



Streamside Bird Monitoring in the Eastern Rivers and Mountains Network

Allegheny Portage Railroad National Historic Site
2007–2019

Natural Resource Report NPS/ERMN/NRR—2021/2311



ON THE COVER

Tufted Titmouse (*Baeolophus bicolor*). One of the most abundant bird species at Allegheny Portage Railroad National Historic Site point count stations. Photo © Bill Thompson.

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Executive Summary

This report summarizes the first 12 years of monitoring (2007 to 2019) the streamside bird community at Allegheny Portage Railroad National Historic Site (Allegheny Portage Railroad NHS). During that time period one observer conducted 372 point count surveys detecting 2,759 individual birds at 17 point count stations within the park.

Allegheny Portage Railroad NHS contains a rich and diverse streamside bird community with a total 64 species detected; 58 of which are target species and presumed to be breeding in the park during summer months. The majority of the 20 most abundant species were forest-associated species including both forest interior species and forest generalist species but also a large number of species that thrive in human modified (in this case suburban) landscapes with sufficient tree and shrub cover.

Fifteen species overall and six of the 20 most abundant species were of conservation importance in the Appalachian Mountains bird conservation region, highlighting the significance of even a relatively small park like Allegheny Portage Railroad NHS to avian conservation. Almost all of the species of conservation importance at the park were species dependent on intact, mature, deciduous forest as habitat for nesting and breeding. Management actions that maintain and improve the condition of forested habitats in the park (and regionally) will likely be beneficial to maintaining these bird populations as well.

Trends in unadjusted abundance over the period of monitoring were assessed for the 58 species in the defined target population (Table E-1). Trends in adjusted abundance that take into account detection probability were estimated for 24 species for which there were sufficient data. Both estimates were included in this report to provide multiple lines of evidence when assessing population trends.

Table E-1. Summary of trends in unadjusted abundance for 58 bird species at Allegheny Portage Railroad National Historic Site point count stations from 2007–2019.

Abundance Trend		Number of Species (% total)	Species
Symbol	Definition		
↑↑	Significant Increase	3 (5%)	Song Sparrow, Hooded Warbler, House Sparrow
↑	Increase	12 (21%)	–
↔	Stable	25 (43%)	–
↓	Decrease	13 (22%)	–
↓↓	Significant Decrease	5 (9%)	Ovenbird, Indigo Bunting, Northern Flicker, Blue-headed Vireo, Black-throated Green Warbler

Out of 58 species in the target population, 40 species (69%) were stable or increasing and only 18 species (31%) decline during the period of monitoring based on unadjusted abundance estimates.

The primary message from monitoring thus far appears to be that most species were stable or increasing in abundance at the park and were species associated with mature deciduous forest—the regional conservation priority.

Two of the declining species (Blue-headed Vireo and Black-throated Green Warbler) are species associated with Eastern hemlock (*Tsuga canadensis*) and have declined regionally as the hemlock woolly adelgid (*Adelges tsugae*) continues to decimate hemlocks. Continued management of hemlock stands is likely to benefit these species.

This report provides the first information regarding long-term population trends of breeding birds in Allegheny Portage Railroad NHS. Continued monitoring will provide new insights and future analyses will explore specific factors linked to population trends. As anthropogenic land use and climate change continue to reshape the Appalachian landscape, park managers will need this information to best allocate effort that aligns with regional conservation planning and other park priorities.

Acknowledgments

Thank you to everyone in Eastern Rivers and Mountains Network (ERMN) for their help developing and implementing this protocol especially Kristina Callahan and Caleb Tzilkowski. And thanks to the Region 1 bird monitoring working group particularly J. P. Schmit, Aaron Weed, Mark Johnson, and Zach Ladin for many helpful discussions and statistical code that greatly improved and streamlined data analyses. Jim Comiskey, Caleb Tzilkowski, Andy Weber, Mark Johnson, Elizabeth Matthews, and Greg Shriver provided reviews and many helpful suggestions on this report. Thanks also to Allegheny Portage Railroad National Historic Site for many forms of support, guidance, and assistance. I look forward to working with you on the management implications of this information.

