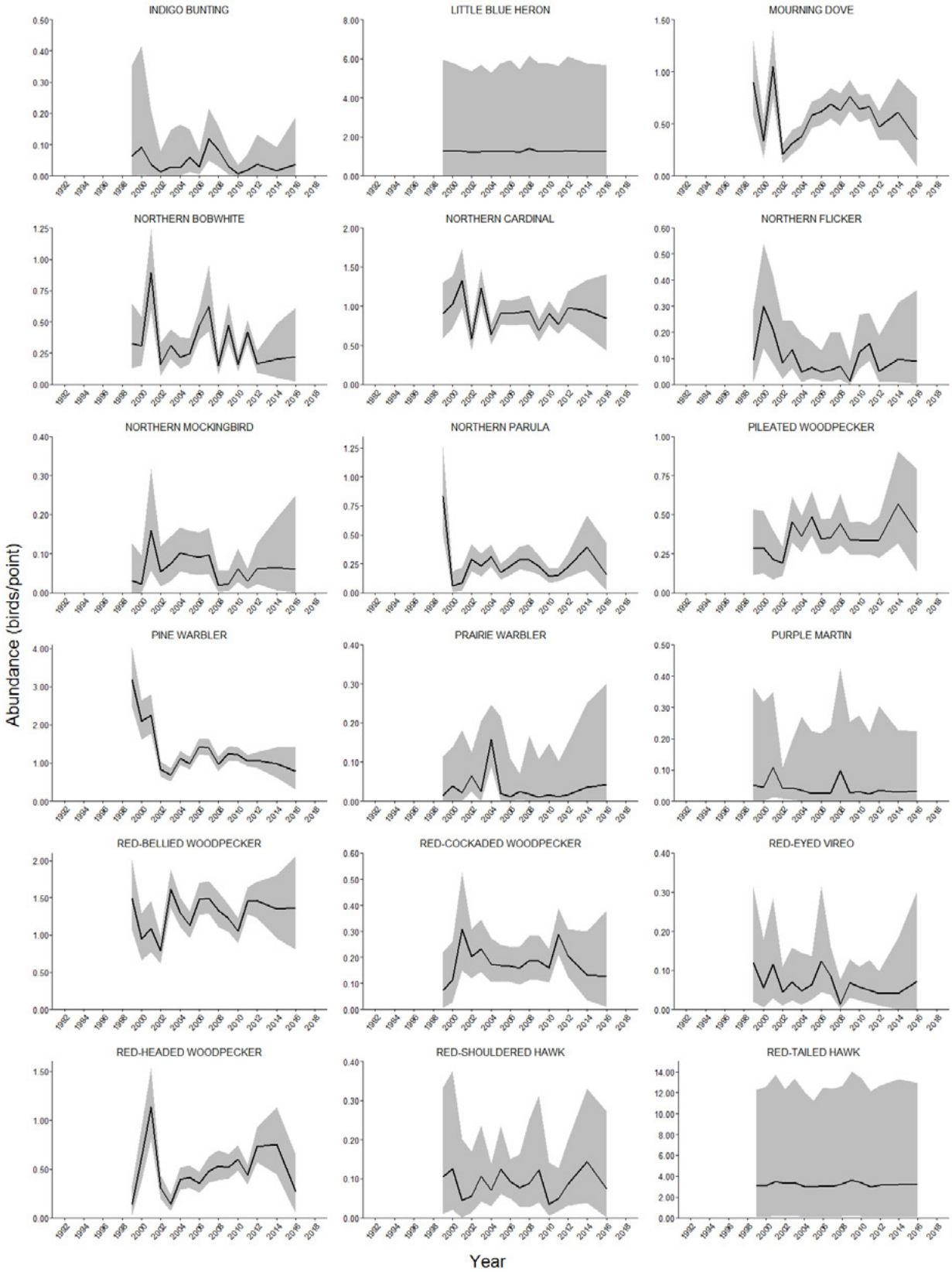

Figure 12 (page 3 of 4)

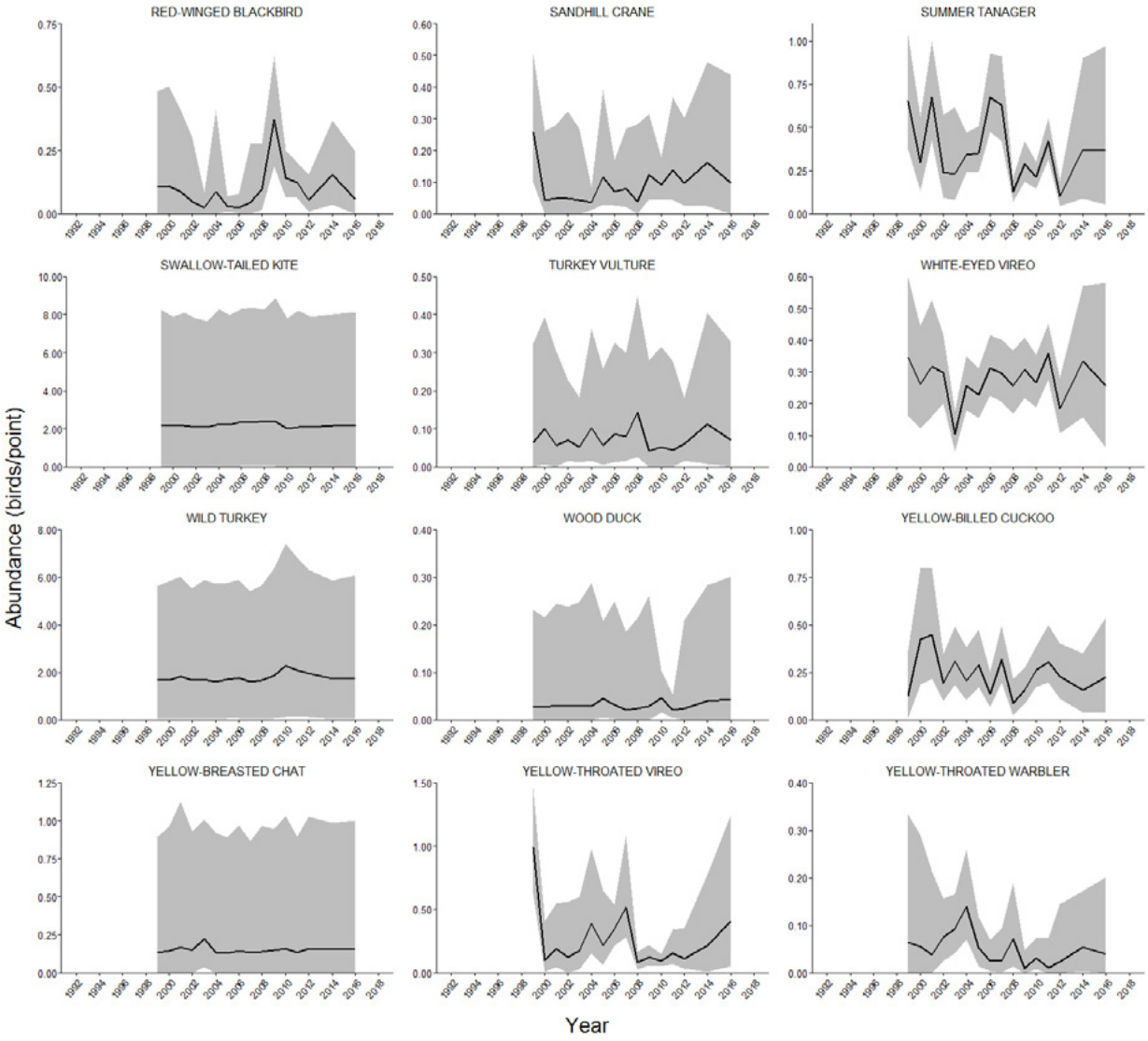

Figure 12 (page 4 of 4)

Francis Marion and Sumter National Forests

Francis Marion and Sumter National Forests completed 5,939 point counts between 1993 and 2017. The number of points surveyed ranged from 330 in 2007 to 56 in 2006, excluding the 1 point surveyed in 1993. We estimated abundances and population trends for 104 species (Table 8). Red-eyed vireo (1.19 birds/point), American crow (1.10 birds/point), and northern cardinal (1.07 birds/point) had the highest average abundances. White ibis (0.01 bird/point), eastern screech-owl (0.01 bird/point), and common nighthawk (0.01 bird/point) had the lowest average abundances. More species had negative than positive annual trends, but only three species had significant annual trends (Figs. 13, 14). Blue-headed vireo was the only species with a significant positive annual trend (6.86 percent), and white-eyed vireo (-7.63) and Acadian flycatcher (-4.59 percent) had significant negative annual trends. Linear trends were in the same direction but smaller than annual trends (Fig. 13).

Table 8.—Number of detections, annual trend, linear trend, 95-percent credible interval defined by LCI and UCI, and average abundance for 104 bird species in Francis Marion and Sumter National Forests, 1993–2017; caution should be used in interpreting species abundances marked with Δ because they are based on fewer than 50 detections or had wide credible intervals and may be inaccurate or imprecise

		Annual trend			Linear trend			
Species name	Detections	Trend	LCI	UCI	Trend	LCI	UCI	Abundance (birds/point)
		percent						
Acadian flycatcher	1,852	-4.59	-7.86	-0.55	-1.66	-2.95	-0.38	0.33
American crow	6,332	-2.04	-4.72	1.10	-4.15	-5.31	-3.00	1.10
American goldfinch	704	-1.62	-6.85	6.61	-1.07	-3.17	1.03	0.27
American redstart	87	0.27	-9.98	24.47	-1.23	-3.47	1.02	0.05 Δ
American robin	42	-0.07	-4.42	4.74	-0.65	-1.16	-0.15	2.27 Δ
Bachman's sparrow	283	-9.33	-25.19	10.48	-3.95	-7.43	-0.48	0.05
Barn swallow	51	3.25	-11.00	54.73	-0.10	-3.73	3.52	0.03 Δ
Barred owl	108	-2.81	-25.33	13.69	-0.63	-1.53	0.26	0.72 Δ
Belted kingfisher	19	0.20	-3.79	4.97	-0.33	-0.60	-0.05	2.54 Δ
Black vulture	76	6.06	-8.37	66.57	-1.48	-6.69	3.73	0.02 Δ
Black-and-white warbler	725	4.35	-0.97	13.73	2.25	-0.71	5.21	0.22
Black-throated blue warbler	108	1.00	-9.35	28.92	-3.27	-6.51	-0.03	0.06
Black-throated green warbler	850	1.58	-4.01	10.83	2.88	1.26	4.51	0.18
Blue grosbeak	339	-2.50	-10.92	13.73	1.42	-1.41	4.24	0.06
Blue jay	3,118	0.73	-2.49	4.85	-0.15	-1.06	0.77	0.66
Blue-gray gnatcatcher	2,110	-1.34	-4.85	3.55	-0.74	-1.84	0.36	0.38
Blue-headed vireo	530	6.86	0.09	20.88	6.01	3.45	8.57	0.11
Blue-winged warbler	83	-6.66	-36.34	34.15	-1.93	-5.36	1.49	0.04 Δ
Broad-winged hawk	41	-0.43	-5.58	4.26	-0.08	-0.59	0.44	3.65 Δ
Brown thrasher	336	0.79	-6.81	17.05	-1.42	-3.76	0.91	0.07
Brown-headed cowbird	667	-1.81	-7.42	7.50	0.39	-1.32	2.10	0.18
Brown-headed nuthatch	923	-1.01	-6.45	8.40	3.50	1.36	5.63	0.18
Canada goose	226	-0.17	-6.90	12.76	0.45	-2.96	3.86	0.13
Carolina chickadee	2,172	-1.16	-4.70	3.47	0.16	-1.33	1.64	0.41
Carolina wren	4,662	-2.39	-4.84	0.64	0.52	-0.77	1.82	0.86
Cedar waxwing	90	14.05	-5.92	182.67	-2.01	-8.35	4.34	0.10 Δ
Chimney swift	283	1.09	-7.93	20.17	-4.03	-7.11	-0.95	0.06
Chipping sparrow	274	4.36	-3.82	25.55	8.60	5.16	12.04	0.08

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(Table 8 continued)

Species name	Detections	Annual trend			Linear trend			Abundance (birds/point)
		Trend	LCI	UCI	Trend	LCI	UCI	
		percent						
Chuck-will's-widow	33	-1.15	-15.84	44.42	-0.17	-3.13	2.80	0.03 Δ
Common grackle	438	-1.04	-9.05	12.20	-3.76	-5.72	-1.79	0.12
Common nighthawk	12	-9.23	-81.79	329.22	-3.48	-7.50	0.54	0.01 Δ
Common yellowthroat	2,531	-3.56	-7.69	2.00	-2.16	-4.35	0.03	0.44
Cooper's hawk	10	-0.13	-5.66	5.13	-0.04	-0.41	0.34	1.62 Δ
Downy woodpecker	694	-2.38	-8.65	7.72	-0.76	-2.72	1.21	0.14
Eastern bluebird	463	-1.66	-8.96	12.42	-1.51	-4.55	1.54	0.09
Eastern kingbird	156	0.01	-7.98	17.32	-2.42	-4.96	0.13	0.08
Eastern meadowlark	20	3.64	-15.75	118.48	-1.05	-3.68	1.58	0.02 Δ
Eastern phoebe	133	0.17	-10.40	29.00	-5.93	-9.82	-2.04	0.03
Eastern screech-owl	11	-8.03	-71.74	189.99	-1.18	-4.98	2.61	0.01 Δ
Eastern towhee	5,037	-2.46	-5.28	1.20	-1.78	-2.87	-0.70	0.86
Eastern tufted titmouse	5,453	-0.23	-2.63	2.61	1.29	0.41	2.17	1.01
Eastern wood-pewee	1,179	1.33	-3.48	9.15	1.97	0.34	3.59	0.23
Field sparrow	489	1.50	-5.28	15.65	-4.53	-8.04	-1.03	0.12
Fish crow	246	-4.20	-17.97	12.08	-0.87	-3.89	2.14	0.10
Grasshopper sparrow	9	-0.30	-44.24	53.53	-0.26	-0.57	0.05	1.15 Δ
Gray catbird	188	-9.24	-28.62	15.92	-7.88	-10.29	-5.48	0.04
Great blue heron	74	2.60	-10.74	45.12	-4.67	-8.54	-0.80	0.02 Δ
Great crested flycatcher	4,160	-3.26	-6.12	0.18	-0.40	-1.72	0.92	0.74
Great egret	10	-1.32	-37.93	50.54	-1.45	-3.67	0.78	0.06 Δ
Great horned owl	15	-0.21	-9.36	7.39	-0.19	-0.61	0.23	1.36 Δ
Hairy woodpecker	277	-4.51	-15.20	15.23	-7.52	-10.59	-4.46	0.06
Hermit thrush	13	-6.59	-58.14	105.63	-5.78	-9.59	-1.97	0.04 Δ
Hooded warbler	2,785	-0.83	-4.50	4.30	-0.09	-2.28	2.09	0.49
Indigo bunting	3,185	-0.67	-3.92	3.76	-1.86	-3.01	-0.72	0.61
Kentucky warbler	339	-3.30	-12.23	14.02	-2.07	-5.54	1.41	0.06
Killdeer	22	-0.24	-6.70	4.96	-0.21	-0.66	0.24	2.37 Δ
Laughing gull	157	-4.34	-29.11	25.78	-4.45	-8.96	0.05	0.07
Little blue heron	16	-0.77	-34.32	52.36	0.85	-1.61	3.32	0.05 Δ
Louisiana waterthrush	177	0.07	-9.08	21.79	5.52	2.46	8.58	0.06
Mississippi kite	11	-0.63	-67.21	196.32	-0.26	-5.45	4.94	0.01 Δ
Mourning dove	2,496	-2.32	-6.06	2.66	-1.61	-2.63	-0.60	0.46
Northern bobwhite	1,381	-2.38	-7.38	5.04	-3.85	-5.84	-1.86	0.25
Northern cardinal	5,968	-1.20	-3.56	1.77	-0.90	-1.60	-0.19	1.07
Northern flicker	783	-0.04	-5.98	11.09	-5.66	-7.66	-3.67	0.15
Northern mockingbird	120	4.89	-5.09	34.19	0.38	-2.76	3.52	0.03
Northern parula	2,234	-3.36	-6.43	0.51	0.25	-1.50	2.00	0.40

(continued on next page)

(Table 8 continued)

Species name	Detections	Annual trend			Linear trend			Abundance (birds/point)
		Trend	LCI	UCI	Trend	LCI	UCI	
		percent						
Orchard oriole	114	-8.31	-26.32	13.72	-2.42	-5.68	0.83	0.05
Ovenbird	1,508	1.65	-2.62	7.92	2.07	0.63	3.50	0.32
Painted bunting	8	-0.10	-21.76	20.25	-0.06	-0.40	0.28	1.18 Δ
Pileated woodpecker	3,044	-2.58	-5.77	1.42	-1.48	-2.43	-0.54	0.57
Pine warbler	5,411	-0.55	-3.09	2.54	0.73	-0.45	1.92	0.99
Prairie warbler	1,953	1.11	-3.00	7.32	-3.25	-4.84	-1.66	0.37
Prothonotary warbler	698	-4.85	-14.55	5.60	1.91	-0.80	4.63	0.21
Purple martin	207	-7.96	-24.29	12.53	-2.80	-6.17	0.56	0.06
Red-bellied woodpecker	3,539	-3.14	-6.43	1.21	-0.63	-2.14	0.88	0.64
Red-breasted nuthatch	61	8.16	-4.90	68.96	3.89	0.49	7.28	0.04 Δ
Red-cockaded woodpecker	207	-5.80	-21.77	13.88	0.37	-3.38	4.11	0.06
Red-eyed vireo	6,980	1.26	-1.06	4.07	-1.15	-2.03	-0.27	1.19
Red-headed woodpecker	972	-1.85	-7.29	6.77	-1.91	-4.08	0.26	0.20
Red-shouldered hawk	391	-1.06	-8.55	12.09	3.94	1.63	6.24	0.11
Red-tailed hawk	143	-3.36	-15.05	21.06	-8.27	-11.42	-5.12	0.05
Red-winged blackbird	39	-6.84	-43.08	49.15	-3.03	-5.69	-0.38	0.02 Δ
Ruby-crowned kinglet	8	-0.09	-6.35	6.26	-0.03	-0.31	0.25	3.56 Δ
Ruby-throated hummingbird	240	-3.92	-14.17	12.18	-2.95	-5.03	-0.87	0.08
Scarlet tanager	910	2.89	-2.27	11.48	1.01	-0.98	3.01	0.20
Song sparrow	52	-5.70	-44.02	48.80	-5.07	-7.34	-2.80	0.03 Δ
Summer tanager	1,822	-3.03	-7.51	3.08	-0.13	-1.81	1.55	0.34
Swainson's thrush	52	13.13	-6.75	207.61	-1.04	-5.25	3.17	0.03 Δ
Swainson's warbler	157	-1.22	-11.56	20.63	2.50	-0.14	5.15	0.04
Swallow-tailed kite	9	-0.16	-41.98	58.52	0.24	-0.16	0.64	0.80 Δ
Turkey vulture	188	-1.84	-14.05	22.56	-3.26	-7.09	0.56	0.05
Whip-poor-will	38	6.46	-8.40	78.78	-1.37	-4.70	1.96	0.02 Δ
White ibis	14	-1.93	-70.41	196.24	-0.73	-4.22	2.76	0.01 Δ
White-breasted nuthatch	273	-0.36	-8.79	17.22	3.16	0.05	6.26	0.06
White-eyed vireo	1,856	-7.63	-11.83	-2.86	-2.67	-4.42	-0.91	0.34
Wild turkey	220	-3.00	-11.26	12.25	-1.73	-3.89	0.44	0.09
Wood duck	48	-4.99	-33.73	31.35	-2.27	-4.80	0.25	0.04 Δ
Wood thrush	1,144	-1.84	-6.40	4.63	-3.90	-5.92	-1.88	0.19
Worm-eating warbler	754	2.51	-3.46	14.11	5.57	3.29	7.86	0.14
Yellow warbler	26	0.25	-4.92	9.31	-0.43	-0.77	-0.10	1.89 Δ
Yellow-billed cuckoo	2,498	-2.16	-5.22	1.75	-1.67	-2.96	-0.38	0.51
Yellow-breasted chat	2,818	-5.73	-10.01	0.06	-5.50	-7.14	-3.85	0.47
Yellow-throated vireo	413	2.23	-4.81	17.36	-1.25	-3.16	0.66	0.08
Yellow-throated warbler	766	0.83	-4.88	10.45	5.35	3.22	7.49	0.17

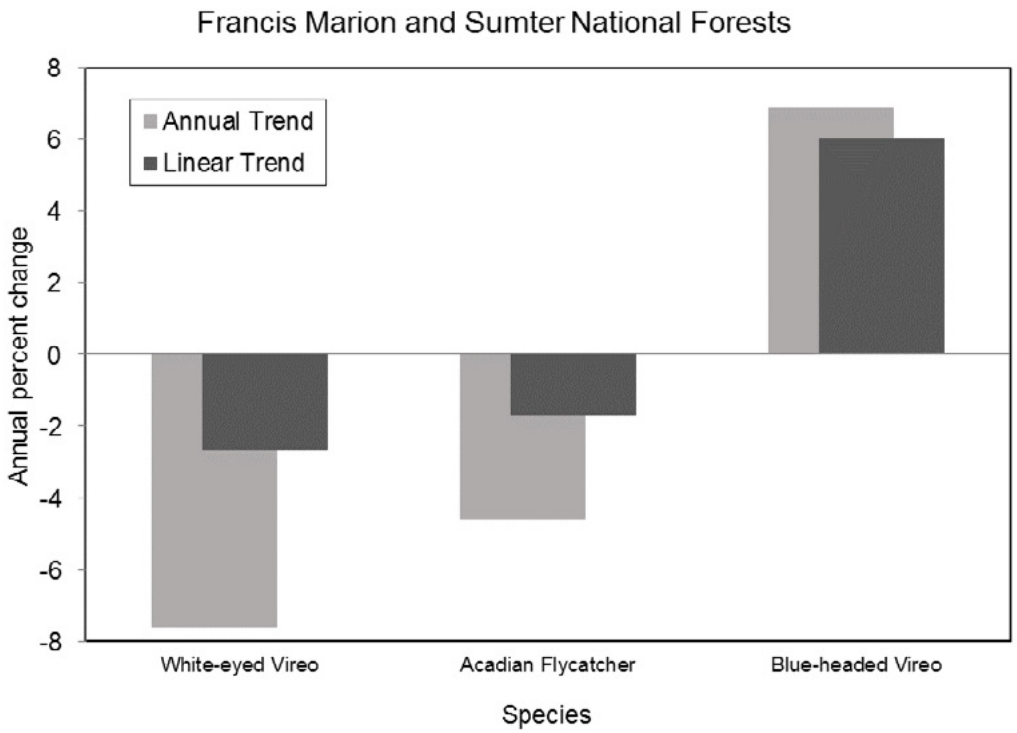


Figure 13.—Significant (based on 95-percent credible interval) positive and negative annual and linear trends for bird species in Francis Marion and Sumter National Forests, 1993–2017.

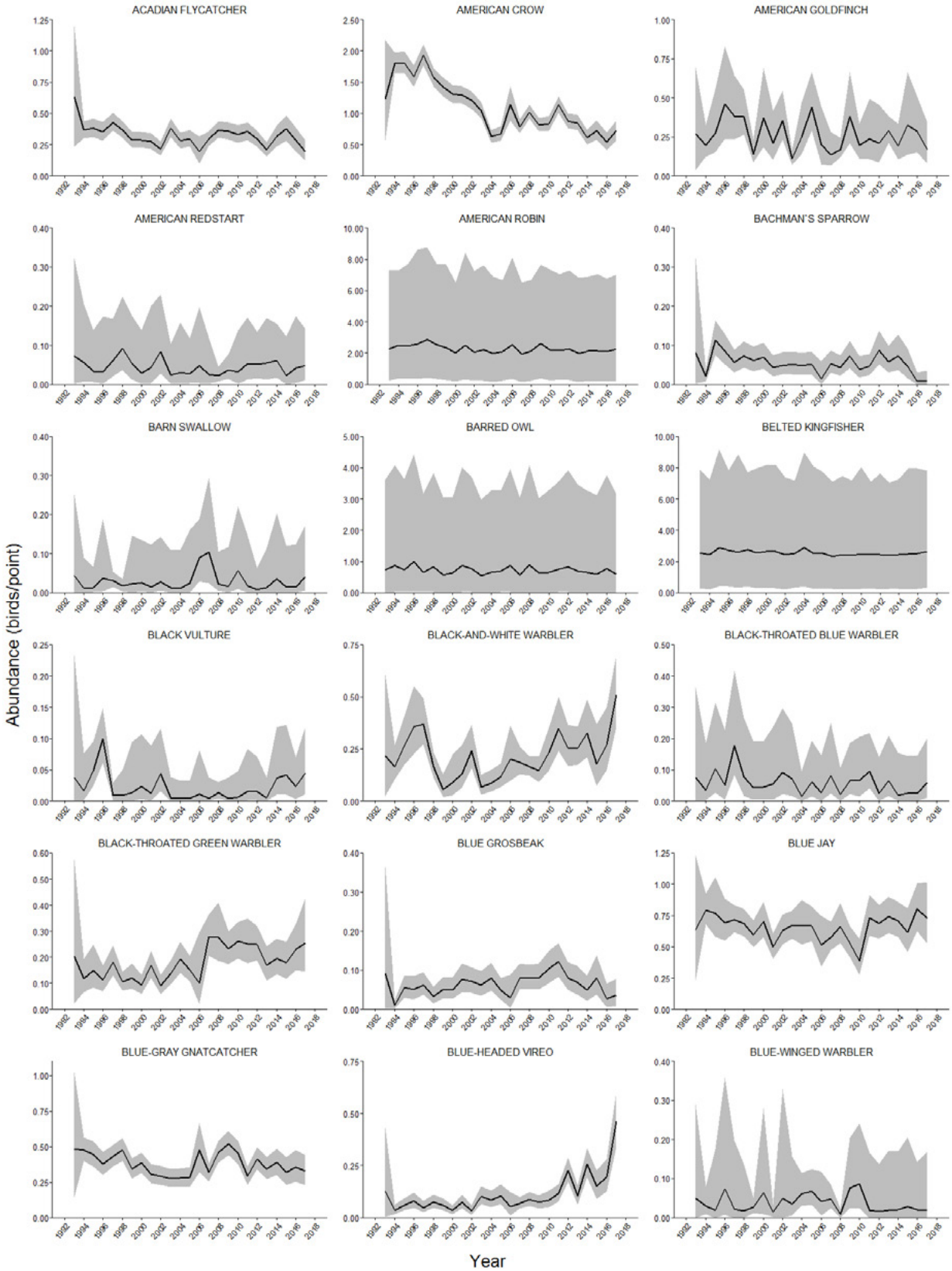


Figure 14. (page 1 of 6)—Estimated abundances and 95-percent credible intervals (shaded areas) for 104 bird species in Francis Marion and Sumter National Forests, by year. The scale of the abundance axes may vary among species to best illustrate patterns in abundance.

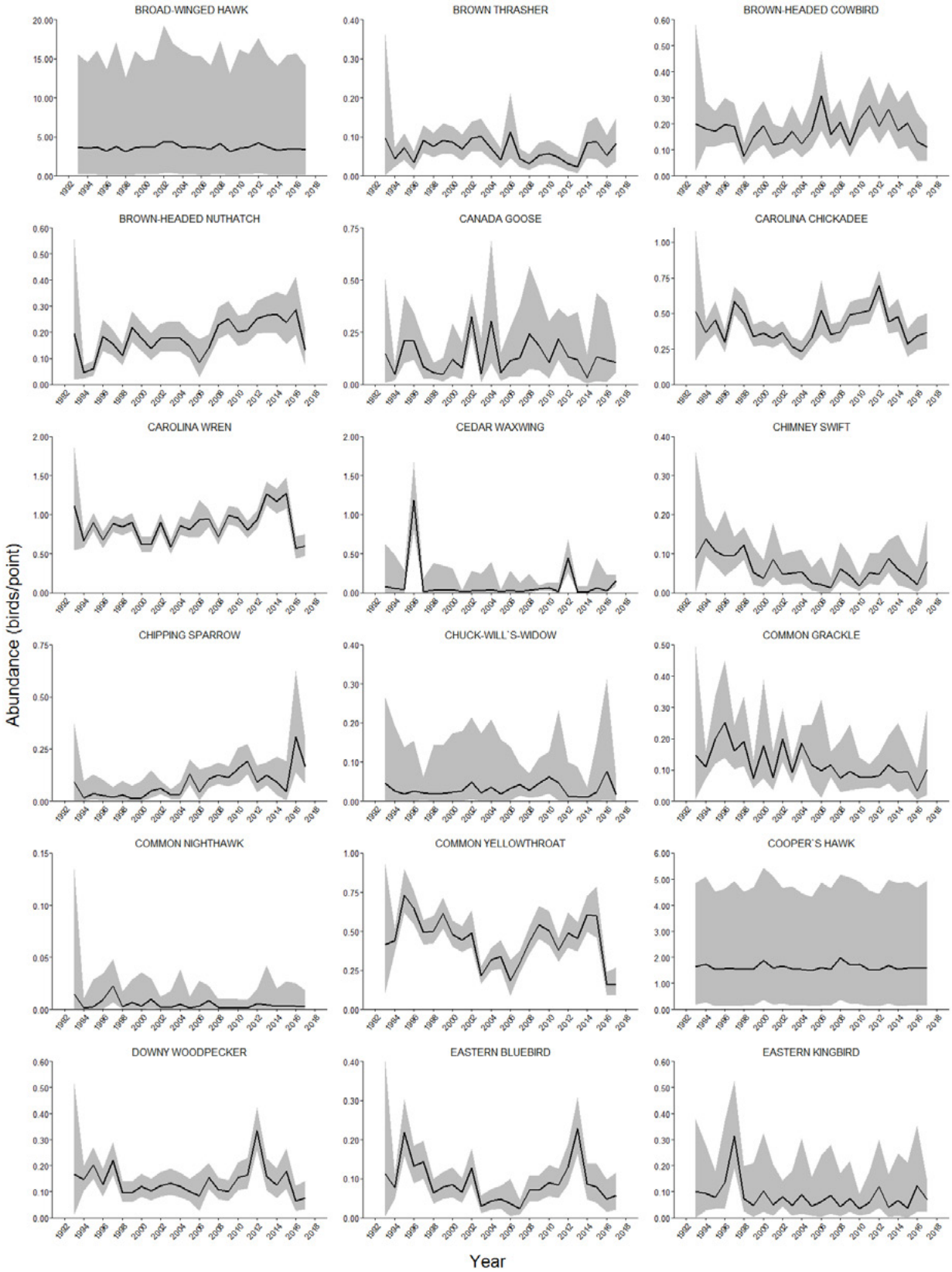


Figure 14 (page 2 of 6)

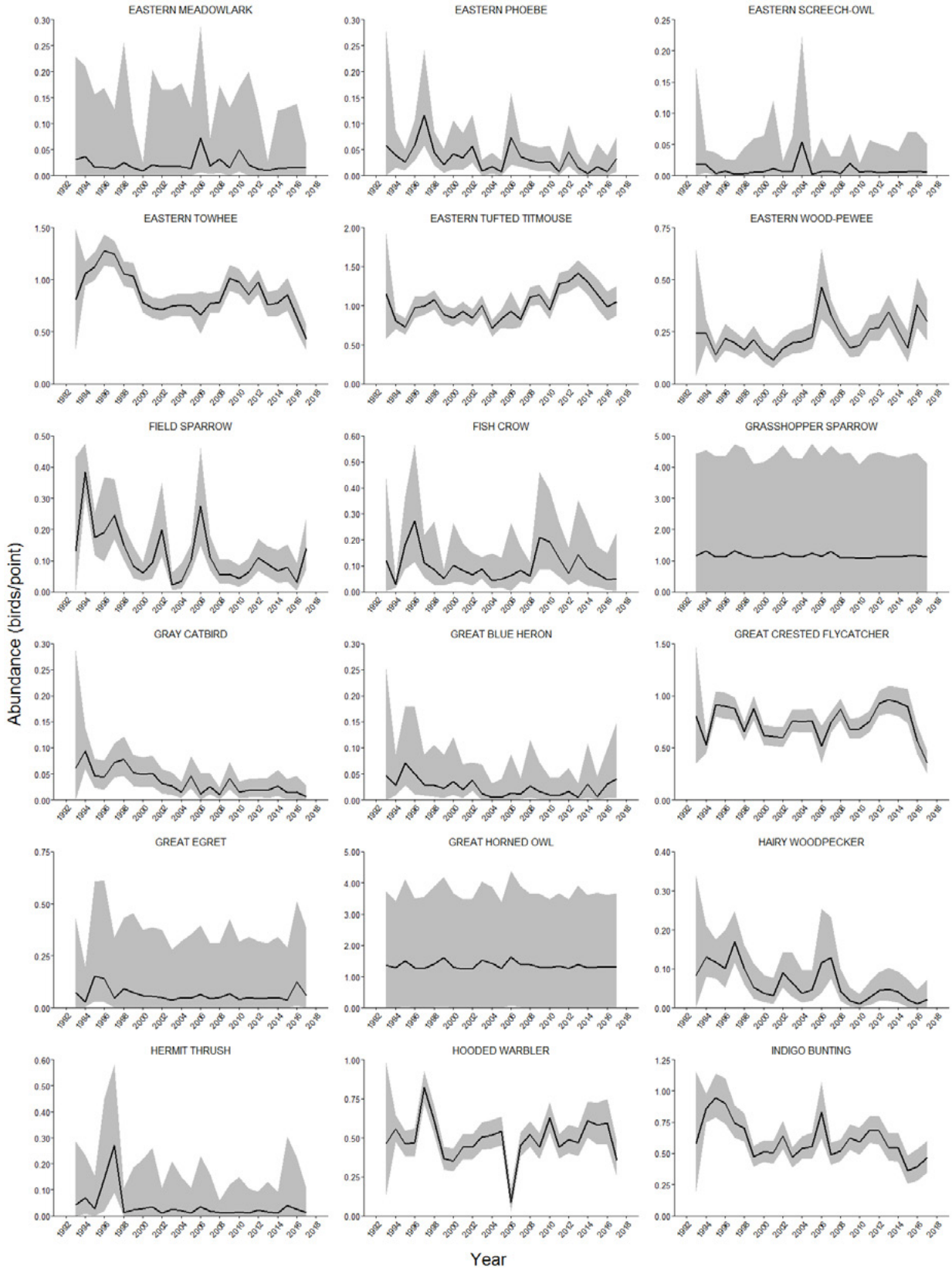
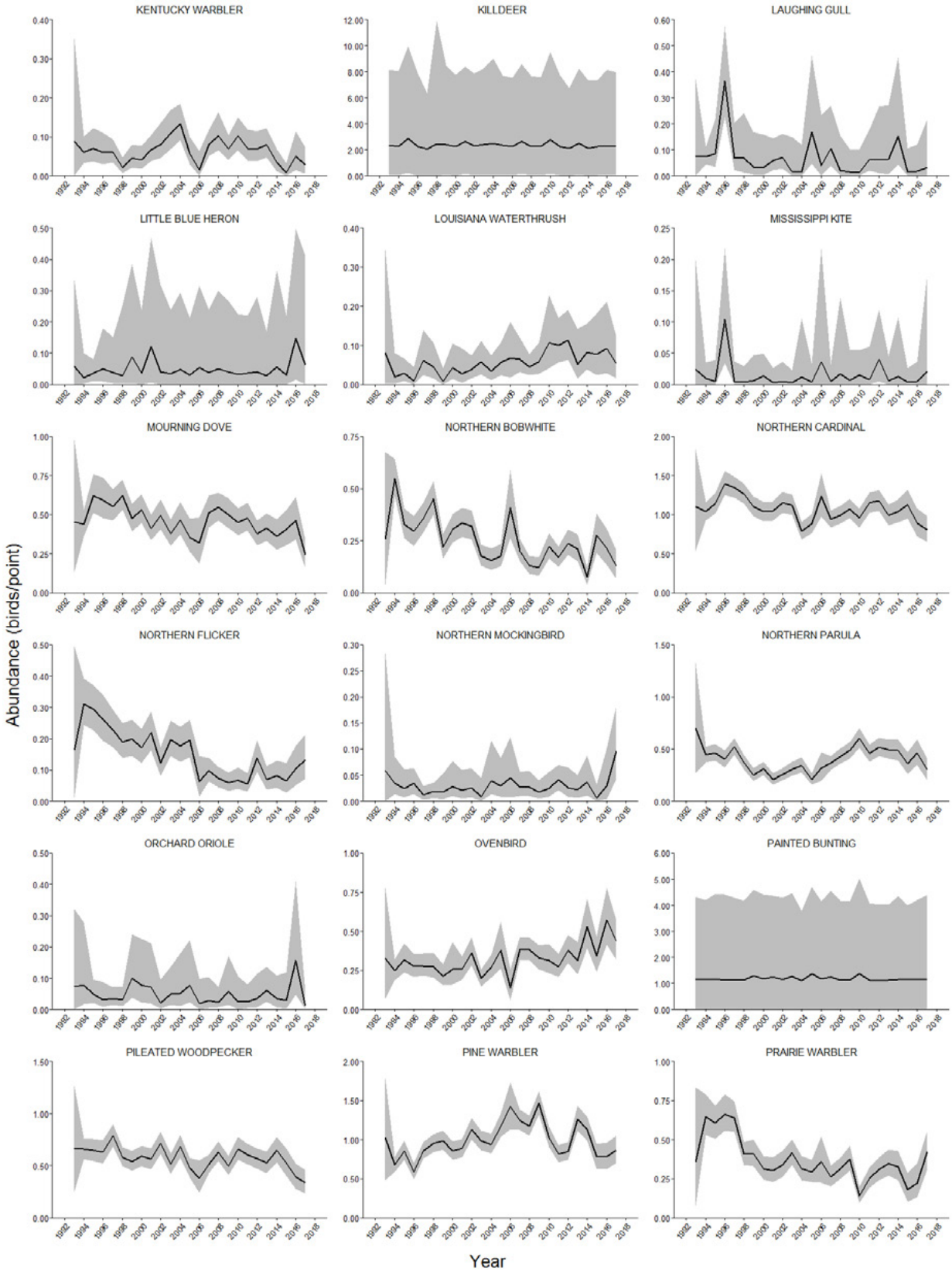


Figure 14 (page 3 of 6)



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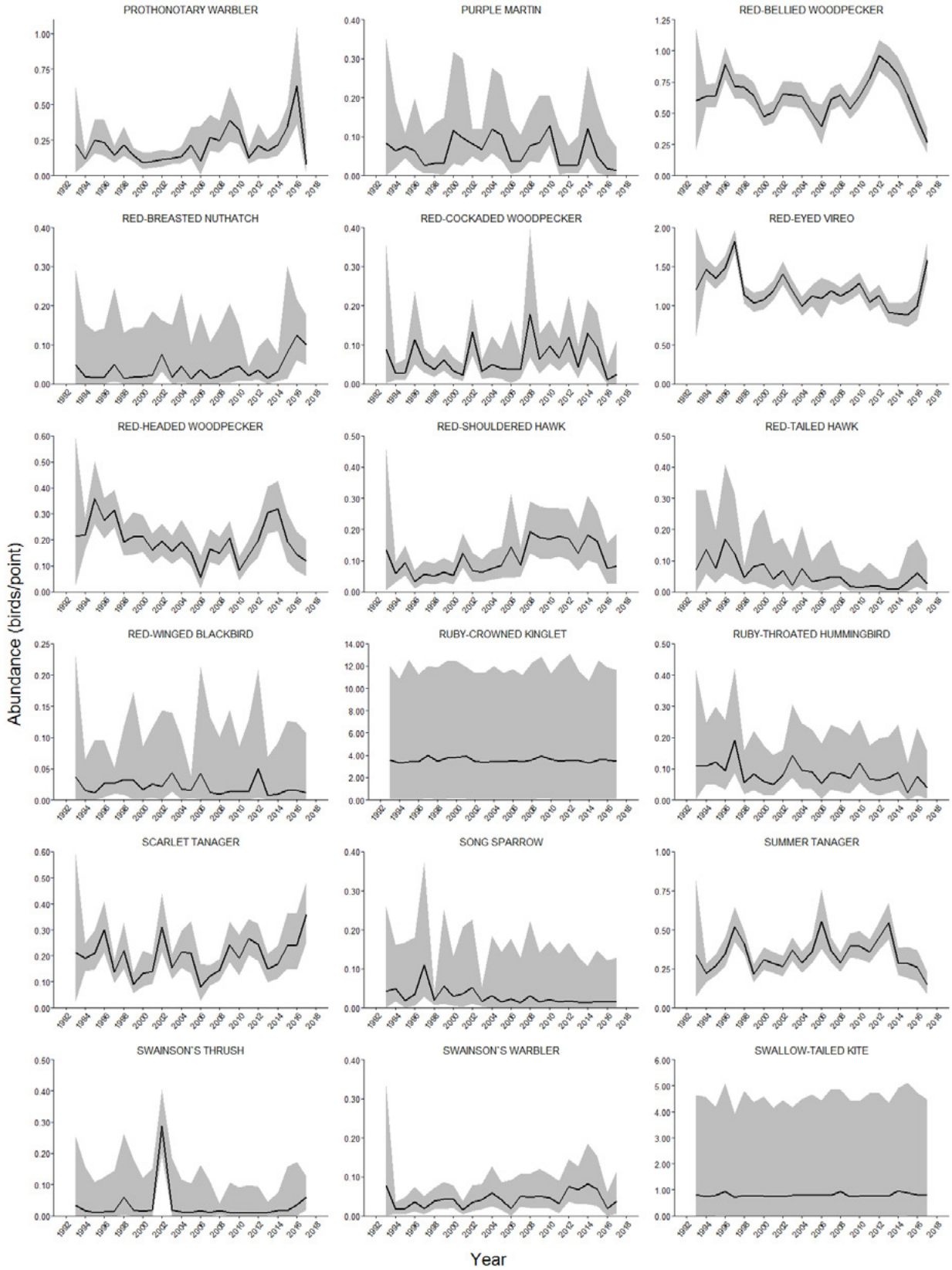

Figure 14 (page 5 of 6)

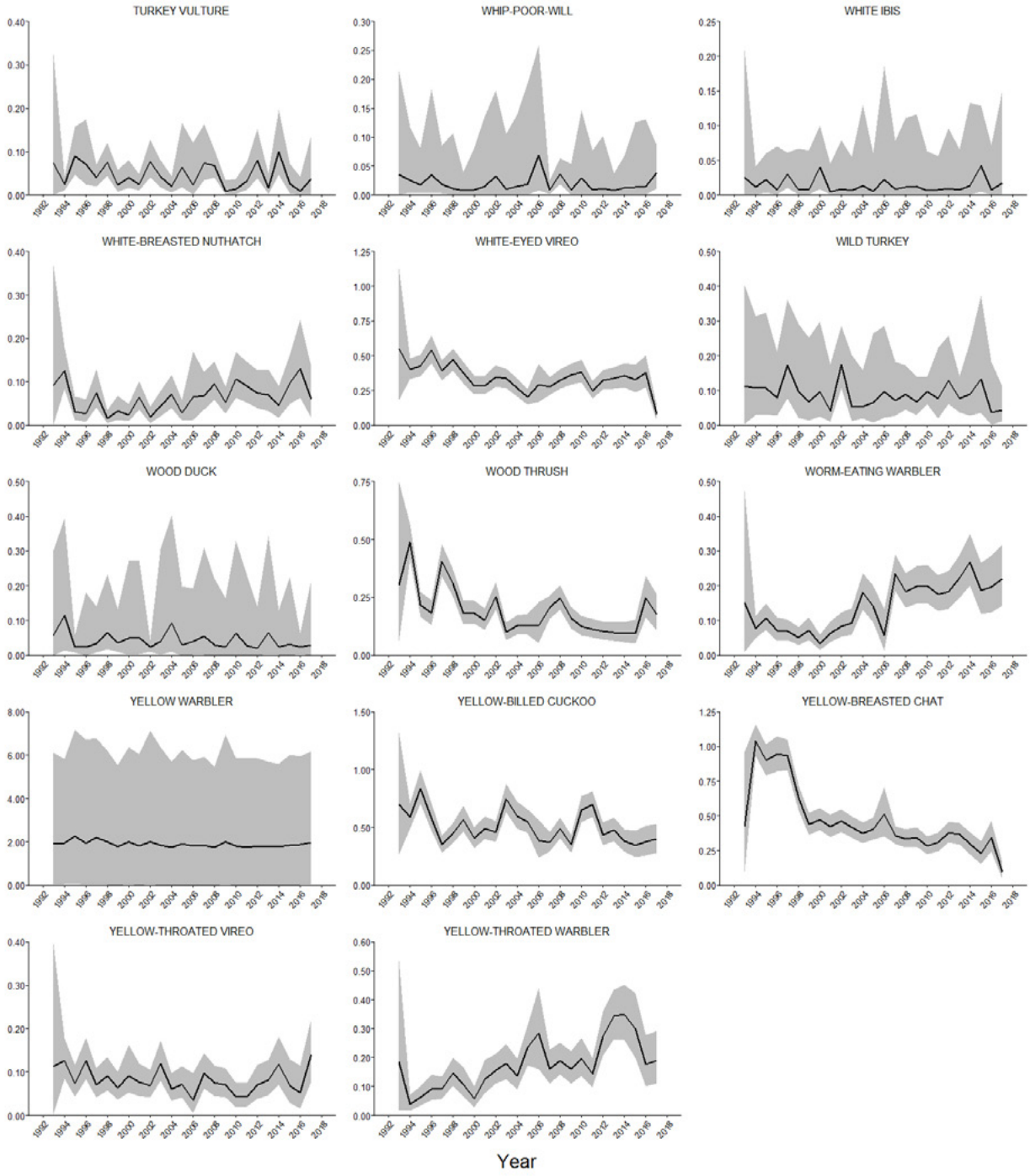

Figure 14 (page 6 of 6)

George Washington and Jefferson National Forests

George Washington and Jefferson National Forests completed 11,359 point counts between 1993 and 2017. The number of points surveyed ranged from 796 points in 2001 to 15 points in 1993. We estimated abundances and population trends for 100 species (Table 9). Red-eyed vireo had the highest average abundance (1.08 birds/point), followed by ovenbird (1.05 birds/point) and scarlet tanager (0.69 bird/point). Winter wren, red-tailed hawk, and northern rough-winged swallow, each with 0.01 bird/point, had the lowest average abundances. Overall, the same number of species had positive and negative annual trends; 11 species showed significant positive annual trends and 10 species had significant negative annual trends (Figs. 15, 16). Only woodland-breeding species had significant positive annual trends and these were Carolina chickadee (8.90 percent), American redstart (7.22 percent), blue-headed vireo (6.75 percent), veery (6.12 percent), eastern wood-pewee (6.10 percent), black-and-white warbler (5.39 percent), hooded warbler (5.00 percent), wood thrush (4.82 percent), ovenbird (4.67 percent), red-eyed vireo (4.39 percent), and scarlet tanager (3.82 percent). Several early-successional, scrub-breeding species had significant and substantial negative annual trends: northern bobwhite (23.19 percent), brown thrasher (-17.22 percent), field sparrow (-17.01 percent), gray catbird (-15.48 percent), common yellowthroat (-9.62 percent), and eastern towhee (-3.48 percent). Woodland-breeding species with significant negative annual trends were dark-eyed junco (-7.76 percent), American crow (-6.83 percent), and cedar waxwing (-3.41 percent). All linear trends followed annual trends, except for American robin (Fig. 15).