List of Acronyms

ALPO	Allegheny Portage Railroad National Historic Site
BLUE	Bluestone National Scenic River
DEWA	Delaware Water Gap National Recreational Area
ERMN	Eastern Rivers and Mountains Network
FONE	Fort Necessity National Battlefield
FRHI	Friendship Hill National Historic Site
GARI	Gauley River National Recreational Area
IMD	Inventory and Monitoring Division
JOFL	Johnstown Flood National Memorial
NB	National Battlefield
NERI	New River Gorge National Park and Preserve
NHS	National Historic Site
NMem	National Memorial
NP & PRES	National Park and Preserve
NPS	National Park Service
NRA	National Recreation Area
NSR	National Scenic River
SRR	Scenic and Recreational River

Introduction

Each summer, more than 130 bird species breed within the national parks of the Eastern Rivers and Mountains Network. These birds are essential components of park ecosystems and have tremendous appeal to visitors and stewards of national parks. They rely on habitats associated with the extensive network of forested Appalachian streams to eat, build nests, and raise their young. Some remain in the parks year-round and others, including tanagers, thrushes, vireos, flycatchers, and warblers are migrants that fly thousands of miles twice a year between breeding and wintering areas—connecting the parks, landscapes, and people of eastern North America to those of Central and South America.

The National Park Service Inventory and Monitoring Division implements an integrated long-term ecological monitoring program to track changes in a suite of selected park resources and processes termed "vital signs" (Fancy et al. 2009, Marshall and Piekielek 2007). As part of this program the Eastern Rivers and Mountains Network monitors breeding bird populations in seven national parks under a peer-reviewed protocol referred to as the streamside bird monitoring protocol (Marshall et al. 2016). The background and justification for monitoring breeding birds, rationale for focusing monitoring on the bird community along streams, monitoring objectives, and other programmatic considerations are described in detail in the protocol.

The information gained from this monitoring program helps inform park management decision making to ensure park resources remain unimpaired for the enjoyment of future generations and to preserve the habitats and ecosystems on which these birds depend.

This report summarizes results from the beginning of the program in 2007 through 2019 at Allegheny Portage Railroad NHS with emphasis on species-specific trends during this time period. Detecting changes in species abundance over time is the primary objective of the protocol (Marshall et al. 2016).

Methods

The following sections describe procedures as of 2014 and incorporate several changes to the protocol that have occurred since monitoring began in 2007 (documented in Marshall et al. 2016) including the following. First, a redesign of the site selection methodology occurred in 2014 and as a result the number sites and point count stations at Allegheny Portage Railroad NHS has varied through time (Tables 1 and 2). Second, all sites were sampled every year from 2007–2013 whereas every-other-year sampling began with the 2014/2015 sampling period (Allegheny Portage Railroad NHS sampling occurs during odd numbered years). Third, the point count duration increased from 5 to 10 minutes in 2011.

Marshall et al. (2013) summarized results for the 2007–2012 period including methods, terminology, and maps of sampling locations.

Table 1. Number of sites sampled by park and year between 2007 and 2019 as part of the Eastern Rivers and Mountains Network Streamside Bird Monitoring Protocol.

Park	2007	2008	2009	2010	2011	2012	2013	2014/15	2016/17	2018/19
ALPO	1	2	3	3	3	3	4	2	2	4
BLUE	0	0	2	2	2	3	3	4	4	4
DEWA	21	24	24	24	24	24	0	32	32	32
FONE	0	3	3	3	3	3	3	2	2	4
FRHI	0	2	2	2	2	2	2	2	2	2
GARI	3	3	3	3	3	6	0	0	0	0
NERI	22	25	25	25	24	24	0	35	35	35
Total	47	59	62	62	61	64	12	77	77	81

Table 2. Number of point count stations sampled by park and year between 2007 and 2019 as part of the Eastern Rivers and Mountains Network Streamside Bird Monitoring Protocol. A total of 317 unique stations were sampled across all parks and years.

Park	2007	2008	2009	2010	2011	2012	2013	2014/15	2016/17	2018/19
ALPO	5	8	11	11	11	11	12	6	6	12
BLUE	0	0	10	10	10	13	8	12	12	12
DEWA	105	120	120	120	120	120	0	96	96	96
FONE	0	10	10	10	10	10	9	6	6	12
FRHI	0	9	9	9	9	9	6	6	6	6
GARI	15	15	15	15	15	28	0	0	0	0
NERI	110	125	125	125	120	120	0	105	105	105
Total	235	287	300	300	295	311	35	231	231	243

Field Methods and Sampling Locations

Point count surveys are the most widely used quantitative method of monitoring bird populations (e.g., Ralph et al. 1995) and are used in this protocol as well (Marshall et al. 2016). The survey technique involves using a standardized methodology to record (“count”) all birds seen or heard during a fixed amount of time at count locations (“points”). The resultant counts are used as an index of population abundance and are amenable to a number of analytical techniques to correct for potential detection biases (i.e., failing to detect birds that are actually present at the site).

As of 2019, four sites were sampled in Allegheny Portage Railroad NHS (Table 1, Figure 1). Each site consisted of three spatially replicated point count stations with point centers spaced 200 to 250 m apart; adjacent and parallel to the stream (Table 2, Figure 1). Each site was defined as a discrete 100 m segment of stream where benthic macroinvertebrates, water quality, stream habitat (Tzilkowski et al. 2016, Tzilkowski 2021) and stream fish (Faulk and Weber 2016) were also sampled. These four index sites were deliberately placed (i.e., non-randomly) toward the downstream end of the few stream segments in the park (Marshall et al. 2016).