Table 9.—Number of detections, annual trend, linear trend, 95-percent credible interval defined by LCI and UCI, and average abundance for 100 bird species in George Washington and Jefferson National Forests, 1993–2017; caution should be used in interpreting species abundances marked with Δ because they are based on fewer than 50 detections or had wide credible intervals and may be inaccurate or imprecise

		Annual trend			Linear trend			
Species name	Detections	Trend	LCI	UCI	Trend	LCI	UCI	Abundance (birds/point)
		percent						
Acadian flycatcher	2,296	1.38	-3.76	9.55	-0.68	-2.55	1.18	0.20
American coot	53	-6.48	-50.58	74.12	-4.82	-9.40	-0.23	0.03 Δ
American crow	5,046	-6.83	-8.61	-4.94	-4.74	-6.36	-3.13	0.49
American goldfinch	1,499	-0.43	-4.72	5.30	0.98	-1.44	3.39	0.16
American redstart	1,316	7.22	1.24	18.72	4.79	3.02	6.56	0.14
American robin	831	-4.82	-8.19	-1.08	1.23	-1.53	3.99	0.17
Barn swallow	4	-0.01	-7.73	7.45	0.00	-0.17	0.17	1.87 Δ
Barred owl	119	0.38	-8.15	22.53	1.09	0.47	1.71	1.30 Δ
Belted kingfisher	12	-0.18	-13.06	13.10	-0.22	-0.64	0.20	0.79 Δ
Black vulture	15	-0.56	-56.06	111.12	-0.70	-1.73	0.33	0.24 Δ
Black-and-white warbler	2,171	5.39	0.41	13.94	3.84	2.38	5.29	0.22
Black-billed cuckoo	172	-6.69	-23.81	13.40	-5.45	-9.12	-1.78	0.08
Blackburnian warbler	155	11.08	-2.91	69.45	4.05	-2.66	10.75	0.02
Black-capped chickadee	980	2.66	-4.14	15.38	-0.56	-2.42	1.31	0.10
Black-throated blue warbler	680	6.15	-0.30	19.51	5.25	2.85	7.66	0.13
Black-throated green warbler	1,099	5.54	-0.98	18.53	7.21	4.51	9.91	0.13
Blue jay	2,560	2.58	-1.45	8.46	1.95	0.97	2.93	0.27
Blue-gray gnatcatcher	888	3.72	-3.15	16.69	4.08	1.92	6.24	0.10
Blue-headed vireo	1,892	6.75	1.53	15.68	3.35	2.00	4.70	0.20

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(Table 9 continued)

Species name	Detections	Annual trend			Linear trend			Abundance (birds/point)
		Trend	LCI	UCI	Trend	LCI	UCI	
		percent						
Broad-winged hawk	49	-0.25	-4.28	3.78	-0.03	-0.39	0.32	1.58 Δ
Brown creeper	30	-0.12	-4.75	4.69	0.18	-0.36	0.72	2.22 Δ
Brown thrasher	59	-17.22	-46.06	-1.06	-0.70	-4.33	2.93	0.02 Δ
Brown-headed cowbird	685	-0.40	-5.09	6.23	-2.76	-4.73	-0.79	0.09
Canada goose	25	-0.93	-47.48	59.73	0.08	-0.59	0.74	0.98 Δ
Canada warbler	425	4.79	-3.13	19.04	5.33	2.11	8.55	0.12
Carolina chickadee	598	8.90	1.04	26.37	3.72	-0.07	7.51	0.09
Carolina wren	449	4.22	-5.70	30.54	4.43	-0.84	9.70	0.05
Cedar waxwing	706	-3.41	-6.25	-0.09	-0.80	-5.34	3.73	0.10
Cerulean warbler	216	1.00	-8.38	24.57	1.86	-1.92	5.63	0.04
Chestnut-sided warbler	1,390	-0.53	-3.75	3.54	-0.89	-3.25	1.47	0.14
Chimney swift	69	-4.41	-40.48	49.84	-0.44	-3.45	2.57	0.02 Δ
Chipping sparrow	231	-2.61	-7.19	3.26	1.34	-1.92	4.60	0.04
Common grackle	169	1.80	-13.72	52.10	-6.62	-12.40	-0.84	0.02
Common raven	1,247	0.76	-4.73	10.35	-0.99	-4.13	2.16	0.19
Common yellowthroat	95	-9.62	-16.60	-2.03	-3.69	-7.90	0.52	0.02
Dark-eyed junco	1,602	-7.76	-9.87	-5.51	-2.79	-5.57	0.00	0.28
Downy woodpecker	805	2.99	-3.81	15.13	-0.05	-1.62	1.52	0.11
Eastern bluebird	67	1.07	-3.32	7.89	0.48	-0.46	1.42	1.20 Δ
Eastern meadowlark	8	-0.08	-6.97	6.81	-0.16	-0.45	0.13	1.17 Δ
Eastern phoebe	196	-6.29	-34.73	32.50	-1.48	-7.75	4.78	0.02
Eastern screech-owl	10	-0.29	-39.86	51.94	-0.23	-0.72	0.26	0.73 Δ
Eastern towhee	6,026	-3.48	-5.17	-1.63	-2.71	-3.80	-1.61	0.59
Eastern tufted titmouse	4,298	2.37	-1.48	7.71	0.30	-0.92	1.52	0.43
Eastern wood-pewee	2,894	6.10	1.52	13.44	2.01	0.49	3.52	0.29
Field sparrow	400	-17.01	-31.84	-7.20	-7.32	-11.88	-2.77	0.13
Golden-crowned kinglet	65	-2.74	-52.24	90.01	-0.86	-7.71	5.99	0.01
Golden-winged warbler	7	-0.06	-6.68	6.57	0.09	-0.19	0.37	1.09 Δ
Gray catbird	395	-15.48	-30.00	-6.19	-6.32	-10.14	-2.50	0.06
Great blue heron	7	-0.01	-11.10	11.83	0.03	-0.25	0.31	1.15 Δ
Great crested flycatcher	1,876	1.27	-3.51	8.61	-2.65	-3.85	-1.46	0.28
Hairy woodpecker	608	1.82	-5.84	17.33	0.35	-1.26	1.95	0.07
Hermit thrush	59	-1.59	-34.58	42.86	2.00	-1.34	5.34	0.03 Δ
Hooded warbler	2,781	5.00	0.45	12.10	1.69	0.32	3.06	0.27
House wren	9	-0.04	-8.08	9.00	-0.05	-0.28	0.19	1.58 Δ
Indigo bunting	4,117	2.00	-2.15	8.01	-1.92	-3.43	-0.40	0.35
Kentucky warbler	100	-5.91	-38.55	41.41	-6.66	-10.43	-2.89	0.01
Least flycatcher	43	-5.69	-31.53	10.55	2.32	-1.22	5.86	0.03 Δ
Louisiana waterthrush	424	3.44	-6.05	27.49	-2.29	-5.71	1.13	0.04
Magnolia warbler	128	9.25	-3.10	46.52	5.37	1.43	9.30	0.03
Mallard	6	0.98	-9.69	98.48	-0.04	-0.43	0.35	0.67 Δ

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(Table 9 continued)

Species name	Detections	Annual trend			Linear trend			Abundance (birds/point)
		Trend	LCI	UCI	Trend	LCI	UCI	
		percent						
Mourning dove	1,542	-3.95	-8.36	1.40	-1.55	-3.36	0.26	0.19
Northern bobwhite	31	-23.19	-70.31	-0.82	-4.51	-9.61	0.59	0.02 Δ
Northern cardinal	752	4.40	-2.84	20.70	2.25	0.18	4.33	0.07
Northern flicker	565	0.80	-7.38	17.73	0.59	-1.85	3.04	0.06
Northern mockingbird	19	-0.13	-7.23	7.24	0.18	-0.42	0.78	1.01 Δ
Northern parula	566	-1.25	-11.16	15.37	0.93	-3.00	4.86	0.08
Northern rough-winged swallow	14	-1.43	-74.45	264.23	3.52	-1.10	8.13	0.01 Δ
Orchard oriole	3	-0.04	-12.03	14.00	-0.06	-0.34	0.22	1.09 Δ
Ovenbird	11,199	4.67	1.90	8.24	2.58	1.56	3.60	1.05
Pileated woodpecker	3,418	0.91	-3.37	6.95	-2.00	-3.37	-0.63	0.37
Pine warbler	1,290	3.10	-3.01	14.25	-1.39	-2.89	0.10	0.13
Prairie warbler	174	-6.28	-28.55	22.48	-3.15	-6.83	0.53	0.05
Red-bellied woodpecker	499	6.08	-1.35	21.60	3.22	1.00	5.43	0.08
Red-breasted nuthatch	134	9.48	-2.70	50.07	-0.89	-5.66	3.89	0.02
Red-eyed vireo	12,502	4.39	1.83	7.52	1.77	0.59	2.95	1.08
Red-headed woodpecker	7	0.94	-6.44	37.49	0.14	-0.25	0.53	0.77 Δ
Red-shouldered hawk	49	0.91	-3.92	9.60	0.47	-0.30	1.24	0.96 Δ
Red-tailed hawk	44	-6.03	-49.08	71.74	0.26	-2.95	3.46	0.01 Δ
Red-winged blackbird	48	-2.72	-41.46	55.71	1.49	-1.24	4.22	0.02 Δ
Rose-breasted grosbeak	1,242	4.32	-1.71	15.26	-0.98	-2.43	0.48	0.13
Ruby-throated hummingbird	181	2.85	-9.60	39.36	-0.03	-4.05	3.98	0.02
Ruffed grouse	377	0.45	-9.70	21.27	-1.81	-5.86	2.24	0.06
Scarlet tanager	7,243	3.82	0.91	7.73	0.99	0.13	1.85	0.69
Sharp-shinned hawk	10	-0.09	-7.46	7.64	-0.11	-0.61	0.39	1.00 Δ
Song sparrow	65	-0.68	-26.79	34.73	-3.11	-7.27	1.06	0.03
Swainson's warbler	198	-2.63	-23.89	23.18	3.37	-1.20	7.95	0.04
Turkey vulture	127	-5.44	-28.94	26.17	-0.52	-3.73	2.68	0.04 Δ
Veery	1,365	6.12	0.60	15.60	4.53	2.38	6.69	0.21
Whip-poor-will	101	0.55	-16.69	68.52	-0.97	-6.65	4.71	0.02
White-breasted nuthatch	1,914	3.26	-1.93	11.86	0.57	-1.06	2.20	0.21
White-eyed vireo	23	-0.05	-8.84	9.15	-0.10	-0.70	0.49	4.87 Δ
Wild turkey	273	7.01	-3.14	34.61	-1.61	-4.71	1.49	0.03
Winter wren	74	-4.02	-40.52	53.57	0.04	-5.56	5.64	0.01
Wood thrush	3,679	4.82	0.60	11.15	0.29	-1.16	1.74	0.34
Worm-eating warbler	3,514	4.02	-0.21	10.37	1.80	0.46	3.15	0.33
Yellow-billed cuckoo	2,166	2.07	-2.76	9.25	0.77	-1.38	2.92	0.29
Yellow-breasted chat	144	-7.64	-33.59	27.02	-6.65	-10.75	-2.55	0.04
Yellow-rumped warbler	38	-5.91	-48.54	69.05	1.20	-1.79	4.19	0.02 Δ
Yellow-throated vireo	38	0.22	-4.84	7.04	0.69	0.11	1.26	1.52 Δ
Yellow-throated warbler	15	-1.29	-78.53	340.94	0.61	-2.91	4.12	0.01 Δ

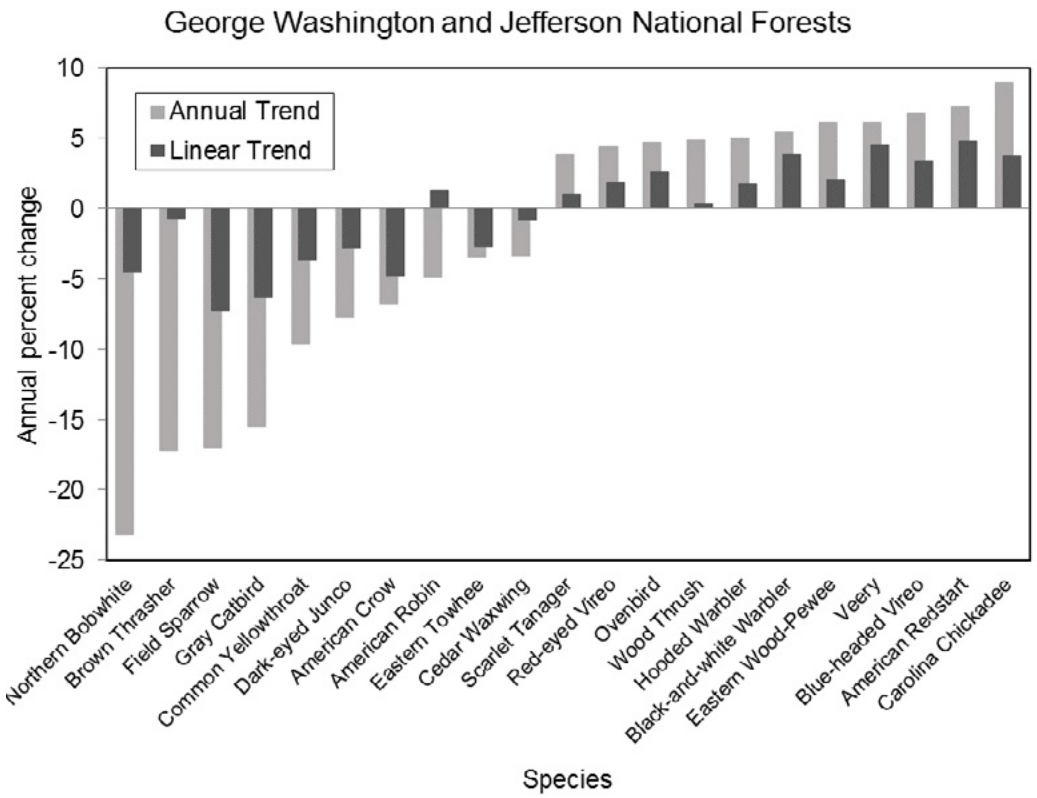


Figure 15.—Significant (based on 95-percent credible interval) positive and negative annual and linear trends for bird species in George Washington and Jefferson National Forests, 1993–2017.

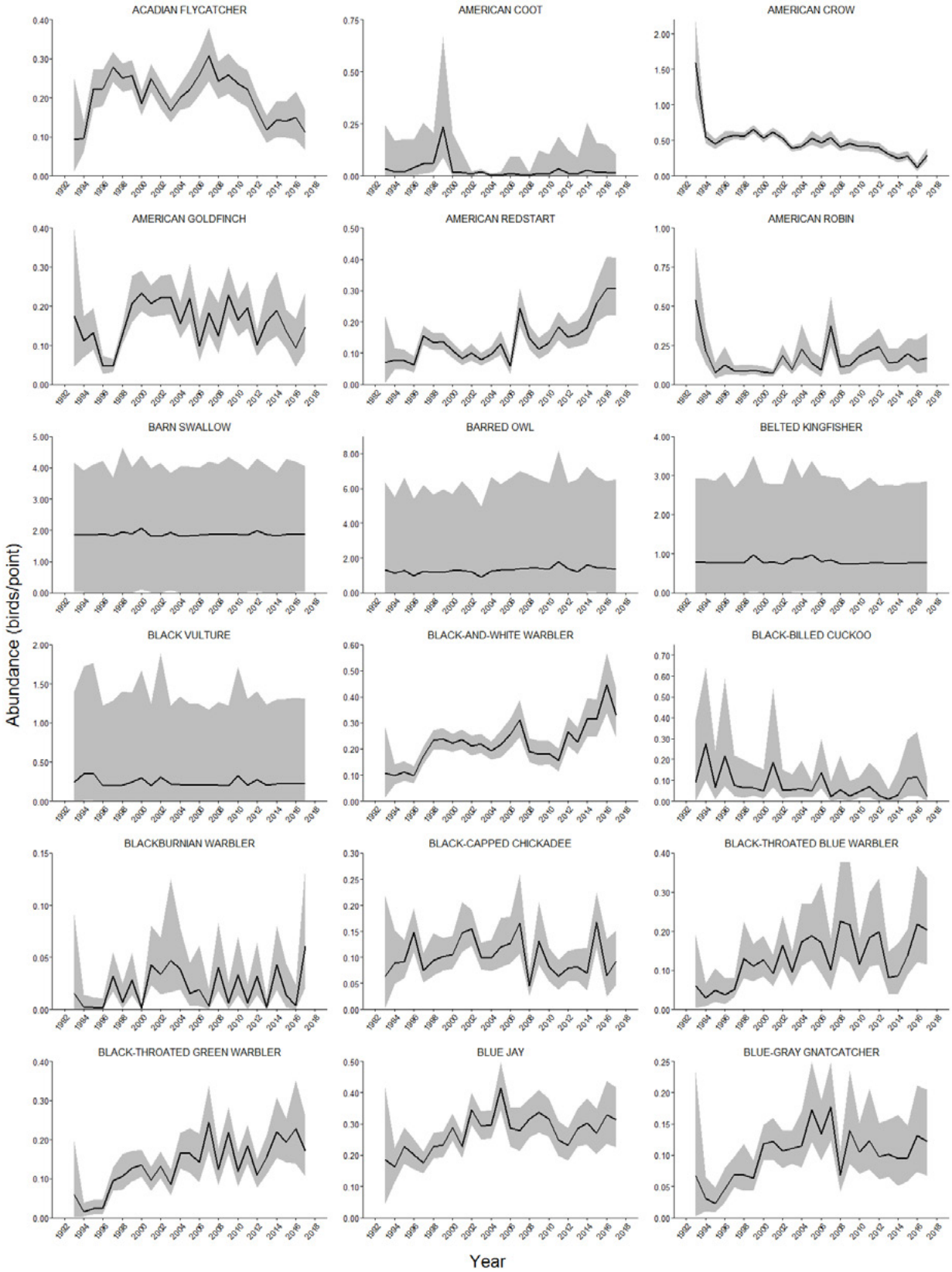
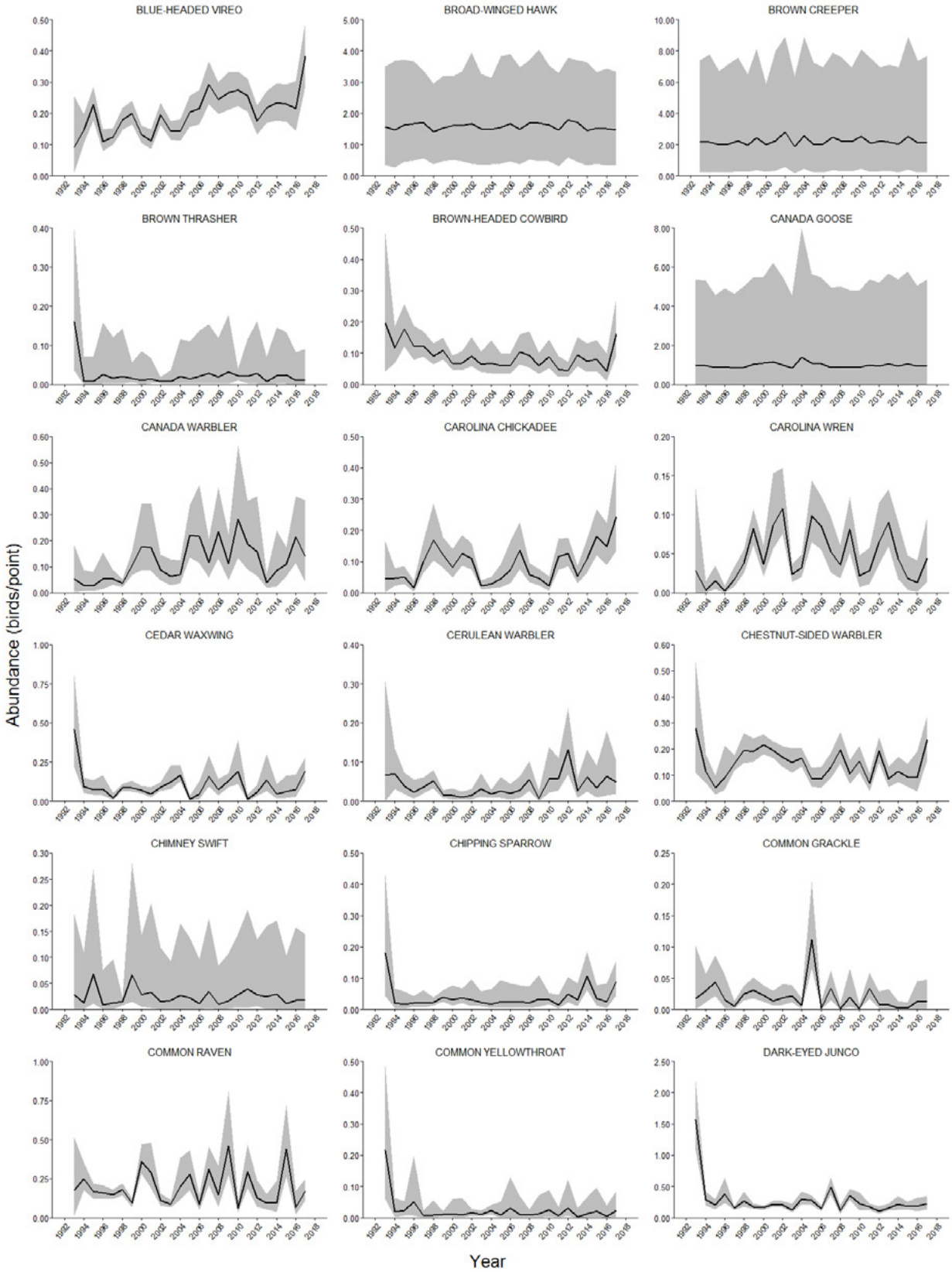


Figure 16. (page 1 of 6)—Estimated abundances and 95-percent credible intervals (shaded areas) for 100 bird species in George Washington and Jefferson National Forests, by year. The scale of the abundance axes may vary among species to best illustrate patterns in abundance.



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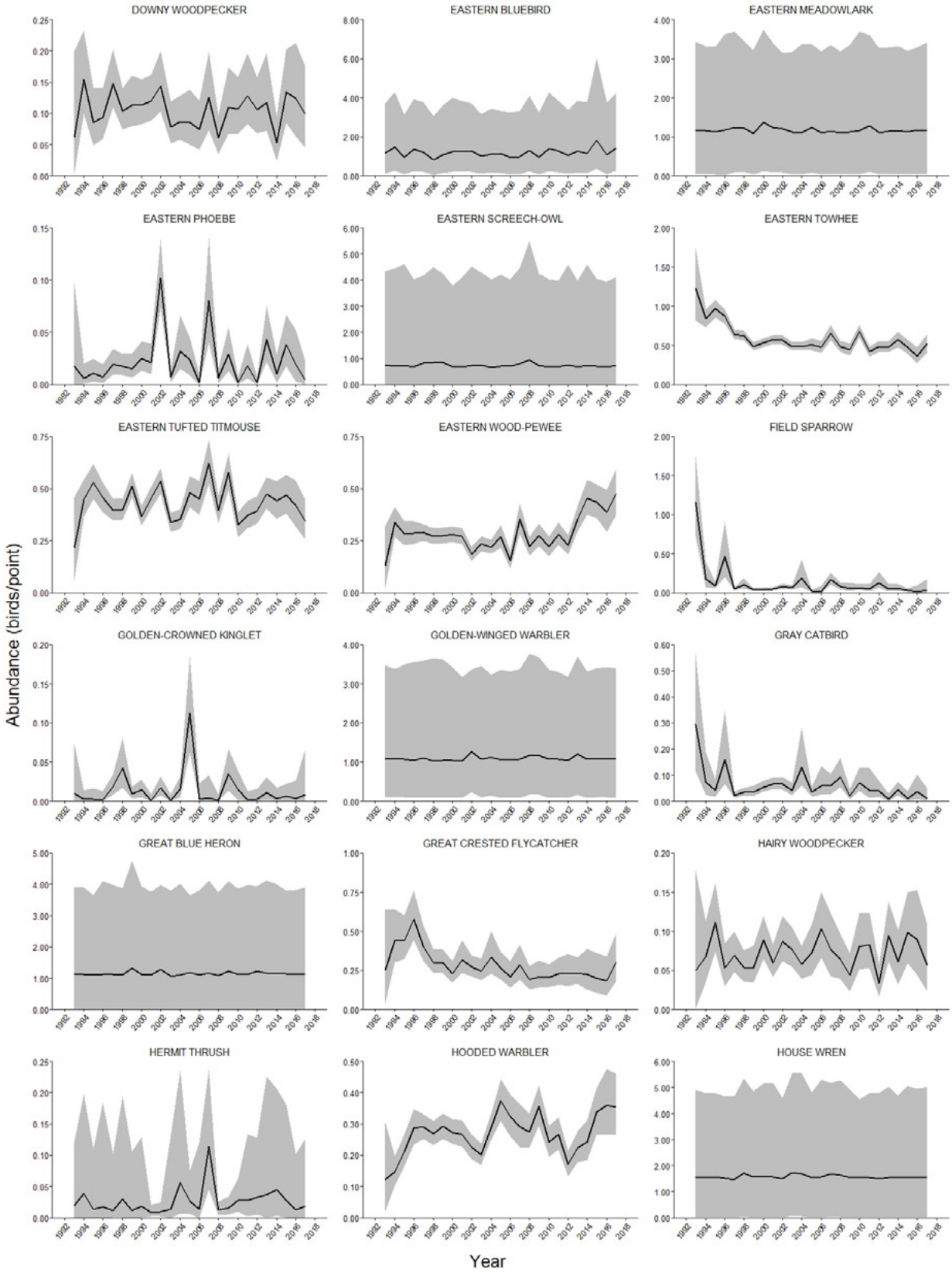

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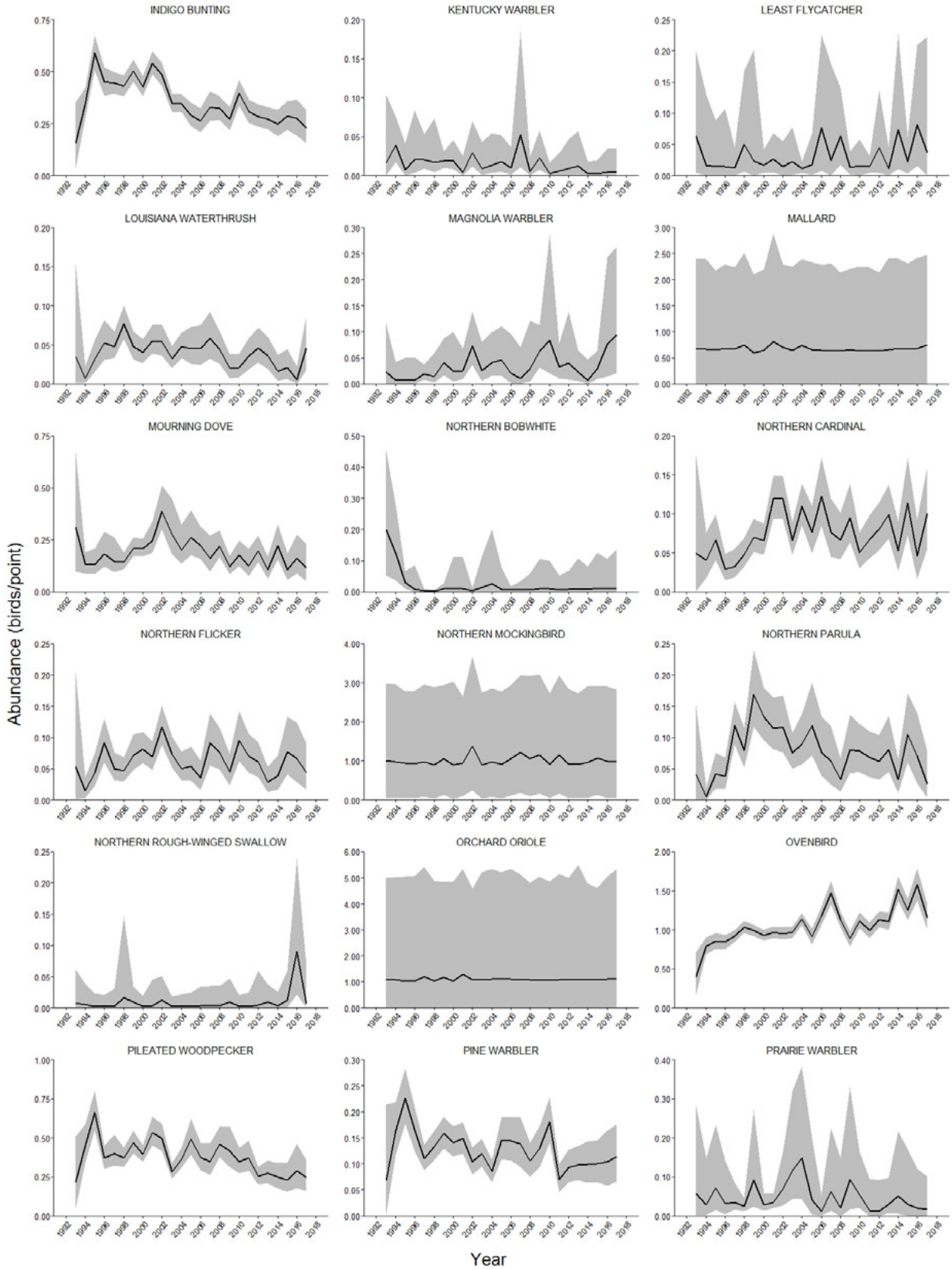

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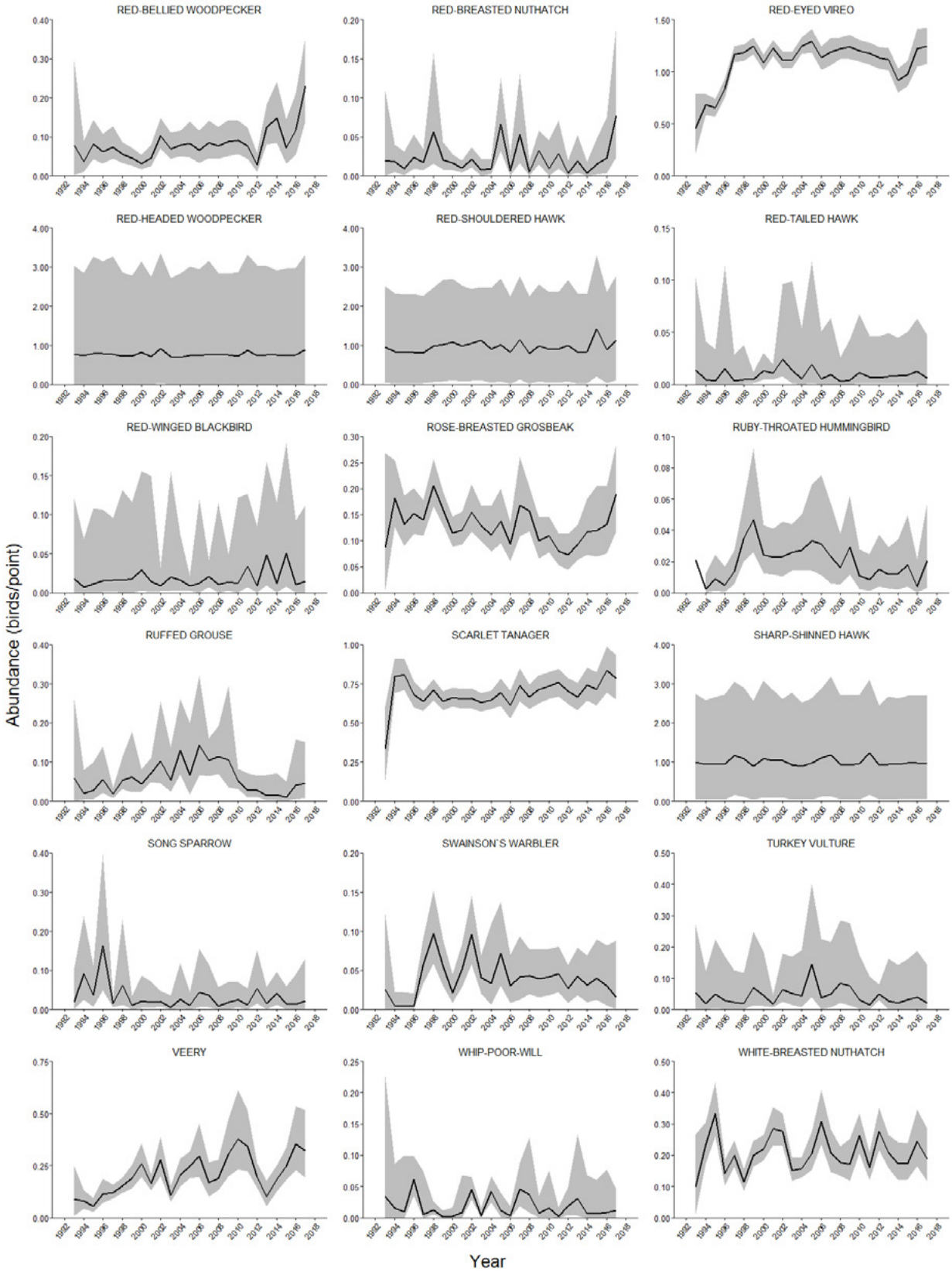

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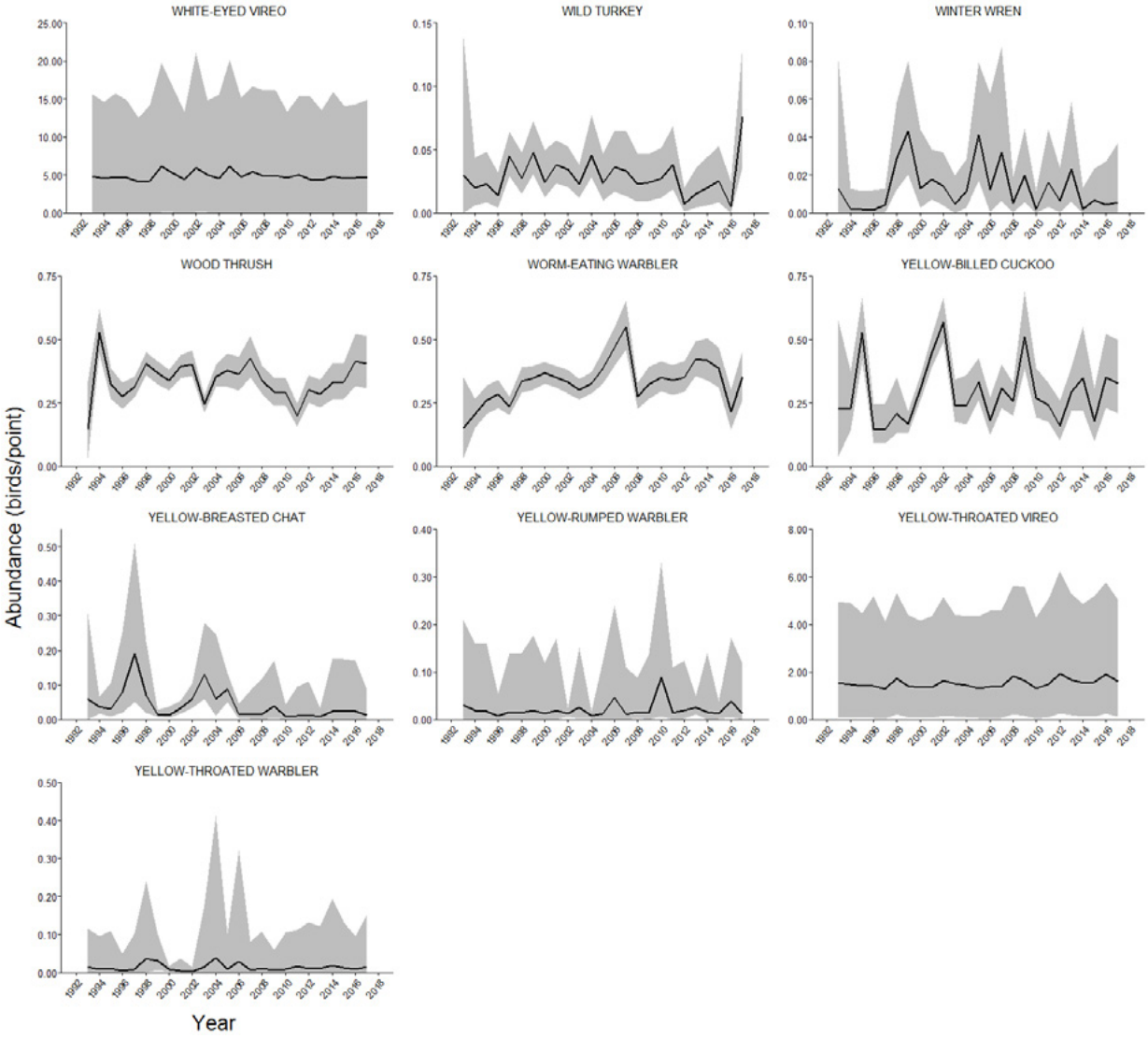


Figure 16 (page 6 of 6)

Kisatchie National Forest

Kisatchie National Forest completed 2,239 point counts between 1998 and 2016. The number of points surveyed ranged from 130 in 2005 and 2006 to 12 in 2016. We estimated abundances and population trends for 79 species (Table 10). Northern cardinal (1.25 birds/point), American crow (1.17 birds/point), and yellow-breasted chat (1.10 birds/point) showed the highest average abundances, whereas green heron, great blue heron, and black vulture had the lowest average abundances, at 0.02 bird/point apiece. More species had negative annual trends than positive annual trends, and nine species had significant negative annual trends (Figs. 17, 18). Common yellowthroat was the only early-successional, scrub-breeding species with a significant negative annual trend (-13.90 percent). Woodland-breeding species with significant negative annual trends were worm-eating warbler (-13.72 percent), eastern wood-pewee (-8.24 percent), Carolina chickadee (-7.20 percent), blue jay (-6.53 percent), pine warbler (-5.69 percent), red-eyed vireo (-4.90 percent), American crow (-4.41 percent), and eastern tufted titmouse (-3.60 percent). Most linear trends were smaller than annual trends, except for pine warbler and red-eyed vireo (Fig. 17).

Table 10.—Number of detections, annual trend, linear trend, 95-percent credible interval defined by LCI and UCI, and average abundance for 79 bird species in Kisatchie National Forest, 1998–2016; caution should be used in interpreting species abundances marked with Δ because they are based on fewer than 50 detections or had wide credible intervals and may be inaccurate or imprecise

		Annual trend			Linear trend			
Species name	Detections	Trend	LCI	UCI	Trend	LCI	UCI	Abundance (birds/point)
		percent						
Acadian flycatcher	406	-4.01	-9.82	0.90	-9.20	-14.51	-3.88	0.20
American crow	2,450	-4.41	-7.21	-1.90	-3.12	-4.75	-1.48	1.17
American kestrel	44	-0.94	-12.73	4.54	-0.31	-1.21	0.58	1.67 Δ
American redstart	75	-11.57	-44.68	3.22	-10.45	-15.45	-5.44	0.06 Δ
Bachman's sparrow	308	-3.17	-15.03	5.02	-3.41	-6.85	0.04	0.17
Barn swallow	74	1.43	-26.76	48.24	-0.52	-7.10	6.06	0.22 Δ
Barred owl	16	-0.21	-7.84	6.69	0.01	-0.44	0.46	2.68 Δ
Black vulture	11	6.77	-59.18	184.46	-1.93	-5.53	1.68	0.02 Δ
Black-and-white warbler	44	-7.59	-48.94	10.03	-5.34	-9.96	-0.73	0.05 Δ
Blue grosbeak	156	0.75	-8.96	8.83	-0.35	-3.05	2.35	0.13
Blue jay	986	-6.53	-13.07	-1.76	-3.44	-5.34	-1.54	0.46
Blue-gray gnatcatcher	196	-4.28	-21.23	7.72	-6.99	-10.14	-3.84	0.13
Blue-winged warbler	10	6.38	-59.94	193.25	0.62	-1.81	3.06	0.05 Δ
Broad-winged hawk	17	-0.10	-8.12	6.66	-0.28	-0.83	0.27	2.08 Δ
Brown thrasher	15	7.84	-3.95	89.38	0.48	-0.24	1.20	0.76 Δ
Brown-headed cowbird	73	-7.09	-27.39	4.72	-1.09	-4.83	2.65	0.10 Δ
Brown-headed nuthatch	238	-3.41	-12.44	3.25	-4.54	-9.63	0.54	0.14
Carolina chickadee	385	-7.20	-17.54	-0.33	-7.13	-9.65	-4.62	0.20
Carolina wren	1,689	1.29	-1.77	4.04	-0.17	-1.33	0.99	0.81
Chimney swift	67	-5.74	-28.84	5.73	-3.59	-5.15	-2.03	0.14 Δ
Chipping sparrow	124	-3.80	-18.48	7.18	-2.03	-4.08	0.01	0.14 Δ
Chuck-will's-widow	57	-5.86	-31.49	8.85	-0.39	-6.09	5.31	0.05
Common grackle	8	0.47	-22.08	41.68	-0.11	-0.63	0.41	1.51 Δ
Common nighthawk	12	1.95	-43.68	101.06	-0.73	-1.66	0.19	0.25 Δ
Common yellowthroat	91	-13.90	-38.07	-2.41	-4.73	-11.14	1.69	0.05
Downy woodpecker	120	-8.60	-30.82	3.45	-8.89	-12.77	-5.02	0.08
Eastern bluebird	63	-3.74	-16.17	6.95	-3.37	-10.29	3.54	0.10 Δ
Eastern kingbird	50	-2.05	-14.96	7.59	-4.68	-9.80	0.44	0.04 Δ
Eastern towhee	352	2.82	-3.67	8.53	3.65	-2.05	9.34	0.20
Eastern tufted titmouse	1,423	-3.60	-7.46	-0.22	-3.79	-4.85	-2.73	0.70

(continued on next page)

(Table 10 continued)

Species name	Detections	Annual trend			Linear trend			Abundance (birds/point)
		Trend	LCI	UCI	Trend	LCI	UCI	
		percent						
Eastern wood-pewee	254	-8.24	-16.79	-2.02	-5.61	-9.79	-1.43	0.13
Field sparrow	5	-0.47	-7.87	5.68	-0.30	-0.62	0.03	2.17 Δ
Fish crow	158	-6.14	-29.37	5.35	-0.41	-6.65	5.83	0.29 Δ
Gray catbird	36	0.99	-4.44	8.77	-0.25	-1.21	0.72	3.41 Δ
Great blue heron	16	6.85	-48.48	135.85	-0.57	-3.73	2.59	0.02 Δ
Great crested flycatcher	314	-2.56	-8.43	2.35	-4.94	-8.01	-1.87	0.18
Great egret	14	1.92	-28.57	62.53	-0.63	-1.94	0.68	1.41 Δ
Green heron	5	3.08	-79.03	416.09	-0.29	-2.26	1.67	0.02 Δ
Hairy woodpecker	46	-0.24	-5.70	4.95	-0.88	-1.63	-0.13	2.36 Δ
Hooded warbler	988	-2.79	-6.84	0.76	-4.06	-6.32	-1.79	0.49
Indigo bunting	1,037	-3.01	-6.37	0.10	-6.38	-8.95	-3.81	0.53
Kentucky warbler	554	-0.49	-8.09	5.69	1.49	-0.76	3.74	0.31
Little blue heron	15	8.85	-49.25	136.06	3.10	-1.52	7.71	0.03 Δ
Louisiana waterthrush	33	-0.66	-12.53	5.29	-0.86	-1.33	-0.40	2.87 Δ
Mourning dove	555	0.55	-4.39	5.09	0.49	-1.97	2.95	0.28
Northern bobwhite	179	-1.63	-9.63	4.41	-6.22	-10.61	-1.82	0.09
Northern cardinal	2,644	-1.42	-4.08	1.05	-2.50	-3.61	-1.40	1.25
Northern flicker	62	-4.73	-31.13	9.39	-3.15	-8.20	1.91	0.04 Δ
Northern mockingbird	26	0.13	-4.79	5.83	0.53	-0.20	1.26	2.91 Δ
Northern parula	129	-7.51	-26.46	3.06	-8.21	-12.42	-3.99	0.07
Orchard oriole	45	-1.08	-8.00	4.46	-0.82	-1.64	0.01	1.74 Δ
Painted bunting	27	-13.06	-78.22	9.10	-4.05	-7.05	-1.05	0.05 Δ
Pileated woodpecker	615	0.11	-5.37	4.54	-0.78	-2.48	0.93	0.36
Pine warbler	1,345	-5.69	-10.97	-1.64	-6.48	-8.15	-4.81	0.65
Prairie warbler	296	-3.58	-10.44	1.74	-6.58	-9.78	-3.37	0.16
Prothonotary warbler	21	-10.35	-55.91	9.33	-2.77	-6.29	0.74	0.03 Δ
Purple martin	68	-5.77	-28.03	7.46	-4.68	-7.31	-2.05	0.09 Δ
Red-bellied woodpecker	875	0.46	-3.35	3.87	-0.24	-1.48	1.00	0.45
Red-cockaded woodpecker	105	-6.09	-22.45	4.43	-2.13	-7.05	2.78	0.13
Red-eyed vireo	1,416	-4.90	-8.77	-1.62	-7.36	-9.08	-5.64	0.65
Red-headed woodpecker	205	4.65	-2.57	11.08	1.39	-1.30	4.08	0.11
Red-shouldered hawk	132	-9.67	-27.13	0.02	-6.01	-8.95	-3.07	0.08
Red-tailed hawk	64	-6.70	-31.90	7.41	-6.04	-9.91	-2.17	0.04 Δ
Red-winged blackbird	9	-3.43	-65.44	22.88	-0.17	-0.75	0.40	0.37 Δ
Ruby-throated hummingbird	28	0.18	-5.11	6.12	-0.05	-0.73	0.63	2.25 Δ
Summer tanager	1,032	-3.19	-7.27	0.41	-3.43	-4.94	-1.93	0.50
Swainson's warbler	13	-0.11	-5.57	4.92	-0.50	-0.90	-0.10	6.43 Δ
Turkey vulture	71	-5.45	-30.33	7.54	-4.14	-7.91	-0.36	0.08 Δ
White-breasted nuthatch	37	4.75	-32.70	70.34	-4.42	-7.76	-1.07	0.06 Δ
White-eyed vireo	894	1.40	-3.06	5.38	-0.99	-2.36	0.38	0.43
Wild turkey	48	0.45	-31.26	21.42	-1.14	-6.08	3.81	0.04 Δ
Wood duck	51	-1.28	-19.92	5.19	-0.25	-1.29	0.79	1.17 Δ
Wood thrush	155	2.63	-7.95	10.83	-1.46	-4.35	1.42	0.10
Worm-eating warbler	95	-13.72	-40.28	-0.62	-7.92	-13.31	-2.54	0.09 Δ
Yellow-billed cuckoo	936	-0.18	-4.88	4.04	-1.28	-4.02	1.47	0.50
Yellow-breasted chat	2,347	0.47	-1.92	2.73	-1.11	-2.29	0.07	1.10
Yellow-crowned night heron	16	-0.94	-37.87	16.03	-1.09	-2.14	-0.04	0.54 Δ
Yellow-throated vireo	388	-2.89	-14.10	4.87	-7.32	-9.89	-4.75	0.20
Yellow-throated warbler	42	-6.85	-35.38	8.30	-4.41	-9.08	0.27	0.05 Δ

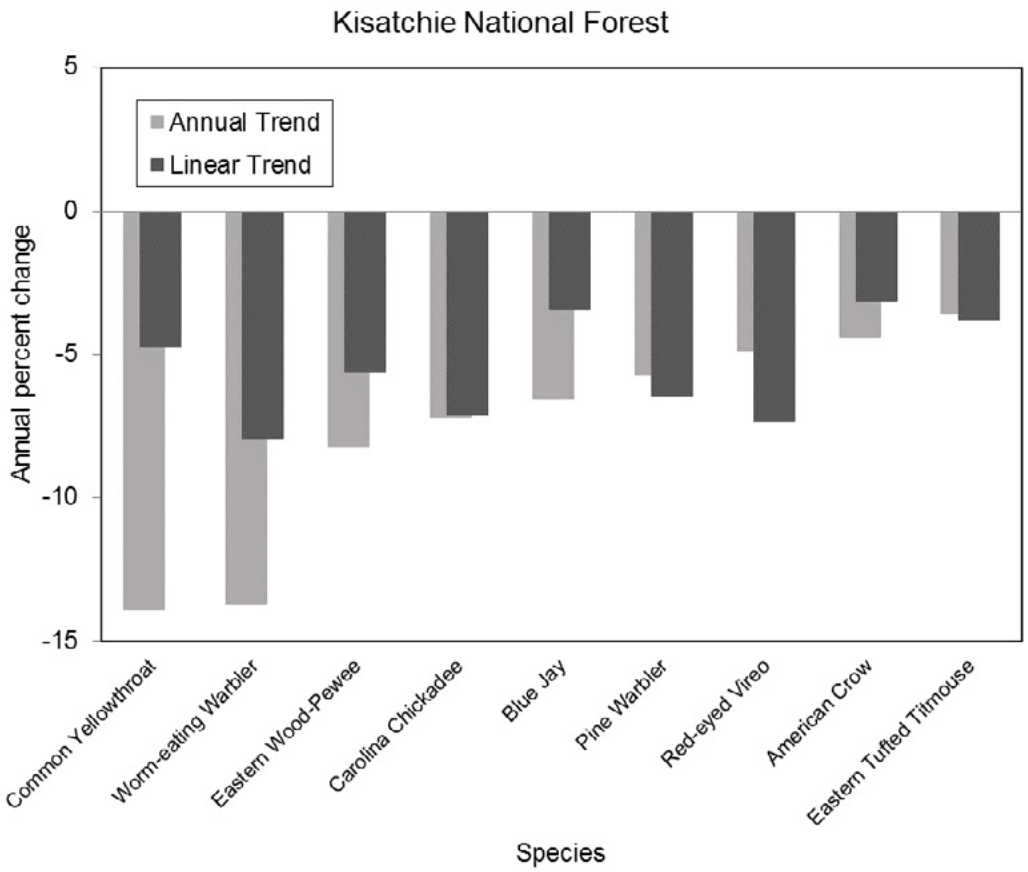


Figure 17.—Significant (based on 95-percent credible interval) negative annual and linear trends for bird species in Kisatchie National Forest, 1998–2016.

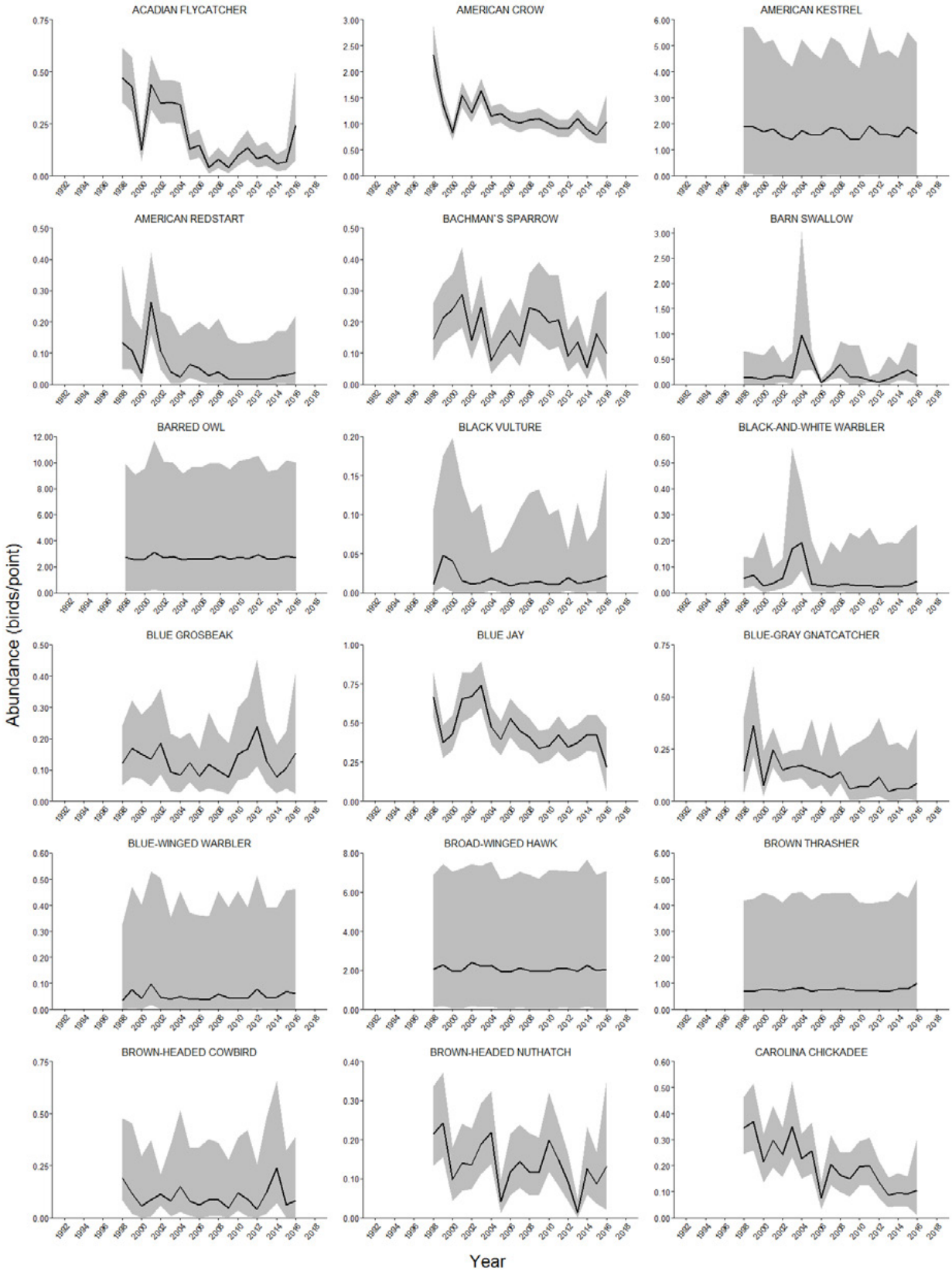
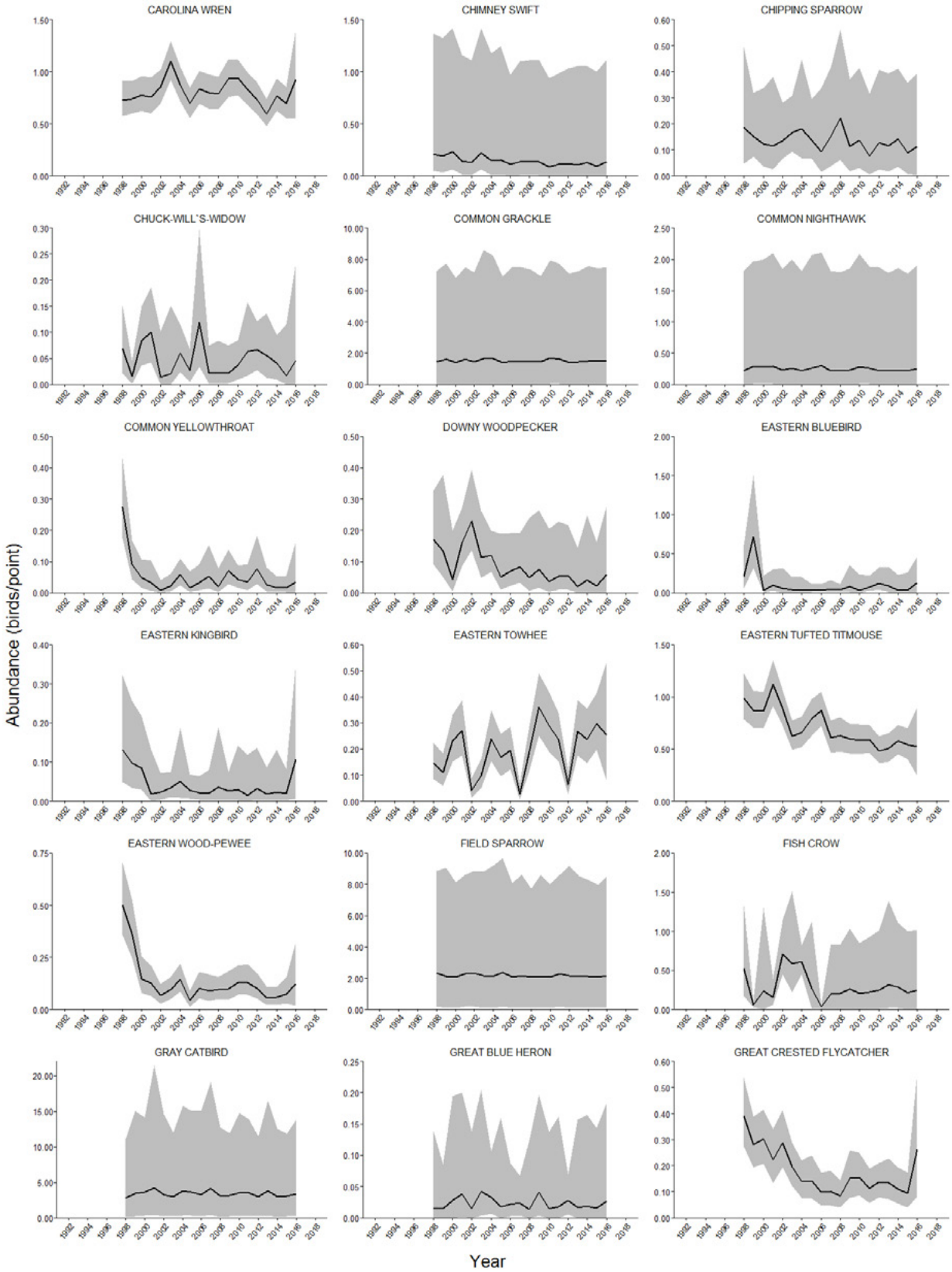


Figure 18. (page 1 of 5)—Estimated abundances and 95-percent credible intervals (shaded areas) for 79 bird species in Kisatchie National Forest, by year. The scale of the abundance axes may vary among species to best illustrate patterns in abundance.