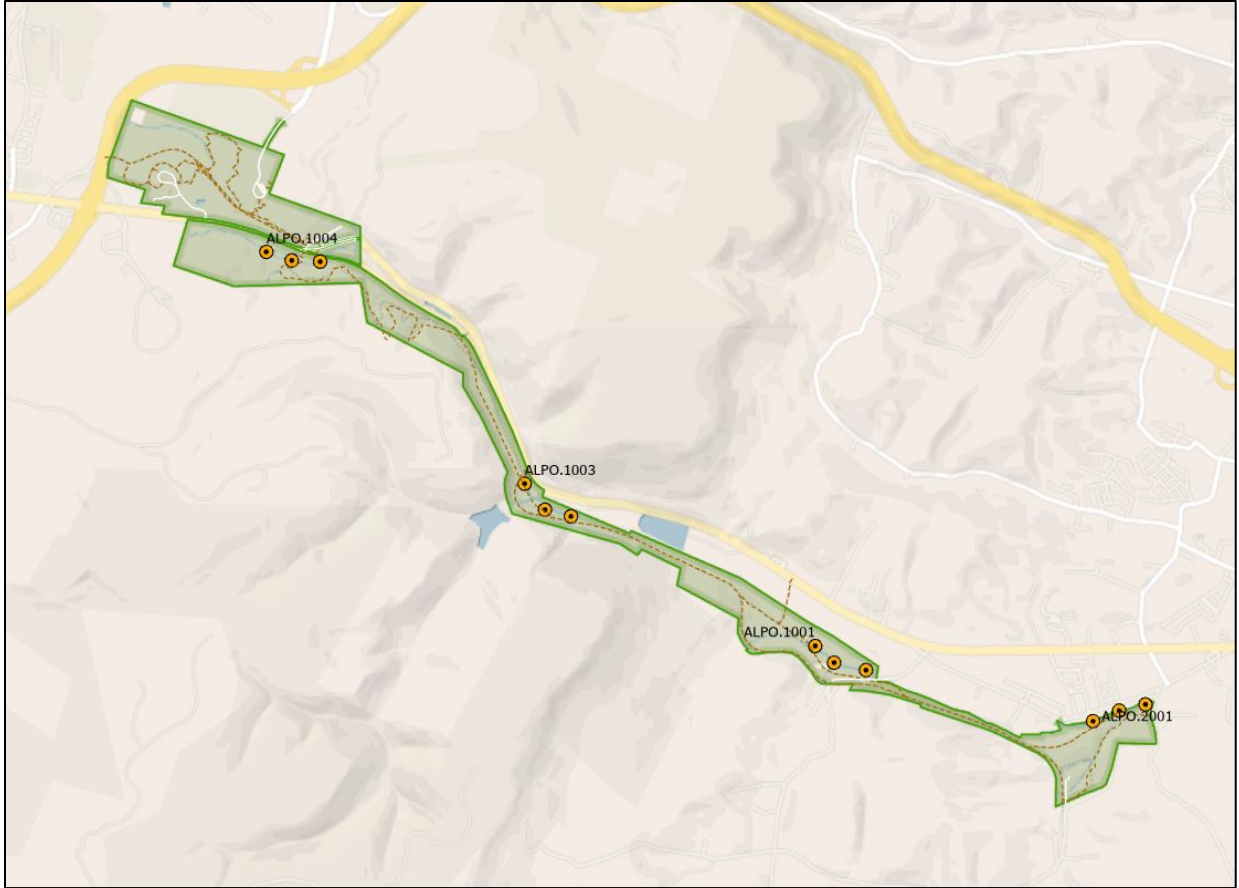


Figure 1. Location of four sites and 12 point count stations (orange circles) established to monitor breeding birds at Allegheny Portage Railroad National Historic Site as part of the Eastern Rivers and Mountains Network streamside bird monitoring protocol.

Data collection consisted of trained and experienced field personnel (here forward; observer) navigating to permanent point count stations (Figure 2) which served as the center of a circular sampling area and remaining at the point for 10 minutes counting all birds detected. The following information for each individual bird detected was recorded: 1) species identity; 2) type of detection (e.g., song, call, drumming, visual); 3) distance from observer (<50 m, 50–75 m, or >75 m); 4) if the bird was a juvenile; 5) if the bird was flying over the canopy at the time of detection; and 6) the minute of first detection.



Figure 2. Example of multi-colored cable ties and engraved aluminum tree tag used to permanently mark point count stations that are part of the Eastern Rivers and Mountains Network streamside bird monitoring protocol.

The observer visited each point count station four times during each sampling season on days with no precipitation and little wind and conducted a single 10 minute count each visit (temporal replicates; Table 3). Each point count occurred between sunrise and 4.5 hours after sunrise to limit sampling to the period of the day when birds were most active and vocal (>97% of all detections were auditory meaning that the observer detected a song, call, or other audible cue rather than seeing the bird, which is typical of point counts conducted in forested environments).

Table 3. Number of point counts by park and year between 2007 and 2019 as part of the Eastern Rivers and Mountains Network Streamside Bird Monitoring Protocol.

Park	2007	2008	2009	2010	2011	2012	2013	2014/15	2016/17	2018/19	Total
ALPO	20	32	44	44	44	44	48	24	24	48	372
BLUE	0	0	40	40	40	52	32	48	48	48	348
DEWA	420	478	480	480	480	480	0	384	384	384	3970
FONE	0	40	40	40	40	40	36	24	24	48	332
FRHI	0	36	36	36	36	36	24	24	24	24	276
GARI	60	60	60	60	60	112	0	0	0	0	412
NERI	440	498	500	500	480	480	0	420	420	420	4158
Total	940	1144	1200	1200	1180	1244	140	924	924	972	9868

Target Population

Sampling was limited to the breeding season (mid-May through early-July) for eastern North America resident and neotropical (Central America, South America, and the Caribbean) migratory bird species that potentially breed in the streamside sampling area. Species of the Orders Passeriformes (perching birds including songbirds) were particularly well sampled; additionally, species in the orders Piciformes (woodpeckers), Columbiformes (doves and pigeons), Cuculiformes (cuckoos), and Apodiformes (swifts and hummingbirds) constitute the target population. In the central Appalachians, this group of birds includes about 112 potential species (e.g., O’Connell et al. 2000). In general, these species establish breeding pairs in defined territories for the duration of the sampling period so that the point count methodology can be used to estimate the abundance of breeding birds in the sampled area.

While detections of nocturnal raptors like owls (Strigiformes), diurnal raptors (Accipitriformes), waterfowl (Anseriformes), waders (Peleconiformes), and turkey and grouse (Galliformes), and other non-target species do occur, they constitute less than 1% of all detections which effectively precludes these groups from any meaningful status and trends analyses.

Data Analysis

In addition to summaries of the species detected and their conservation status, two indices of abundance were estimated to help evaluate if trends in abundance have occurred over time. The first index, referred to as the “unadjusted” estimate, was calculated by dividing the total number of birds detected by the number of point count stations sampled (i.e., birds per point). The maximum number of detections per species across the four visits was used in this calculation. A hypothetical example is shown in Table 4.

Table 4. Hypothetical example showing the number of birds of a single species detected during each of four visits to six point count stations including the maximum number detected during any single visit.

Point Count Station	Visit 1	Visit 2	Visit 3	Visit 4	Maximum
1	1	1	1	1	1
2	0	1	0	1	1
3	1	0	2	1	2
4	0	0	0	0	0
5	1	0	0	0	1
6	0	0	0	0	0
Mean birds per point					0.83

Because some birds present during the point count period were likely not detected by the observer (Simons et al. 2007, Johnson 2008, Schmidt et al. 2013, Marshall et al. 2016), a second “adjusted” estimate was calculated that incorporated detection probabilities into the abundance estimates. For the adjusted estimates, the point count data were analyzed with N-mixture models (Royle 2004, Kery et al. 2005) in the ‘unmarked’ R package using the *pcount* function (Fiske and Chandler 2011) to explicitly estimate both a detection probability and an estimate of abundance adjusted by the detection probability. The data from all sampling years and the four visits within years were fit to four models. These models can be viewed as hypotheses regarding variability over time (e.g., years) in detection probability and bird abundance. Year of sampling was included as a covariate in models where either detection and/or abundance varied through time. No other covariates were used in these analyses. The four models were: a null model where both detection and abundance were constant (i.e., both abundance and detection were the same in all years of sampling and did not vary across years); a model where detection probability varied over time (i.e., sampling years) but abundance was constant; a model where detection probability was constant but abundance varied over time; and a model where both detection and abundance varied over time. All models used the Poisson mixture and $K=6$ and the analyses were run for each species independently. Abundance estimates for each sampling year were derived from the weighted average of all four models because a best model ($AICc < 2$) was rarely indicated.

The null model was also used to estimate the mean species abundance across all years of monitoring.

For both the unadjusted and adjusted estimates trends were evaluated by fitting linear models to the annual abundance estimates regressed against year. The linear model slope estimate provides both the direction (e.g., positive slopes indicate increases in abundance over time) and magnitude of change for each species. Species were considered to have statistically significant increases or decreases when the slope was significantly different from zero ($\alpha = 0.05$) and were considered “stable” when the SE of the slope estimate overlapped zero.

All analyses were performed in the statistical software program R (version 4.0.3; R Core Team 2020).

The datasets and statistical code are available from the NPS IRMA DataStore (<https://irma.nps.gov/>).

Results

One observer conducted a total of 372 point counts at 17 unique point count stations at Allegheny Portage Railroad NHS during the 12 year period between program inception in 2007 and 2019 (Tables 3 and 5). All point count stations were sampled the expected four times per year during the appropriate sampling year (100% sampling completeness) and all data were certified prior to analyses as defined by the quality assurance procedures described in the protocol quality assurance plan (Marshall and Callahan 2018).

Table 5. One observer conducted a total of 372 point counts at Allegheny Portage Railroad National Historic Site between 2007 and 2019 as part of the Eastern Rivers and Mountains Network Streamside Bird Monitoring Protocol.

Observer	2007	2008	2009	2010	2011	2012	2013	2014/15	2016/17	2018/19	Total
MRM	20	32	44	44	44	44	48	24	24	48	372

The observer detected 2,759 individual birds representing 64 species during all years of sampling (Appendix 1). These totals do not include records where the observer could not identify the bird to species. Even though observers were encouraged to use an “unidentified bird” category to limit false positive observations, these constituted less than 1.4% of all records across all years and parks due to observer experience and training.

The observer detected 6.6 species per point count, on average, across all 372 point counts conducted. The maximum number of species detected during a single point count was 16 and only 12 counts had ≥ 12 species. On average the observer detected 9.6 individual birds per point ranging from four to 18 during all years of monitoring.

Nonnative bird species were rarely detected (four European Starling and 21 House Sparrow detections; scientific names of all species used in the text are in Appendix 1).

No state or federally threatened or endangered species were detected during monitoring.