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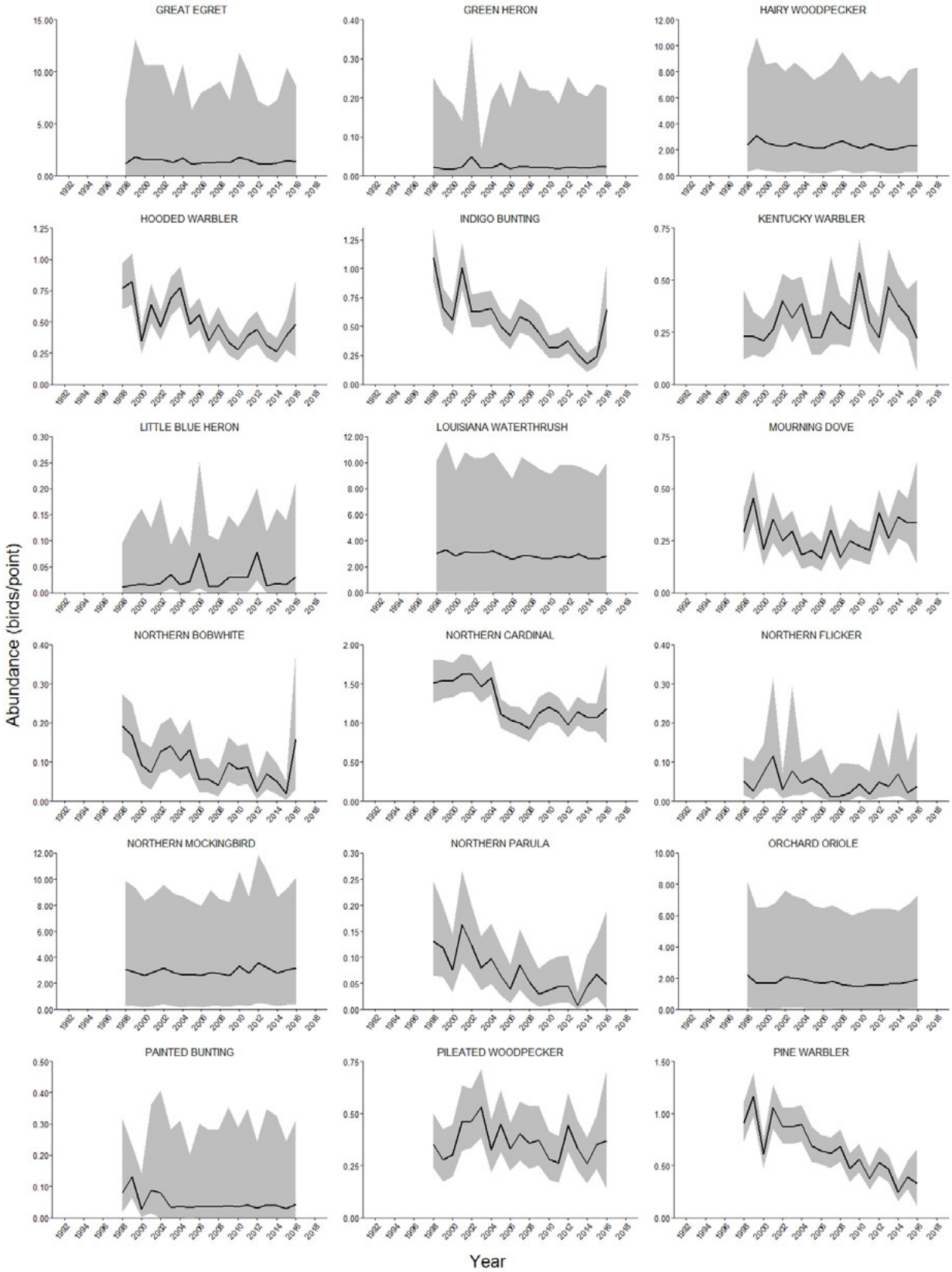

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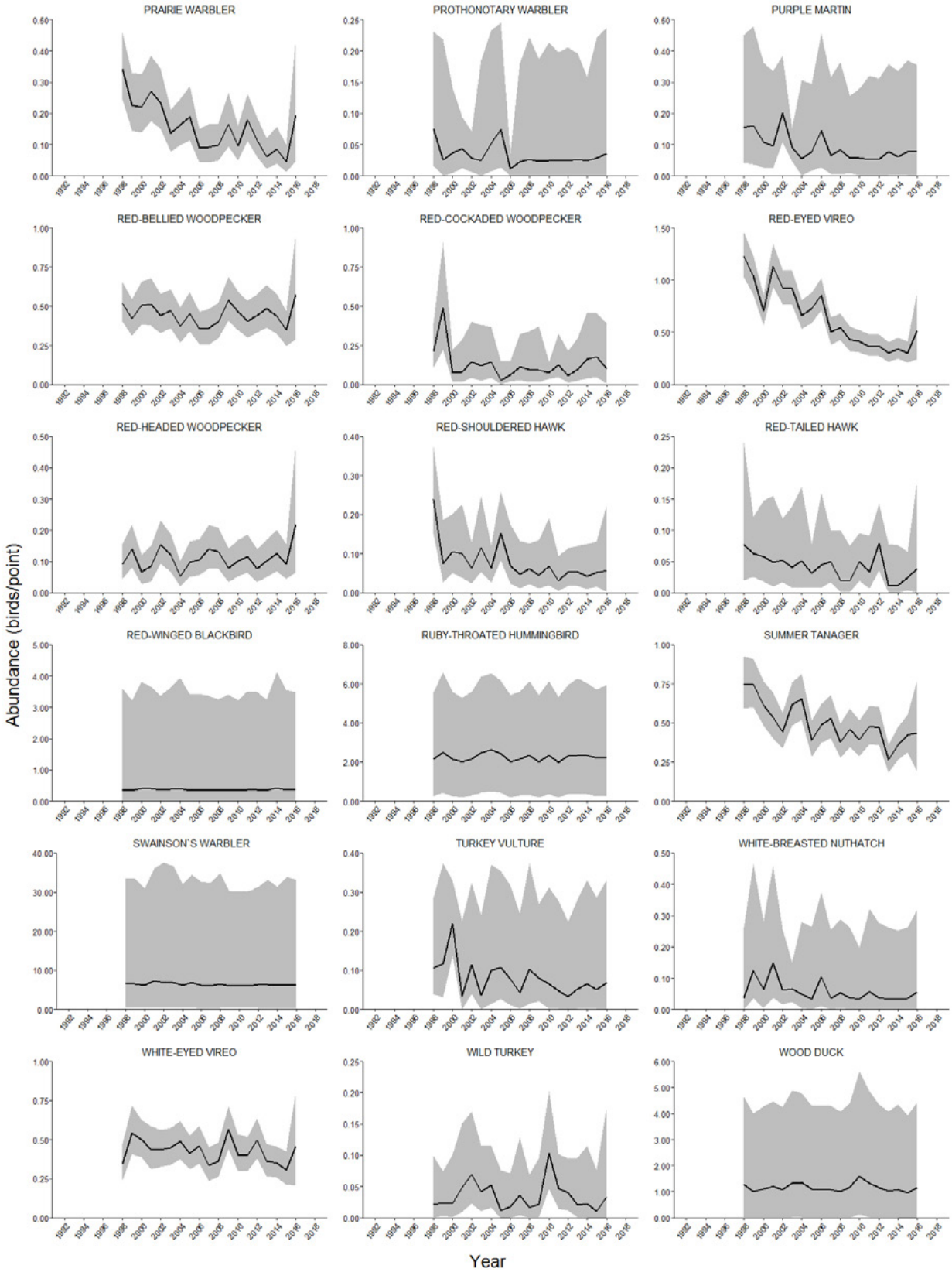

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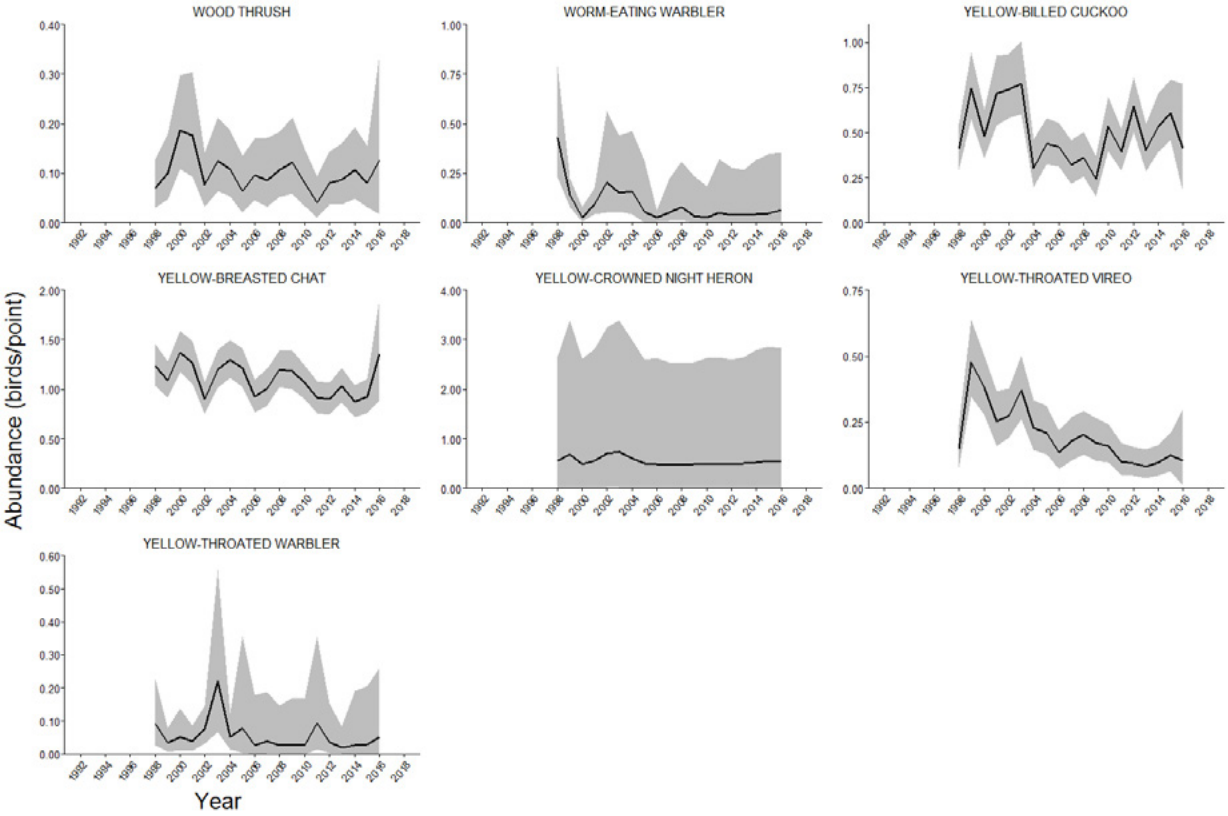

Figure 18 (page 5 of 5)

Land Between the Lakes National Recreation Area

Land Between the Lakes National Recreation Area completed 4,371 point counts between 1993 and 2017. The number of points surveyed ranged from 213 points in 2008 to 107 points in 1996. We estimated abundances and population trends for 77 species (Table 11). Species with the highest average abundances included American crow (1.76 birds/point), yellow-billed cuckoo (1.60 birds/point), and red-eyed vireo (1.33 birds/point). Warbling vireo (0.02 bird/point), green heron (0.01 bird/point), and broad-winged hawk (0.01 bird/point) had some of the lowest average abundances. More species showed negative than positive annual trends; 9 species had significant positive annual trends and 26 species had significant negative annual trends (Figs. 19, 20). Only woodland-breeding species had significant positive trends: yellow-throated warbler (10.95 percent), black-and-white warbler (10.28 percent), northern parula (10.27 percent), yellow-throated vireo (9.80 percent), Acadian flycatcher (8.22 percent), red-shouldered hawk (7.38 percent), downy woodpecker (5.76 percent), Louisiana waterthrush (4.57 percent), and blue-gray gnatcatcher (1.44 percent). Land Between the Lakes National Recreation Area had the most species with significant negative trends in the region. Woodland-breeding species with significant negative annual trends were red-winged blackbird (-17.51 percent), eastern phoebe (-12.11 percent), American crow (-8.03 percent), pileated woodpecker (-7.85 percent), great crested flycatcher (-5.04 percent), red-bellied woodpecker (-3.25 percent), and red-eyed vireo (-3.12 percent). Early-successional, scrub-breeding species with large negative annual trends were brown thrasher (-14.17 percent), field sparrow (-10.87 percent), eastern towhee (-8.06 percent), common yellowthroat (-7.11 percent), prairie warbler (-4.61 percent), indigo bunting (-4.49 percent), Carolina wren (-4.27 percent), and northern cardinal (-3.08 percent). Eastern bluebird had an annual population trend of -8.53 percent. With a few exceptions, linear trends were in the same direction as annual trends, but there was variation in which trend estimate was greater (Fig. 19).

Table 11.—Number of detections, annual trend, linear trend, 95-percent credible interval defined by LCI and UCI, and average abundance for 77 bird species in Land Between the Lakes National Recreation Area, 1993–2017; caution should be used in interpreting species abundances marked with Δ because they are based on fewer than 50 detections or had wide credible intervals and may be inaccurate or imprecise

		Annual trend			Linear trend			
Species name	Detections	Trend	LCI	UCI	Trend	LCI	UCI	Abundance (birds/point)
		percent						
Acadian flycatcher	2,672	8.22	0.99	12.75	4.16	2.57	5.75	0.69
American crow	3,003	-8.03	-11.75	-5.38	-8.76	-12.17	-5.36	1.76
American goldfinch	329	-4.15	-8.16	0.19	-0.09	-3.41	3.23	0.12
American robin	38	-0.33	-5.50	4.00	-0.26	-0.54	0.02	4.56 Δ
Bald eagle	4	0.03	-6.71	7.86	0.04	-0.12	0.21	1.69 Δ
Barn swallow	222	0.24	-4.21	7.72	-0.89	-4.89	3.11	0.12
Barred owl	84	-1.01	-6.33	2.70	-0.19	-0.99	0.62	4.02 Δ
Belted kingfisher	21	-5.71	-52.79	5.18	-0.28	-0.85	0.29	0.42 Δ
Black-and-white warbler	350	10.28	5.10	16.53	12.10	9.48	14.71	0.12
Blue grosbeak	56	-3.29	-14.68	7.88	4.88	2.29	7.47	0.03 Δ
Blue jay	1,067	-8.85	-11.63	-6.17	-5.73	-10.60	-0.87	0.56
Blue-gray gnatcatcher	2,699	1.44	0.42	2.46	4.40	3.14	5.65	0.64
Blue-winged warbler	51	0.57	-27.28	40.90	-0.82	-3.64	2.00	0.06 Δ
Broad-winged hawk	12	1.61	-65.16	205.66	3.67	-0.96	8.30	0.01 Δ
Brown thrasher	120	-14.17	-36.01	-0.83	-6.36	-9.69	-3.04	0.07 Δ

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(Table 11 continued)

Species name	Detections	Annual trend			Linear trend			Abundance (birds/point)
		Trend	LCI	UCI	Trend	LCI	UCI	
		percent						
Brown-headed cowbird	1,333	-7.62	-9.68	-5.86	-0.19	-3.35	2.96	0.42
Canada goose	81	-0.76	-22.36	29.16	2.99	-0.65	6.62	0.10 Δ
Carolina chickadee	826	0.55	-1.43	2.58	2.22	-0.22	4.67	0.22
Carolina wren	1,868	-4.27	-6.54	-2.21	-0.91	-3.53	1.72	0.55
Cerulean warbler	8	0.48	-3.75	6.63	0.41	0.22	0.59	1.76 Δ
Chimney swift	168	-9.78	-18.82	-1.08	0.54	-2.83	3.91	0.12
Chipping sparrow	115	-1.11	-4.08	2.11	3.90	0.60	7.19	0.04
Common grackle	37	-4.15	-43.26	3.43	-0.92	-1.35	-0.49	0.54 Δ
Common yellowthroat	506	-7.11	-10.27	-3.09	-4.33	-7.35	-1.32	0.16
Cooper's hawk	13	-1.67	-32.15	9.89	-0.11	-0.73	0.52	0.48 Δ
Downy woodpecker	859	5.76	3.05	8.85	5.19	2.88	7.51	0.24
Eastern bluebird	97	-8.53	-15.91	-0.35	-2.84	-6.26	0.58	0.05 Δ
Eastern kingbird	50	-0.23	-8.06	5.69	-0.08	-0.61	0.45	1.36 Δ
Eastern phoebe	113	-12.11	-20.85	-4.88	2.02	-2.84	6.88	0.03
Eastern towhee	591	-8.06	-11.20	-5.15	-7.71	-10.70	-4.72	0.18
Eastern tufted titmouse	3,277	-2.21	-4.76	-0.20	-0.68	-3.90	2.53	1.07
Eastern wood-pewee	2,539	-2.07	-3.94	-0.49	-1.49	-3.74	0.76	0.73
Field sparrow	238	-10.87	-15.75	-6.17	-4.69	-8.47	-0.91	0.09
Gray catbird	33	-3.80	-35.87	7.29	0.21	-1.13	1.56	0.09 Δ
Great blue heron	188	-2.56	-9.57	1.45	-1.25	-2.17	-0.34	1.77 Δ
Great crested flycatcher	840	-5.04	-8.12	-1.49	-2.36	-5.01	0.30	0.25
Green heron	8	-21.74	-81.71	6.60	-2.52	-6.33	1.29	0.01 Δ
Hairy woodpecker	120	9.32	-3.33	32.13	1.94	-0.42	4.29	0.08 Δ
Hooded warbler	179	0.46	-3.81	5.35	10.42	7.23	13.61	0.05
Indigo bunting	2,379	-4.49	-5.97	-3.00	-2.32	-3.33	-1.31	0.60
Kentucky warbler	627	-2.03	-5.25	0.86	3.31	0.30	6.31	0.18
Louisiana waterthrush	189	4.57	0.41	9.53	8.01	5.26	10.75	0.05
Mallard	2	0.06	-5.20	4.37	0.04	-0.10	0.18	1.68 Δ
Mourning dove	502	-6.65	-9.65	-3.32	-3.25	-7.41	0.90	0.21
Northern bobwhite	129	-0.25	-6.30	3.61	-0.28	-0.45	-0.12	5.39 Δ
Northern cardinal	1,514	-3.08	-5.44	-1.08	-1.87	-4.07	0.34	0.47

(continued on next page)

(Table 11 continued)

Species name	Detections	Annual trend			Linear trend			Abundance (birds/point)
		Trend	LCI	UCI	Trend	LCI	UCI	
		percent						
Northern flicker	41	0.48	-4.99	7.58	-0.43	-0.83	-0.02	1.26 Δ
Northern parula	1,911	10.27	7.21	13.15	10.68	8.68	12.67	0.47
Orchard oriole	203	-1.35	-7.79	5.22	-2.36	-5.84	1.12	0.07
Osprey	5	0.34	-3.23	4.08	0.04	-0.12	0.21	6.05 Δ
Ovenbird	293	4.00	-1.30	9.03	4.68	2.43	6.92	0.08
Pileated woodpecker	979	-7.85	-12.41	-2.07	-4.17	-8.07	-0.28	0.59
Pine warbler	261	-2.18	-7.35	3.17	-1.22	-3.13	0.70	0.09
Prairie warbler	547	-4.61	-7.56	-1.58	-1.92	-4.00	0.16	0.16
Prothonotary warbler	195	-4.54	-9.41	0.47	1.04	-1.94	4.02	0.07
Purple martin	47	0.16	-19.17	23.86	-0.11	-0.71	0.50	1.49 Δ
Red-bellied woodpecker	1,804	-3.25	-5.62	-1.15	-0.30	-3.24	2.64	0.62
Red-eyed vireo	4,985	-3.12	-4.92	-1.59	0.98	-0.36	2.32	1.33
Red-headed woodpecker	26	-0.65	-32.68	45.31	0.26	-1.85	2.38	0.05 Δ
Red-shouldered hawk	235	7.38	0.79	14.76	6.00	4.19	7.80	0.08
Red-tailed hawk	45	0.17	-3.63	4.30	0.09	-0.53	0.70	1.88 Δ
Red-winged blackbird	88	-17.51	-45.90	-2.30	-8.04	-12.19	-3.89	0.10 Δ
Ruby-throated hummingbird	236	2.41	-3.20	8.22	3.94	1.37	6.52	0.09
Scarlet tanager	1,669	0.51	-4.57	5.76	-0.17	-2.06	1.73	0.47
Summer tanager	2,112	0.76	-1.91	2.77	-0.01	-1.56	1.54	0.58
Turkey vulture	40	3.22	-8.72	17.99	0.82	-1.81	3.44	0.04 Δ
Warbling vireo	24	0.20	-39.19	62.19	2.65	-0.64	5.94	0.02 Δ
Whip-poor-will	9	0.15	-54.82	122.49	-0.23	-0.58	0.13	0.49 Δ
White-breasted nuthatch	1,467	-2.27	-4.27	-0.38	0.88	-1.40	3.15	0.41
White-eyed vireo	2,088	-1.38	-3.03	0.05	1.33	-0.34	3.00	0.54
Wild turkey	191	-3.61	-9.11	2.22	-3.83	-6.21	-1.45	0.07
Wood thrush	993	-7.64	-10.40	-5.35	-5.62	-8.82	-2.41	0.36
Worm-eating warbler	1,130	1.86	-0.19	3.98	3.24	2.19	4.29	0.28
Yellow-billed cuckoo	2,352	-8.48	-11.29	-6.07	-9.98	-13.79	-6.17	1.60
Yellow-breasted chat	1,308	-6.69	-8.94	-4.69	-1.30	-4.21	1.61	0.38
Yellow-throated vireo	900	9.80	5.73	14.78	9.82	7.20	12.44	0.23
Yellow-throated warbler	526	10.95	6.67	16.84	13.30	10.98	15.63	0.13

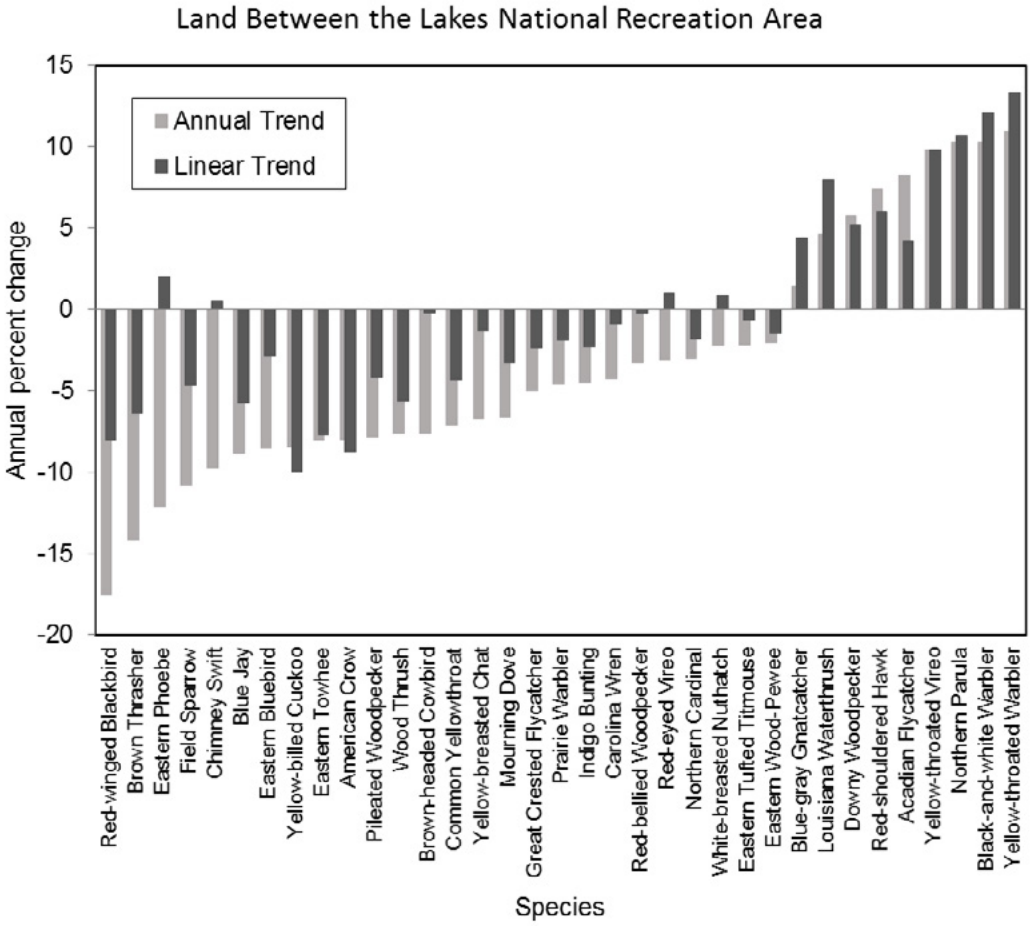

Figure 19.—Significant (based on 95-percent credible interval) positive and negative annual and linear trends for bird species in Land Between the Lakes National Recreation Area, 1993–2017.

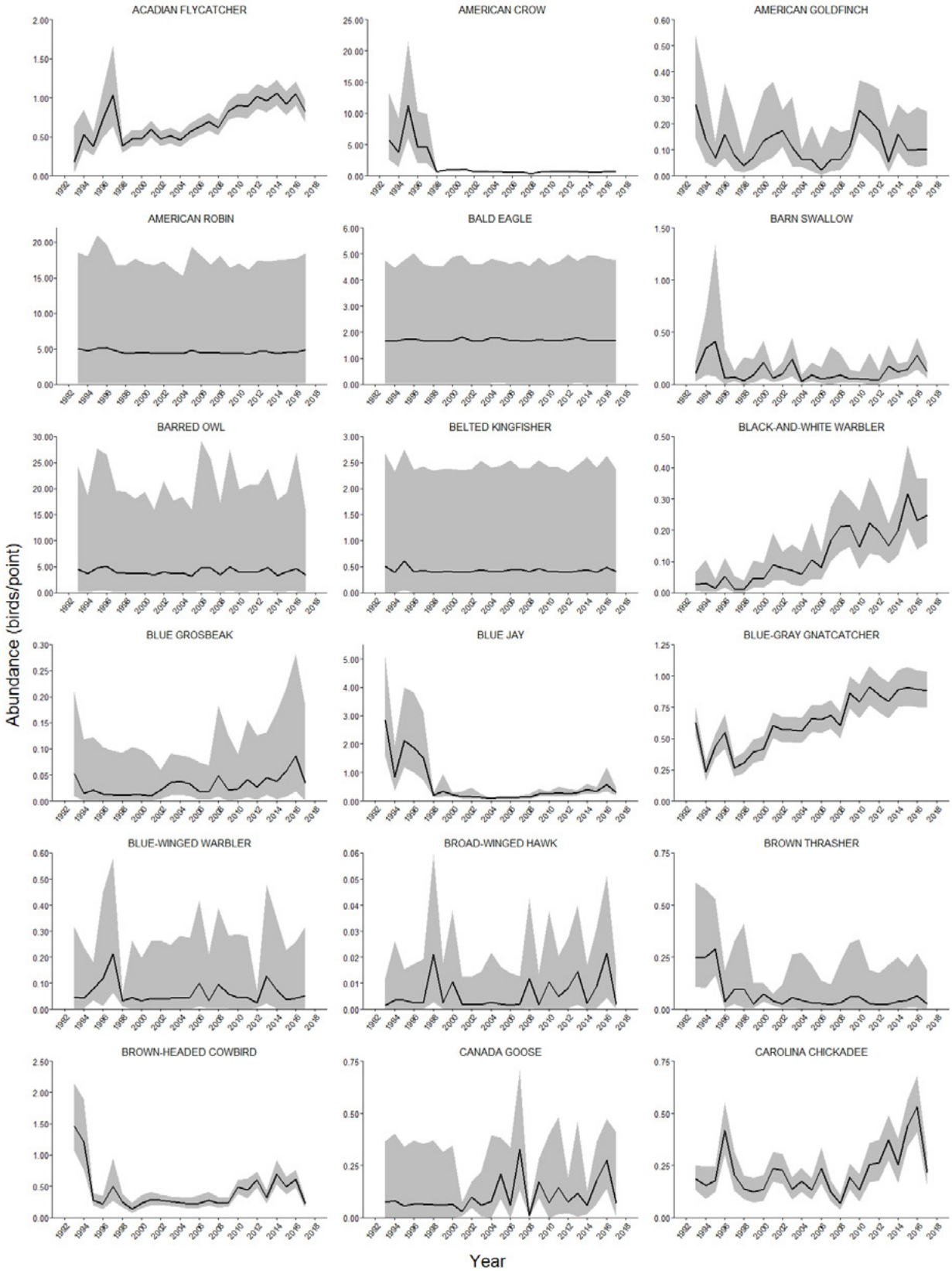

Figure 20. (page 1 of 5)—Estimated abundances and 95-percent credible intervals (shaded areas) for 77 bird species in Land Between the Lakes National Recreation Area, by year. The scale of the abundance axes may vary among species to best illustrate patterns in abundance.

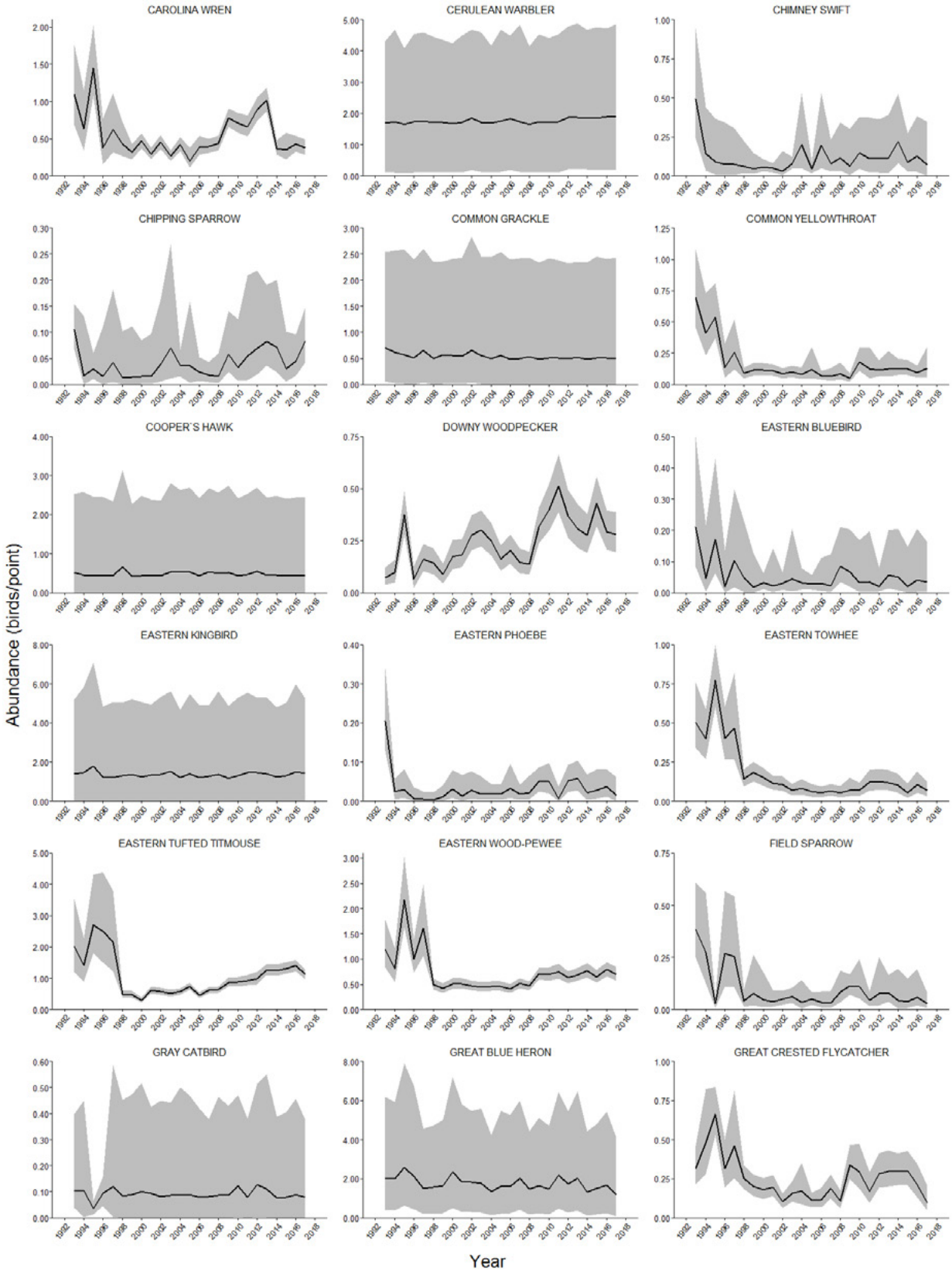

Figure 20 (page 2 of 5)

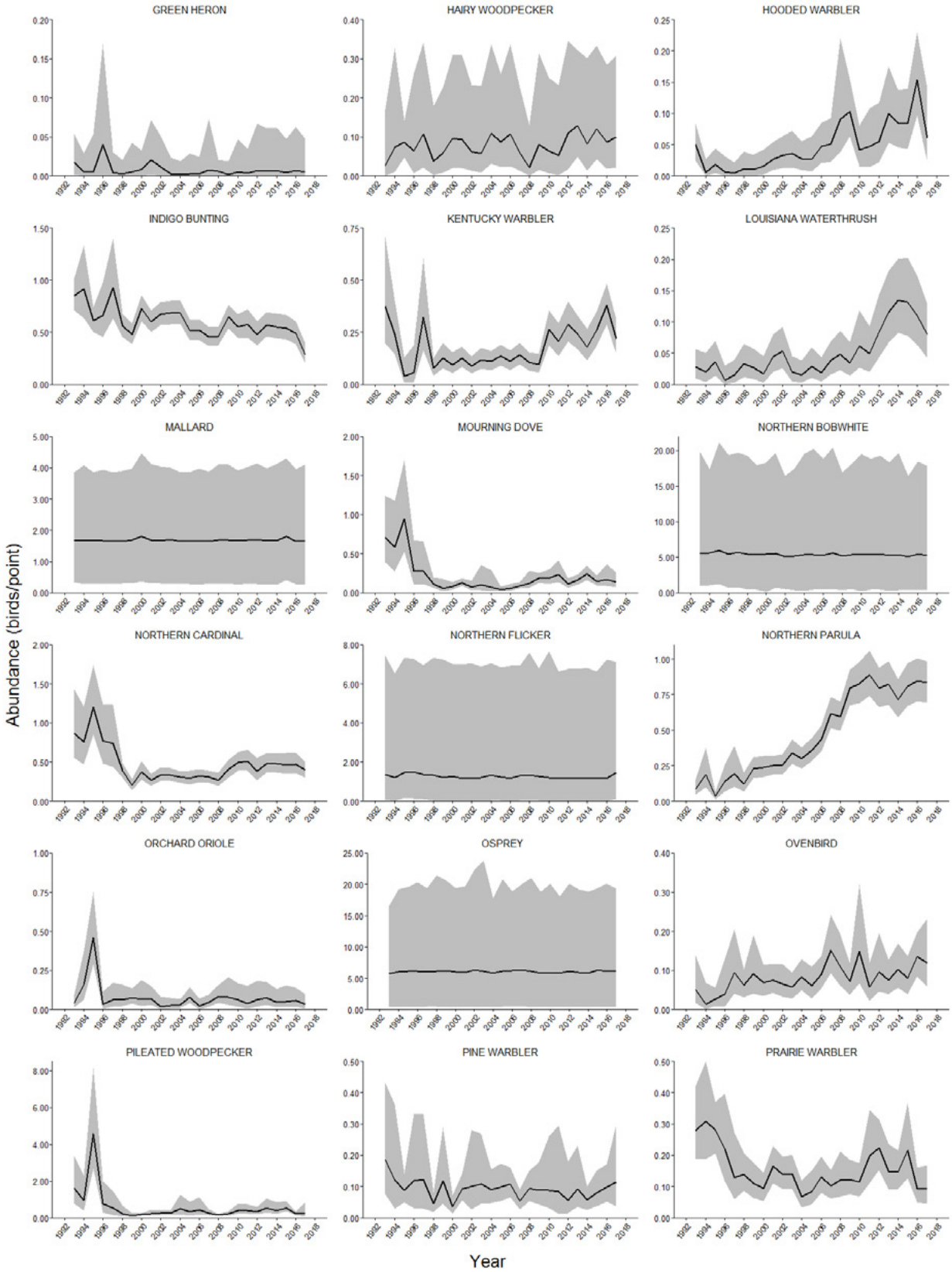

Figure 20 (page 3 of 5)

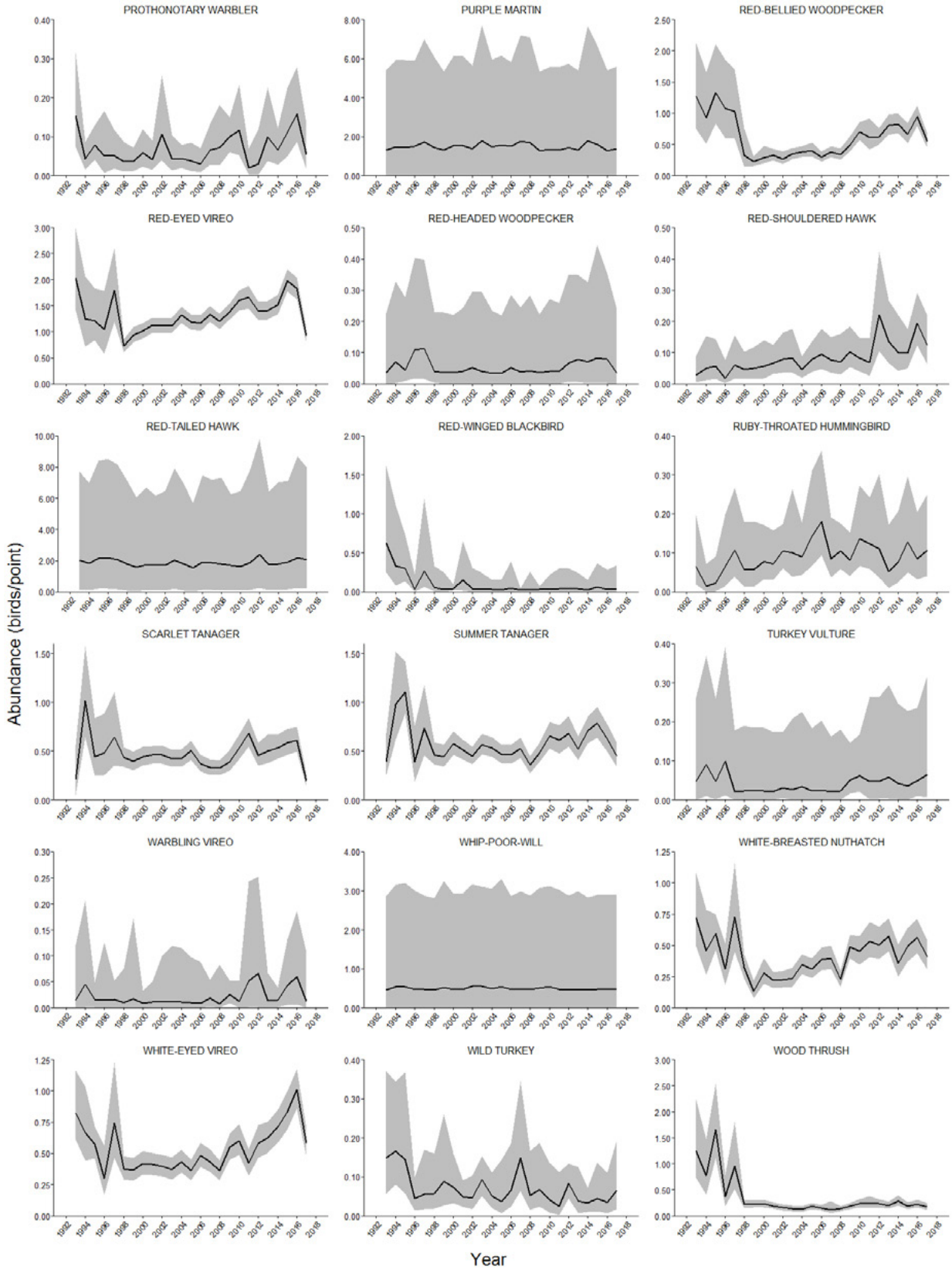

Figure 20 (page 4 of 5)

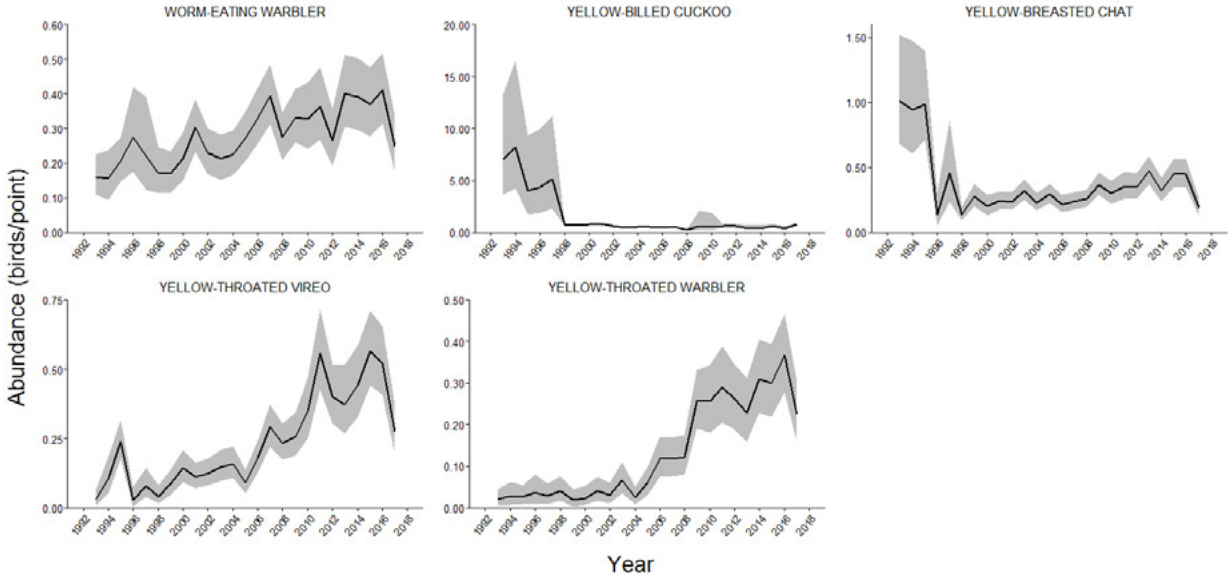

Figure 20 (page 5 of 5)

Mississippi National Forests

Mississippi National Forests surveyed the greatest number of points in the region and completed 14,945 point counts between 1994 and 2017. The number of points surveyed ranged from 840 points in 2007 to 39 points in 1998. We estimated abundances and population trends for 92 species (Table 12). Red-eyed vireo showed the highest average abundance (0.92 bird/point), followed by northern cardinal (0.86 bird/point) and eastern tufted titmouse (0.82 bird/point). Species with the lowest average abundances were red-tailed hawk, painted bunting, and chuck-will's-widow, each with 0.01 bird/point. Most of the species had positive annual trends; 15 species had significant positive annual trends and 4 species had significant negative annual trends (Figs. 21, 22). Woodland-breeding species with significant annual trends were hairy woodpecker (17.43 percent), white-breasted nuthatch (14.93 percent), downy woodpecker (12.34 percent), red-bellied woodpecker (4.24 percent), eastern wood-pewee (3.90 percent), pileated woodpecker (3.36 percent), and blue-gray gnatcatcher (3.10 percent). Early-successional, scrub-breeding species with significant positive annual trends were eastern towhee (5.86 percent), common yellowthroat (5.61 percent), prairie warbler (4.82 percent), northern cardinal (2.62 percent), and Carolina wren (2.23 percent). Only woodland-breeding species had significant negative annual trends: Swainson's warbler (-16.20 percent), Kentucky warbler (-3.96 percent), yellow-billed cuckoo (-3.35 percent), and red-eyed vireo (-1.64 percent). Most linear trends were similar to annual trends, but differed for a few species (Fig. 21).