In order to examine consistent patterns over time, the total observations summarized above were standardized in two ways. First, the duration of all 2011–2019 point counts were standardized to 5 minutes in length to be consistent with the 2007–2010 data by excluding all records that occurred after the fifth minute. Second, several data flags were used to remove non-target observations. These include 63 records flagged as “flyovers” indicating that detected bird(s) were flying overhead (i.e., above the forest canopy and not “using” the sampled area) at the time of detection (25 of which were Chimney Swifts). And three records flagged as “juveniles” (birds hatched and fledged during the sampling season).

Results presented hereafter are based on this standardized dataset but otherwise include records from all distance bands and detection types.

Species Richness, Abundance, and Conservation Status

On average the observer detected 36 species per year ranging from 27 (2007) to 44 (2013) (Figure 3). The average number of birds detected per point is shown in Figure 4. The number of birds detected per point per year has declined from 2007–2019 (Figure 4).

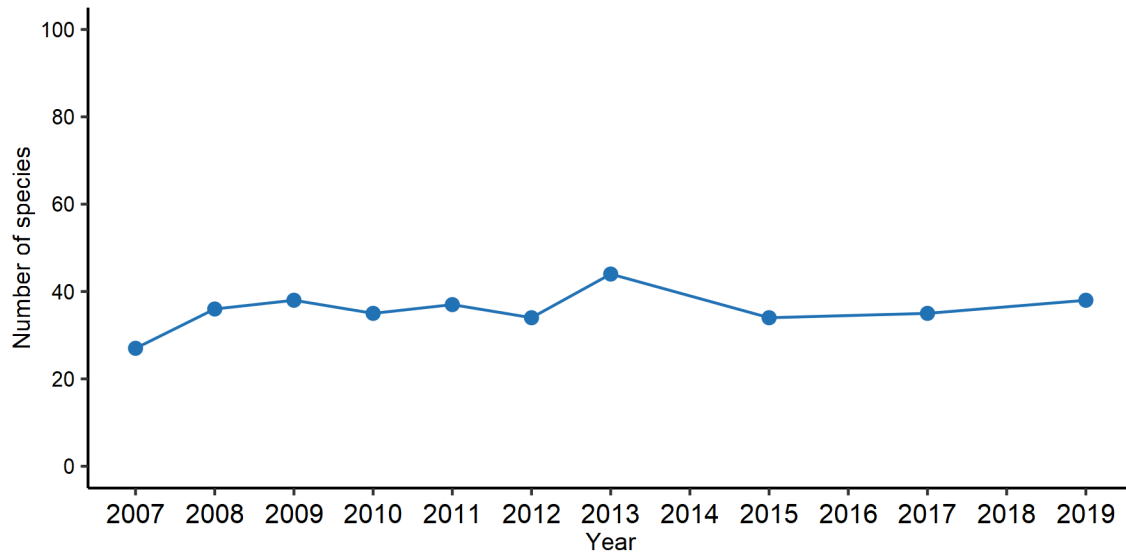


Figure 3. Total number of streamside bird species detected at Allegheny Portage Railroad National Historic Site point count stations from 2007–2019.