Table 12.—Number of detections, annual trend, linear trend, 95-percent credible interval defined by LCI and UCI, and average abundance for 92 bird species in Mississippi National Forests, 1994–2017; caution should be used in interpreting species abundances marked with Δ because they are based on fewer than 50 detections or had wide credible intervals and may be inaccurate or imprecise

		Annual trend			Linear trend			
Species name	Detections	Trend	LCI	UCI	Trend	LCI	UCI	Abundance (birds/point)
		percent						
Acadian flycatcher	6,122	-0.55	-2.47	1.45	-0.06	-1.61	1.50	0.42
American crow	7,719	1.93	0.37	3.58	-0.75	-1.96	0.46	0.55
American redstart	566	-5.82	-15.78	6.33	-4.17	-7.70	-0.64	0.05
American robin	172	19.37	-20.41	151.23	-2.34	-8.54	3.86	0.03
Bachman's sparrow	720	-3.94	-10.56	5.65	-0.01	-2.16	2.14	0.07
Barn swallow	299	12.11	-11.17	60.26	0.80	-4.35	5.94	0.04
Barred owl	445	-2.70	-14.05	8.96	1.67	-3.27	6.61	0.07
Belted kingfisher	18	-0.04	-6.88	6.14	-0.16	-0.66	0.33	1.68 Δ
Black vulture	87	-3.90	-26.90	25.78	-2.33	-7.05	2.39	0.02 Δ
Black-and-white warbler	1,513	5.07	-2.27	14.59	0.45	-3.48	4.38	0.17
Blue grosbeak	295	16.43	-1.40	65.78	7.78	4.41	11.15	0.02
Blue jay	8,566	4.75	3.05	6.63	1.86	0.30	3.41	0.62
Blue-gray gnatcatcher	3,142	3.10	0.25	6.18	1.46	-0.73	3.64	0.22
Blue-winged warbler	14	0.87	-75.29	299.36	-2.54	-7.45	2.38	0.02 Δ
Broad-winged hawk	138	-2.01	-35.52	49.94	-1.41	-4.93	2.11	0.02 Δ
Brown thrasher	515	-0.56	-8.70	11.13	3.97	1.67	6.26	0.05
Brown-headed cowbird	1,198	-0.55	-8.77	7.60	-0.46	-4.54	3.62	0.14
Brown-headed nuthatch	738	1.34	-4.53	11.57	2.21	-1.06	5.48	0.06
Carolina chickadee	4,618	1.92	-0.34	4.30	1.41	-0.02	2.85	0.33
Carolina wren	9,870	2.23	0.74	3.81	1.53	0.39	2.67	0.68

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(Table 12 continued)

Species name	Detections	Annual trend			Linear trend			Abundance (birds/point)
		Trend	LCI	UCI	Trend	LCI	UCI	
		percent						
Cedar waxwing	69	1.37	-49.09	117.61	0.59	-1.16	2.34	0.08 Δ
Chimney swift	391	-2.53	-14.86	13.23	-9.93	-14.86	-5.01	0.06
Chipping sparrow	711	8.64	-9.75	40.50	5.78	0.13	11.43	0.07
Chuck-will's-widow	37	-1.05	-60.75	132.92	0.12	-2.96	3.19	0.01 Δ
Common grackle	30	2.74	-46.11	93.39	-0.51	-4.28	3.25	0.04 Δ
Common nighthawk	21	1.59	-22.89	86.90	0.60	0.01	1.19	0.47 Δ
Common yellowthroat	2,481	5.61	2.18	9.88	2.35	0.29	4.41	0.17
Downy woodpecker	1,692	12.34	4.18	27.06	4.13	-0.08	8.35	0.13
Eastern bluebird	198	1.67	-15.16	22.62	9.63	3.70	15.57	0.07
Eastern kingbird	152	2.38	-21.72	53.85	2.29	-0.82	5.39	0.03 Δ
Eastern meadowlark	9	-0.07	-7.44	8.05	-0.18	-0.68	0.33	1.22 Δ
Eastern phoebe	94	2.18	-46.39	94.55	-3.18	-10.03	3.67	0.03 Δ
Eastern towhee	5,301	5.86	3.56	8.41	1.41	-0.23	3.04	0.37
Eastern tufted titmouse	12,098	0.06	-1.24	1.37	1.42	0.46	2.37	0.82
Eastern wood-pewee	4,048	3.90	1.00	7.22	3.70	2.42	4.99	0.26
Field sparrow	156	0.02	-36.02	53.74	0.37	-4.25	4.98	0.02
Fish crow	359	3.81	-21.15	39.28	-0.73	-5.54	4.08	0.04
Gray catbird	167	14.81	-7.57	72.96	-1.94	-7.68	3.79	0.03
Great blue heron	79	0.77	-4.86	8.52	-0.79	-1.55	-0.03	2.00 Δ
Great crested flycatcher	5,161	2.27	-0.18	4.79	1.50	0.29	2.72	0.36
Great egret	5	2.85	-35.68	68.18	0.40	-3.74	4.54	0.02 Δ
Great horned owl	18	-0.02	-16.34	20.38	-0.45	-1.16	0.26	0.59 Δ
Green heron	17	1.11	-11.68	57.40	0.66	0.17	1.14	1.83 Δ
Hairy woodpecker	322	17.43	1.19	57.18	-0.59	-4.95	3.77	0.03
Hooded warbler	8,639	1.19	-0.34	2.81	1.85	1.05	2.65	0.59
Indigo bunting	7,901	0.90	-1.57	3.38	1.74	-0.93	4.41	0.52
Kentucky warbler	2,116	-3.96	-7.77	-0.28	3.15	0.10	6.19	0.14
Little blue heron	26	0.07	-7.66	9.16	-0.13	-0.69	0.44	1.03 Δ
Louisiana waterthrush	241	8.49	-8.30	51.35	5.67	1.63	9.71	0.03
Mississippi kite	35	0.36	-8.66	11.88	-0.82	-1.64	-0.01	1.14 Δ
Mourning dove	2,140	4.12	-0.02	8.82	2.72	0.88	4.55	0.14
Northern bobwhite	1,076	3.23	-0.54	7.59	-3.61	-6.01	-1.21	0.09
Northern cardinal	12,430	2.62	1.27	4.03	0.37	-0.69	1.42	0.86
Northern flicker	705	10.07	-1.08	25.93	0.47	-3.45	4.39	0.07
Northern mockingbird	283	-10.98	-26.02	7.79	5.69	0.85	10.54	0.05
Northern parula	1,777	0.71	-2.57	5.10	1.39	-1.06	3.84	0.13
Northern waterthrush	26	1.55	-59.17	152.59	-0.67	-5.24	3.90	0.02 Δ
Orchard oriole	247	17.91	-0.84	66.37	4.99	1.52	8.47	0.02
Ovenbird	95	1.28	-37.91	67.47	-2.62	-6.57	1.32	0.03 Δ
Painted bunting	44	0.28	-72.08	250.88	0.73	-3.65	5.11	0.01 Δ
Pileated woodpecker	3,677	3.36	0.55	6.39	1.65	-0.21	3.51	0.28
Pine warbler	11,388	1.36	-0.17	3.01	2.38	0.92	3.85	0.76
Prairie warbler	1,886	4.82	0.54	11.12	2.52	0.74	4.31	0.13
Prothonotary warbler	1,600	0.62	-9.40	12.11	1.85	-4.50	8.20	0.21

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(Table 12 continued)

Species name	Detections	Annual trend			Linear trend			Abundance (birds/point)
		Trend	LCI	UCI	Trend	LCI	UCI	
		percent						
Purple martin	75	1.98	-24.25	69.95	1.44	-2.71	5.59	0.07 Δ
Red-bellied woodpecker	7,952	4.24	2.20	6.56	1.98	0.61	3.35	0.55
Red-cockaded woodpecker	454	-2.08	-10.08	9.75	0.72	-2.28	3.73	0.04
Red-eyed vireo	13,465	-1.64	-2.86	-0.38	1.03	-0.30	2.37	0.92
Red-headed woodpecker	1,433	-2.59	-5.31	0.24	-2.77	-4.39	-1.14	0.12
Red-shouldered hawk	644	6.05	-2.25	18.46	1.37	-1.46	4.20	0.05
Red-tailed hawk	89	-0.52	-43.91	77.70	-5.54	-10.70	-0.37	0.01 Δ
Red-winged blackbird	60	-8.87	-49.25	28.23	-6.32	-10.55	-2.10	0.01 Δ
Ruby-throated hummingbird	748	7.91	-0.88	21.24	1.29	-2.49	5.08	0.07
Scarlet tanager	460	7.47	-11.68	48.24	9.80	5.17	14.43	0.03
Sharp-shinned hawk	5	0.00	-11.06	9.57	0.03	-0.33	0.38	1.00 Δ
Snowy egret	37	2.87	-52.93	135.69	0.40	-1.27	2.07	0.05 Δ
Summer tanager	7,236	1.87	0.25	3.50	0.38	-0.64	1.41	0.52
Swainson's warbler	114	-16.20	-33.97	-3.73	-6.14	-11.13	-1.15	0.01
Swallow-tailed kite	3	-0.13	-8.10	7.57	0.05	-0.19	0.28	1.08 Δ
Turkey vulture	187	0.68	-10.90	21.06	-2.85	-7.10	1.41	0.02
Warbling vireo	32	-0.06	-21.37	26.50	0.13	-0.30	0.56	0.99 Δ
Whip-poor-will	8	-0.02	-10.27	11.27	0.10	-0.28	0.48	1.37 Δ
White-breasted nuthatch	577	14.93	2.61	44.35	7.57	3.80	11.34	0.04
White-eyed vireo	5,881	-0.25	-1.90	1.49	0.56	-0.38	1.49	0.41
Wild turkey	271	2.30	-8.96	20.73	-2.04	-6.48	2.40	0.03
Wood duck	66	2.04	-38.85	72.24	0.93	-2.76	4.62	0.03 Δ
Wood thrush	3,744	-1.82	-3.95	0.36	-2.51	-3.97	-1.04	0.27
Worm-eating warbler	1,837	-4.41	-8.99	0.27	-1.30	-3.91	1.31	0.16
Yellow-billed cuckoo	5,662	-3.35	-4.96	-1.68	-1.39	-3.01	0.22	0.44
Yellow-breasted chat	6,882	-0.27	-1.90	1.43	-1.47	-2.43	-0.50	0.48
Yellow-throated vireo	1,477	1.27	-3.91	8.41	1.75	-0.78	4.29	0.12
Yellow-throated warbler	168	-16.08	-45.95	9.18	-4.18	-8.35	-0.01	0.02

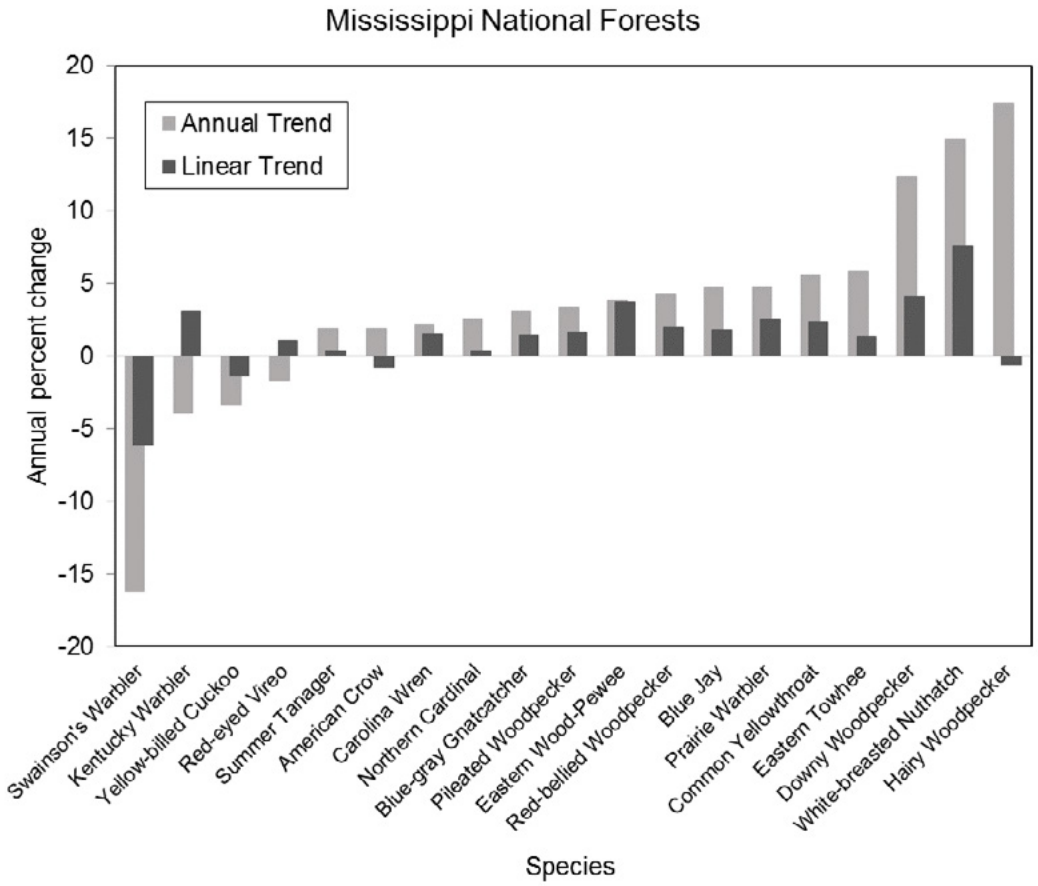


Figure 21.—Significant (based on 95-percent credible interval) positive and negative annual and linear trends for bird species in Mississippi National Forests, 1994–2017.

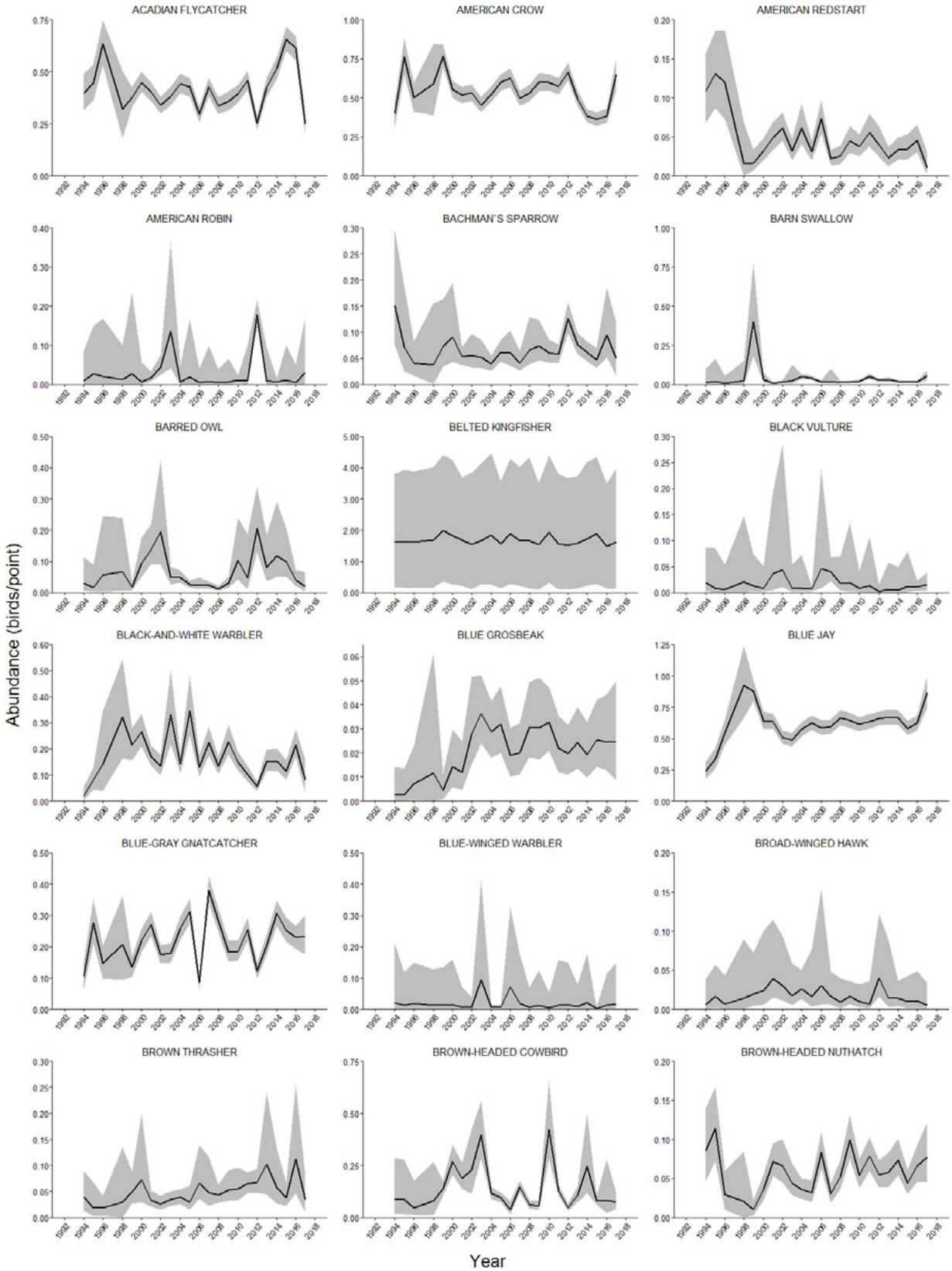
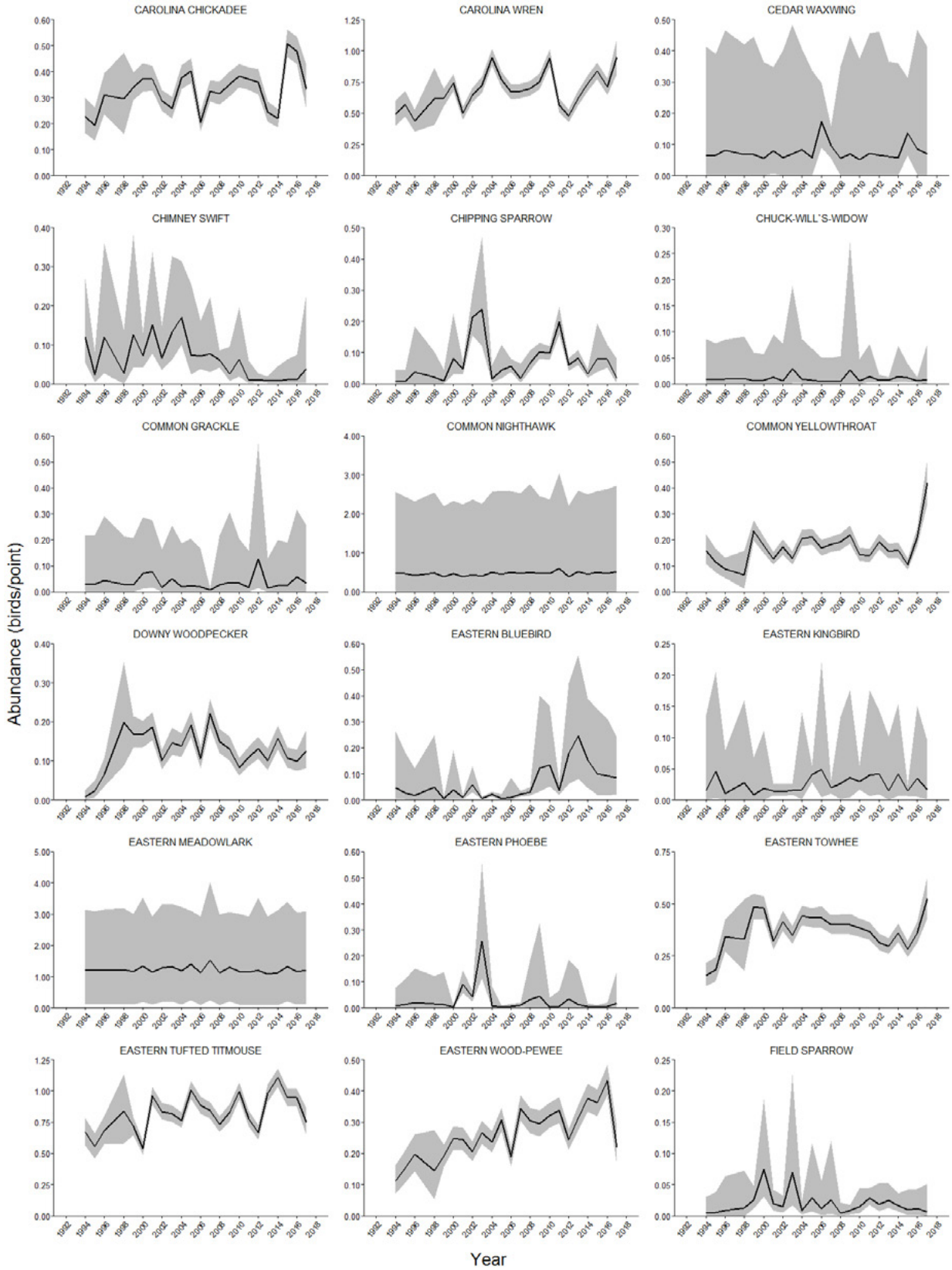


Figure 22. (page 1 of 6)—Estimated abundances and 95-percent credible intervals (shaded areas) for 92 bird species in Mississippi National Forests, by year. The scale of the abundance axes may vary among species to best illustrate patterns in abundance.



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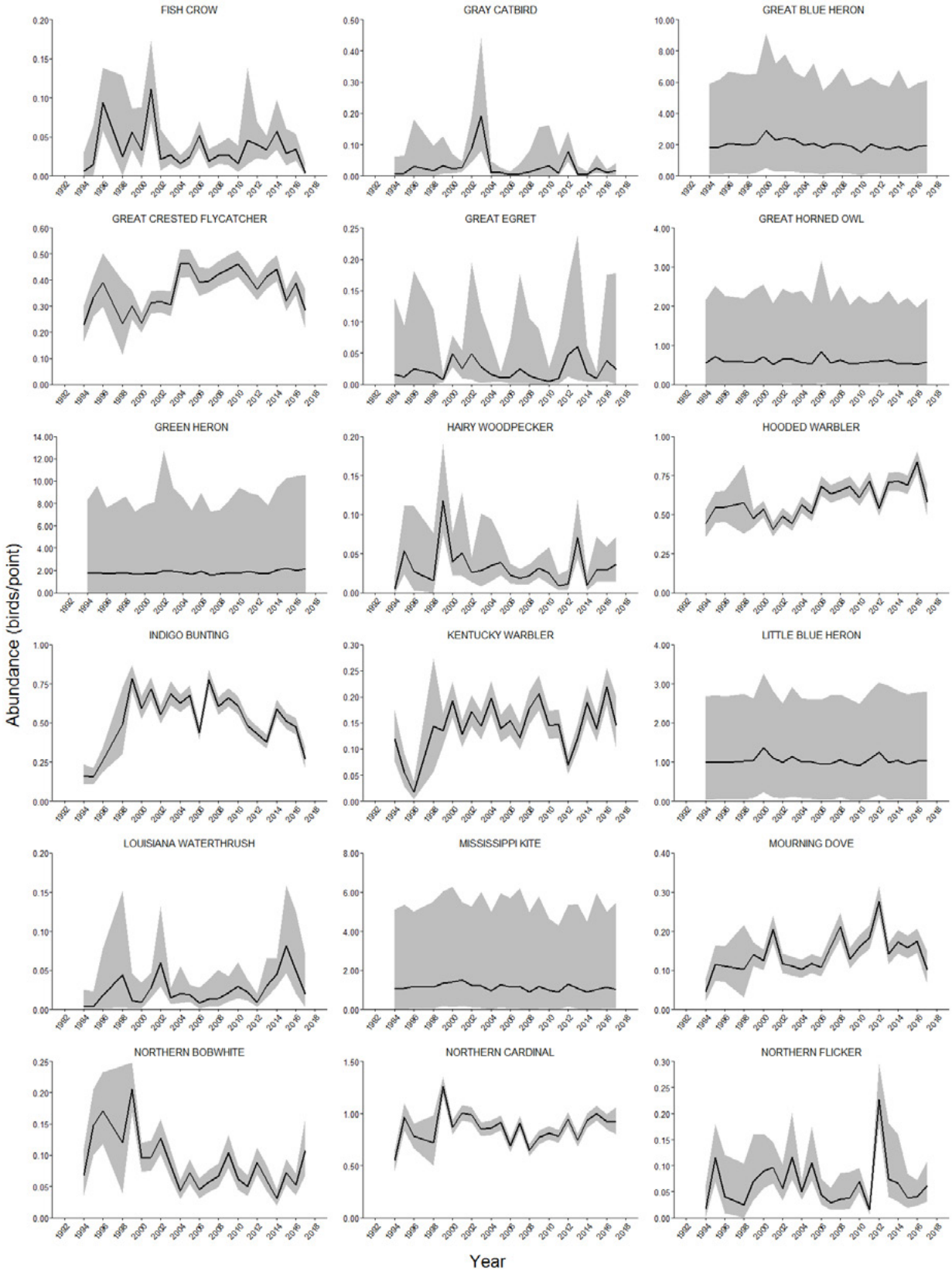
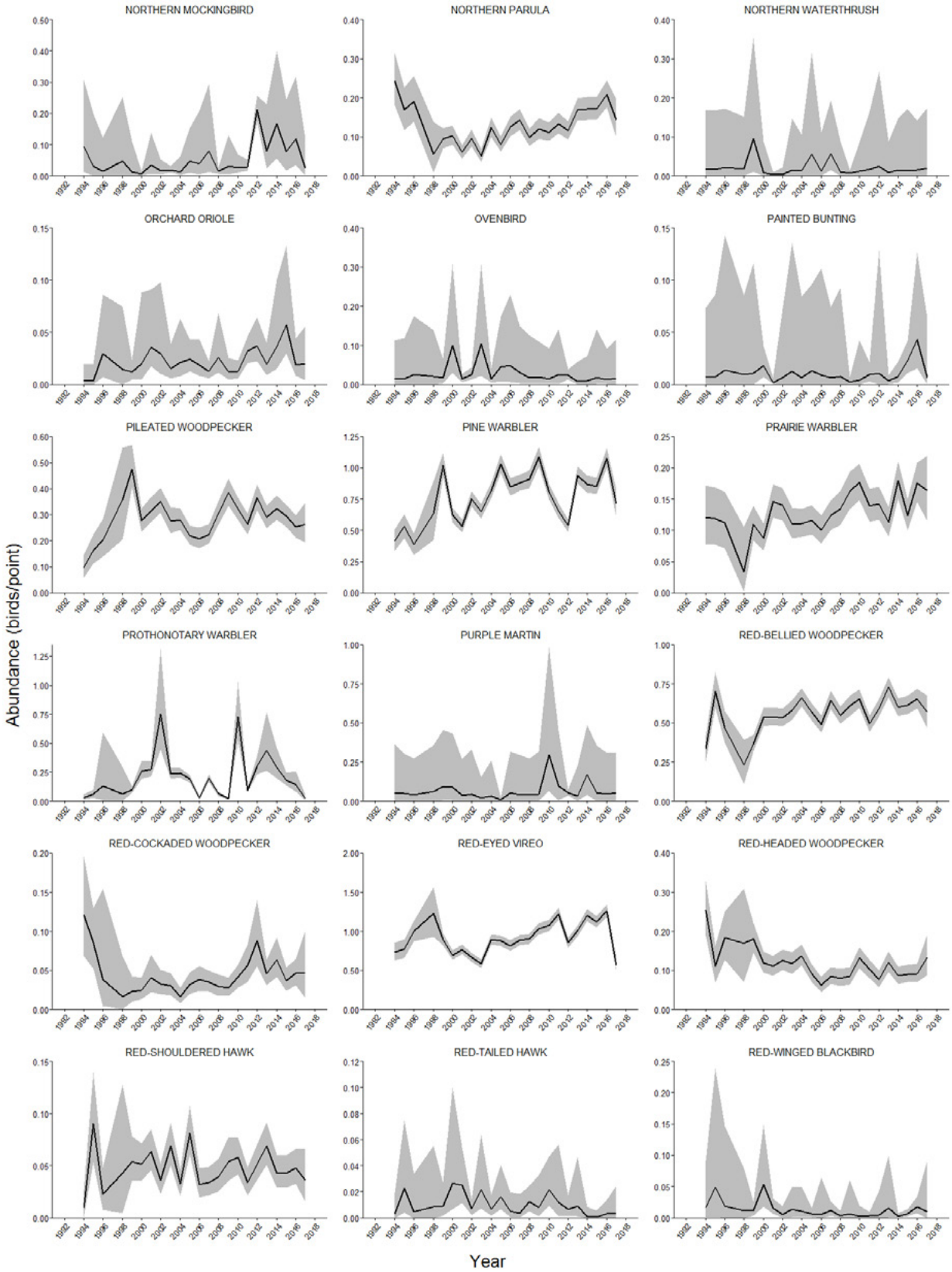


Figure 22 (page 3 of 6)



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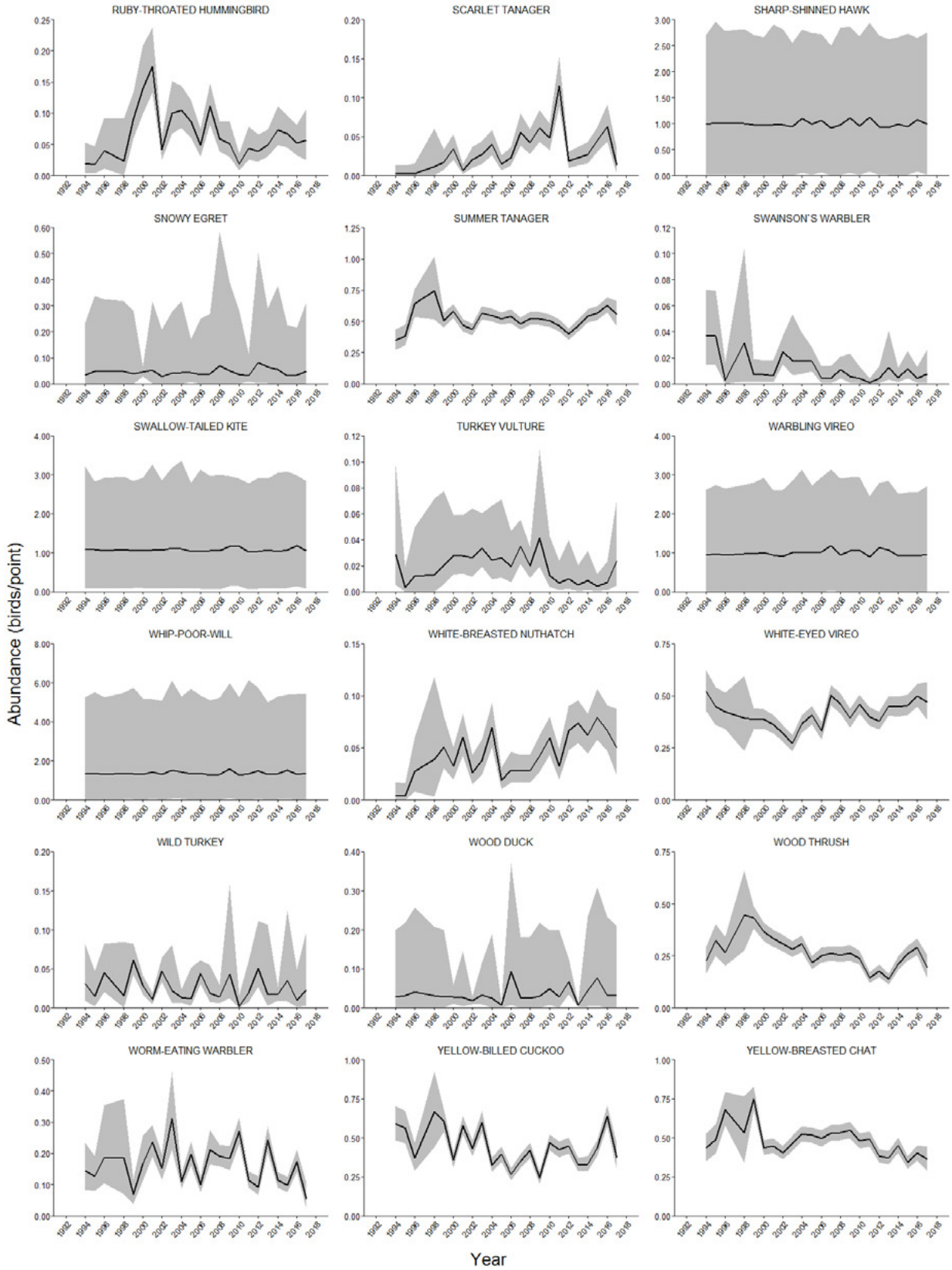

Figure 22 (page 5 of 6)

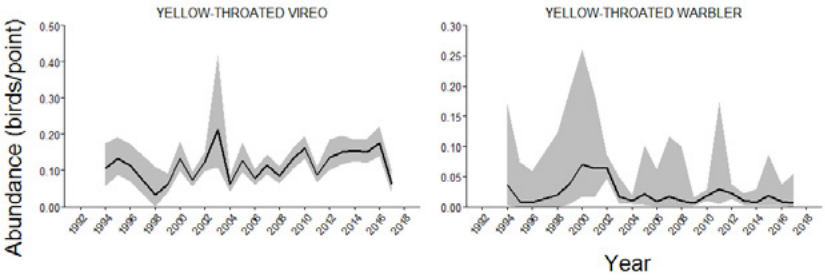

Figure 22 (page 6 of 6)

North Carolina National Forests

North Carolina National Forests completed 6,285 point counts between 1997 and 2017. The number of points surveyed ranged from 343 in 1998 to 225 in 2014. We estimated abundances and population trends for 117 species (Table 13), which was the most species modeled on a forest in the region. Dark-eyed junco (1.36 birds/point), red-eyed vireo (1.11 birds/point), and eastern towhee (0.77 bird/point) had the greatest average abundances. Ruby-crowned kinglet (0.02 bird/point), orchard oriole (0.02 bird/point), and red-winged blackbird (0.01 bird/point) had the lowest average abundances. The number of species with positive annual abundance trends was similar to the number with negative trends; 19 species had significant positive annual trends and 19 species had negative annual trends (Figs. 23, 24). Most of the species with significant positive annual trends were woodland-breeding species. The species with the greatest positive trends were alder flycatcher (23.27 percent), Swainson's warbler (22.47 percent), hermit thrush (11.51 percent), and wild turkey (10.82 percent). Additional woodland-breeding species with annual trends of between 3 and 5.5 percent were Blackburnian warbler, worm-eating warbler, black-throated green warbler, and northern parula. Black-and-white warbler, hooded warbler, scarlet tanager, and wood thrush increased by less than 3 percent per year. The only early-successional, scrub-breeding species with a significant positive annual trend was northern cardinal (2.21 percent). Early-successional, scrub-breeding species with significant negative annual trends were golden-winged warbler (-22.16 percent), northern bobwhite (-16.44 percent), yellow-breasted chat (-7.83 percent), song sparrow (-4.80 percent), prairie warbler (-4.71 percent), chestnut-sided warbler (-4.55 percent), and eastern towhee (-2.84 percent). Woodland-breeding species with significant negative annual trends were Kentucky warbler (-19.34 percent), summer tanager (-14.79 percent), pine siskin (-14.09 percent), dark-eyed junco (-3.85 percent), and red-eyed vireo (-1.33 percent). Linear trends were generally similar to annual trends, but differed in magnitude or direction for a few species (Fig. 23).

Table 13.—Number of detections, annual trend, linear trend, 95-percent credible interval defined by LCI and UCI, and average abundance for 117 bird species in North Carolina National Forests, 1997–2017; caution should be used in interpreting species abundances marked with Δ because they are based on fewer than 50 detections or had wide credible intervals and may be inaccurate or imprecise

		Annual trend			Linear trend			
Species name	Detections	Trend	LCI	UCI	Trend	LCI	UCI	Abundance (birds/point)
		percent						
Acadian flycatcher	1,393	1.16	-1.05	3.35	1.90	0.19	3.60	0.24
Alder flycatcher	151	23.27	0.29	92.24	12.87	9.18	16.55	0.05
American crow	3,443	1.08	0.02	2.17	0.58	-0.45	1.61	0.59
American goldfinch	1,087	-2.83	-5.46	-0.05	-2.95	-5.52	-0.39	0.25
American redstart	111	-12.50	-36.22	2.47	0.85	-3.43	5.13	0.05
American robin	1,629	1.27	-0.84	3.27	-0.53	-2.44	1.38	0.42
Bachman's sparrow	32	-1.14	-43.95	77.95	-4.55	-9.46	0.36	0.02 Δ
Barn swallow	19	-2.22	-29.46	4.00	-0.22	-0.85	0.42	1.11 Δ
Barred owl	53	1.53	-2.45	7.67	0.17	-0.61	0.94	1.79 Δ
Belted kingfisher	14	0.54	-4.24	9.73	0.21	-0.30	0.72	2.88 Δ
Black-and-white warbler	1,136	2.98	0.19	5.45	1.19	-0.86	3.24	0.27
Black-billed cuckoo	17	-0.03	-5.11	6.31	0.17	-0.21	0.54	3.64 Δ
Blackburnian warbler	475	5.48	1.53	9.08	-0.19	-3.59	3.21	0.11

(continued on next page)

(Table 13 continued)

Species name	Detections	Annual trend			Linear trend			Abundance (birds/point)
		Trend	LCI	UCI	Trend	LCI	UCI	
		percent						
Black-capped chickadee	64	1.67	-6.48	10.11	-1.52	-7.71	4.67	0.04
Black-throated blue warbler	1,686	0.52	-1.11	2.17	-0.40	-2.19	1.39	0.32
Black-throated green warbler	2,026	4.06	2.76	5.40	1.46	-0.25	3.18	0.36
Blue grosbeak	87	11.51	-9.17	82.56	0.05	-8.46	8.56	0.02
Blue jay	1,351	-0.35	-2.38	1.86	1.58	0.44	2.71	0.28
Blue-gray gnatcatcher	695	0.06	-2.89	3.03	-1.33	-4.61	1.95	0.13
Blue-headed vireo	1,974	1.75	0.47	3.00	-0.51	-2.99	1.97	0.35
Blue-winged warbler	169	-18.51	-50.71	0.75	-10.39	-13.89	-6.90	0.06 Δ
Broad-winged hawk	71	1.43	-2.89	9.98	1.10	0.39	1.81	2.04 Δ
Brown creeper	216	-5.02	-10.59	0.55	-6.30	-10.43	-2.17	0.09
Brown thrasher	166	1.95	-5.26	9.40	0.29	-4.31	4.90	0.05
Brown-headed cowbird	408	-5.08	-10.55	0.23	-3.39	-8.50	1.71	0.11
Brown-headed nuthatch	207	-5.47	-16.83	4.23	-2.07	-11.53	7.38	0.04
Canada goose	62	-6.42	-12.09	-0.97	-1.55	-6.18	3.08	0.05 Δ
Canada warbler	855	2.19	-0.03	4.49	2.15	-0.10	4.41	0.15
Carolina chickadee	1,574	1.96	0.04	3.99	2.82	1.83	3.80	0.29
Carolina wren	1,889	-2.47	-4.63	-0.32	-2.17	-5.34	1.00	0.32
Cedar waxwing	469	-1.13	-4.55	2.82	-0.85	-4.97	3.27	0.22
Chestnut-sided warbler	2,920	-4.55	-5.89	-3.28	-8.43	-10.29	-6.57	0.49
Chimney swift	312	4.21	-1.38	9.24	-0.30	-2.81	2.21	0.08
Chipping sparrow	111	-1.99	-7.76	4.70	1.35	-2.87	5.57	0.03
Common grackle	194	-13.59	-31.56	-0.45	-4.50	-10.49	1.50	0.09
Common nighthawk	18	0.04	-19.18	23.97	-0.53	-1.45	0.40	0.74 Δ
Common raven	151	0.39	-5.19	5.98	-4.52	-10.00	0.97	0.08
Common yellowthroat	1,587	-0.27	-2.52	1.97	-2.99	-6.35	0.37	0.39
Cooper's hawk	6	0.64	-4.87	9.83	0.20	-0.10	0.50	1.43 Δ
Dark-eyed Junco	3,465	-3.85	-5.85	-2.11	-8.47	-12.41	-4.52	1.36
Downy woodpecker	410	2.37	-1.40	7.20	1.54	-0.77	3.84	0.12
Eastern bluebird	92	-3.14	-15.43	5.47	-0.14	-1.18	0.91	0.60 Δ
Eastern kingbird	53	-2.73	-31.19	4.29	-0.71	-1.59	0.18	1.18 Δ
Eastern phoebe	93	6.30	-3.16	14.00	4.23	1.33	7.13	0.03
Eastern towhee	4,556	-2.84	-3.90	-1.79	-2.70	-3.69	-1.72	0.77
Eastern tufted titmouse	3,083	2.23	1.08	3.39	2.46	1.24	3.68	0.54
Eastern wood-pewee	660	-0.71	-3.89	2.09	0.81	-1.32	2.93	0.13
European starling	8	-0.03	-9.95	8.79	0.02	-0.30	0.34	1.64 Δ
Field sparrow	262	-3.24	-7.31	0.70	-3.68	-5.75	-1.62	0.05
Fish crow	62	-8.11	-39.49	5.70	-1.44	-2.18	-0.70	0.47 Δ
Golden-crowned Kinglet	1,365	-5.18	-7.34	-3.00	-13.34	-18.24	-8.43	0.74
Golden-winged warbler	80	-22.16	-58.96	-1.84	-12.02	-16.59	-7.45	0.02 Δ
Gray catbird	1,158	-0.61	-2.92	1.80	-1.27	-3.59	1.04	0.25
Great crested flycatcher	837	-2.46	-6.29	1.14	-1.72	-6.43	3.00	0.19
Great horned owl	4	-0.64	-9.77	5.48	-0.42	-0.64	-0.20	1.47 Δ
Green heron	10	-0.52	-9.49	5.14	-0.30	-0.60	0.00	2.70 Δ
Hairy woodpecker	254	0.95	-3.61	6.65	0.69	-1.60	2.97	0.07

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(Table 13 continued)

Species name	Detections	Annual trend			Linear trend			Abundance (birds/point)
		Trend	LCI	UCI	Trend	LCI	UCI	
		percent						
Hermit thrush	172	11.51	0.03	26.78	3.81	-1.02	8.64	0.09
Hooded warbler	2,512	2.17	0.92	3.46	1.81	0.75	2.87	0.43
House wren	70	12.51	-6.48	65.58	1.56	-4.03	7.15	0.03 Δ
Indigo bunting	2,610	-3.83	-5.31	-2.38	-4.21	-5.30	-3.12	0.44
Kentucky warbler	92	-19.34	-46.62	-2.91	-9.17	-12.65	-5.69	0.02 Δ
Least flycatcher	206	0.95	-4.67	6.65	-1.48	-5.45	2.48	0.09
Louisiana waterthrush	124	9.14	-1.26	19.61	10.36	7.70	13.01	0.04
Magnolia warbler	11	-0.06	-10.16	10.50	0.04	-0.45	0.54	1.63 Δ
Mourning dove	1,038	0.74	-1.55	3.01	0.49	-1.61	2.60	0.18
Northern bobwhite	217	-16.44	-37.50	-5.91	-10.40	-17.17	-3.64	0.05
Northern cardinal	1,638	2.21	0.17	4.33	1.78	-0.22	3.78	0.31
Northern flicker	354	-2.67	-7.75	2.82	-0.03	-2.61	2.56	0.09
Northern mockingbird	17	-7.88	-72.47	11.40	-0.31	-0.81	0.19	0.24 Δ
Northern parula	1,270	3.24	1.31	5.20	0.80	-0.78	2.38	0.24
Orchard oriole	32	-0.89	-58.35	143.05	-4.95	-10.19	0.30	0.02 Δ
Ovenbird	4,113	1.09	0.02	2.17	0.34	-0.50	1.18	0.71
Peregrine falcon	4	0.77	-6.31	21.55	-0.19	-0.69	0.31	1.13 Δ
Pileated woodpecker	1,615	1.11	-0.54	2.97	1.05	-0.23	2.33	0.34
Pine siskin	245	-14.09	-21.25	-5.68	-5.39	-9.76	-1.02	0.13
Pine warbler	1,142	-0.44	-3.36	2.41	-0.87	-5.13	3.40	0.22
Prairie warbler	1,036	-4.71	-8.94	-1.02	-5.71	-11.49	0.07	0.21
Prothonotary warbler	369	0.56	-28.03	42.22	-1.22	-9.65	7.21	0.09
Purple martin	82	-0.06	-26.84	40.02	0.13	-0.67	0.92	1.11 Δ
Red crossbill	77	3.04	-10.57	20.10	-0.38	-4.53	3.78	0.08 Δ
Red-bellied woodpecker	688	-0.60	-3.30	2.14	1.20	-0.91	3.31	0.13
Red-breasted nuthatch	638	1.26	-3.33	5.53	1.66	-1.83	5.16	0.22
Red-cockaded woodpecker	76	-15.66	-52.47	5.60	-1.51	-8.53	5.51	0.03 Δ
Red-eyed vireo	6,741	-1.33	-2.14	-0.51	-0.95	-1.56	-0.34	1.11
Red-headed woodpecker	119	-13.23	-39.40	0.87	-2.77	-10.20	4.67	0.03
Red-shouldered hawk	28	1.46	-3.97	12.20	0.84	0.04	1.65	1.22 Δ
Red-tailed hawk	26	-2.65	-16.10	3.02	-0.45	-1.14	0.25	1.92 Δ
Red-winged blackbird	29	16.78	-14.79	222.09	-0.37	-4.97	4.24	0.01 Δ
Rose-breasted grosbeak	664	-0.69	-3.61	2.01	-1.87	-4.09	0.36	0.18
Ruby-crowned kinglet	28	-24.42	-84.38	6.24	-4.13	-7.44	-0.83	0.02 Δ
Ruby-throated hummingbird	212	1.17	-4.85	6.60	-0.68	-3.31	1.95	0.06
Ruffed grouse	77	2.56	-2.70	15.08	0.89	-0.05	1.83	1.17 Δ
Scarlet tanager	1,789	1.96	0.59	3.38	0.97	-0.60	2.54	0.33
Sharp-shinned hawk	4	0.14	-7.70	8.77	-0.14	-0.38	0.09	1.42 Δ
Song sparrow	656	-4.80	-8.33	-1.45	-5.17	-7.15	-3.19	0.20
Summer tanager	503	-14.79	-28.67	-4.57	-8.14	-14.46	-1.82	0.12
Swainson's warbler	138	22.47	3.01	69.23	9.11	4.42	13.80	0.04
Tree swallow	14	-11.25	-61.25	11.35	-2.03	-4.67	0.62	0.04 Δ
Turkey vulture	36	-2.86	-17.18	3.47	-0.43	-1.48	0.63	0.81 Δ
Veery	2,092	1.54	0.20	2.89	2.75	1.00	4.51	0.38

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(Table 13 continued)

Species name	Detections	Annual trend			Linear trend			Abundance (birds/point)
		Trend	LCI	UCI	Trend	LCI	UCI	
		percent						
Whip-poor-will	15	3.00	-13.93	20.32	2.92	-0.83	6.67	0.02 Δ
White-breasted nuthatch	753	1.16	-1.36	3.97	-0.41	-1.83	1.02	0.15
White-eyed vireo	441	-2.23	-12.66	8.87	-2.92	-9.18	3.34	0.10
Wild turkey	175	10.82	2.41	18.78	6.43	3.07	9.79	0.04
Willow flycatcher	37	-20.20	-66.59	4.40	-8.13	-11.92	-4.35	0.03 Δ
Winter wren	960	-9.53	-12.66	-6.18	-9.09	-16.48	-1.70	0.50
Wood duck	12	0.06	-9.01	10.54	0.34	-0.09	0.77	1.30 Δ
Wood thrush	1,269	1.78	0.16	3.42	0.93	-0.84	2.69	0.22
Worm-eating warbler	746	4.27	2.07	6.56	4.25	2.13	6.37	0.13
Yellow warbler	42	-8.62	-22.22	7.04	-2.20	-6.27	1.87	0.03 Δ
Yellow-bellied sapsucker	12	-1.28	-56.35	12.32	-0.05	-0.49	0.39	1.11 Δ
Yellow-billed cuckoo	602	8.88	-0.05	18.03	2.37	-1.38	6.11	0.16
Yellow-breasted chat	423	-7.83	-12.83	-3.61	-9.22	-13.38	-5.06	0.07
Yellow-rumped warbler	16	8.81	-21.19	238.28	-1.38	-5.72	2.96	0.03 Δ
Yellow-throated vireo	236	-3.26	-8.07	1.03	-3.03	-7.11	1.04	0.05
Yellow-throated warbler	446	2.03	-1.65	6.03	-1.77	-5.44	1.90	0.08

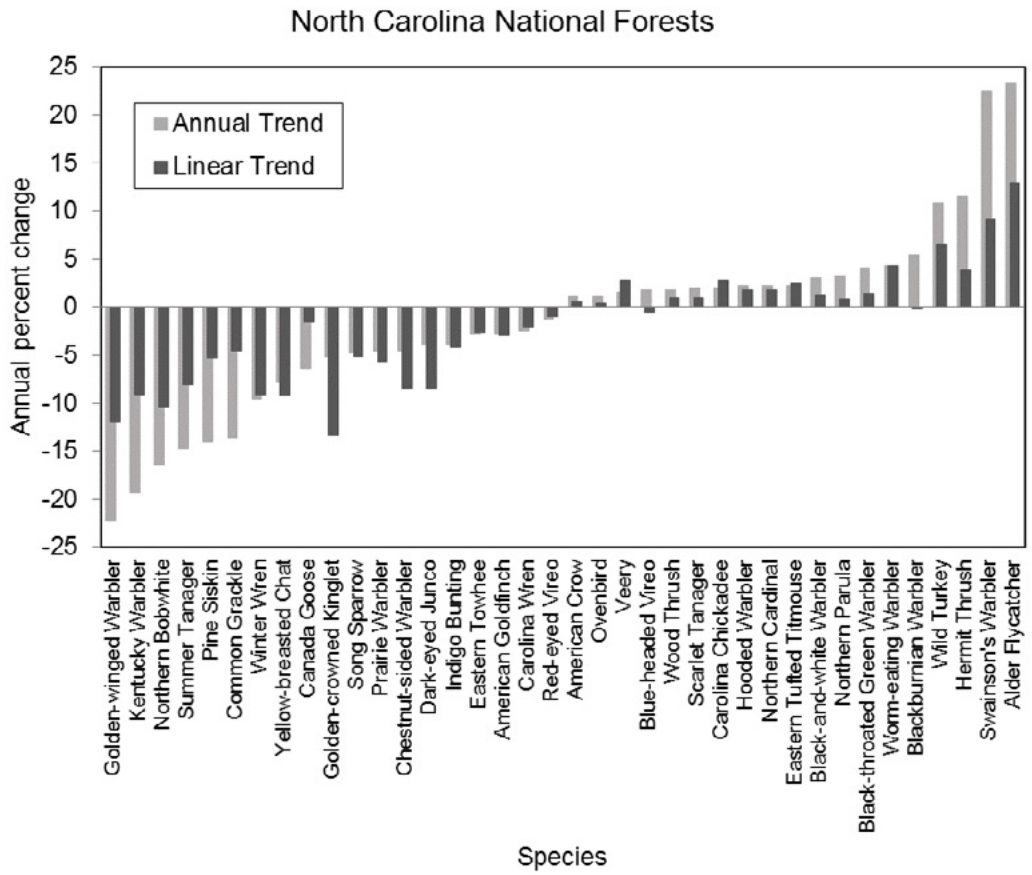


Figure 23.—Significant (based on 95-percent credible interval) positive and negative annual and linear trends for bird species in North Carolina National Forests, 1997–2017.

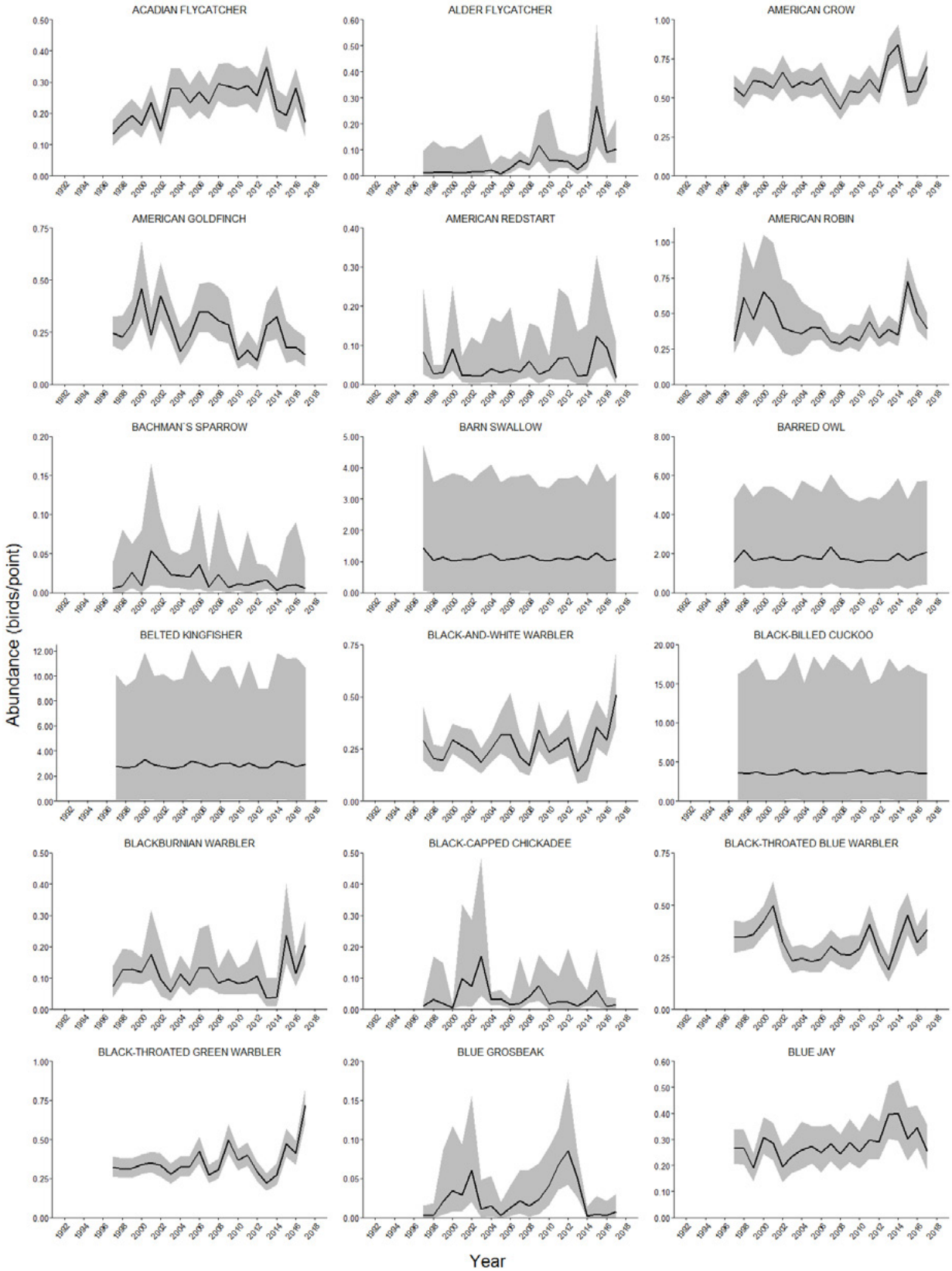


Figure 24. (page 1 of 7)—Estimated abundances and 95-percent credible intervals (shaded areas) for 117 bird species in North Carolina National Forests, by year. The scale of the abundance axes may vary among species to best illustrate patterns in abundance.

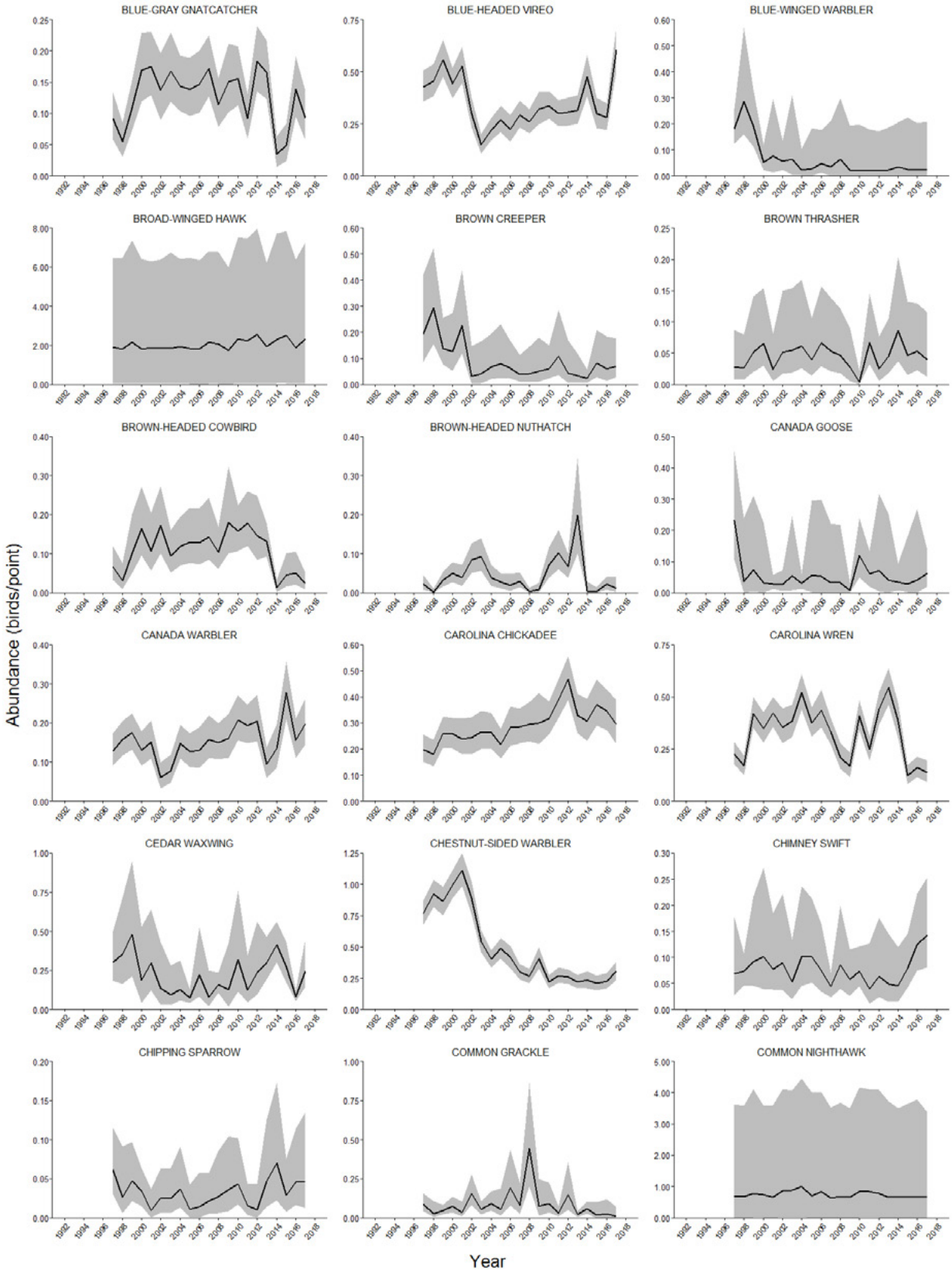


Figure 24 (page 2 of 7)

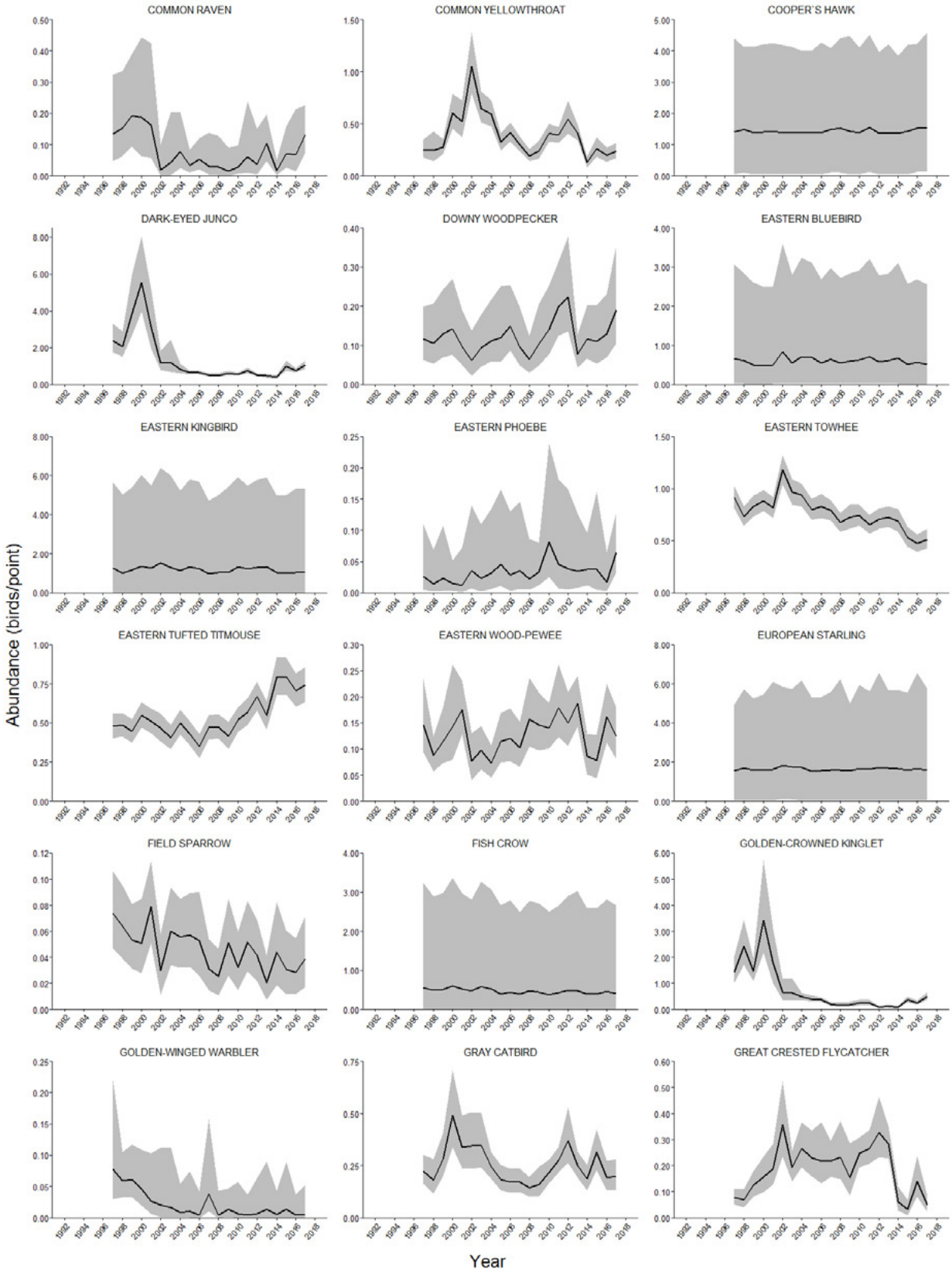
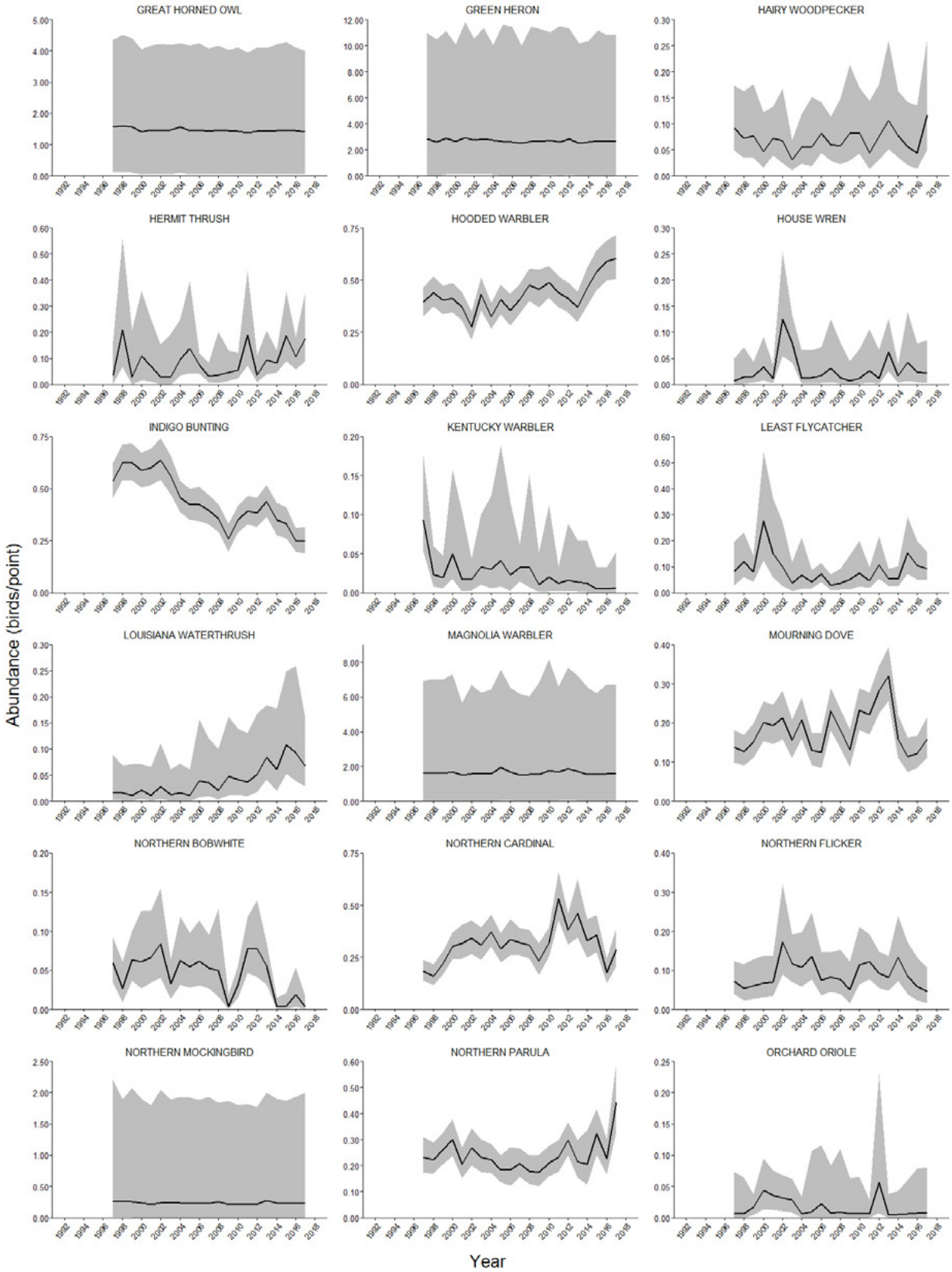


Figure 24 (page 3 of 7)



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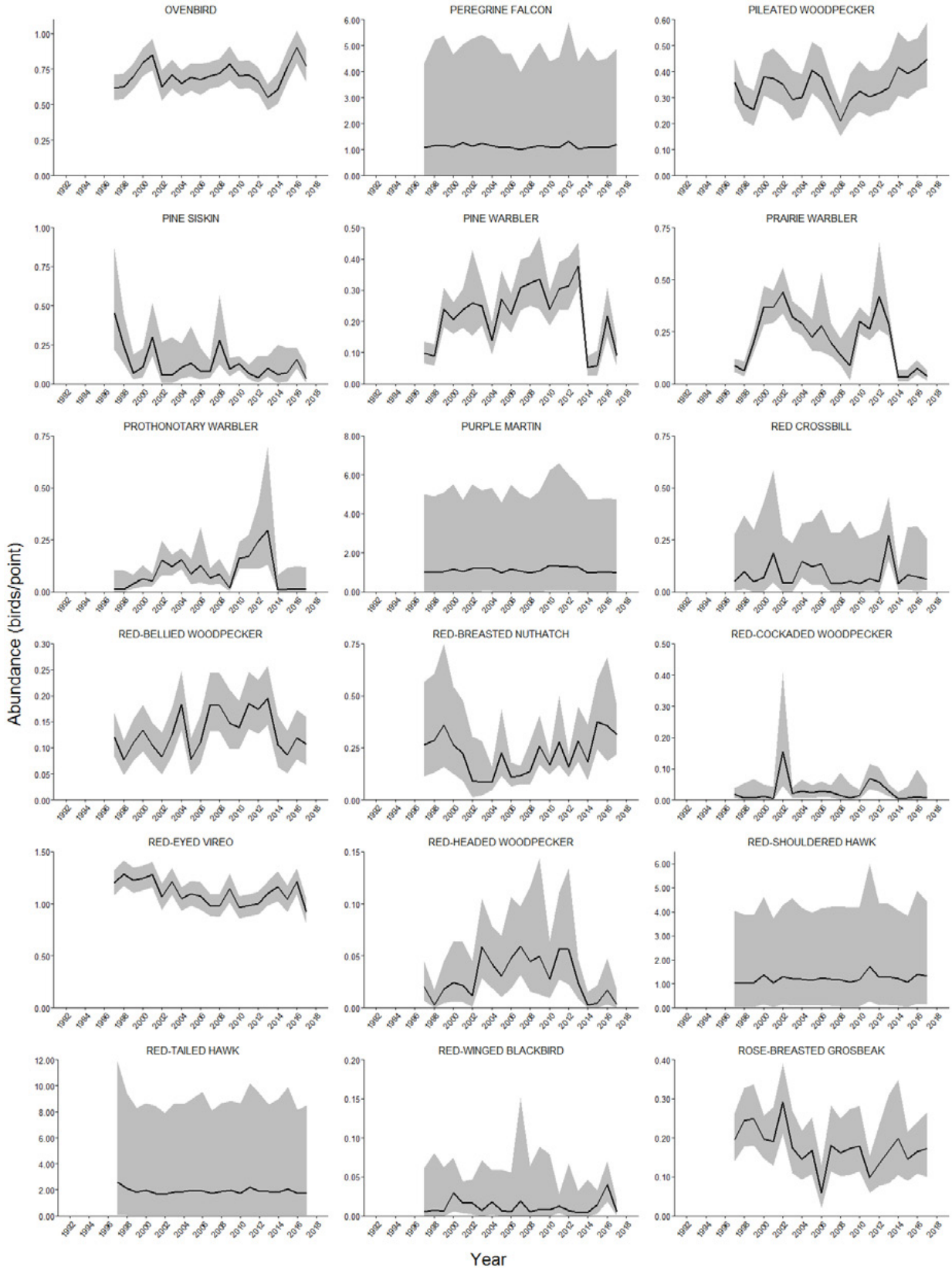

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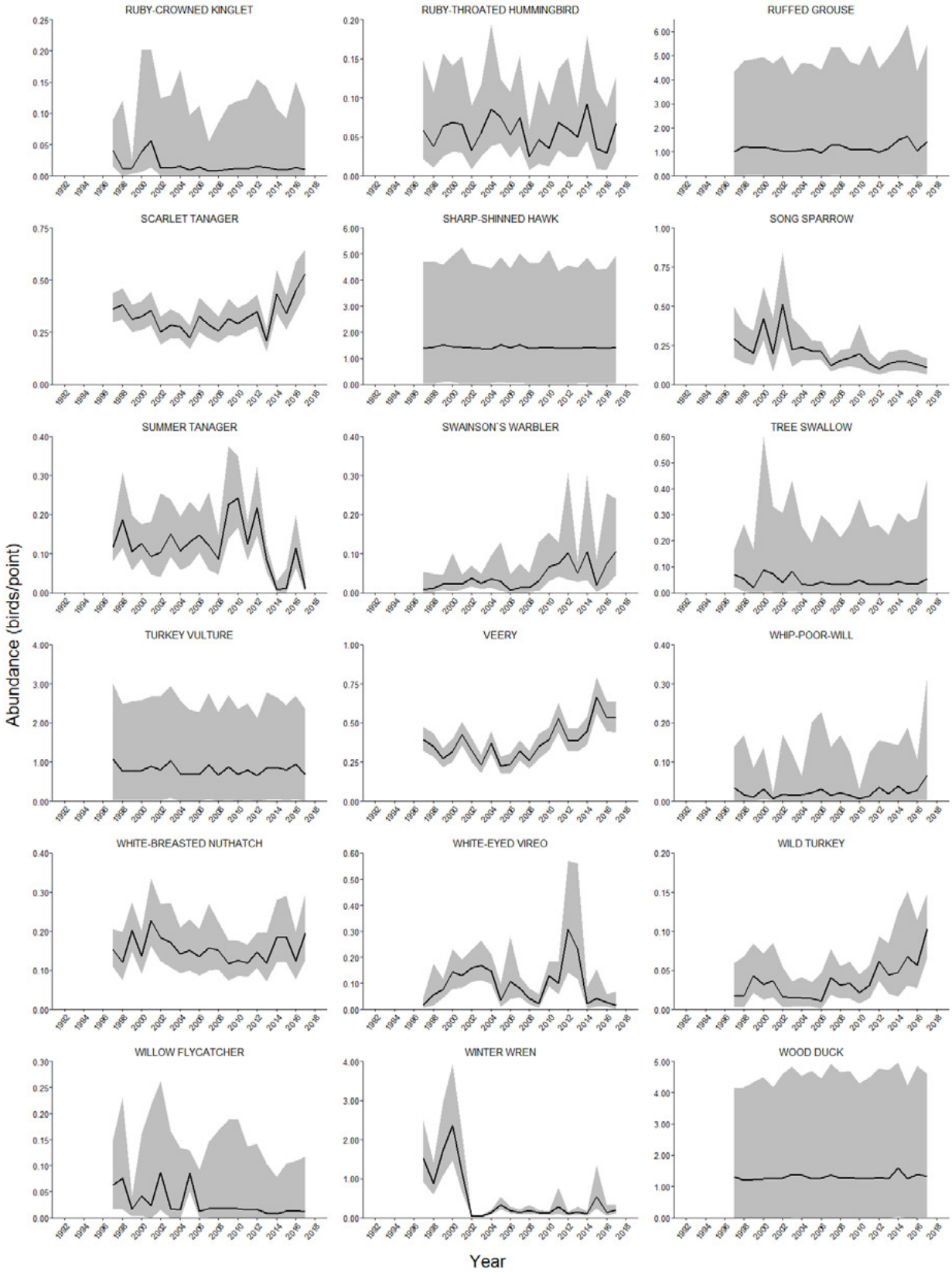

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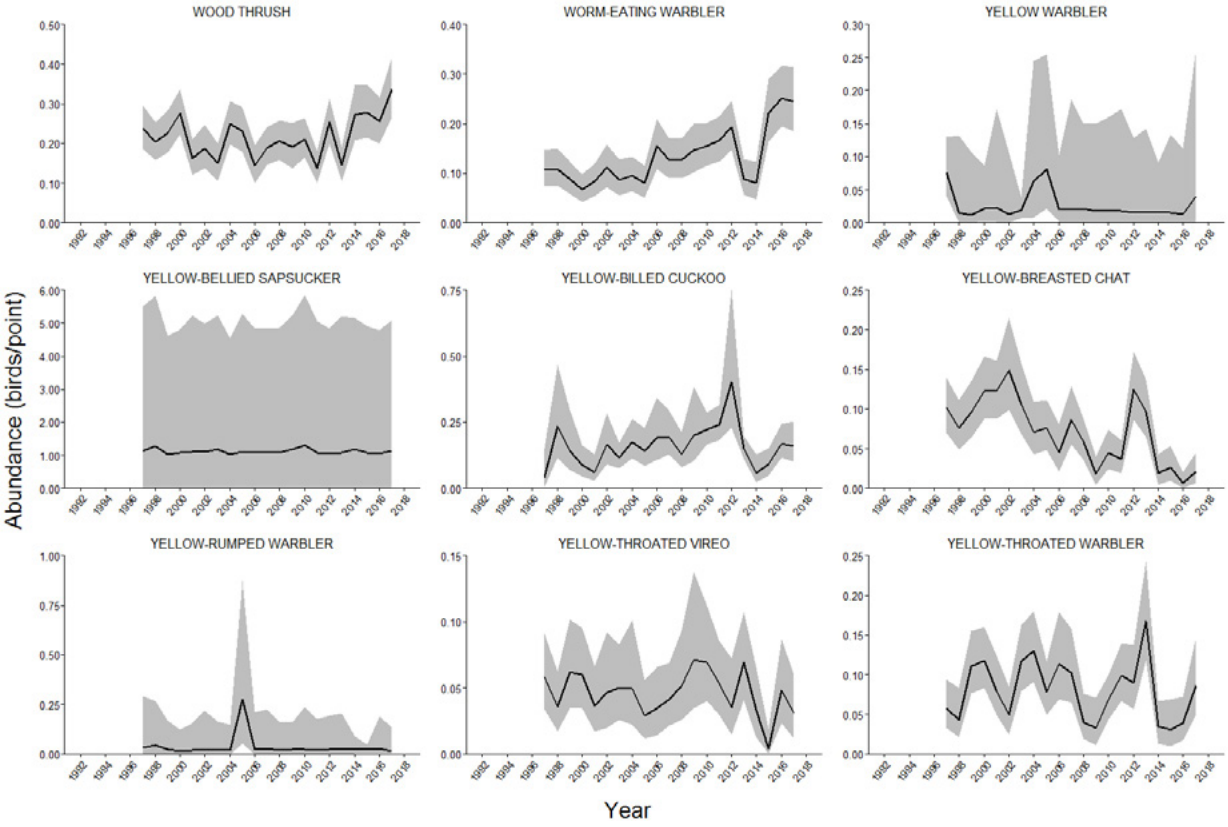

Figure 24 (page 7 of 7)

Ouachita National Forest

Ouachita National Forest completed 5,715 point counts between 1997 and 2017. The number of points surveyed ranged from 314 points in 2006 to 149 points in 2016. We estimated abundances and population trends for 95 species (Table 14). Species with the highest average abundances included red-eyed vireo (1.83 bird/point), indigo bunting (1.06 birds/point), and American crow (1.05 birds/point). Pied-billed grebe, red-cockaded woodpecker, and eastern kingbird, each with 0.01 bird/point, had some of the lowest average abundances. Overall, a similar number of species had positive annual trends as had negative annual trends, but more species had significant negative annual trends (Figs. 25, 26). Six species had significant positive annual trends: red-winged blackbird (14.60 percent), wood duck (9.42 percent), hooded warbler (5.03 percent), mourning dove (4.52 percent), Carolina wren (1.37 percent), and pine warbler (1.36 percent). Fifteen species had significant negative annual trends. Wild turkey (-11.23 percent) and wood thrush (-10.20 percent) had the greatest negative annual trends. Other woodland-breeding birds with significant negative annual trends were hairy woodpecker (-7.23 percent), downy woodpecker (-5.27 percent), worm-eating warbler (-3.75 percent), pileated woodpecker (-2.79 percent), ovenbird (-2.42 percent), yellow-billed cuckoo (-2.35 percent), scarlet tanager (-2.26 percent), red-eyed vireo (-0.96 percent), and American crow (-0.96 percent). Early-successional, scrub-breeding species with significant negative annual trends were blue grosbeak (-8.81 percent), American goldfinch (-8.42 percent), northern bobwhite (-3.88 percent), and prairie warbler (-2.58 percent). Most linear trends were similar to annual trends, except for red-winged blackbird (Fig. 25).

Table 14.—Number of detections, annual trend, linear trend, 95-percent credible interval defined by LCI and UCI, and average abundance for 95 bird species in Ouachita National Forest, 1997–2017; caution should be used in interpreting species abundances marked with Δ because they are based on fewer than 50 detections or had wide credible intervals and may be inaccurate or imprecise

		Annual trend			Linear trend			
Species name	Detections	Trend	LCI	UCI	Trend	LCI	UCI	Abundance (birds/point)
		percent						
Acadian flycatcher	987	0.24	-2.23	2.73	-1.12	-3.09	0.85	0.18
American crow	5,822	-0.96	-1.78	-0.13	-2.18	-2.95	-1.41	1.05
American goldfinch	205	-8.42	-13.62	-3.14	-1.27	-7.48	4.94	0.05
American redstart	29	-0.73	-7.00	3.88	-0.36	-0.79	0.07	3.23 Δ
American robin	15	18.20	-12.90	179.98	0.43	-2.55	3.41	0.01 Δ
Bachman's sparrow	9	0.41	-5.44	9.61	-0.02	-0.45	0.41	1.95 Δ
Barn swallow	41	0.36	-5.84	10.01	-0.41	-1.13	0.31	2.80 Δ
Barred owl	61	-1.48	-8.64	4.86	-0.45	-1.65	0.74	0.84 Δ
Belted kingfisher	14	0.96	-4.22	72.37	0.07	-0.40	0.53	2.77 Δ
Black vulture	42	6.71	-12.03	65.12	0.89	-3.00	4.78	0.05 Δ
Black-and-white warbler	2,035	0.06	-1.42	1.59	-0.20	-1.72	1.31	0.39
Black-throated green warbler	288	2.97	-8.46	17.52	0.17	-3.40	3.75	0.11
Blue grosbeak	134	-8.81	-15.77	-2.58	-1.38	-5.18	2.42	0.04
Blue jay	1,645	0.50	-1.40	2.33	-0.75	-2.33	0.83	0.33
Blue-gray gnatcatcher	2,002	0.29	-1.35	1.98	1.11	-0.28	2.50	0.36
Broad-winged hawk	151	-2.03	-7.29	3.56	0.78	-1.90	3.46	0.03
Brown thrasher	33	-2.28	-15.03	2.57	-0.82	-1.45	-0.19	1.59 Δ
Brown-headed cowbird	593	-2.57	-5.32	0.11	-1.59	-4.20	1.02	0.12
Brown-headed nuthatch	161	6.55	-4.03	18.19	7.50	3.87	11.13	0.05
Canada goose	13	-0.18	-15.29	15.76	0.19	-0.50	0.88	0.85 Δ

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(Table 14 continued)

Species name	Detections	Annual trend			Linear trend			Abundance (birds/point)
		Trend	LCI	UCI	Trend	LCI	UCI	
		percent						
Carolina chickadee	2,814	-1.28	-2.70	0.14	-1.08	-3.04	0.88	0.52
Carolina wren	2,453	1.37	0.10	2.71	2.33	0.90	3.76	0.45
Chimney swift	211	5.07	-4.60	12.92	2.51	-0.04	5.07	0.07
Chipping sparrow	380	3.00	-1.33	7.88	4.68	1.23	8.12	0.07
Chuck-will's-widow	81	-2.82	-8.99	3.33	0.67	-6.08	7.43	0.01
Common grackle	30	17.36	-11.78	230.96	1.04	-2.23	4.31	0.02 Δ
Common yellowthroat	369	-3.01	-6.22	0.17	-1.40	-2.84	0.04	0.07
Cooper's hawk	11	0.53	-4.39	11.41	0.05	-0.35	0.45	2.28 Δ
Downy woodpecker	612	-5.27	-8.62	-2.02	-4.76	-7.36	-2.16	0.12
Eastern bluebird	63	2.54	-8.67	13.94	2.50	-1.05	6.05	0.03 Δ
Eastern kingbird	18	5.28	-7.40	23.61	-2.60	-7.32	2.13	0.01 Δ
Eastern meadowlark	20	0.67	-5.99	11.61	-0.75	-1.42	-0.09	1.42 Δ
Eastern phoebe	104	3.17	-2.91	10.39	-3.98	-9.25	1.30	0.02
Eastern towhee	52	0.06	-3.99	4.02	0.35	-0.18	0.88	3.30 Δ
Eastern tufted titmouse	4,498	0.75	-0.34	1.83	0.66	-0.52	1.84	0.82
Eastern wood-pewee	753	1.87	-0.50	4.35	2.13	0.32	3.95	0.16
Field sparrow	140	-5.44	-12.30	1.36	-0.95	-5.11	3.22	0.03
Fish crow	194	2.75	-1.95	9.52	3.64	-1.14	8.41	0.04
Gray catbird	27	-1.44	-34.38	18.05	-0.45	-1.25	0.34	0.71 Δ
Great blue heron	77	4.53	-6.29	19.48	-4.06	-8.06	-0.06	0.02
Great crested flycatcher	960	-1.70	-3.93	0.48	0.46	-1.04	1.95	0.21
Great egret	17	-1.71	-42.67	65.52	-8.37	-17.43	0.69	0.08 Δ
Green heron	21	0.17	-9.08	7.88	-0.32	-0.93	0.30	1.66 Δ
Hairy woodpecker	231	-7.23	-12.32	-2.73	-5.70	-7.91	-3.50	0.06
Hooded warbler	1,221	5.03	2.74	7.58	5.52	3.84	7.20	0.22
Indigo bunting	5,761	0.08	-0.92	1.07	0.24	-1.57	2.05	1.06
Kentucky warbler	1,212	-1.53	-3.74	0.69	-0.66	-2.26	0.94	0.22
Killdeer	11	0.00	-18.45	19.74	0.06	-0.64	0.76	0.97 Δ
Little blue heron	64	-0.62	-46.19	80.45	-8.67	-17.38	0.03	0.03 Δ
Louisiana waterthrush	252	-1.12	-6.73	4.79	-0.97	-3.80	1.87	0.05
Mourning dove	838	4.52	1.74	7.57	2.72	1.23	4.21	0.16
Northern bobwhite	506	-3.88	-6.92	-0.85	-2.38	-5.18	0.42	0.13
Northern cardinal	2,701	0.35	-0.89	1.62	0.60	-0.57	1.76	0.50
Northern flicker	211	-3.20	-7.68	1.57	4.25	-0.64	9.15	0.07
Northern mockingbird	22	0.08	-7.24	13.13	-0.22	-1.47	1.03	1.08 Δ
Northern parula	617	-2.29	-5.02	0.43	-0.16	-1.70	1.38	0.12
Northern rough-winged swallow	10	0.58	-5.03	19.91	0.02	-0.34	0.39	1.63 Δ
Orchard oriole	26	8.93	-16.74	100.85	0.46	-4.33	5.26	0.02 Δ

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(Table 14 continued)

Species name	Detections	Annual trend			Linear trend			Abundance (birds/point)
		Trend	LCI	UCI	Trend	LCI	UCI	
		percent						
Ovenbird	1,026	-2.42	-4.77	-0.09	-2.30	-4.15	-0.45	0.19
Painted bunting	18	0.69	-5.36	13.27	0.35	-0.27	0.97	1.36 Δ
Pied-billed grebe	43	15.89	-6.39	112.77	-2.11	-9.14	4.93	0.01 Δ
Pileated woodpecker	2,262	-2.79	-4.22	-1.43	-2.57	-3.85	-1.29	0.44
Pine warbler	5,814	1.36	0.43	2.28	0.21	-0.83	1.26	1.04
Prairie warbler	1,278	-2.58	-4.29	-0.89	-0.16	-1.80	1.48	0.24
Prothonotary warbler	27	-7.95	-22.59	6.81	-0.44	-4.87	3.98	0.02 Δ
Purple martin	97	-0.68	-8.16	7.16	-4.28	-8.80	0.25	0.03
Red-bellied woodpecker	502	1.75	-1.39	5.00	1.08	-1.84	4.00	0.12
Red-cockaded woodpecker	33	22.16	-5.83	149.73	4.74	-1.14	10.61	0.01 Δ
Red-eyed vireo	10,353	-0.96	-1.62	-0.29	-1.30	-2.11	-0.50	1.83
Red-headed woodpecker	161	-0.98	-5.00	3.24	7.81	2.96	12.66	0.04
Red-shouldered hawk	195	-1.74	-5.79	2.64	1.96	-2.05	5.97	0.04
Red-tailed hawk	23	0.24	-4.12	4.88	-0.14	-0.67	0.38	1.98 Δ
Red-winged blackbird	221	14.60	5.37	28.47	-2.75	-9.01	3.52	0.07
Ruby-throated hummingbird	192	3.21	-2.92	9.90	-1.44	-4.50	1.61	0.06
Scarlet tanager	1,723	-2.26	-3.87	-0.65	-1.00	-2.38	0.38	0.32
Sharp-shinned hawk	8	-0.80	-9.47	4.99	-0.29	-0.76	0.19	1.32 Δ
Snowy egret	56	26.02	-8.04	360.56	-10.66	-23.84	2.53	0.06 Δ
Summer tanager	2,792	-0.22	-1.39	0.91	0.11	-0.72	0.93	0.51
Swainson's thrush	50	-10.18	-32.12	4.65	-1.18	-5.53	3.16	0.16 Δ
Swainson's warbler	8	-0.44	-6.07	4.46	-0.14	-0.47	0.18	2.90 Δ
Tennessee warbler	19	-1.82	-58.20	14.28	1.25	-0.28	2.78	0.10 Δ
Turkey vulture	101	5.43	-2.03	14.14	1.14	-4.00	6.28	0.03
Whip-poor-will	10	-2.17	-81.87	494.21	-2.58	-7.16	1.99	0.00 Δ
White-breasted nuthatch	486	2.99	-0.14	6.51	1.50	-0.94	3.95	0.10
White-eyed vireo	1,314	1.55	-0.03	3.19	1.42	0.55	2.29	0.24
Wild turkey	137	-11.23	-21.49	-2.10	-6.06	-10.34	-1.77	0.04
Wood duck	74	9.42	1.93	20.51	3.80	-4.45	12.06	0.02 Δ
Wood thrush	189	-10.20	-16.59	-3.71	-5.95	-10.73	-1.17	0.06
Worm-eating warbler	410	-3.75	-7.03	-0.42	-4.26	-7.47	-1.06	0.09
Yellow warbler	48	-3.56	-17.35	13.07	0.72	-2.92	4.37	0.02 Δ
Yellow-bellied sapsucker	7	1.01	-6.01	31.17	0.14	-0.16	0.44	1.51 Δ
Yellow-billed cuckoo	2,471	-2.35	-3.74	-0.93	-4.16	-6.61	-1.72	0.51
Yellow-breasted chat	2,026	-0.06	-1.42	1.30	0.85	-0.30	2.00	0.37
Yellow-throated vireo	482	1.71	-1.57	5.16	1.78	-0.15	3.72	0.10
Yellow-throated warbler	110	4.88	-5.32	13.38	6.49	2.55	10.43	0.03 Δ

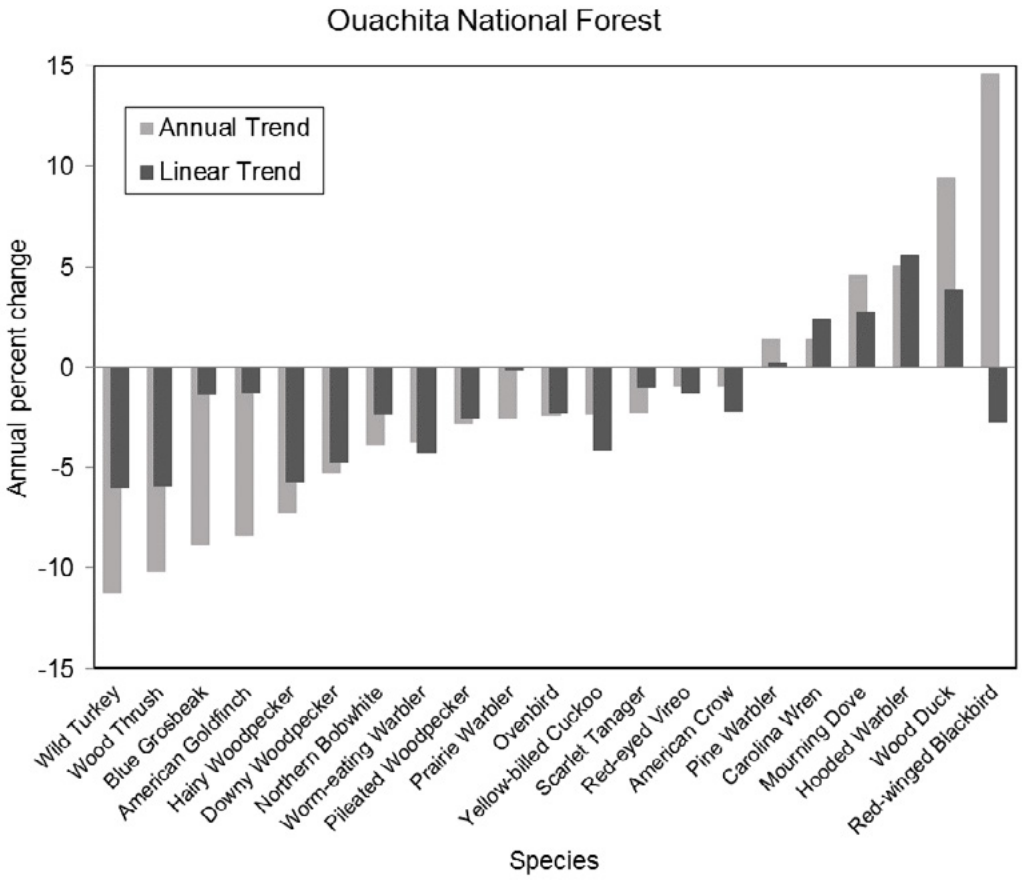

Figure 25.—Significant (based on 95-percent credible interval) positive and negative annual and linear trends for bird species in Ouachita National Forest, 1997–2017.

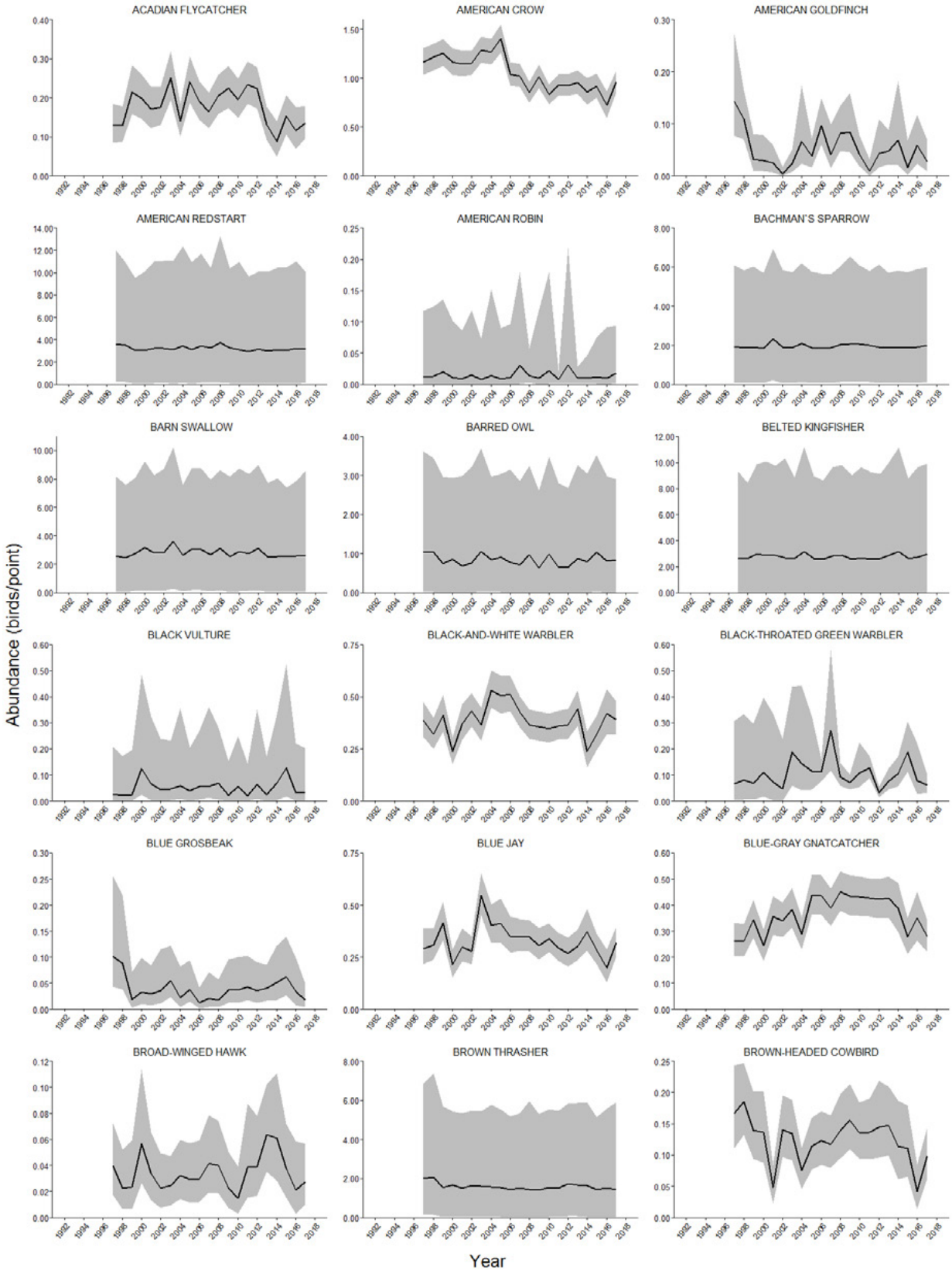

Figure 26. (page 1 of 6)—Estimated abundances and 95-percent credible intervals (shaded areas) for 95 bird species in Ouachita National Forest, by year. The scale of the abundance axes may vary among species to best illustrate patterns in abundance.

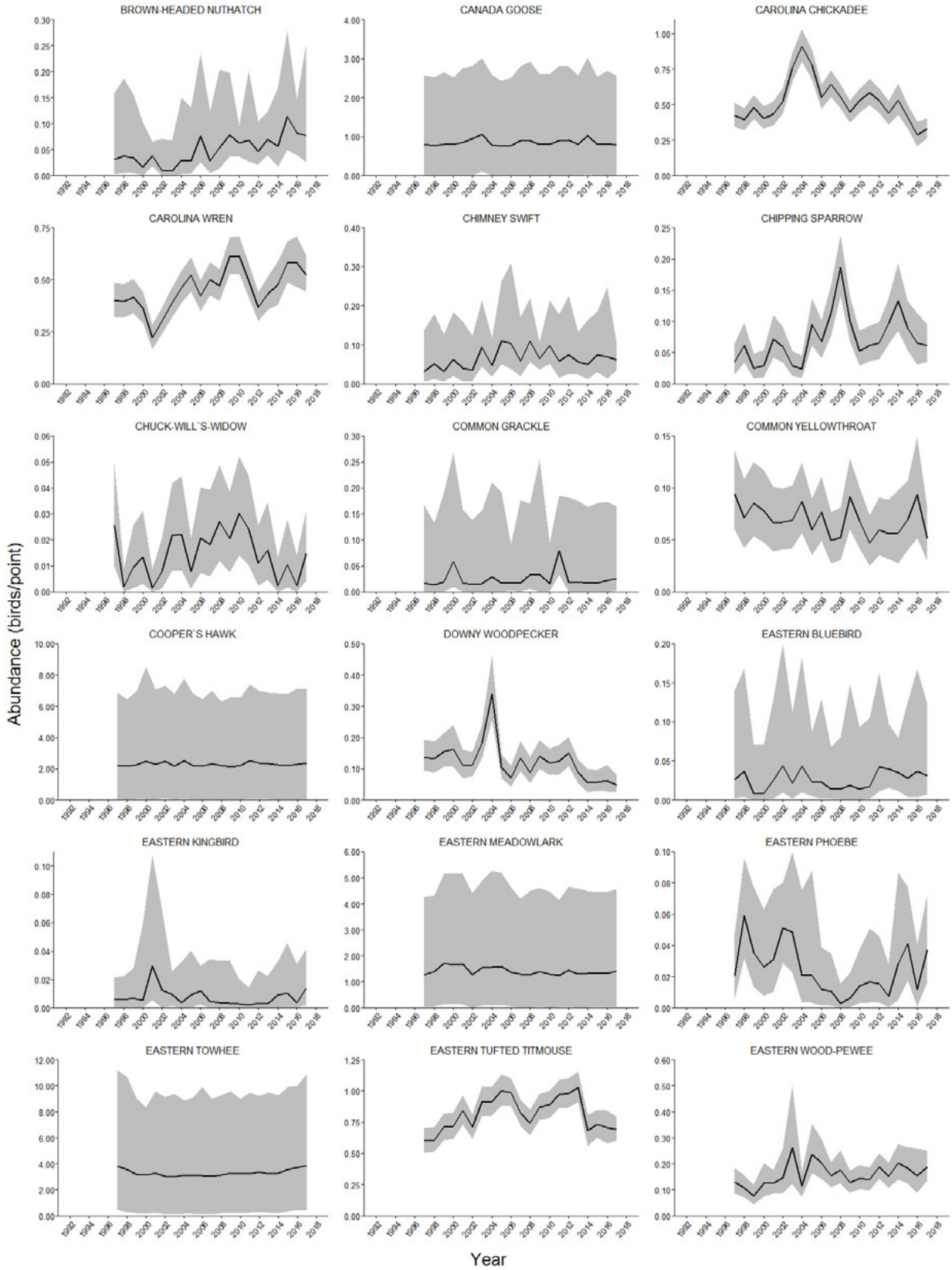

Figure 26 (page 2 of 6)

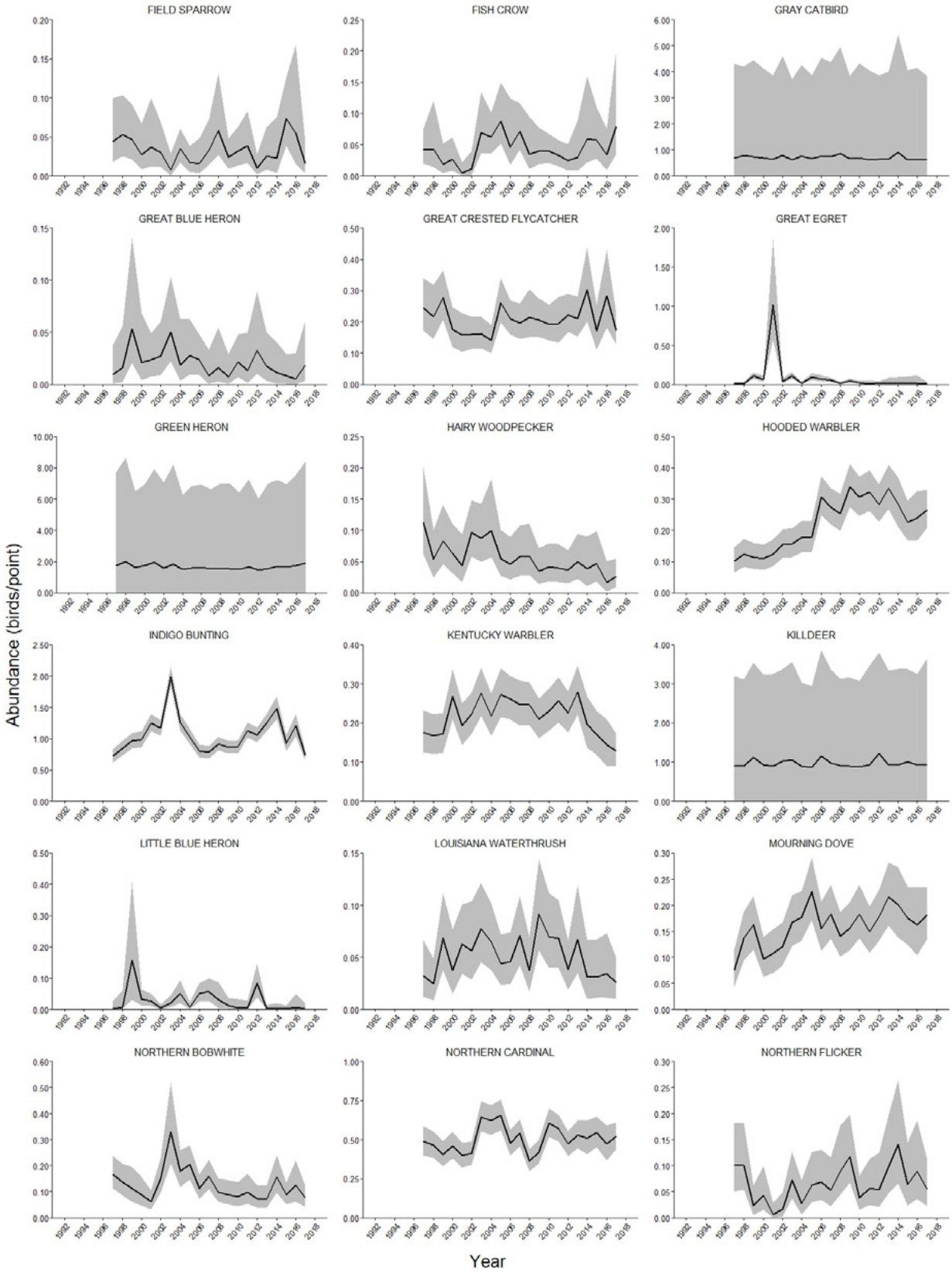

Figure 26 (page 3 of 6)

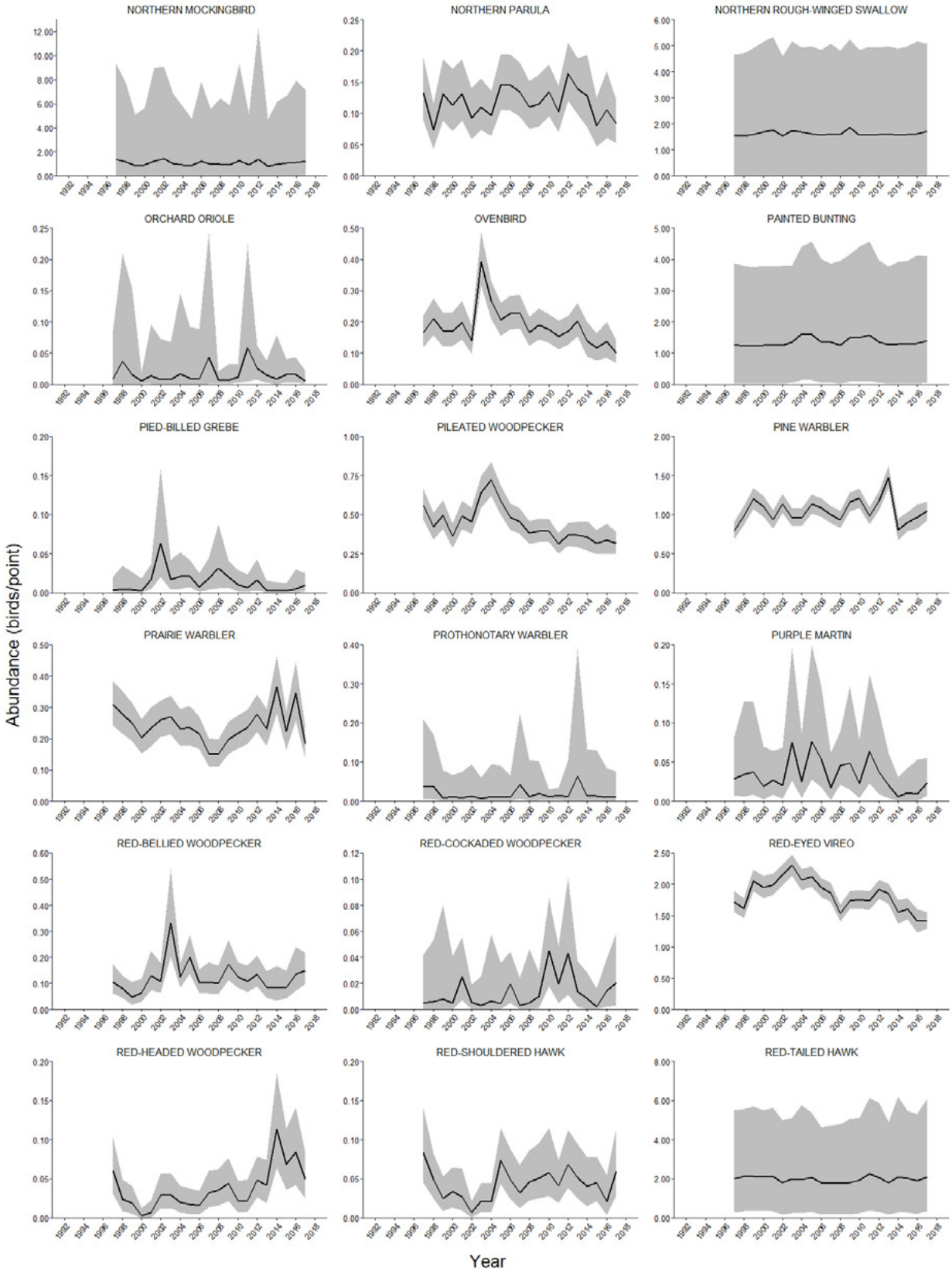

Figure 26 (page 4 of 6)

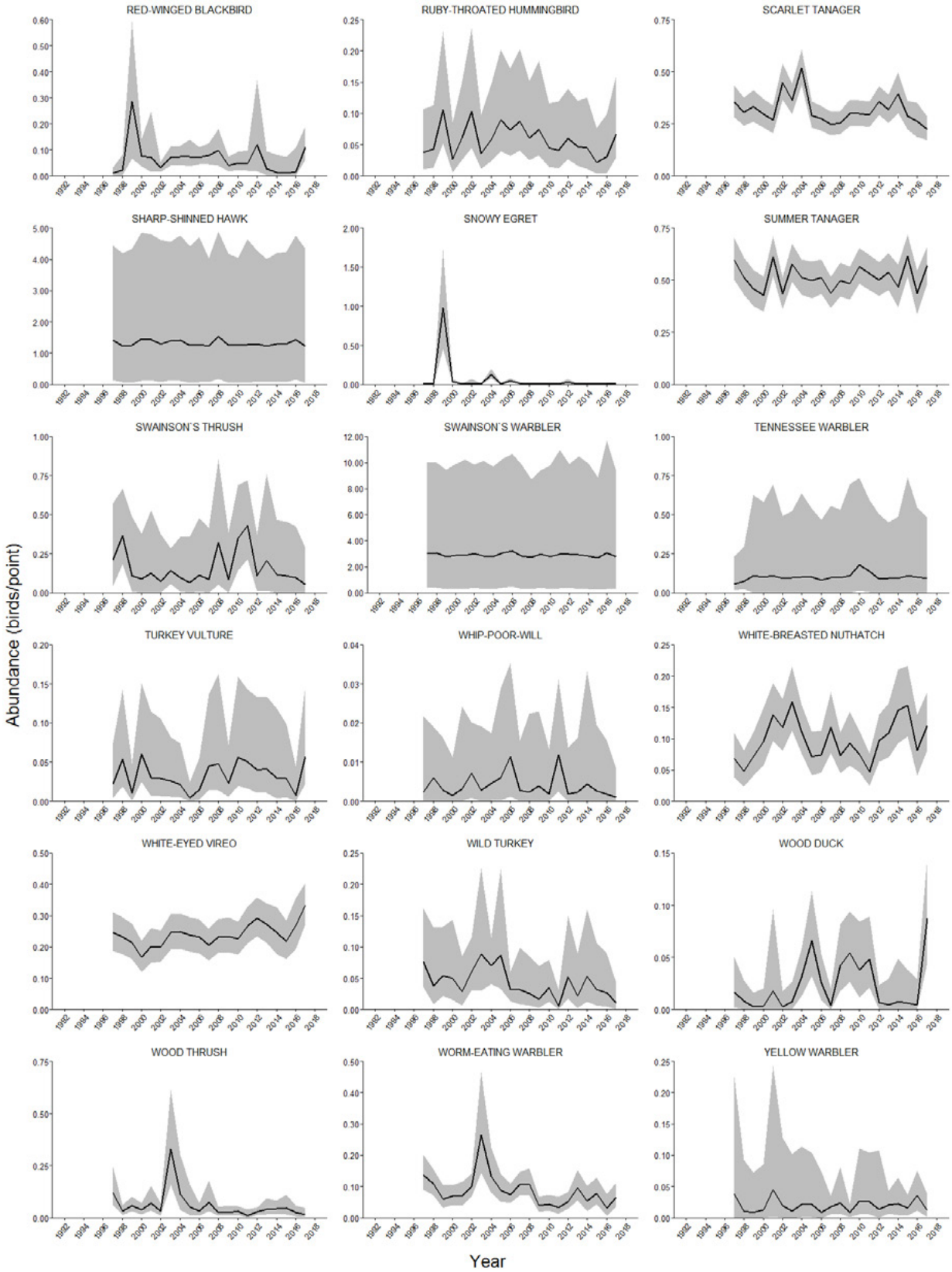

Figure 26 (page 5 of 6)

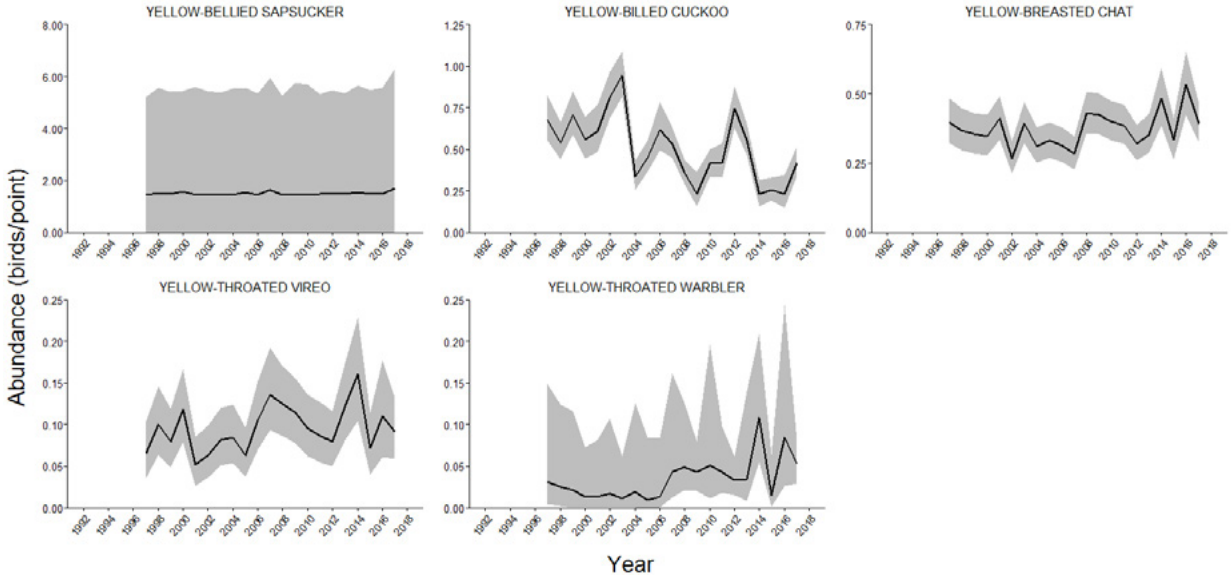

Figure 26 (page 6 of 6)

Ozark-St. Francis National Forests

Ozark-St. Francis National Forests completed 4,879 point counts between 1997 and 2017. The number of points surveyed ranged from 245 points in 2006 to 217 points in 1997. We estimated abundances and population trends for 88 species (Table 15). Species with the highest average abundances were red-eyed vireo (1.47 birds/point), indigo bunting (1.03 birds/point), and ovenbird (0.74 bird/point). Fish crow, Swainson's thrush, and whip-poor-will had the lowest average abundances, each with 0.02 bird/point. Most species had positive annual trends; 17 species had significant positive annual trends and 4 species had significant negative annual trends (Figs. 27, 28). Woodland-breeding birds with significant positive annual trends were yellow-throated warbler (7.89 percent), Louisiana waterthrush (7.60 percent), red-bellied woodpecker (6.39 percent), black-throated green warbler (6.35 percent), yellow-throated vireo (5.94 percent), northern parula (3.54 percent), Acadian flycatcher (3.48 percent), hooded warbler (3.40 percent), Carolina chickadee (3.01 percent), yellow-billed cuckoo (2.80 percent), eastern tufted titmouse (2.42 percent), and white-breasted nuthatch (2.28 percent). Early-successional, scrub-breeding species with significant positive annual trends were white-eyed vireo (5.12 percent), northern cardinal (4.80 percent), Carolina wren (4.29 percent), and yellow-breasted chat (2.48 percent). Early-successional, scrub-breeding species with significant negative annual trends were blue-winged warbler (-10.02 percent) and prairie warbler (-7.98 percent). Woodland-breeding species with significant negative annual trends were summer tanager (-2.88 percent) and ovenbird (-1.81 percent). All linear trends were in the same direction as annual trends, but eight species had linear trends larger than annual trends (Fig. 27).