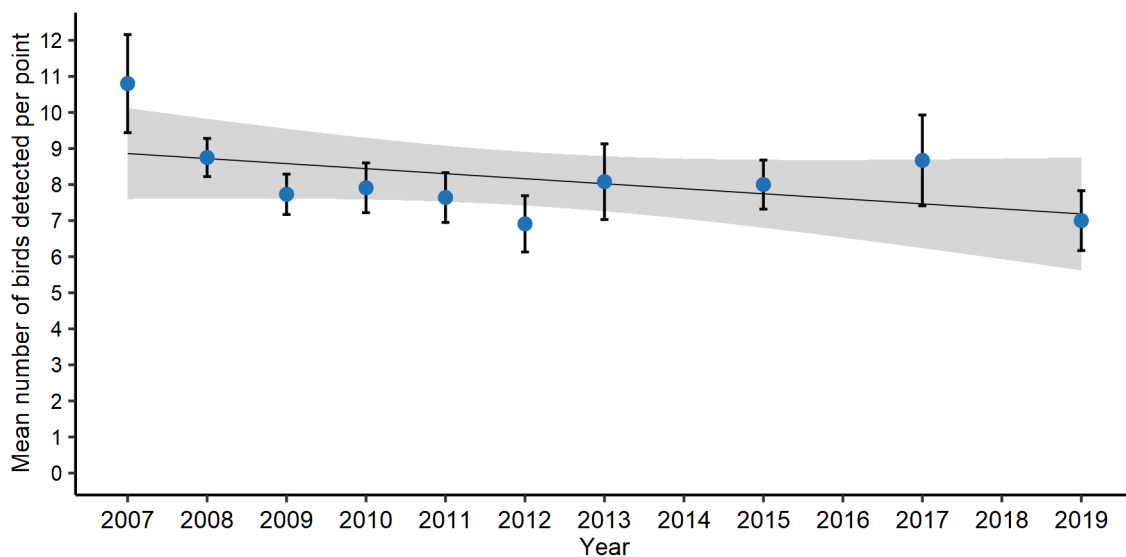


Figure 4. Number of birds detected per point count station at Allegheny Portage Railroad National Historic Site from 2007–2019. Mean per year (blue circles $\pm 1SD$) and linear trend (black horizontal line with $\pm SE$ gray shading) depicted.

Appendix 2 summarizes the average abundance from 2007–2019 for all 58 species in the target population (adjusted estimates are available for the 24 species detected most frequently; for species detected less frequently the data were too sparse for the model to converge on an estimate).

The Red-eyed Vireo was the most abundant bird species detected at Allegheny Portage Railroad NHS point count stations (Appendix 2 and Figure 5) and is likely one of the most abundant forest birds in the Appalachians. The majority of the 20 most abundant species were forest-associated species including forest interior species (e.g., Scarlet Tanager, Wood Thrush, Louisiana Waterthrush and Ovenbird) and forest generalist species (e.g., Red-eyed Vireo and Eastern Wood-Pewee) but also a large number of species that thrive in human modified (in this case suburban) landscapes with sufficient tree and shrub cover (e.g., Tufted Titmouse, American Robin, Red-bellied Woodpecker, Downy Woodpecker and Northern Cardinal).