Table 15.—Number of detections, annual trend, linear trend, 95-percent credible interval defined by LCI and UCI, and average abundance for 88 bird species in Ozark-St. Francis National Forests, 1997–2017; caution should be used in interpreting species abundances marked with Δ because they are based on fewer than 50 detections or had wide credible intervals and may be inaccurate or imprecise

		Annual trend			Linear trend			
Species name	Detections	Trend	LCI	UCI	Trend	LCI	UCI	Abundance (birds/point)
		percent						
Acadian flycatcher	1,600	3.48	1.58	5.44	3.39	2.36	4.41	0.34
American crow	3,206	-0.73	-1.89	0.53	-0.81	-1.62	0.01	0.72
American goldfinch	324	2.84	-2.07	7.60	6.47	3.63	9.31	0.10
American redstart	25	2.28	-6.09	62.34	1.29	0.63	1.95	0.91 Δ
American robin	9	0.03	-6.10	6.71	0.26	-0.19	0.72	1.52 Δ
Barred owl	69	-0.49	-4.39	3.17	0.47	-0.33	1.27	2.76 Δ
Belted kingfisher	25	0.27	-4.92	6.22	0.82	0.28	1.36	1.54 Δ
Black vulture	24	-0.01	-7.18	7.50	0.07	-0.42	0.55	1.72 Δ
Black-and-white warbler	1,617	1.42	-0.10	2.93	1.40	0.34	2.46	0.40
Black-throated green warbler	205	6.35	1.73	11.39	6.86	3.93	9.80	0.06
Blue grosbeak	42	-1.16	-15.69	16.01	-0.27	-3.65	3.12	0.02 Δ
Blue jay	1,294	0.99	-0.93	3.02	0.82	-0.29	1.93	0.31
Blue-gray gnatcatcher	1,775	-0.47	-2.08	1.18	0.34	-0.85	1.53	0.39
Blue-winged warbler	137	-10.02	-20.06	-3.06	-6.07	-10.31	-1.83	0.04
Broad-winged hawk	98	-2.89	-10.52	2.35	-0.39	-1.23	0.45	0.65 Δ
Brown thrasher	20	0.19	-11.65	16.02	1.10	0.35	1.86	0.57 Δ
Brown-headed cowbird	233	-2.40	-5.65	1.20	-2.13	-4.89	0.62	0.06
Brown-headed nuthatch	30	1.27	-3.82	19.13	0.72	0.13	1.32	2.32 Δ

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(Table 15 continued)

Species name	Detections	Annual trend			Linear trend			Abundance (birds/point)
		Trend	LCI	UCI	Trend	LCI	UCI	
		percent						
Canada goose	36	11.72	-3.97	28.63	0.62	-3.98	5.23	0.07 Δ
Carolina chickadee	2,111	3.01	1.29	4.77	2.46	0.72	4.20	0.48
Carolina wren	2,073	4.29	2.55	6.17	5.32	3.49	7.14	0.45
Cedar waxwing	18	-4.69	-48.72	9.01	0.64	-0.18	1.45	0.10 Δ
Cerulean warbler	124	-5.78	-12.50	0.82	-0.93	-3.10	1.24	0.04
Chimney swift	218	8.27	-1.92	17.88	8.27	5.27	11.27	0.09
Chipping sparrow	230	3.57	-1.53	9.30	1.02	-2.36	4.40	0.06
Common yellowthroat	72	-12.68	-37.43	2.21	-1.68	-5.34	1.98	0.02
Downy woodpecker	885	-0.83	-3.43	2.36	0.57	-0.86	2.00	0.24
Eastern bluebird	46	0.93	-3.76	8.39	-0.09	-0.89	0.72	1.73 Δ
Eastern kingbird	8	0.84	-6.82	30.33	0.10	-0.31	0.50	1.11 Δ
Eastern meadowlark	4	-0.66	-10.95	5.78	-0.21	-0.50	0.07	1.22 Δ
Eastern phoebe	158	2.89	-3.19	9.51	2.06	-0.85	4.98	0.05
Eastern screech-owl	7	-0.81	-12.60	5.69	-0.28	-0.66	0.09	1.89 Δ
Eastern towhee	773	0.28	-2.00	2.58	1.53	0.70	2.36	0.17
Eastern tufted titmouse	2,740	2.42	1.07	3.81	2.13	0.99	3.28	0.61
Eastern wood-pewee	1,687	1.30	-0.24	2.86	2.04	1.12	2.95	0.37
Field sparrow	102	0.70	-3.64	5.90	0.62	0.06	1.17	1.61 Δ
Fish crow	24	-13.78	-66.73	17.36	0.81	-3.45	5.07	0.02 Δ
Gray catbird	16	-0.76	-27.17	5.53	-0.29	-0.57	-0.01	2.60 Δ
Great blue heron	71	6.89	-7.42	45.42	4.65	0.26	9.04	0.07
Great crested flycatcher	223	1.98	-3.34	8.78	0.88	-1.03	2.80	0.08
Great egret	21	-2.39	-16.38	49.67	0.57	-2.92	4.06	0.19 Δ
Great horned owl	7	0.03	-20.62	29.95	0.17	-0.25	0.59	2.58 Δ
Hairy woodpecker	236	0.22	-3.59	4.62	0.69	-0.44	1.82	0.92 Δ
Hooded warbler	2,283	3.40	1.97	4.90	4.84	3.92	5.77	0.48
Indigo bunting	4,848	0.35	-0.64	1.38	0.80	-0.07	1.66	1.03
Kentucky warbler	770	1.00	-1.62	3.76	-0.91	-2.56	0.74	0.18
Little blue heron	7	7.59	-15.74	190.83	-1.61	-4.09	0.88	0.02 Δ
Louisiana waterthrush	264	7.60	2.57	14.00	6.37	4.29	8.45	0.06
Mississippi kite	22	-5.00	-47.77	72.37	-1.43	-7.09	4.23	0.05 Δ
Mourning dove	572	5.65	1.76	10.13	2.76	0.66	4.87	0.15
Northern bobwhite	141	-7.02	-18.30	4.35	-13.04	-17.53	-8.55	0.04
Northern cardinal	1,357	4.80	2.45	7.31	5.91	3.99	7.84	0.30
Northern flicker	149	0.46	-8.46	5.96	-1.00	-2.17	0.17	0.90 Δ
Northern mockingbird	5	-3.16	-72.08	11.87	-0.64	-1.42	0.13	0.29 Δ

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(Table 15 continued)

Species name	Detections	Annual trend			Linear trend			Abundance (birds/point)
		Trend	LCI	UCI	Trend	LCI	UCI	
		percent						
Northern parula	957	3.54	1.10	6.17	3.25	2.18	4.33	0.21
Orchard oriole	13	0.68	-5.82	20.73	-0.10	-0.59	0.38	2.39 Δ
Ovenbird	3,538	-1.81	-2.85	-0.78	-1.30	-2.01	-0.60	0.74
Pileated woodpecker	1,776	-0.97	-2.61	0.78	-1.23	-2.20	-0.26	0.44
Pine warbler	2,185	0.37	-0.89	1.66	0.94	-0.08	1.97	0.47
Prairie warbler	347	-7.98	-13.06	-3.33	-4.64	-6.48	-2.80	0.08
Prothonotary warbler	55	8.77	-4.99	44.38	5.34	-0.31	10.99	0.09 Δ
Purple martin	20	0.20	-14.45	20.45	-0.28	-1.20	0.64	0.89 Δ
Red-bellied woodpecker	890	6.39	3.58	9.69	4.83	2.81	6.85	0.21
Red-eyed vireo	7,036	-0.15	-0.92	0.64	-0.23	-0.66	0.20	1.47
Red-headed woodpecker	83	6.34	-1.57	17.40	5.86	2.81	8.90	0.03
Red-shouldered hawk	124	-0.63	-7.07	6.94	1.72	-1.17	4.61	0.04
Red-tailed hawk	37	-1.37	-14.28	3.90	-0.78	-1.56	0.00	1.79 Δ
Rose-breasted grosbeak	4	0.01	-8.57	11.41	0.20	-0.04	0.45	1.79 Δ
Ruby-throated hummingbird	168	-1.03	-4.58	2.38	-0.26	-1.32	0.79	2.43 Δ
Scarlet tanager	1,959	1.40	-0.12	2.92	1.56	0.71	2.41	0.43
Summer tanager	1,129	-2.88	-4.58	-1.14	-1.89	-3.10	-0.68	0.25
Swainson's thrush	9	-20.46	-88.53	13.92	0.10	-4.32	4.52	0.02 Δ
Turkey vulture	133	0.25	-3.30	4.16	0.36	-0.60	1.32	4.31 Δ
Veery	6	0.41	-19.84	29.87	0.35	-0.17	0.88	0.59 Δ
Warbling vireo	51	18.03	-6.34	139.07	6.81	4.88	8.74	0.06 Δ
Whip-poor-will	17	11.97	-15.59	181.72	-6.24	-10.80	-1.67	0.02 Δ
White-breasted nuthatch	1,081	2.28	0.15	4.56	3.23	1.84	4.62	0.26
White-eyed vireo	1,223	5.12	2.71	7.76	5.34	4.25	6.43	0.28
Wild turkey	76	7.57	-2.80	22.81	2.46	-2.52	7.44	0.03
Wood thrush	744	1.37	-0.91	3.80	1.74	0.53	2.95	0.16
Worm-eating warbler	534	0.10	-2.74	3.01	0.16	-1.44	1.76	0.13
Yellow warbler	172	5.63	-3.32	13.62	4.95	0.53	9.38	0.15
Yellow-bellied sapsucker	36	0.71	-3.41	6.24	0.07	-0.50	0.63	1.98 Δ
Yellow-billed cuckoo	1,553	2.80	0.08	5.72	0.35	-1.95	2.65	0.46
Yellow-breasted chat	1,223	2.48	0.59	4.52	1.98	1.00	2.96	0.26
Yellow-crowned night heron	26	9.75	-9.44	97.72	-0.33	-2.93	2.27	0.05 Δ
Yellow-throated vireo	290	5.94	1.06	11.28	8.80	6.04	11.56	0.07
Yellow-throated warbler	146	7.98	1.29	17.62	8.05	4.31	11.79	0.05

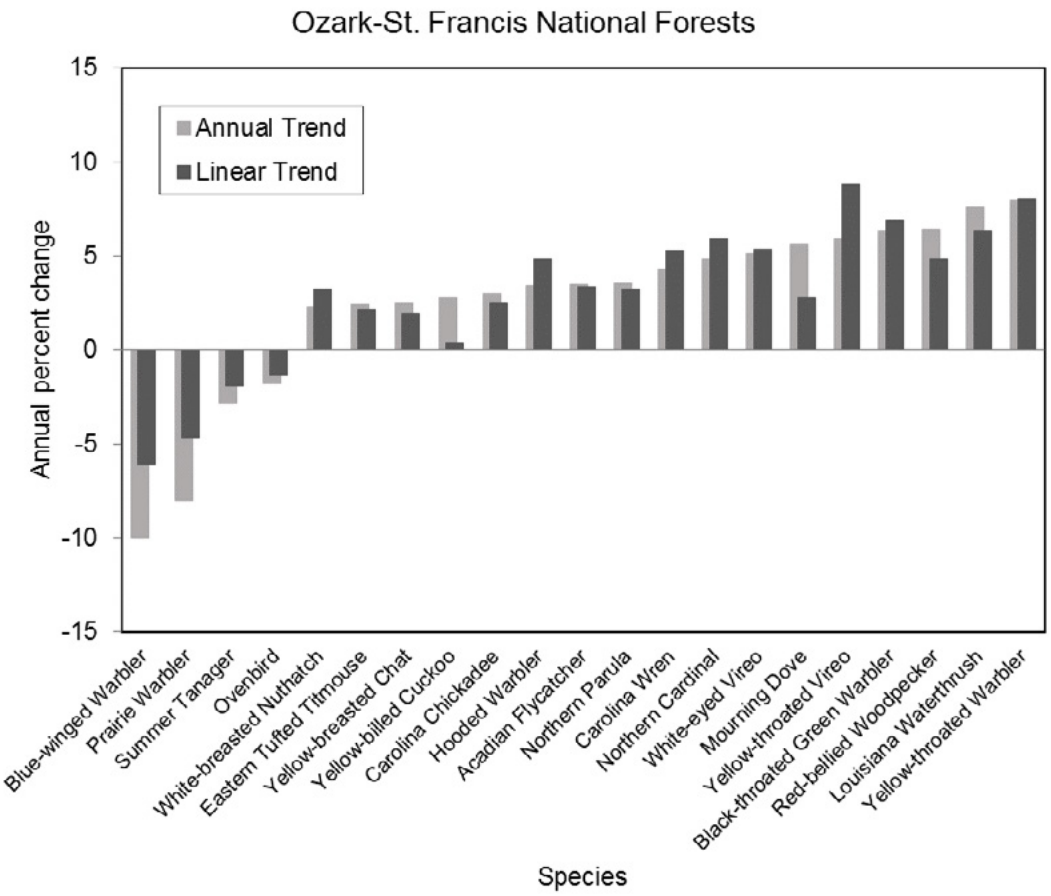


Figure 27.—Significant (based on 95-percent credible interval) positive and negative annual and linear trends for bird species in Ozark-St. Francis National Forests, 1997–2017.

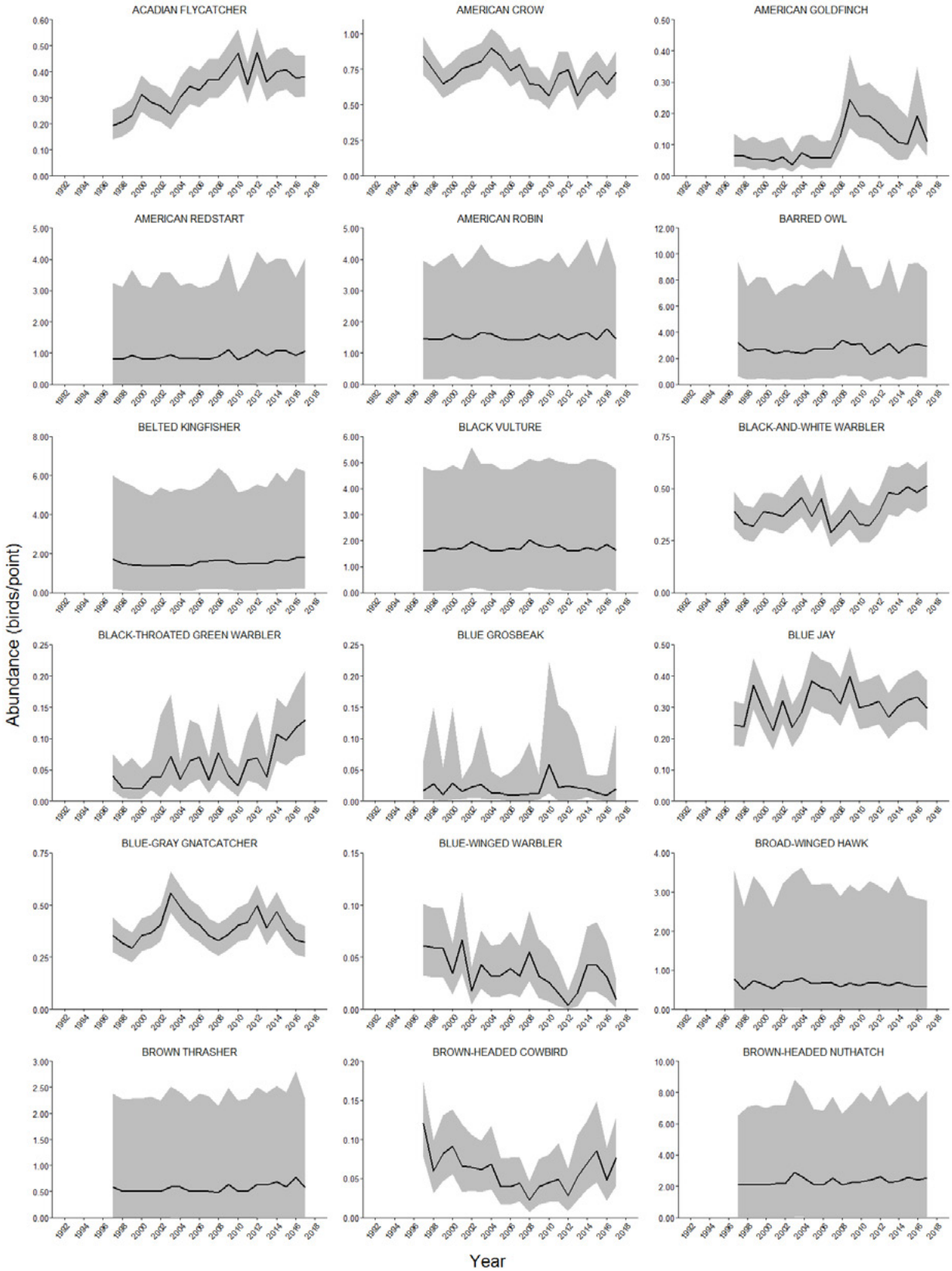


Figure 28. (page 1 of 5)—Estimated abundances and 95-percent credible intervals (shaded areas) for 88 bird species in Ozark-St. Francis National Forests, by year. The scale of the abundance axes may vary among species to best illustrate patterns in abundance.

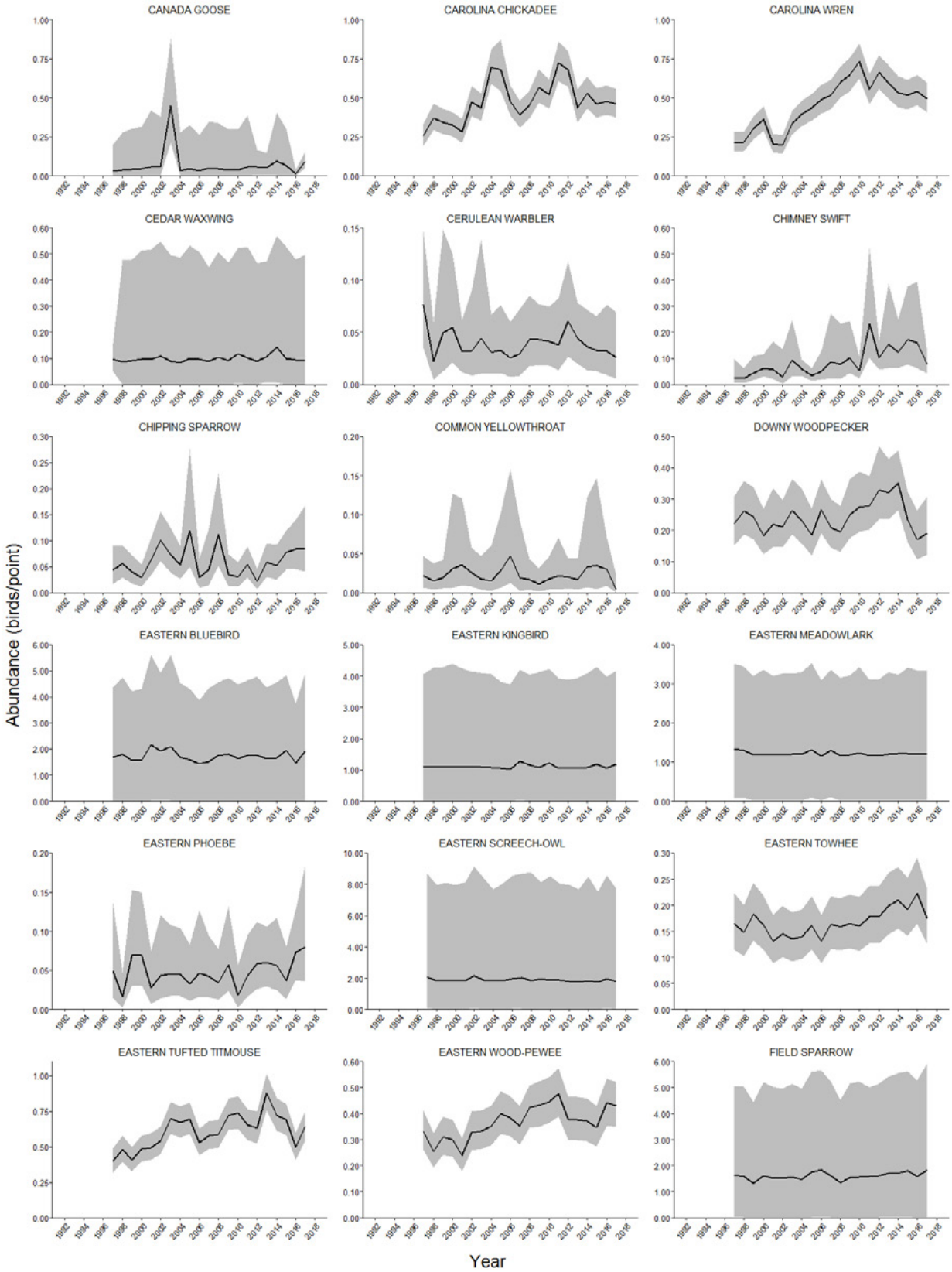
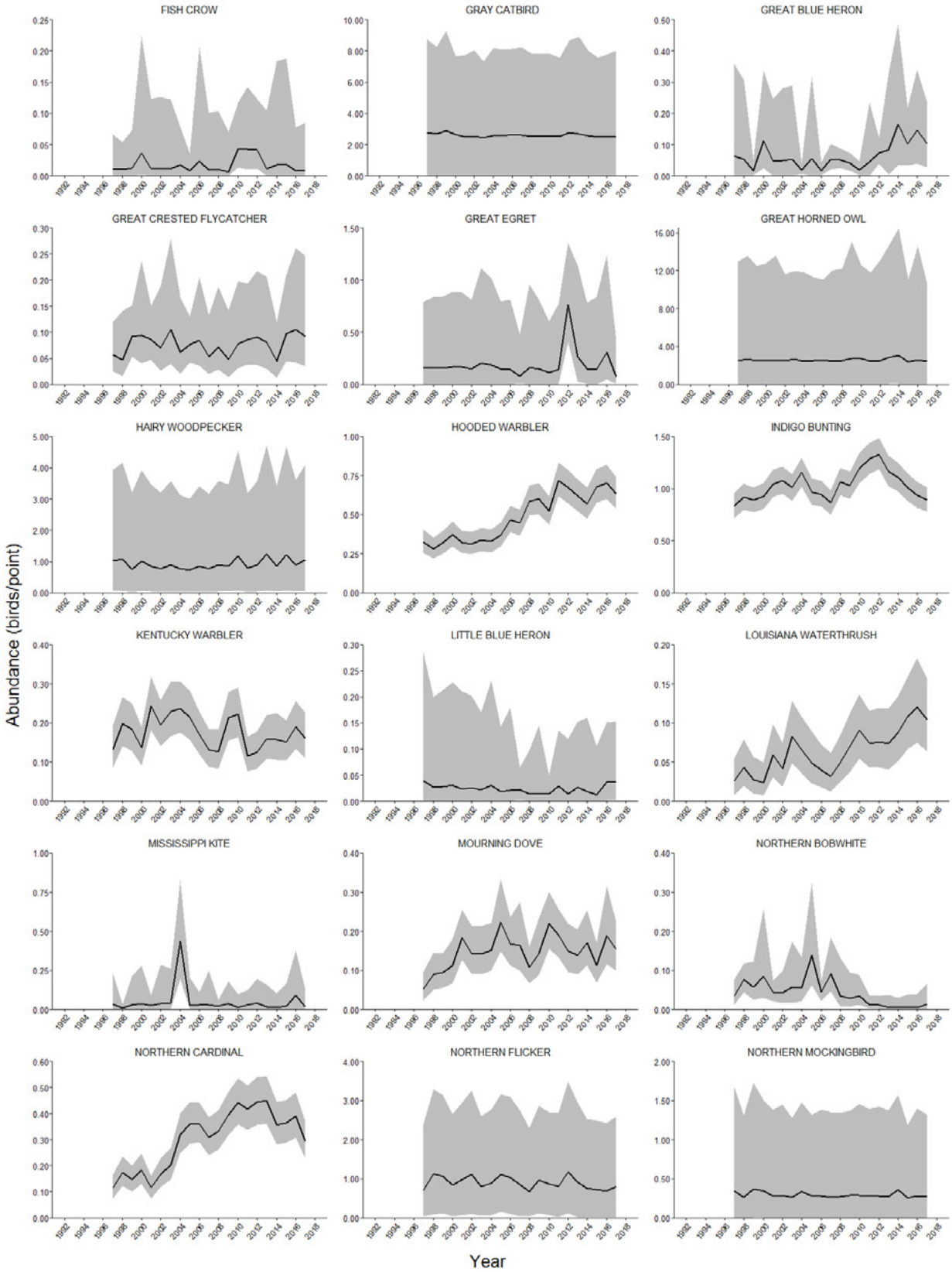


Figure 28 (page 2 of 5)



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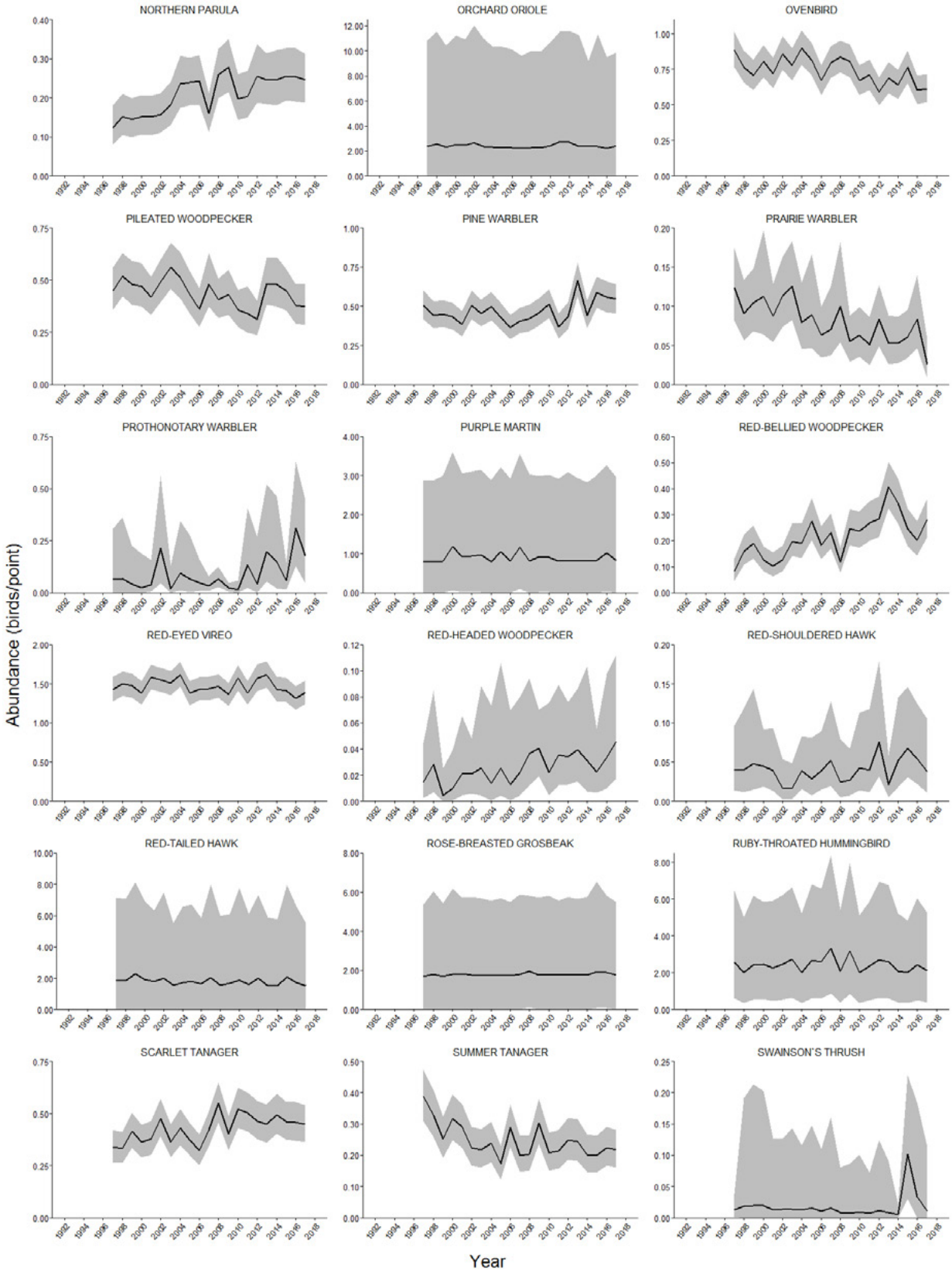

Figure 28 (page 4 of 5)

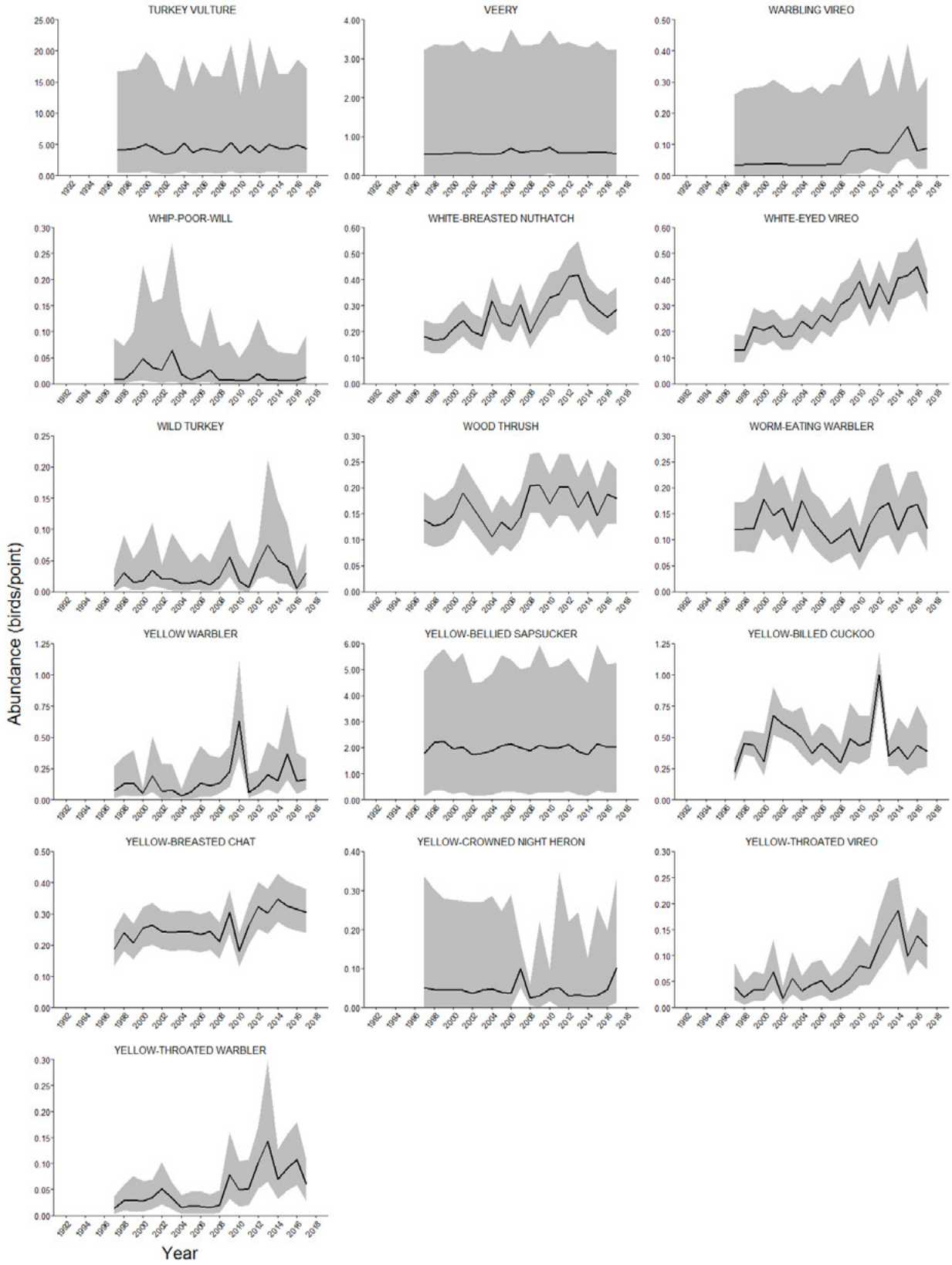

Figure 28 (page 5 of 5)

Savannah River Site

Savannah River Site had the fewest survey points and years in the region; 513 point counts were completed between 2011 and 2017. The number of points surveyed ranged from 86 in 2013, 2014, and 2015 to 29 points in 2017. We estimated abundances and population trends for 58 species (Table 16). Pine warbler (1.85 birds/point), Carolina wren (1.20 birds/point), and northern cardinal (1.19 birds/point) had the greatest average abundances. Species with the lowest average abundances were hairy woodpecker (0.04 bird/point), Kentucky warbler (0.04 bird/point), and blue-headed vireo (0.03 bird/point). Four species had significant positive annual trends and four species had significant negative annual trends (Figs. 29, 30). Early-successional, scrub-breeding species with significant positive annual trends were blue grosbeak (70.78 percent) and white-eyed vireo (15.26 percent). Woodland-breeding species with significant positive annual trends were blue-gray gnatcatcher (14.34 percent) and northern parula (10.72 percent). Woodland-breeding species with significant negative annual trends were blue jay (-17.41 percent), American crow (-15.52 percent), summer tanager (-10.42 percent), and eastern tufted titmouse (-7.85 percent). No early-successional, scrub-breeding species had significant negative annual trends. Linear trends were similar to annual trends, except for blue-gray gnatcatcher (Fig. 29).

Table 16.—Number of detections, annual trend, linear trend, 95-percent credible interval defined by LCI and UCI, and average abundance for 58 bird species in Savannah River Site, 2011–2017; caution should be used in interpreting species abundances marked with Δ because they are based on fewer than 50 detections or had wide credible intervals and may be inaccurate or imprecise

		Annual trend			Linear trend			
Species name	Detections	Trend	LCI	UCI	Trend	LCI	UCI	Abundance (birds/point)
		percent						
Acadian flycatcher	75	-0.97	-18.42	17.76	-6.17	-17.57	5.23	0.18
American crow	375	-15.52	-24.63	-6.75	-10.14	-19.88	-0.39	0.75
American goldfinch	10	3.66	-13.48	54.96	0.94	-1.84	3.72	2.15 Δ
Bachman's sparrow	80	-6.95	-27.15	13.52	5.74	-9.42	20.90	0.18
Black-and-white warbler	8	59.92	-23.89	1861.35	12.23	1.30	23.15	0.05 Δ
Blue grosbeak	46	70.78	12.45	243.15	33.26	16.92	49.60	0.15 Δ
Blue jay	224	-17.41	-31.68	-3.86	-11.09	-24.83	2.65	0.45
Blue-gray gnatcatcher	176	14.34	2.82	26.76	15.98	12.00	19.96	0.42
Blue-headed vireo	7	10.83	-88.91	1043.71	-1.31	-15.16	12.55	0.03 Δ
Brown thrasher	32	0.08	-17.18	20.78	1.34	-0.90	3.57	1.33 Δ
Brown-headed cowbird	55	-8.68	-27.65	13.27	-2.14	-10.56	6.28	0.31 Δ
Brown-headed nuthatch	127	-4.52	-17.38	8.31	-2.96	-8.67	2.75	0.28
Carolina chickadee	151	-7.34	-21.93	9.48	-3.25	-14.79	8.29	0.39
Carolina wren	576	-5.12	-11.62	1.44	-1.61	-7.87	4.64	1.20
Chipping sparrow	37	17.57	-22.76	149.79	-1.55	-17.59	14.50	0.13 Δ
Common yellowthroat	23	8.52	-27.51	53.55	14.63	-2.54	31.79	0.07 Δ
Downy woodpecker	80	14.06	-8.07	39.44	13.80	1.15	26.45	0.24
Eastern bluebird	64	-5.42	-26.58	21.08	-0.89	-10.11	8.33	0.21
Eastern kingbird	9	0.03	-22.14	34.59	-0.37	-2.65	1.90	2.44 Δ
Eastern towhee	257	-6.90	-16.32	2.32	0.35	-9.83	10.53	0.54
Eastern tufted titmouse	510	-7.85	-14.98	-0.61	-4.92	-10.59	0.75	1.05
Eastern wood-pewee	222	6.08	-4.65	17.67	6.90	-1.74	15.54	0.47
Field sparrow	6	-0.51	-29.99	26.88	-2.53	-7.27	2.21	19.32 Δ
Fish crow	9	1.65	-35.95	61.20	-1.86	-21.92	18.19	0.08 Δ

(continued on next page)

(Table 16 continued)

Species name	Detections	Annual trend			Linear trend			Abundance (birds/point)
		Trend	LCI	UCI	Trend	LCI	UCI	
		percent						
Great crested flycatcher	379	-4.48	-12.95	3.98	0.00	-9.28	9.28	0.77
Hairy woodpecker	7	61.31	-10.03	572.76	25.48	-0.31	51.28	0.04 Δ
Hooded warbler	42	11.77	-7.33	34.28	7.87	-3.03	18.78	0.14 Δ
Indigo bunting	379	-2.77	-11.03	5.99	0.09	-3.74	3.92	0.78
Kentucky warbler	6	41.73	-30.00	810.46	2.11	-15.86	20.08	0.04 Δ
Mourning dove	224	-6.67	-16.82	3.20	-4.16	-8.14	-0.17	0.47
Northern bobwhite	70	-8.56	-28.07	10.60	-10.64	-16.27	-5.00	0.18
Northern cardinal	589	-2.15	-8.69	4.30	-0.97	-5.52	3.58	1.19
Northern flicker	21	2.85	-58.18	183.88	1.24	-3.45	5.92	0.12 Δ
Northern mockingbird	22	37.02	-18.38	238.89	11.86	1.04	22.69	0.08 Δ
Northern parula	193	10.72	0.60	21.52	7.57	-2.86	18.00	0.41
Orchard oriole	13	7.28	-13.49	95.41	2.86	0.10	5.62	1.51 Δ
Ovenbird	41	-1.58	-33.15	33.91	-4.64	-17.68	8.40	0.11 Δ
Pileated woodpecker	167	0.37	-11.85	13.78	-0.13	-5.60	5.35	0.41
Pine warbler	909	-2.46	-7.69	2.90	-3.27	-6.82	0.28	1.85
Prairie warbler	203	4.34	-6.80	16.72	6.41	-2.53	15.35	0.44
Prothonotary warbler	8	-2.28	-38.82	40.48	0.32	-9.09	9.74	0.05 Δ
Red-bellied woodpecker	249	-2.32	-11.73	7.86	-2.22	-5.91	1.46	0.57
Red-cockaded woodpecker	29	3.10	-17.46	31.93	-1.61	-8.47	5.25	0.49 Δ
Red-eyed vireo	283	-7.06	-16.56	2.59	-6.24	-10.92	-1.56	0.57
Red-headed woodpecker	210	-1.66	-14.12	12.94	1.79	-9.54	13.12	0.48
Red-shouldered hawk	27	0.85	-21.60	25.34	1.85	-1.82	5.52	1.65 Δ
Red-winged blackbird	4	-17.12	-92.46	53.34	2.61	-15.67	20.88	0.06 Δ
Ruby-throated hummingbird	8	3.64	-16.19	86.54	2.86	1.12	4.60	4.09 Δ
Summer tanager	327	-10.42	-19.23	-1.85	-4.22	-12.30	3.86	0.66
Swainson's warbler	3	0.10	-23.54	31.19	0.66	-1.26	2.59	1.94 Δ
White-breasted nuthatch	87	-5.55	-22.79	13.58	-2.41	-12.97	8.15	0.21
White-eyed vireo	136	15.26	0.96	31.82	14.13	8.64	19.63	0.32
Wild turkey	21	-8.81	-64.65	45.94	0.78	-15.71	17.27	0.11 Δ
Wood thrush	15	2.75	-28.10	44.24	1.64	-2.01	5.29	0.62 Δ
Yellow-billed cuckoo	113	0.53	-13.26	14.30	1.04	-4.51	6.59	0.28
Yellow-breasted chat	108	-2.28	-19.66	14.76	1.62	-11.98	15.22	0.23
Yellow-throated vireo	31	34.95	-8.84	96.44	22.42	16.94	27.90	0.13 Δ
Yellow-throated warbler	30	28.06	-7.31	73.67	14.28	-3.07	31.62	0.12 Δ

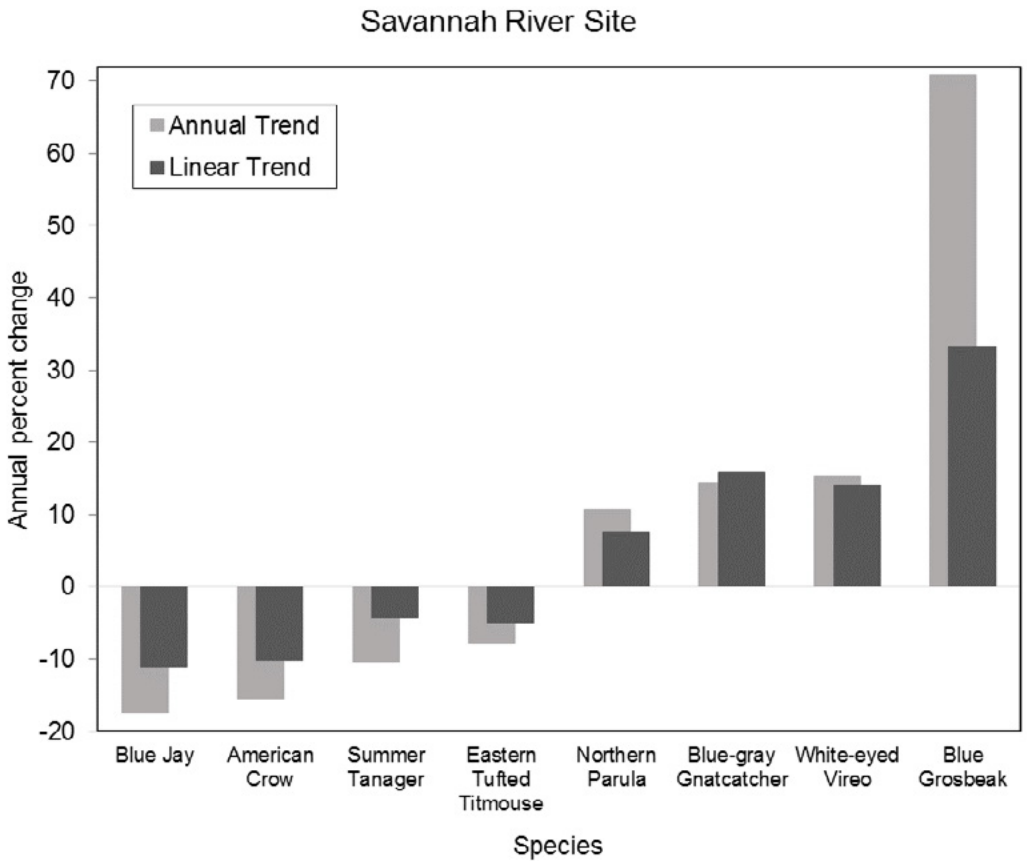

Figure 29.—Significant (based on 95-percent credible interval) positive and negative annual and linear trends for bird species in Savannah River Site, 2011–2017.

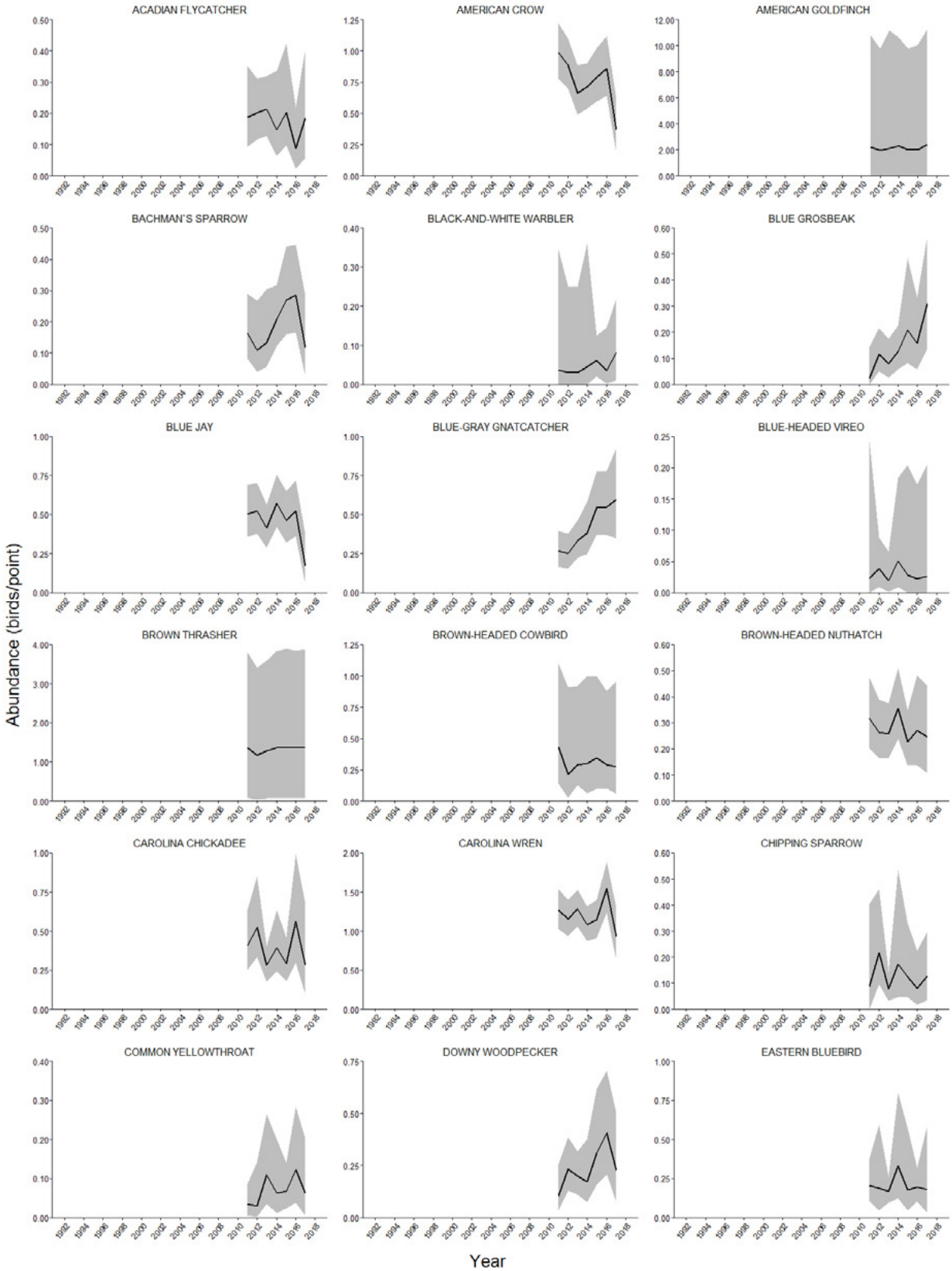

Figure 30. (page 1 of 4)—Estimated abundances and 95-percent credible intervals (shaded areas) for 58 bird species in Savannah River Site, by year. The scale of the abundance axes may vary among species to best illustrate patterns in abundance.

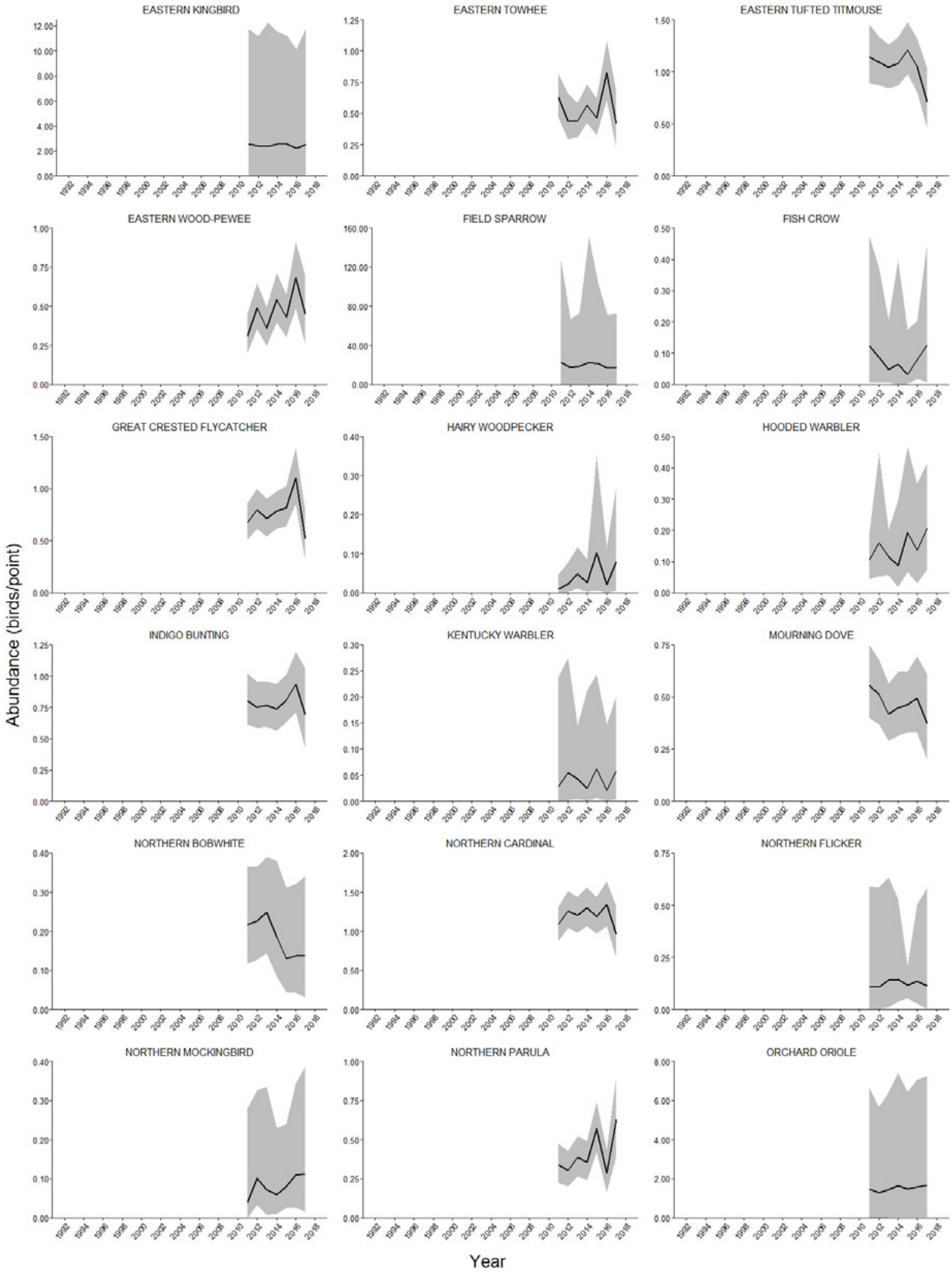

Figure 30 (page 2 of 4)

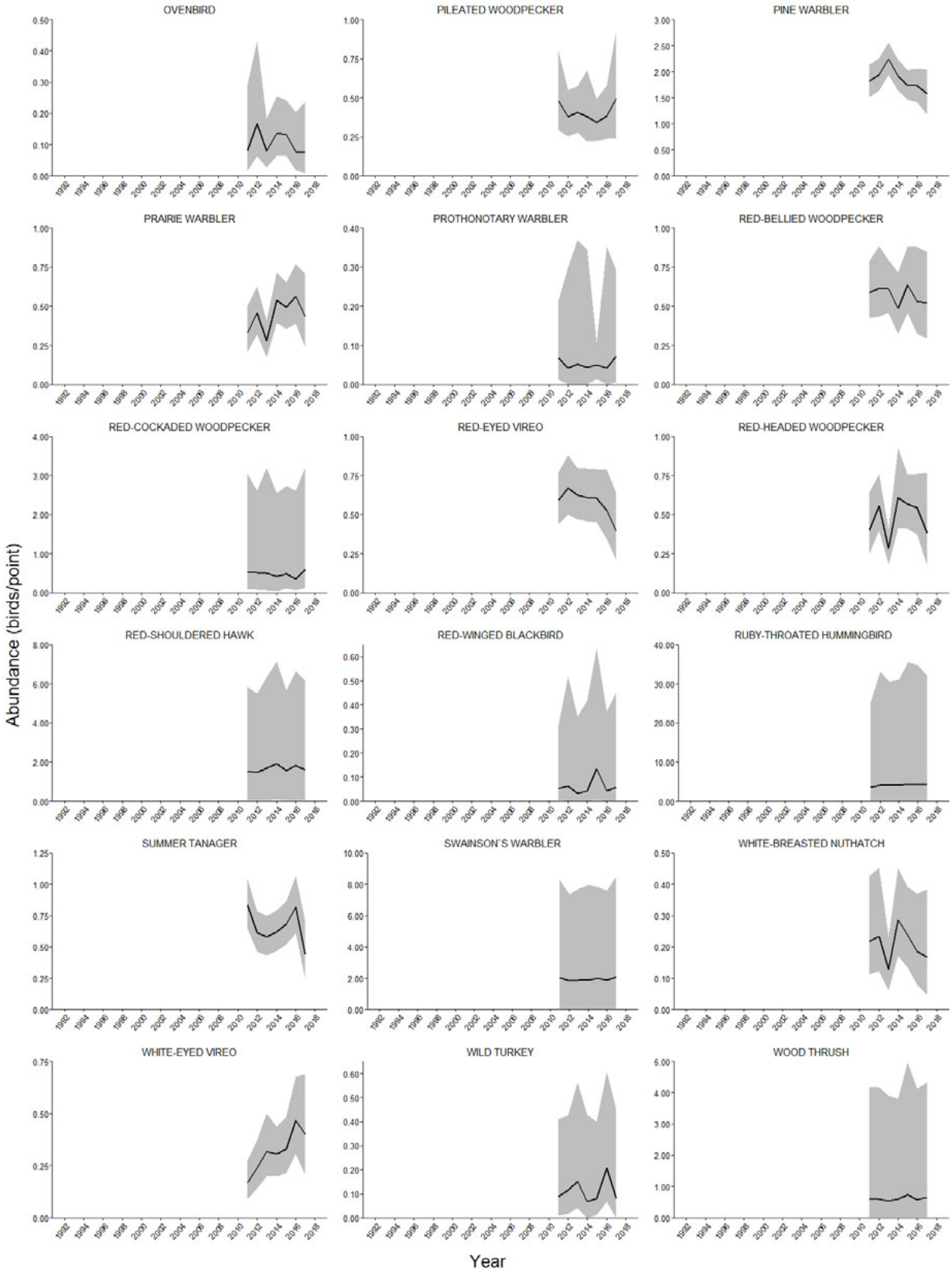

Figure 30 (page 3 of 4)

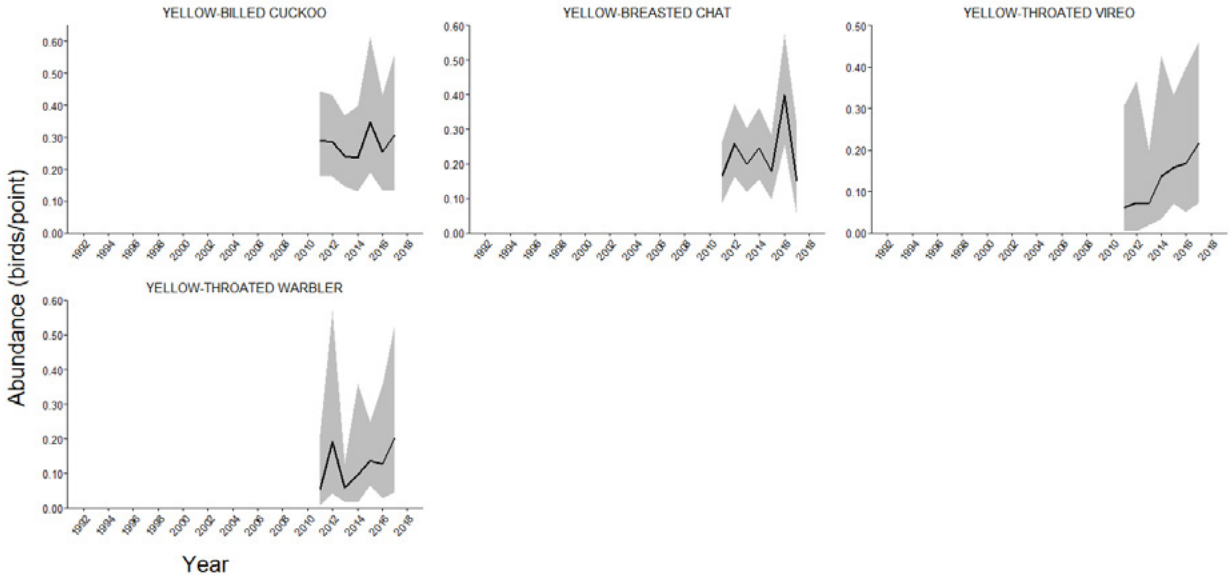

Figure 30 (page 4 of 4)

Texas National Forests

Texas National Forests completed 3,805 point counts from 1998 to 2017. The number of points surveyed ranged from 228 points in 2010 through 2013 to 178 points in 2003. We estimated abundances and population trends for 89 species (Table 17). Northern cardinal (2.44 birds/point), pine warbler (2.42 birds/point), and Carolina wren (1.90 birds/point) had some of the highest average abundances, whereas sharp-shinned hawk (0.03 bird/point), Canada goose (0.02 bird/point), and red-winged blackbird (0.02 bird/point) had some of the lowest average abundances. Five species had significant positive annual trends and 15 species had significant negative annual trends (Figs. 31, 32). Scissor-tailed flycatcher had the largest positive annual trend (29.12 percent). Woodland-breeding species with significant positive annual trends were chuck-will's-willow (21.53 percent), white-breasted nuthatch (18.77 percent), blue-gray gnatcatcher (7.05 percent), and yellow-throated vireo (5.74 percent). Woodland-breeding species with significant negative annual trends were Swainson's warbler (-16.46 percent), wood thrush (-8.62 percent), red-headed woodpecker (-8.12 percent), Acadian flycatcher (-7.08 percent), Kentucky warbler (-6.49 percent), brown-headed nuthatch (-5.64 percent), red-eyed vireo (-4.90 percent), eastern wood-pewee (-4.54 percent), yellow-billed cuckoo (-4.53 percent), blue jay (-4.02 percent), Bachman's sparrow (-3.85 percent), pine warbler (-3.20 percent), red-bellied woodpecker (-1.85 percent), and American crow (-1.71 percent). Yellow-breasted chat was the only early-successional, scrub-breeding species that showed a significant negative annual trend (-1.25 percent). Linear trends followed annual trends; however, most linear trends were larger than annual trends (Figure 31).

Table 17.—Number of detections, annual trend, linear trend, 95-percent credible interval defined by LCI and UCI, and average abundance for 89 bird species in Texas National Forests, 1998–2017; caution should be used in interpreting species abundances marked with Δ because they are based on fewer than 50 detections or had wide credible intervals and may be inaccurate or imprecise

		Annual trend			Linear trend			
Species name	Detections	Trend	LCI	UCI	Trend	LCI	UCI	Abundance (birds/point)
		percent						
Acadian flycatcher	1,363	-7.08	-9.30	-5.02	-8.98	-11.04	-6.92	0.39
American crow	5,744	-1.71	-2.70	-0.75	-1.82	-3.15	-0.49	1.63
American kestrel	96	-0.51	-7.07	6.38	0.16	-0.95	1.26	1.14 Δ
American redstart	20	-1.64	-42.63	13.42	-1.16	-1.67	-0.65	0.94 Δ
Bachman's sparrow	800	-3.85	-6.69	-0.25	-5.34	-8.64	-2.03	0.28
Barn swallow	54	2.11	-6.41	16.60	1.35	0.46	2.24	0.78 Δ
Barred owl	137	3.95	-2.74	11.64	-1.97	-6.66	2.72	0.05
Belted kingfisher	7	0.48	-6.39	26.45	-0.24	-0.54	0.06	3.51 Δ
Bewick's wren	25	30.13	-2.26	485.50	6.76	3.27	10.25	0.04 Δ
Black vulture	70	1.94	-3.59	12.21	1.16	0.02	2.30	1.12 Δ
Black-and-white warbler	178	2.30	-3.54	7.46	4.66	0.06	9.27	0.06
Blue grosbeak	233	-3.45	-9.46	2.47	-1.24	-4.62	2.14	0.07
Blue jay	2,911	-4.02	-5.39	-2.68	-5.79	-7.77	-3.82	0.89
Blue-gray gnatcatcher	911	7.05	4.30	10.22	5.37	2.92	7.83	0.26
Broad-winged hawk	56	-1.91	-19.91	4.83	-1.60	-2.38	-0.83	1.23 Δ
Brown-headed cowbird	661	2.73	-2.17	6.83	4.40	0.53	8.26	0.23
Brown-headed nuthatch	629	-5.64	-8.75	-2.50	-6.46	-9.82	-3.09	0.22
Canada goose	28	29.44	-6.94	568.95	2.73	0.08	5.37	0.02 Δ

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(Table 17 continued)

Species name	Detections	Annual trend			Linear trend			Abundance (birds/point)
		Trend	LCI	UCI	Trend	LCI	UCI	
		percent						
Canada warbler	4	-0.06	-8.34	8.71	-0.24	-0.47	-0.01	1.65 Δ
Carolina chickadee	1,914	-0.66	-2.68	1.37	-3.44	-5.95	-0.93	0.58
Carolina wren	6,614	-0.58	-1.46	0.28	-3.03	-4.99	-1.08	1.90
Cattle egret	266	1.33	-35.68	65.93	11.34	3.88	18.81	0.15
Cedar waxwing	610	21.34	-14.14	219.64	14.50	6.21	22.79	0.74
Chestnut-sided warbler	6	0.19	-45.73	79.11	0.16	-0.22	0.53	3.24 Δ
Chimney swift	123	-6.00	-13.75	2.58	-7.37	-10.53	-4.22	0.10
Chuck-will's-widow	66	21.53	0.28	86.16	11.73	7.75	15.70	0.03
Common grackle	52	-3.65	-35.60	19.82	-0.43	-3.05	2.20	0.06 Δ
Common nighthawk	26	0.19	-5.24	6.80	0.41	-0.15	0.96	3.58 Δ
Common yellowthroat	211	-0.79	-8.12	7.41	-6.73	-10.39	-3.07	0.10
Dickcissel	711	0.64	-4.42	109.50	1.24	-1.01	3.48	0.62 Δ
Downy woodpecker	396	-1.02	-5.08	3.33	-2.63	-5.88	0.61	0.15
Eastern bluebird	51	1.09	-7.93	14.53	1.52	0.79	2.26	1.03 Δ
Eastern kingbird	73	-12.89	-39.06	5.19	-5.82	-9.44	-2.19	0.05
Eastern meadowlark	69	5.18	-10.42	71.65	2.80	-0.35	5.95	0.09 Δ
Eastern phoebe	13	0.52	-4.56	8.75	0.75	0.35	1.15	1.76 Δ
Eastern screech-owl	8	-0.17	-45.04	79.63	-0.38	-0.97	0.21	0.38 Δ
Eastern tufted titmouse	4,823	-0.38	-1.49	0.74	-0.80	-2.30	0.69	1.36
Eastern wood-pewee	547	-4.54	-7.74	-1.43	-3.53	-5.40	-1.66	0.16
Field sparrow	56	1.25	-60.97	162.82	9.72	3.54	15.91	0.03 Δ
Fish crow	35	20.47	-5.47	181.93	6.13	2.30	9.97	0.04 Δ
Gray catbird	31	-1.09	-14.14	14.95	2.63	0.23	5.03	0.10 Δ
Great blue heron	87	7.94	-4.43	23.74	2.32	-1.91	6.54	0.04
Great crested flycatcher	666	-1.16	-3.54	1.26	-2.71	-5.12	-0.29	0.20
Great egret	8	9.33	-14.10	107.24	-0.07	-2.48	2.35	0.05 Δ
Hairy woodpecker	151	3.52	-3.97	12.80	-1.52	-4.84	1.80	0.07
Hooded warbler	2,776	-1.27	-2.66	0.17	-5.87	-8.44	-3.29	0.79
Indigo bunting	3,605	-0.93	-2.10	0.23	-2.14	-4.00	-0.28	1.01
Kentucky warbler	356	-6.49	-11.06	-2.45	-8.07	-10.65	-5.50	0.11
Louisiana waterthrush	167	-1.44	-6.64	3.88	-1.09	-4.71	2.53	0.08
Magnolia warbler	11	-3.04	-64.13	11.32	-0.18	-0.53	0.17	1.04 Δ
Mourning dove	2,047	-0.27	-1.91	1.35	-0.88	-2.68	0.92	0.57
Northern bobwhite	159	-1.66	-7.47	5.66	-4.14	-8.13	-0.16	0.07
Northern cardinal	8,580	-0.43	-1.17	0.33	-1.54	-3.59	0.50	2.44
Northern flicker	109	-2.26	-9.23	4.64	-1.31	-3.09	0.48	0.34 Δ

(continued on next page)

(Table 17 continued)

Species name	Detections	Annual trend			Linear trend			Abundance (birds/point)
		Trend	LCI	UCI	Trend	LCI	UCI	
		percent						
Northern mockingbird	106	3.88	-5.37	13.06	7.49	2.39	12.59	0.05 Δ
Northern parula	508	-2.45	-6.10	1.21	-3.74	-6.45	-1.03	0.15
Orchard oriole	89	16.64	-1.75	69.75	-1.20	-8.36	5.95	0.04
Painted bunting	468	5.31	-2.67	152.81	4.35	1.79	6.91	0.37 Δ
Pileated woodpecker	1,371	-1.48	-3.25	0.30	-3.31	-4.66	-1.97	0.46
Pine warbler	8,363	-3.20	-4.01	-2.38	-6.36	-8.66	-4.06	2.42
Prairie warbler	212	-6.04	-16.32	3.05	-4.09	-9.41	1.22	0.07
Prothonotary warbler	85	6.99	-5.55	21.99	5.48	2.31	8.64	0.07 Δ
Purple martin	236	-2.04	-7.02	3.47	-1.04	-3.78	1.69	0.09
Red-bellied woodpecker	2,115	-1.85	-3.29	-0.42	-2.31	-3.70	-0.91	0.63
Red-cockaded woodpecker	307	-1.70	-5.05	1.63	-0.25	-2.66	2.16	0.09
Red-eyed vireo	4,624	-4.90	-6.09	-3.72	-8.47	-10.80	-6.15	1.29
Red-headed woodpecker	537	-8.12	-11.96	-4.65	-5.63	-8.25	-3.01	0.17
Red-shouldered hawk	212	-0.96	-5.33	3.59	-1.93	-4.67	0.81	0.07
Red-tailed hawk	69	-1.85	-11.42	7.62	-1.17	-4.11	1.78	0.03 Δ
Red-winged blackbird	13	1.61	-78.72	421.80	7.41	0.73	14.09	0.02 Δ
Rose-breasted grosbeak	9	3.00	-6.05	100.98	0.45	-0.10	0.99	0.64 Δ
Ruby-throated hummingbird	60	0.76	-3.44	5.68	0.49	-0.48	1.46	1.68 Δ
Scissor-tailed flycatcher	83	29.12	2.73	164.22	13.79	8.95	18.63	0.06 Δ
Sharp-shinned hawk	22	-2.54	-16.96	12.95	-4.56	-8.75	-0.38	0.03 Δ
Summer tanager	2,111	-0.86	-2.37	0.65	-3.30	-4.69	-1.92	0.60
Swainson's thrush	80	15.58	-5.63	78.22	4.56	-1.74	10.86	0.05 Δ
Swainson's warbler	42	-16.46	-27.64	-3.95	-8.85	-14.32	-3.38	0.04 Δ
Tennessee warbler	19	-0.43	-7.45	5.61	0.39	-0.22	1.00	2.11 Δ
Turkey vulture	369	3.43	-0.92	8.00	2.04	-2.73	6.81	0.13
White-breasted nuthatch	111	18.77	3.83	63.85	10.27	5.30	15.24	0.04
White-eyed vireo	3,261	0.68	-0.58	1.97	-1.95	-4.28	0.38	0.92
Wild turkey	44	-1.52	-16.06	7.58	-0.26	-1.24	0.71	0.93 Δ
Wood duck	86	-1.02	-12.18	11.06	-1.13	-2.75	0.49	0.23 Δ
Wood thrush	257	-8.62	-12.42	-5.28	-8.97	-12.61	-5.33	0.07
Worm-eating warbler	41	-0.97	-7.91	4.69	-1.00	-1.86	-0.13	1.40 Δ
Yellow-billed cuckoo	1,352	-4.53	-7.24	-1.87	-2.88	-6.10	0.35	0.46
Yellow-breasted chat	3,207	-1.25	-2.40	-0.09	-2.98	-4.70	-1.26	0.88
Yellow-throated vireo	383	5.74	1.14	11.33	-1.56	-4.54	1.42	0.12
Yellow-throated warbler	43	-1.15	-7.37	3.91	-0.29	-1.22	0.64	1.53 Δ

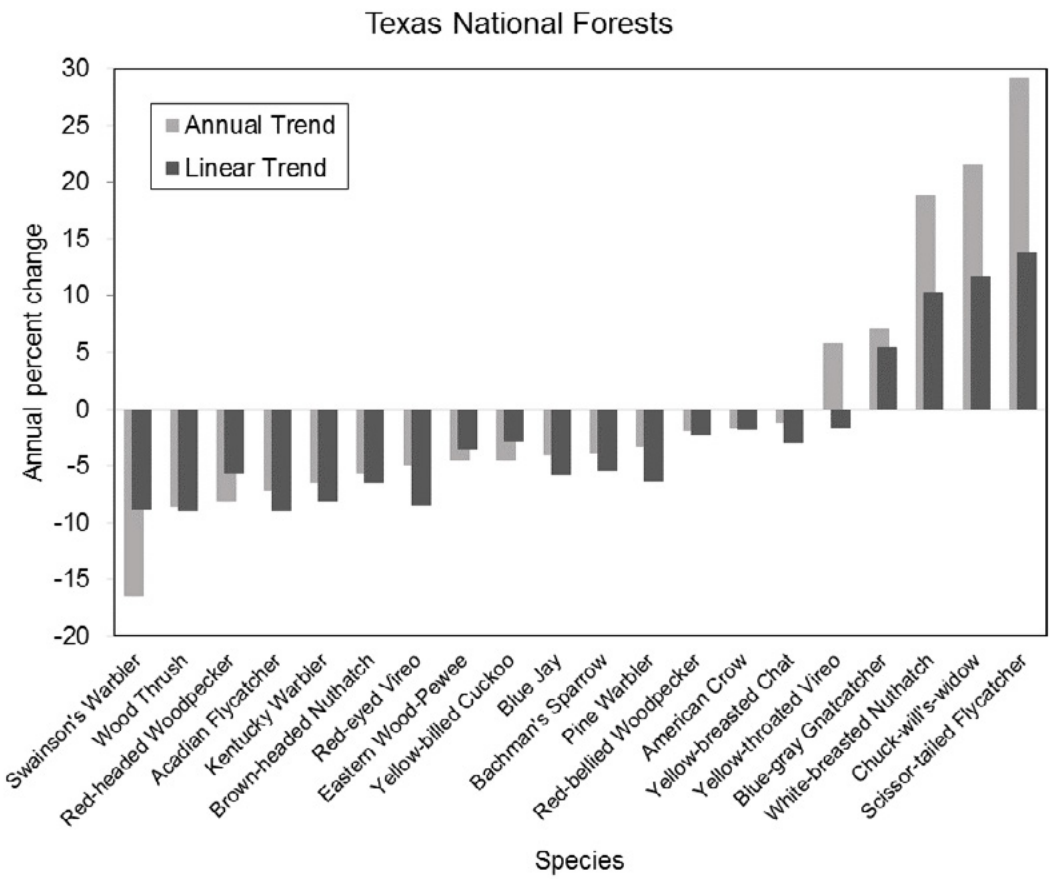


Figure 31.—Significant (based on 95-percent credible interval) positive and negative annual and linear trends for bird species in Texas National Forests, 1998–2017.

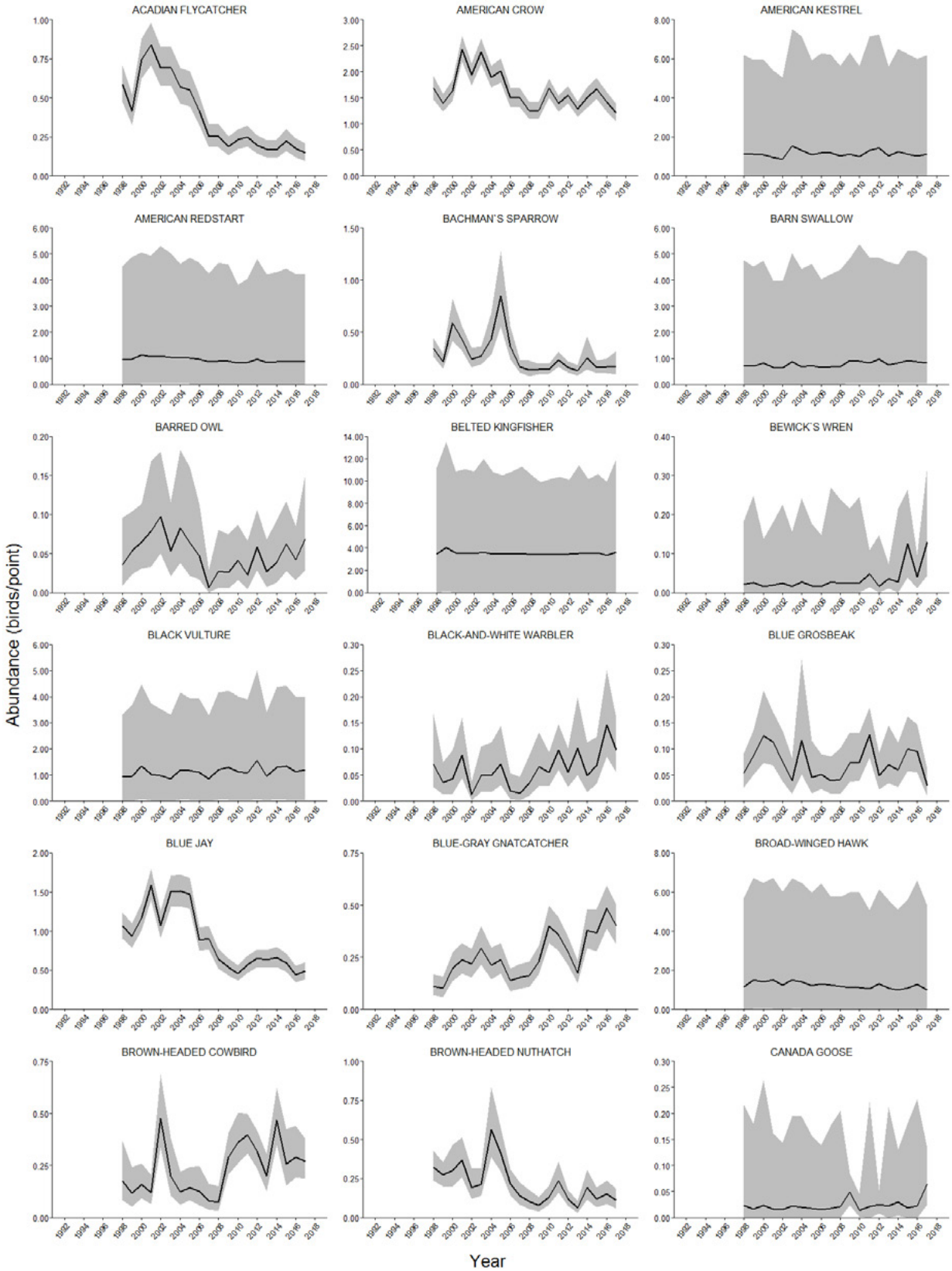
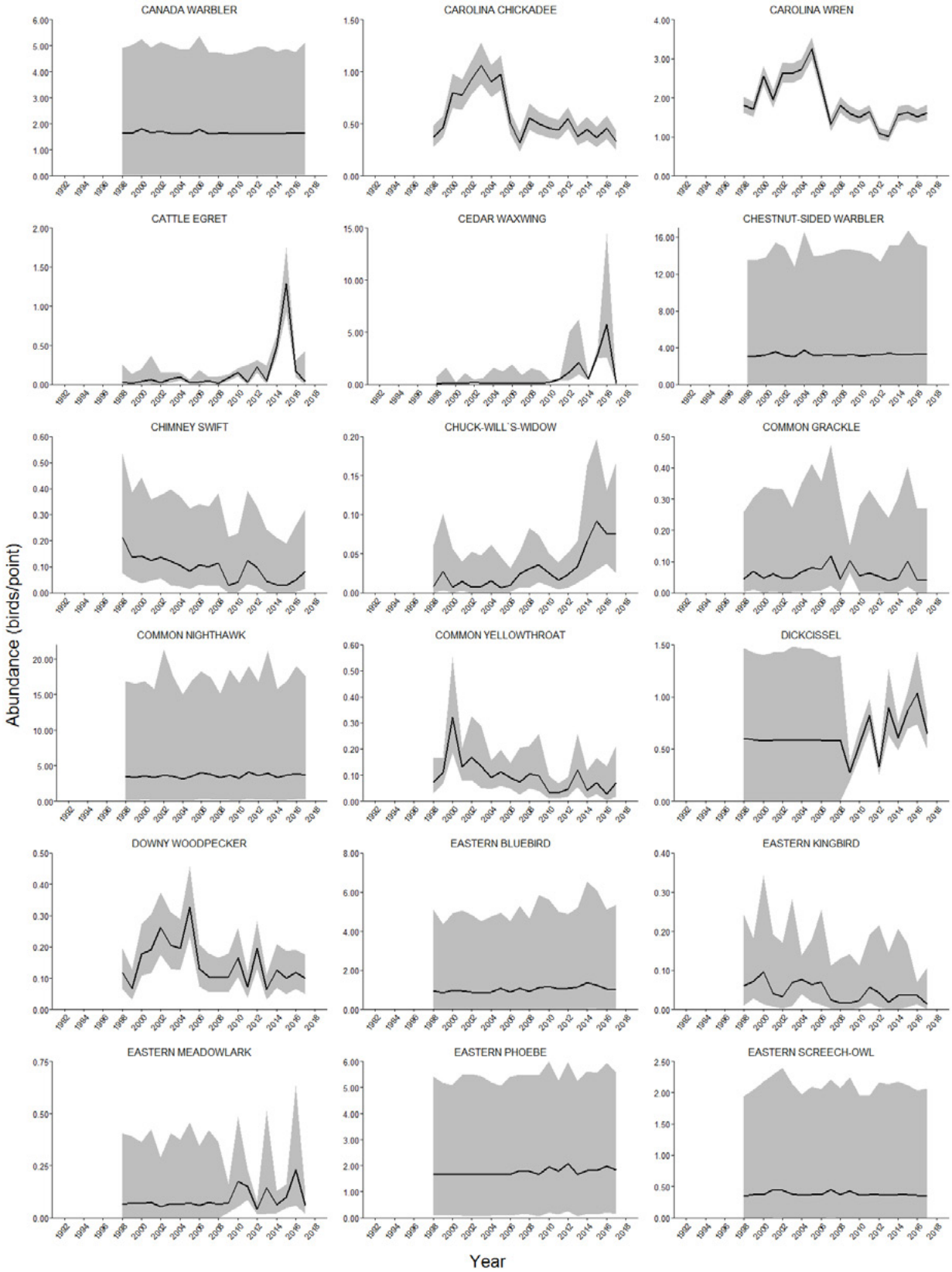


Figure 32. (page 1 of 5)—Estimated abundances and 95-percent credible intervals (shaded areas) for 89 bird species in Texas National Forests, by year. The scale of the abundance axes may vary among species to best illustrate patterns in abundance.



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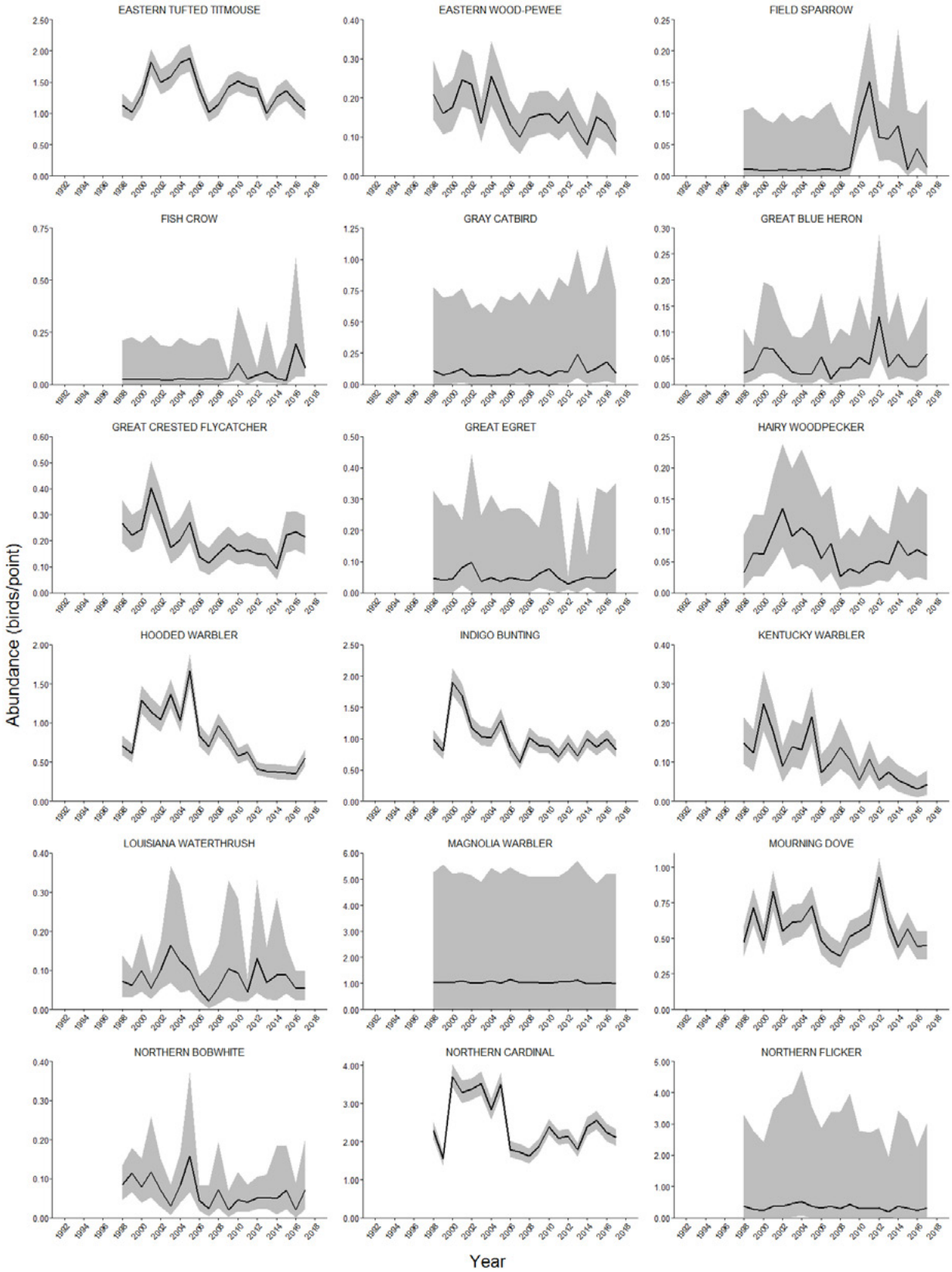

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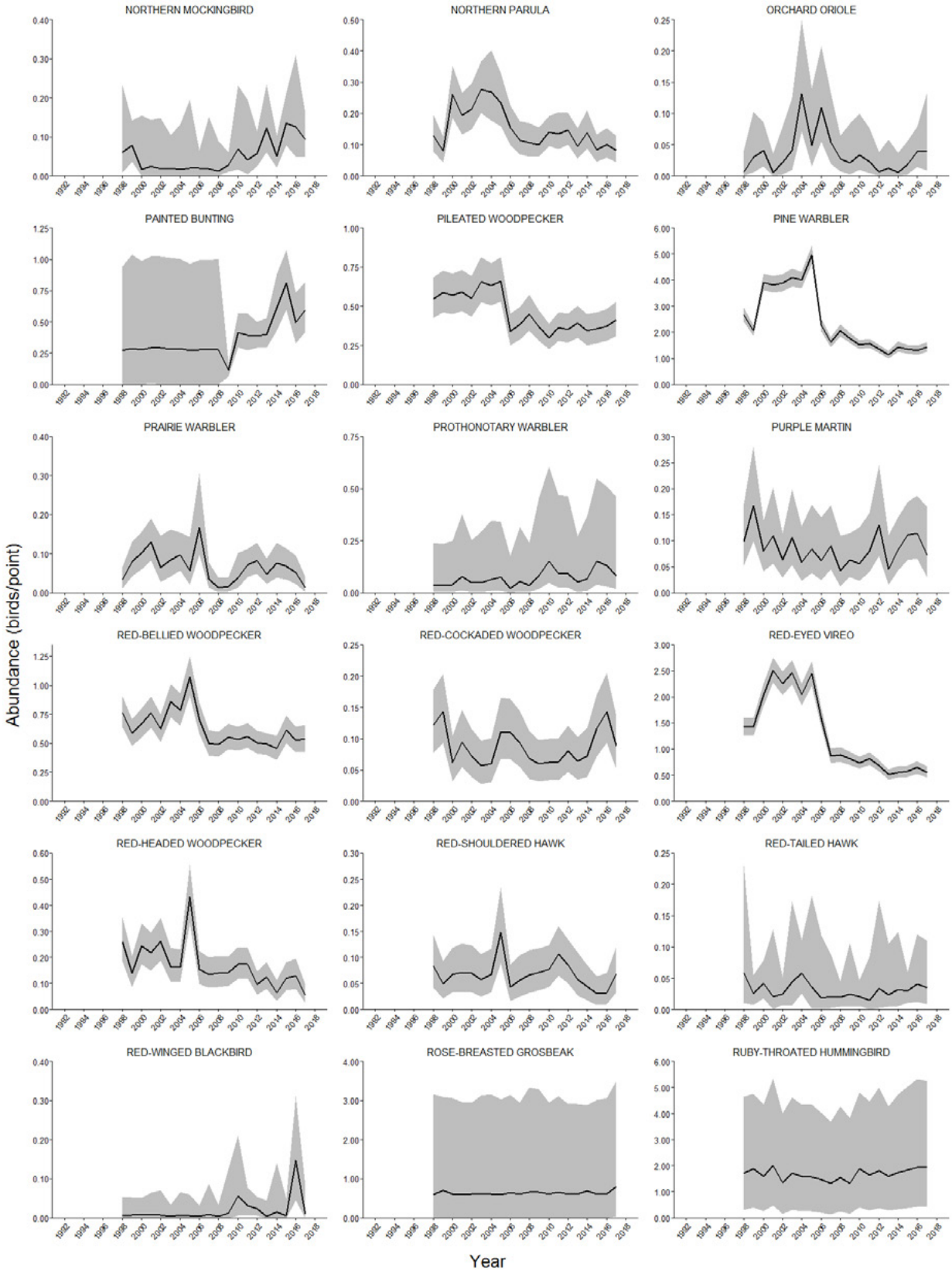

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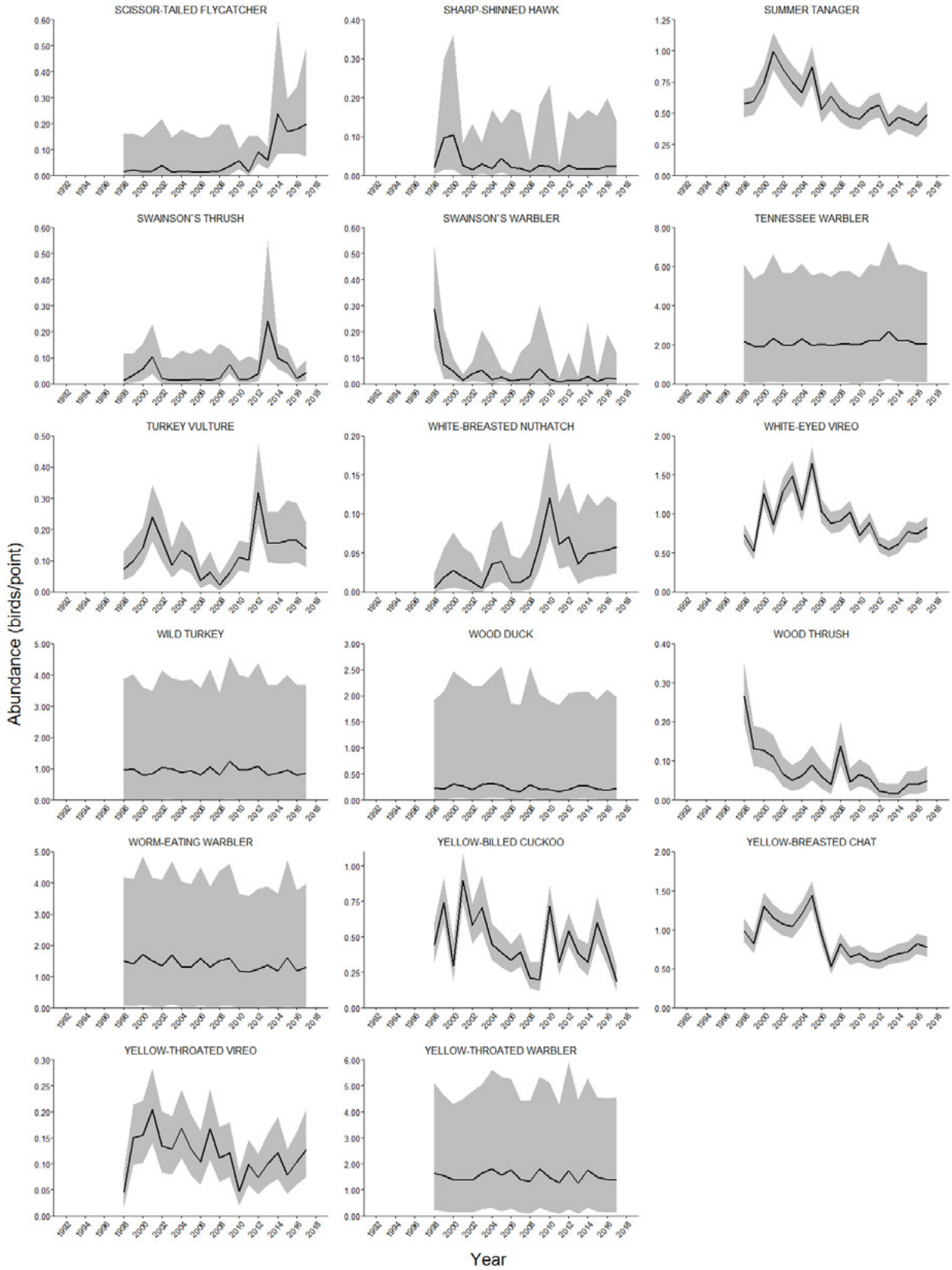

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Regional Habitat Associations

We estimated abundance in relation to 8 forest types and 5 successional classes for 101 individual bird species at the regional level (Fig. 33). Species abundances varied across forest types and successional classes. Thirteen species generally had greater abundances in later successional classes (i.e., sawtimber and late successional), and 29 species had greater abundances in early-successional classes (i.e., grass/forb and shrub/seedling). Twenty-one species were generally more abundant in specific forest types, and abundances of 38 species were more mixed or variable among forest type and successional class.

Some species had greater abundances in sawtimber or late-successional classes across most or all forest types. Most species that had a strong association with later successional classes are described as woodland-breeding species (Sauer et al. 2017). Eastern tufted titmouse, Kentucky warbler, and pine warbler were more abundant in sawtimber and late-successional classes in most forest types. Acadian flycatcher, black-throated green warbler, and ovenbird were also associated with late-successional classes; however, in mesic hardwood forests they showed higher abundances in shrub/seedling stands. Woodland-breeding species such as red-eyed vireo, worm-eating warbler, and yellow-throated vireo use shrubby understories (Rodewald 2015), which probably explains their strong association with later successional classes, but they also had large abundances in earlier successional classes in some forests. Other species such as Blackburnian warbler, Louisiana waterthrush, and Swainson's warbler showed a strong association with later successional classes in only four or five forest types. Cattle egret was the only wetland-open water breeding species that showed high abundances in later successional classes. Cattle egrets occur in riverside woodlands or upland forest and nest in trees (Telfair 2006), which is likely why we found a preference for late-successional classes.

More species had greater abundances in early-successional classes across most or all forest types. Most species that preferred grass/forb and shrub/seedling classes were early-successional, scrub-breeding species. Eastern towhee, gray catbird, and indigo bunting had the highest abundances in grass/forb and shrub/seedling classes. American goldfinch, field sparrow, mourning dove, northern bobwhite, prairie warbler, and white-eyed vireo favor shrubby areas and overgrown fields (Brennan et al. 2014, Carey et al. 2008, Hopp et al. 1995, McGraw and Middleton 2017, Nolan et al. 2014), which is probably why they had greater abundances in early-successional classes. Species that can be found along forest edges, such as blue jay, brown thrasher, brown-headed cowbird, Carolina wren, chipping sparrow, northern cardinal, red-headed woodpecker, and yellow-breasted chat, also had higher abundances in early-successional classes. Other species that showed some preference for early-successional classes included blue grosbeak, common yellowthroat, eastern bluebird, northern mockingbird, and orchard oriole. Woodland-breeding species such as Carolina chickadee, eastern wood-pewee, and yellow-billed cuckoo also showed high abundances in early-successional classes in most forest types. These species can be found in open woodlands with low, shrubby vegetation (Hughes 2015, Mostrum et al. 2002, Watt et al. 2017). This preference could explain their high abundances in early-successional classes, which often have some residual mature trees.

Many species showed a strong association with one or two forest types. Species that had higher abundances in spruce/fir/cedar forests included Bachman's sparrow, brown-headed nuthatch, cerulean warbler, common nighthawk, and red-cockaded woodpecker. Additionally, brown-headed nuthatch and common nighthawk were relatively abundant in loblolly/shortleaf pine

forests. Some species were also strongly associated with successional classes within a forest type. American robin, song sparrow, and winter wren showed the highest abundances in longleaf/slash pine forests, but song sparrow and winter wren were also strongly associated with late-successional classes. Blue-headed vireo, Canada warbler, and dark-eyed junco had the largest abundances in longleaf/slash pine and mesic hardwood forests. Blue-headed vireo and dark-eyed junco also preferred later successional classes, in contrast with Canada warbler, which had larger abundances in shrub/seedling stands of mesic hardwood forests. Other species that showed higher abundances in mesic hardwood forests included black-throated blue warbler, least flycatcher, and rose-breasted grosbeak. Barred owl, blue-gray gnatcatcher, and great blue heron were strongly associated with early-successional classes in bottomland hardwood forests, whereas prothonotary warbler preferred sapling/pole stands in these forests. Within oak/hickory forests great egret, red-winged blackbird, and ruffed grouse preferred earlier successional classes.

Most species showed mixed responses to forest type and successional class. Most of the species with mixed responses were woodland-breeding species. Black-and-white warbler, hooded warbler, scarlet tanager, white-breasted nuthatch, and wood thrush usually favor mature deciduous forests (Chiver et al. 2011, Evans et al. 2011, Grubb and Pravosudov 2008, Kricher 2014, Mowbray 1999), but were abundant in all forests, except longleaf/slash pine forests. Woodpecker species such as downy woodpecker, northern flicker, pileated woodpecker, and red-bellied woodpecker were generally abundant across successional class and forest type, likely because of residual trees left in harvested stands. Great crested flycatcher also did not have a strong association with successional class, but did have high abundances in six forest types. American redstart and northern parula showed larger abundances in deciduous forest types, whereas cedar waxwing and chuck-will's-widow had larger abundances in pine-evergreen forests. Species that did not respond to successional class and showed similar, but small, abundances across all forest types included broad-winged hawk, hairy woodpecker, red-shouldered hawk, summer tanager, and yellow-throated warbler. Other species with varied abundances across forest type and successional class were black-billed cuckoo, veery, and whip-poor-will. Some early-successional, scrub-breeding species such as blue-winged warbler, chestnut-sided warbler, eastern kingbird, and yellow warbler also showed a mixed response to forest type and successional class.

Some of the mixed responses that we detected and the large credible intervals around some abundance estimates could be a result of the survey and analysis methods. Bird detections were recorded in three distance-from-observer classes, but the outer class did not have a fixed outer radius and was defined as more than 50 m. Points were supposed to be located farther than 50 m from edges, but this still would permit birds to potentially be detected in adjacent habitat types. We chose to include detections from all distance classes to maximize sample size, but future analyses focused on habitat use could restrict detections to less than 50 m to reduce detecting birds in adjacent vegetation types.

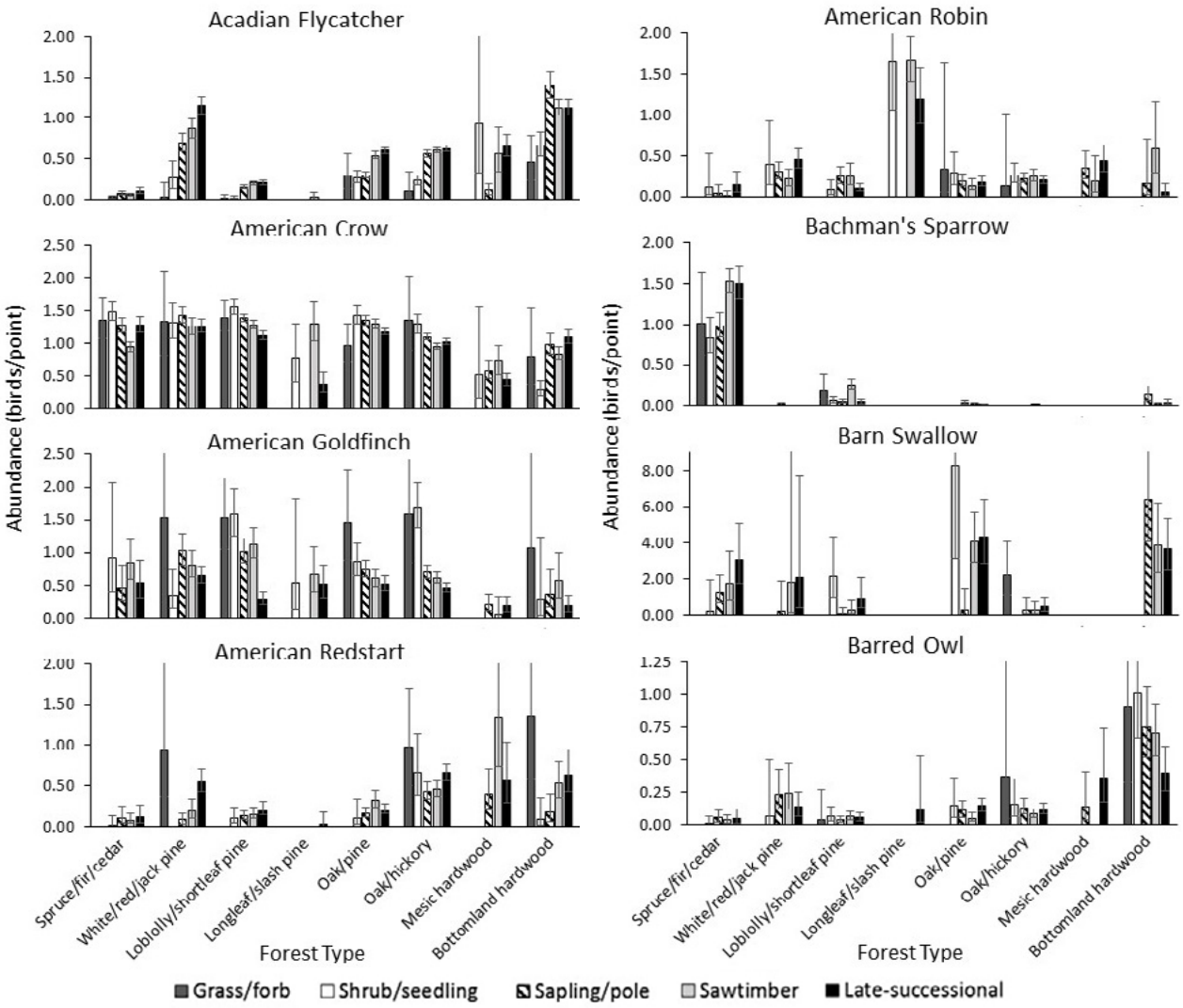


Figure 33. (page 1 of 13)—Estimated abundances and 95-percent credible intervals for 101 bird species by forest type and successional class in the Southern Region of the USDA Forest Service, 1992–2017.

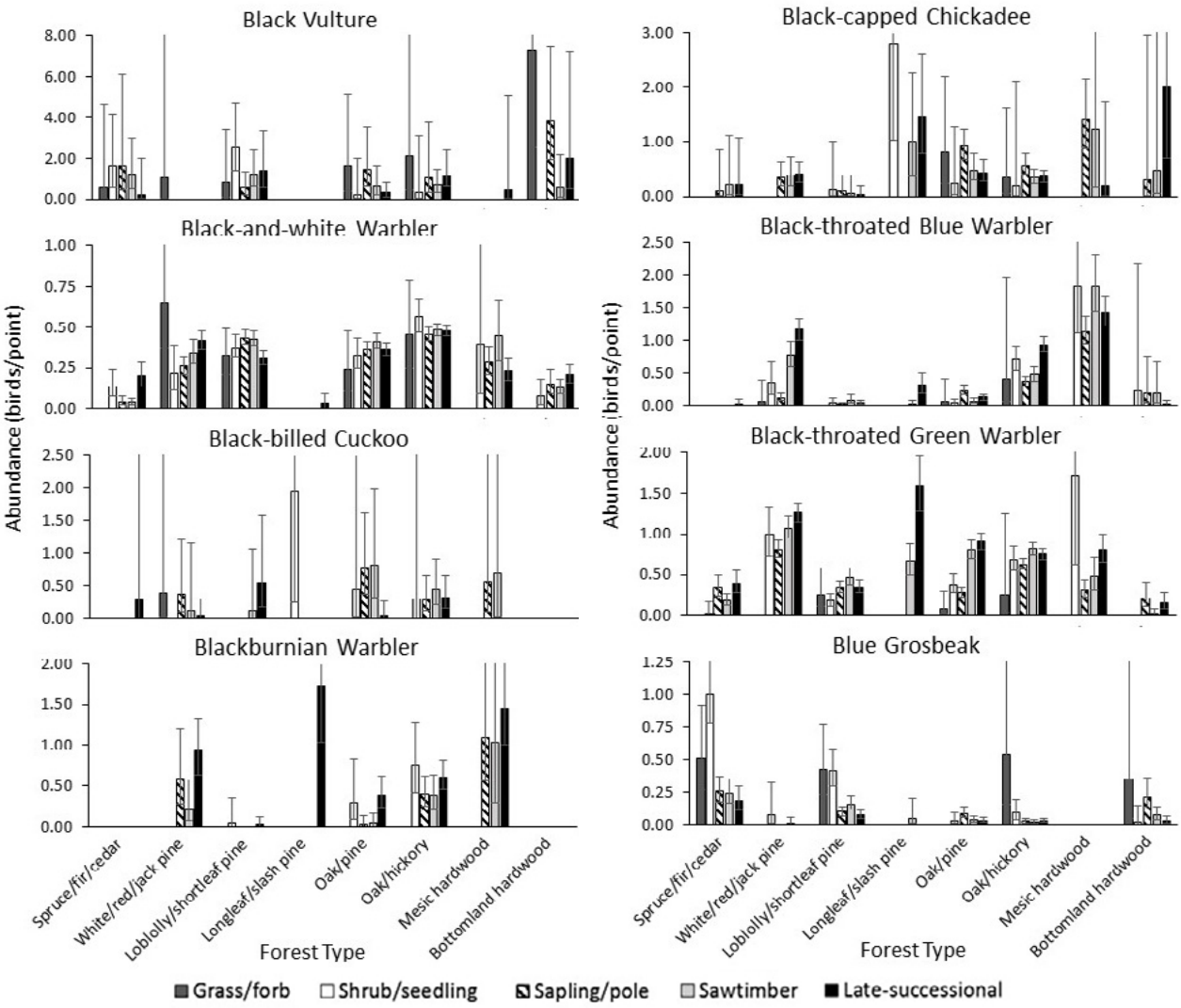
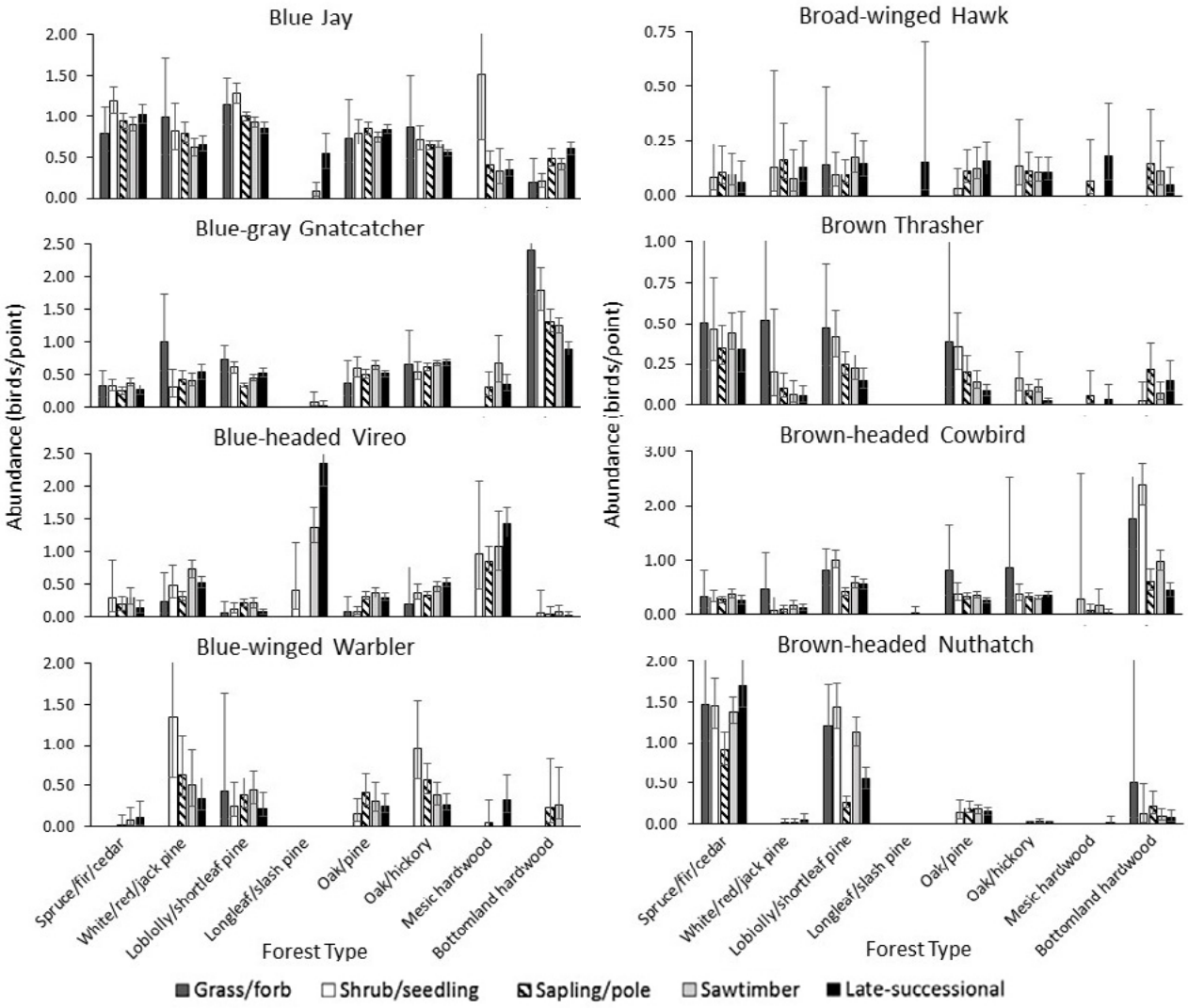


Figure 33 (page 2 of 13)



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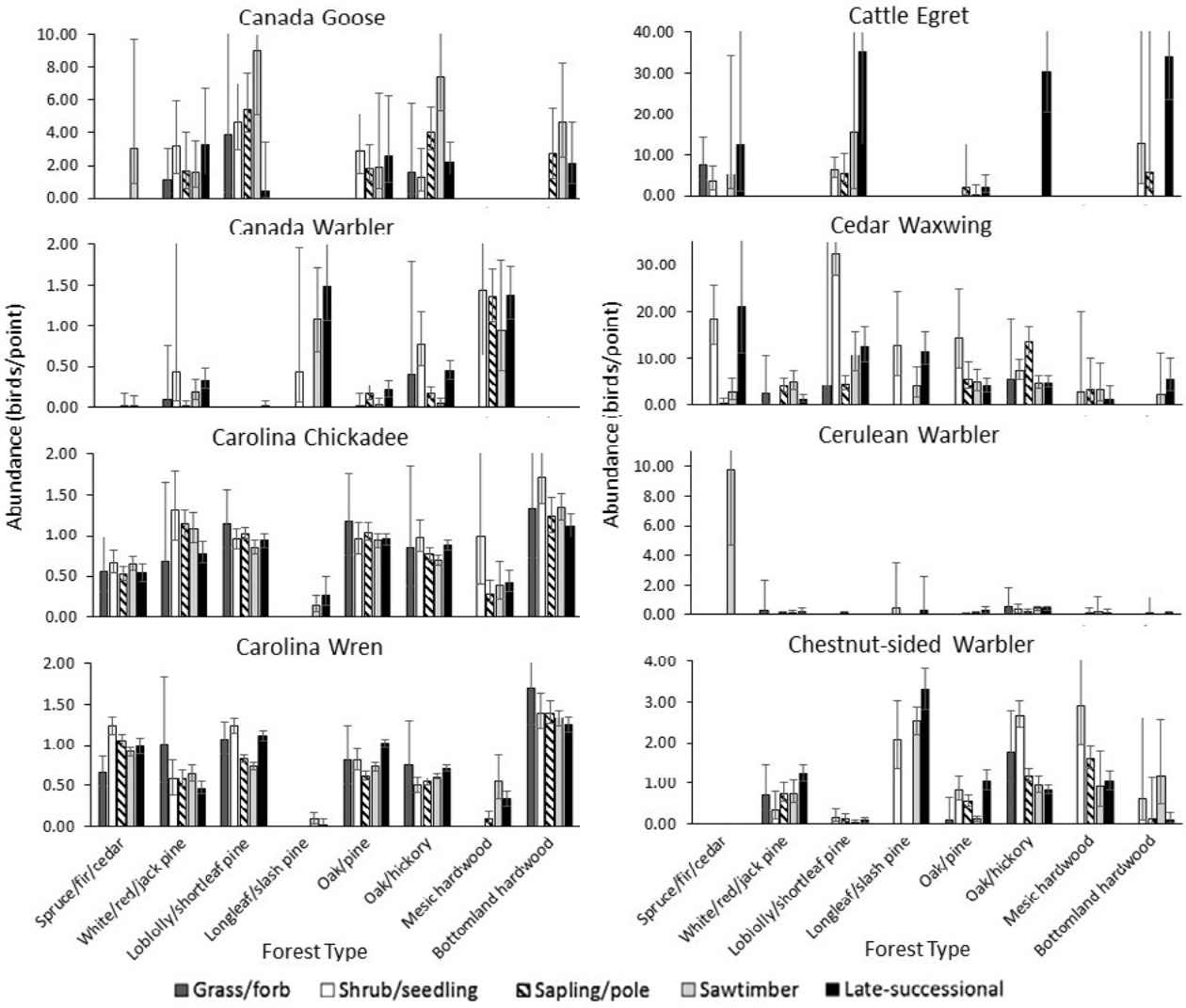

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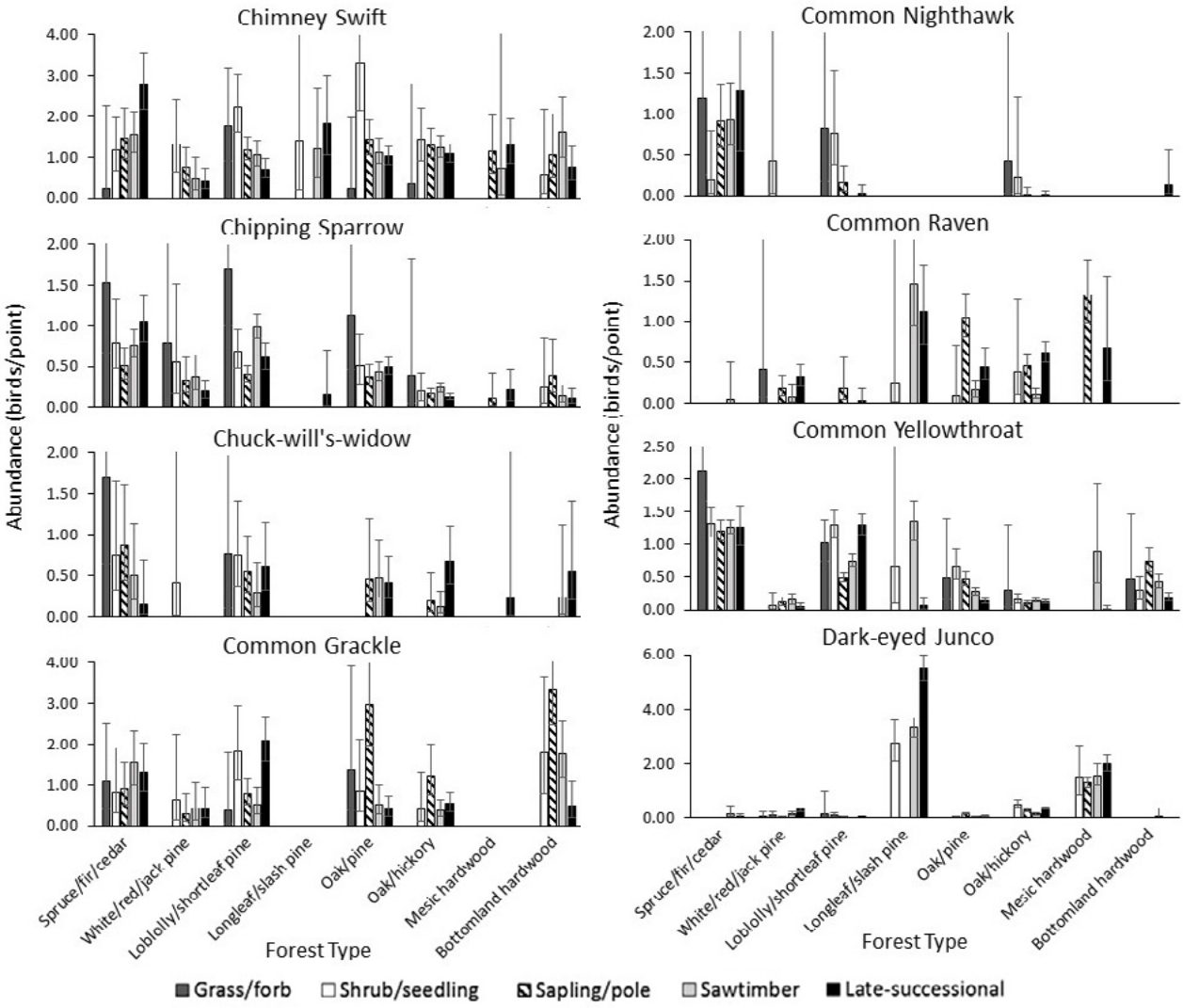

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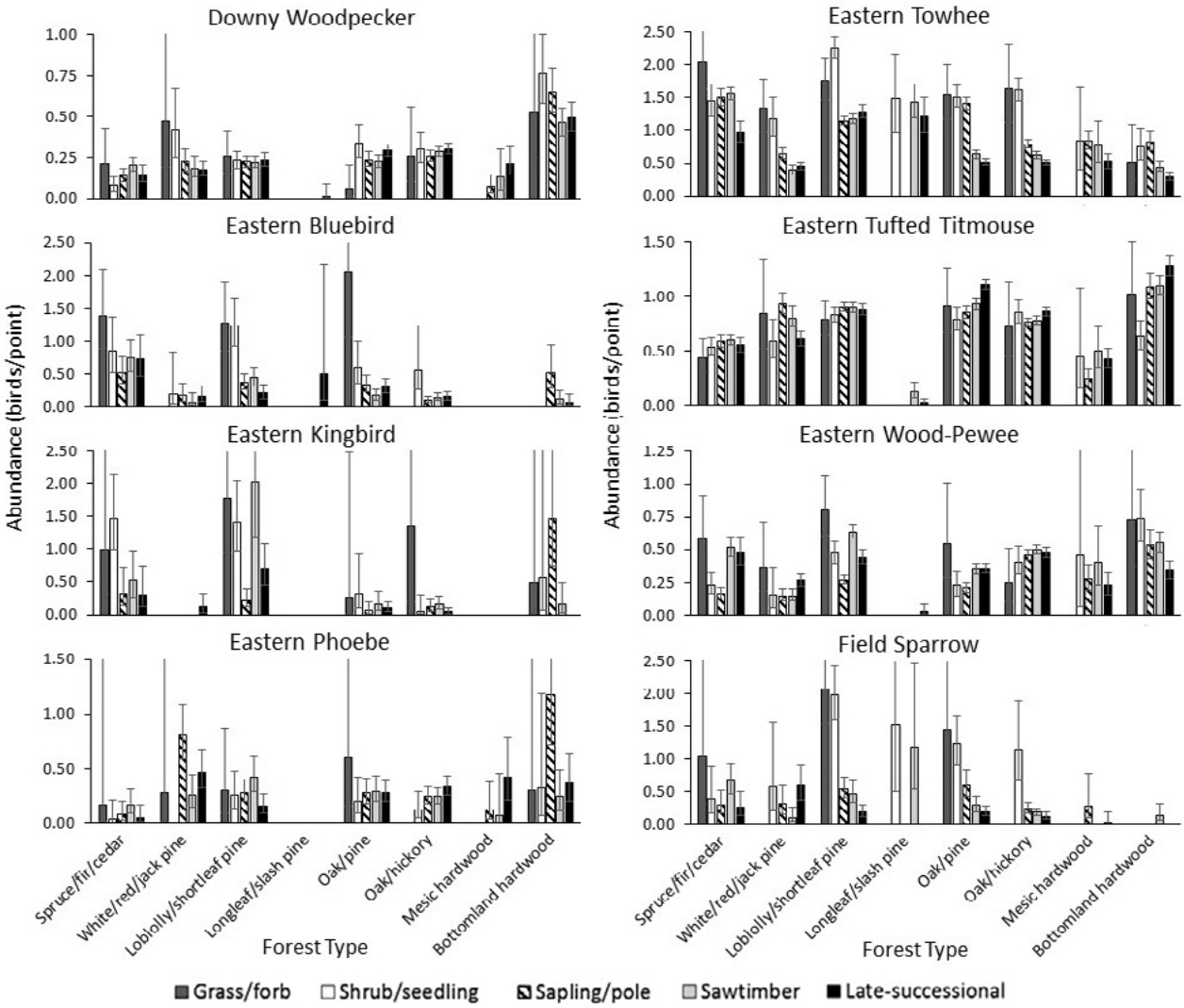

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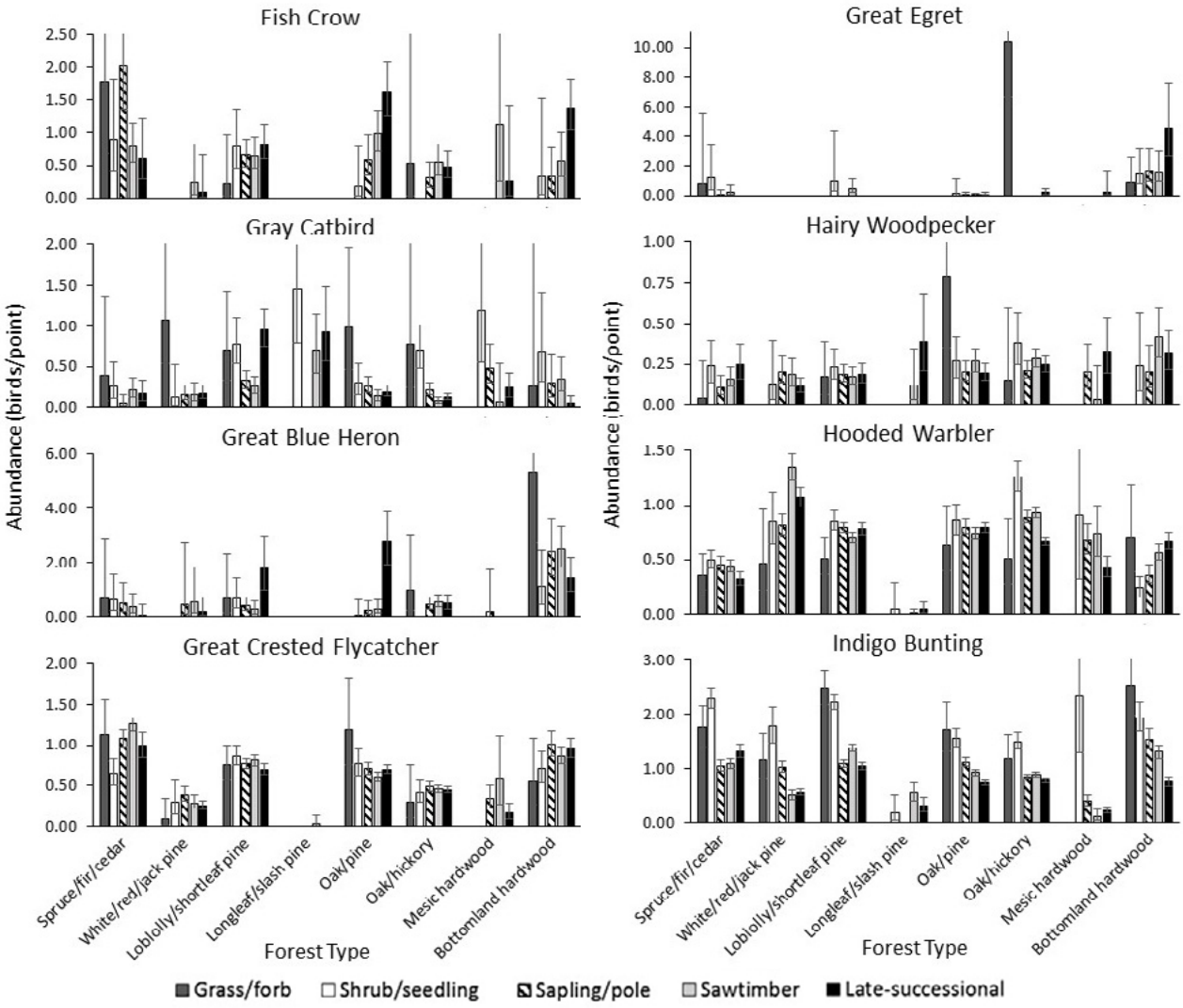

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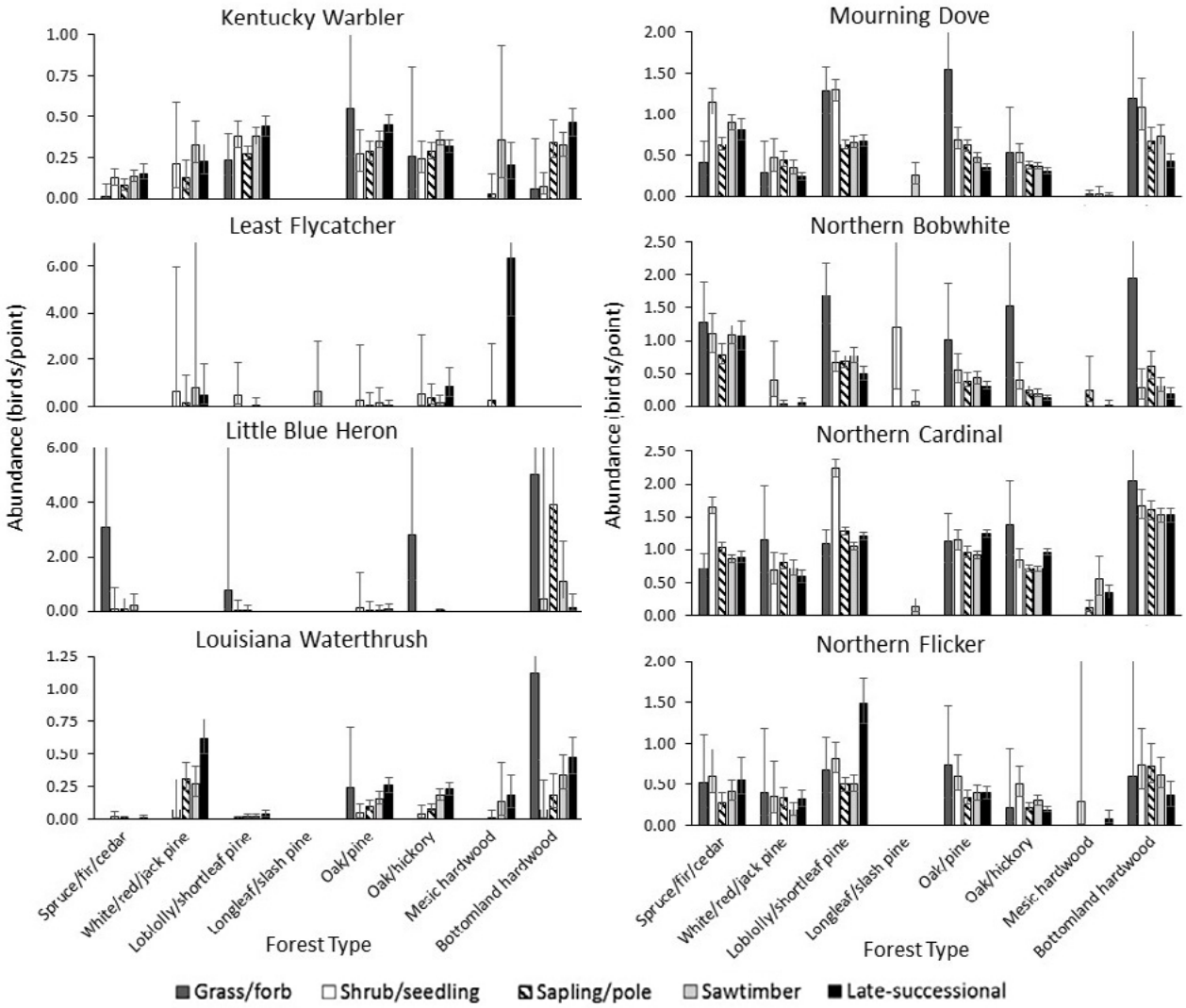

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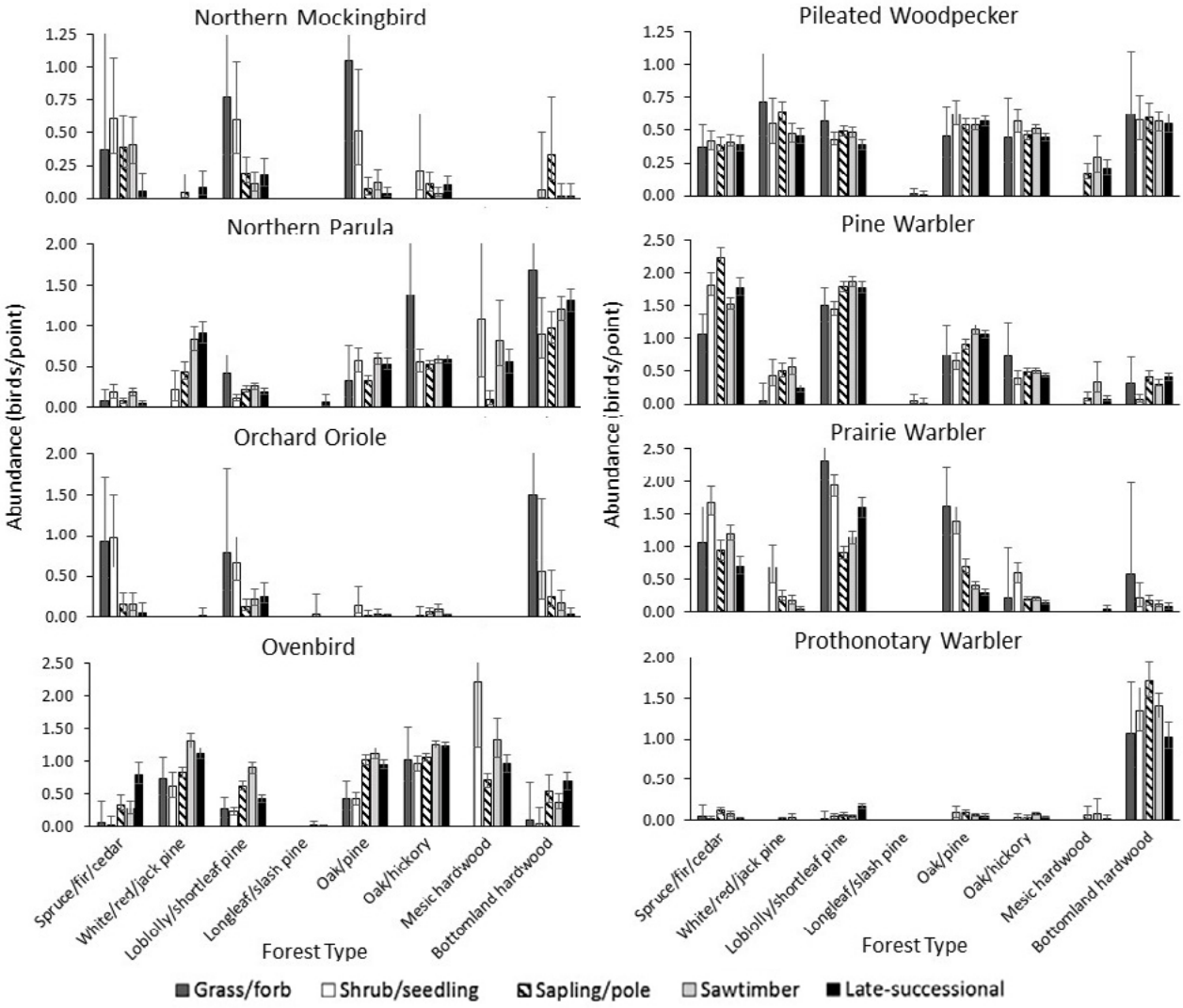

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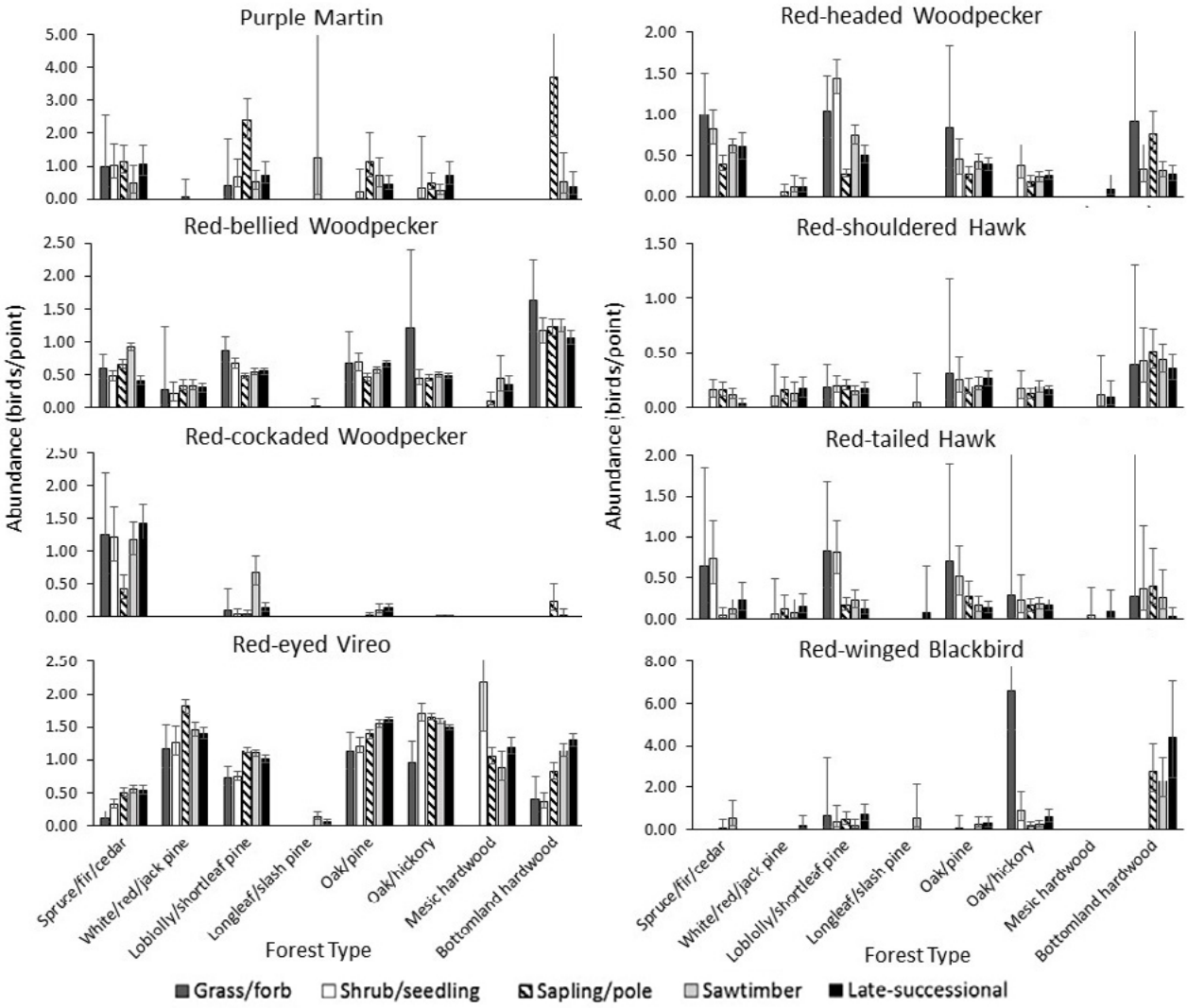

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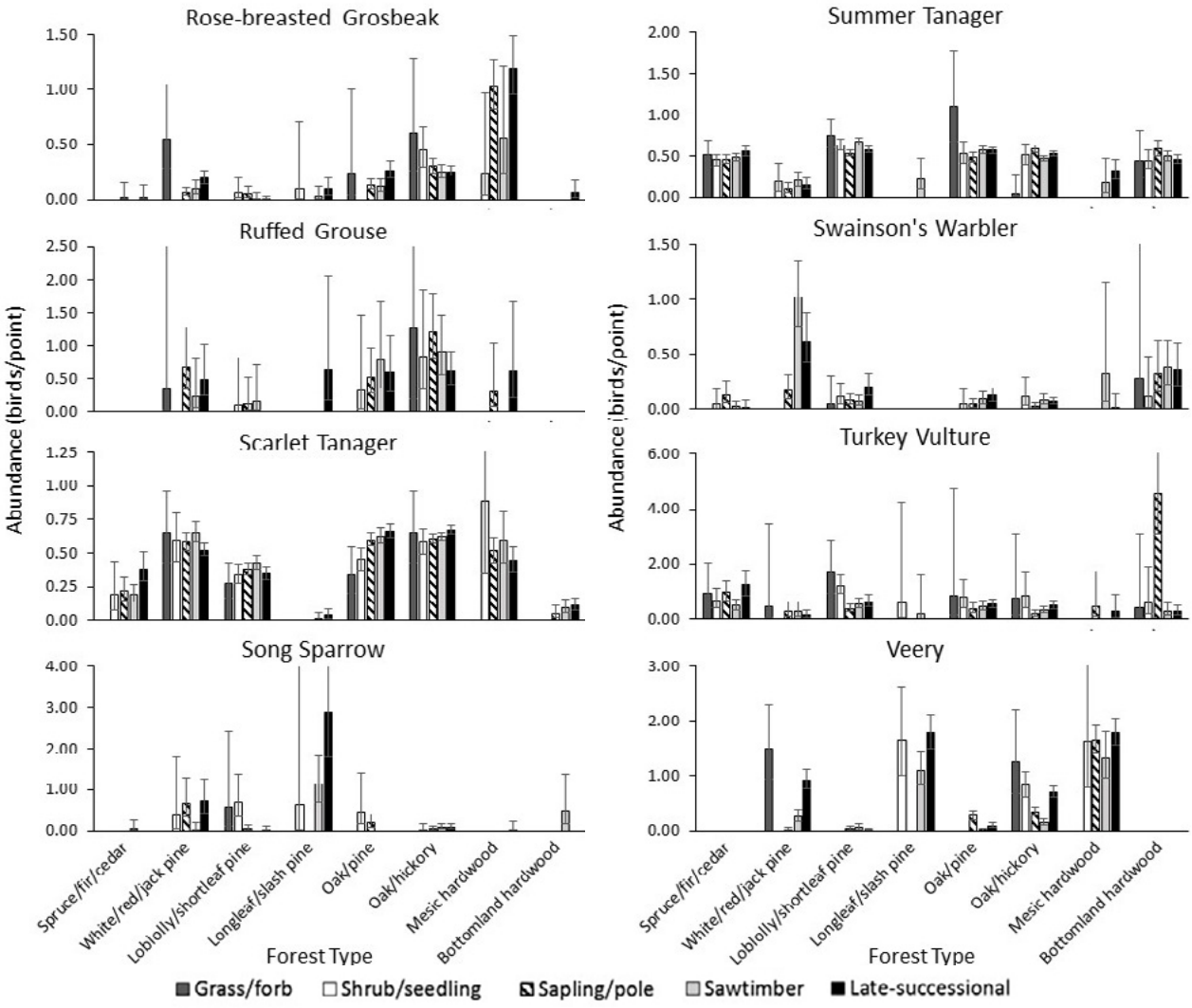

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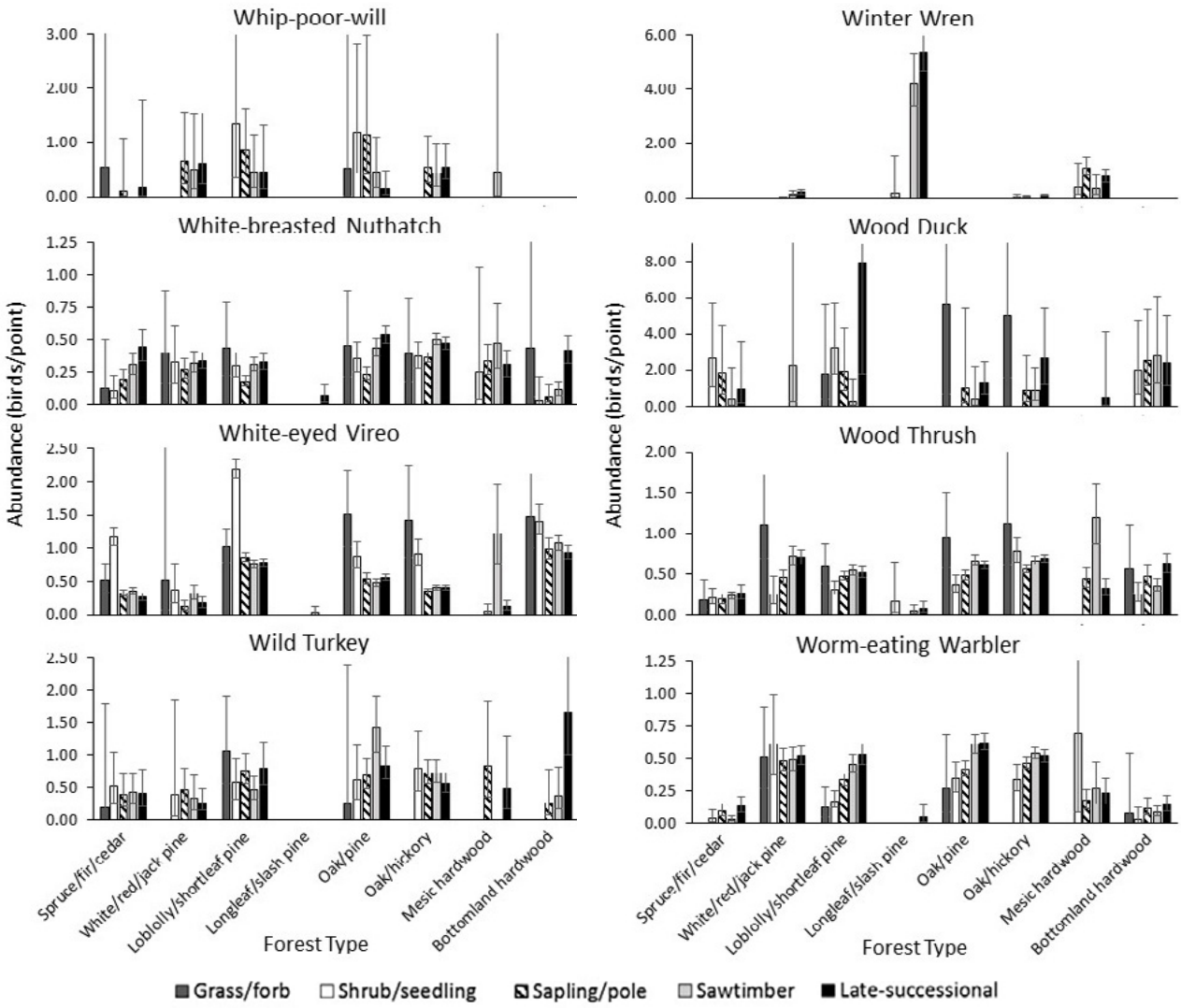

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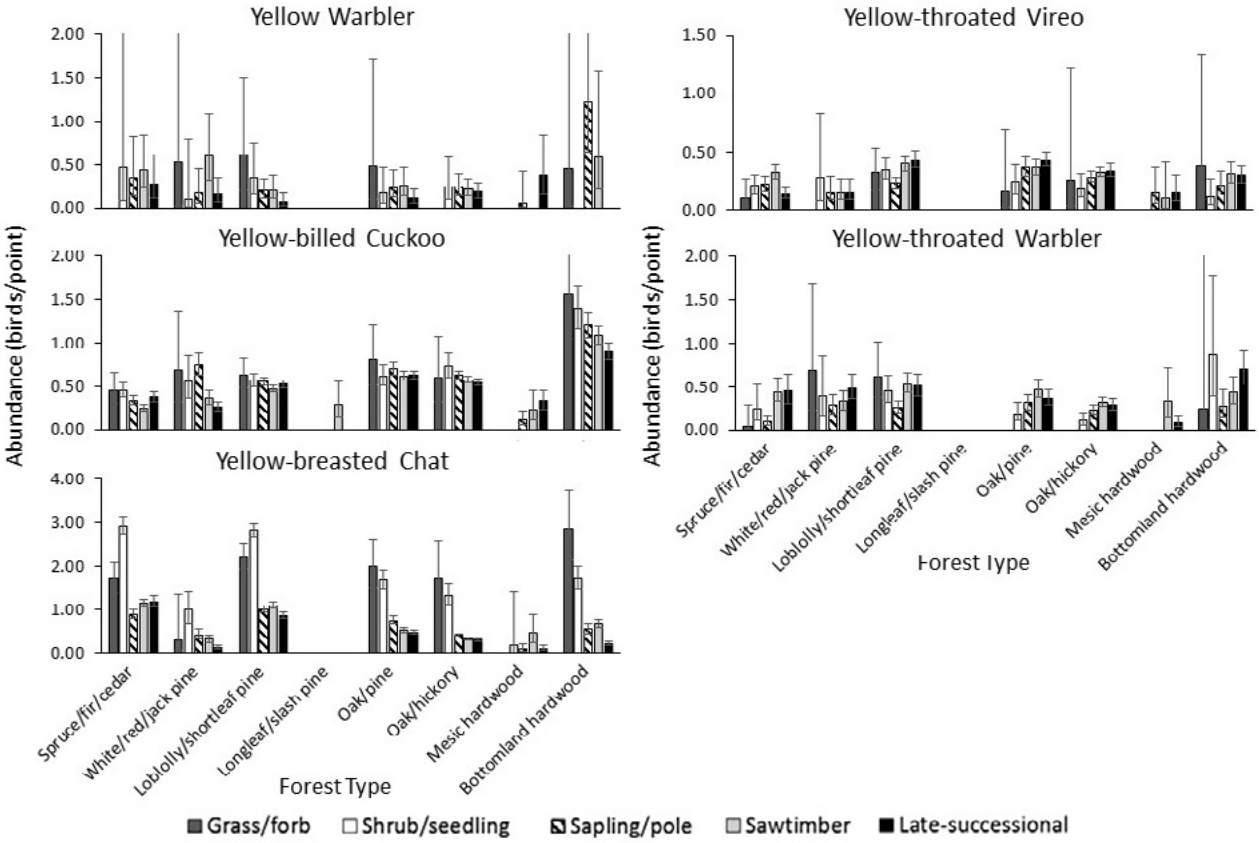

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CONCLUSIONS AND RECOMMENDATIONS

The results in this report indicate variable bird populations with a range of trends across species and forests. From the trend models, we identified 166 instances of significant growth and 145 instances of significant decline by a species on a national forest. The remaining estimates from the 1,351 models showed no significant change over time, which may be because trends were stable or we were not able to precisely estimate them. Most of the significant changes in these populations were less than 10 percent annually; however, in 29 and 30 instances species grew or declined by 10 percent or more, respectively. Species with large declines in multiple national forests included northern bobwhite, American crow, field sparrow, common grackle, and blue jay. Species such as white-breasted nuthatch, blue-gray gnatcatcher, hooded warbler, and blue-headed vireo experienced significant growth in multiple national forests. Yet others, such as wild turkey, worm-eating warbler, and eastern phoebe, experienced declines or growth, depending on the national forest. When we considered trends by the habitats where we found the species to be most abundant, we noticed that species associated with loblolly/shortleaf pine, oak/pine, and spruce/fir/cedar forest types showed significant declines more often than growth over the 26 years. The same was true for species most abundant in sapling/pole stages, which is consistent with concerns that have been raised for disturbance-dependent or early-successional birds in the region. However, these observations are only general summaries and do not indicate confirmed effects. We suggest additional analyses later in this section to address this and other objectives.

Few other avian monitoring programs have been implemented with the consistency, rigor, and spatial and temporal extent of the Southern Region's bird monitoring program. The U.S. Geological Survey's North American Breeding Bird Survey is a long-term, large-scale, international avian monitoring program begun in 1966 to track the status and trends of North American bird populations (U.S. Geological Survey 2018). While that program provides important data on species across their ranges, it is less capable of considering local populations and their response to changes in factors like habitat, or at the scale of a national forest. The focus of the Southern Region's bird monitoring program on national forests and the inclusion of forest and vegetation data provide an effective means to relate bird populations to vegetation and management on national forests across the region.

Given that the program was implemented before much of the recent development of monitoring and analytical approaches, we think it is remarkable that it has remained unchanged and still highly relevant today. Nevertheless, we think that some changes to the survey methodology could improve relevance while not sacrificing previous data. For example, to estimate actual population size of species on national forests, abundance estimates need to be linked to density, which requires that point estimates be for a defined sample area. Bird detections are currently recorded in distance intervals of 0–25, 25–50, and more than 50 meters. Limiting detections to the area defined by a 50-meter radius would allow estimation of density but unfortunately excludes many detections heard outside of 50 meters, which can affect the precision of estimates. Modifying distance intervals to 0–25, 25–50, 50–100, and more than 100 meters would define a sampled area based on 100 meters that would include many more detections, and by retaining an unbounded outer radius, maintain compatibility with previous counts. Additionally, modeling bird abundance by habitat can be improved by increasing the frequency with which vegetation is sampled at a point over time. Although habitat-based results included only samples with fewer than 5 years between point counts and vegetation sampling, that is still enough time for some changes in forest structure and stage. This discrepancy reduces the precision with which we can link bird abundance to habitat.

We suggest that additional analyses beyond the scope of this study are possible and worthy of pursuit, and could provide additional information on the status of birds or causal factors for the patterns reported here. For example, species trends on national forests could be assessed for larger ecological units such as physiographic regions and compared to trends reported by the Breeding Bird Survey to provide insight on how well the Forest Service is managing its lands for birds. Trends in bird abundance could also be related to landscape changes in land cover and land use on national forests and the surrounding landscape.

ACKNOWLEDGMENTS

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The USDA Forest Service has a legislative mandate to maintain species and community diversity on National Forest System lands and uses monitoring to determine whether national forests are meeting this goal. The Southern Region of the Forest Service adopted the Southern National Forest's Migrant and Resident Landbird Conservation Strategy in 1996 to address conservation concerns arising from long-term population declines in many birds. The strategy implemented a regionwide program to improve monitoring, research, and management of avian populations and their habitats. Monitoring is conducted by 10-minute point counts from early April to late June across 15 national forest units. Our objective was to analyze 26 years of monitoring data collected by this program from 1992 through 2017 to assess population trends and habitat associations of birds. We used time-removal models within a hierarchical Bayesian model framework to estimate species abundance by year, population trends, and abundance related to forest type and successional class. There were 82,367 point counts completed and 1,104,423 birds detected. We determined population trends for a total of 152 species and between 58 and 117 species per national forest. Seventy-five species had a majority of positive annual trends and 68 species had a majority of negative annual trends across all national forests. We estimated abundance in relation to forest type and successional class for 101 individual bird species. Thirteen species generally had greater abundances in late-successional classes and 29 species in early-successional classes. Twenty-one species were generally more abundant in specific forest types, and abundances of 38 species were more mixed or variable among forest types. This represents the first comprehensive effort to analyze this 26-year dataset, and these results can help inform management and conservation of migrant and resident birds in the Southern Region. We suggest that additional analyses are possible to investigate causal factors for the patterns reported here and further inform management efforts.

KEY WORDS: Bayesian model, monitoring, point counts, Southeastern United States, long term, resident, migrant

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