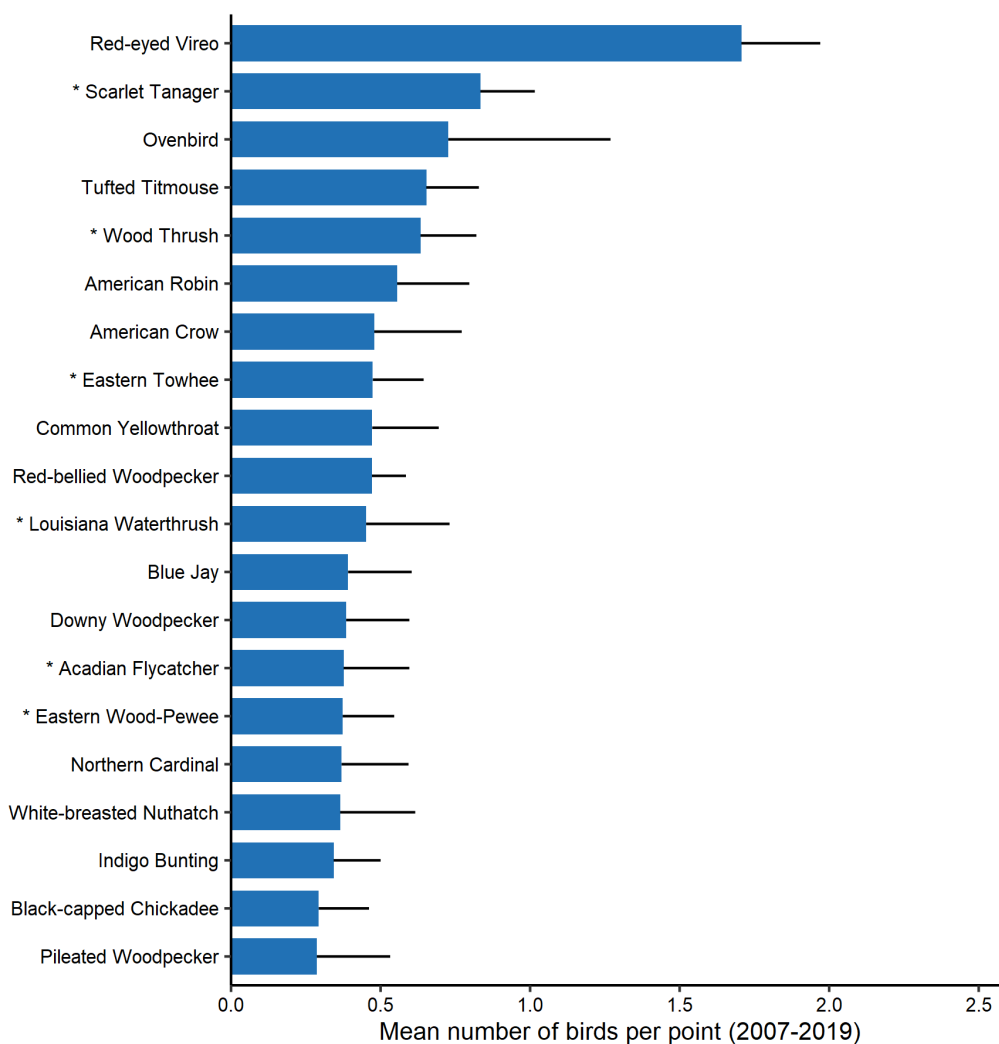


Figure 5. Twenty most abundant streamside bird species at Allegheny Portage Railroad National Historic Site point count stations from 2007–2019. Bars represent the unadjusted mean birds per point (+1SD) across all years of monitoring. *Species of regional conservation importance (Panjabi et al. 2020).

Fifteen species overall (Appendix 2) and six of the 20 most abundant species (Figure 5) were of conservation importance in the Appalachian Mountains bird conservation region (BCR 28; <https://nabci-us.org/resources/bird-conservation-regions-map/>) based on the peer-reviewed ranking criteria of the conservation consortium Partners in Flight (Panjabi et al. 2020).

Conservation “importance” includes one designation for species facing multiple threats and currently in decline (“conservation concern”) and a non-mutually exclusive designation (“conservation stewardship”) which emphasizes the regional responsibility to maintain these populations because the majority of the global population breeds in the Appalachian Mountains region. Figures 6 and 7 show the most abundant species at Allegheny Portage Railroad NHS point count stations in these two categories, respectively.

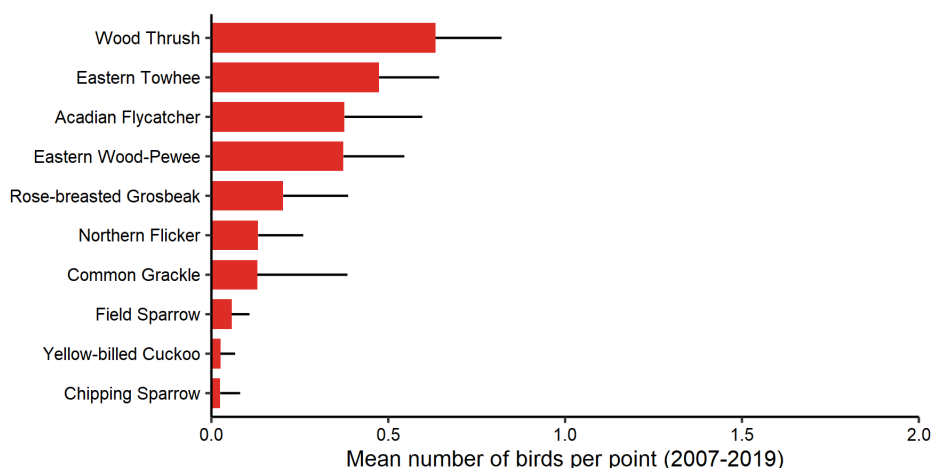


Figure 6. Ten most abundant streamside bird species of regional conservation concern (Panjabi et al. 2020) at Allegheny Portage Railroad National Historic Site point count stations from 2007–2019. Bars represent the mean unadjusted birds per point (+1SD) across all years of monitoring.

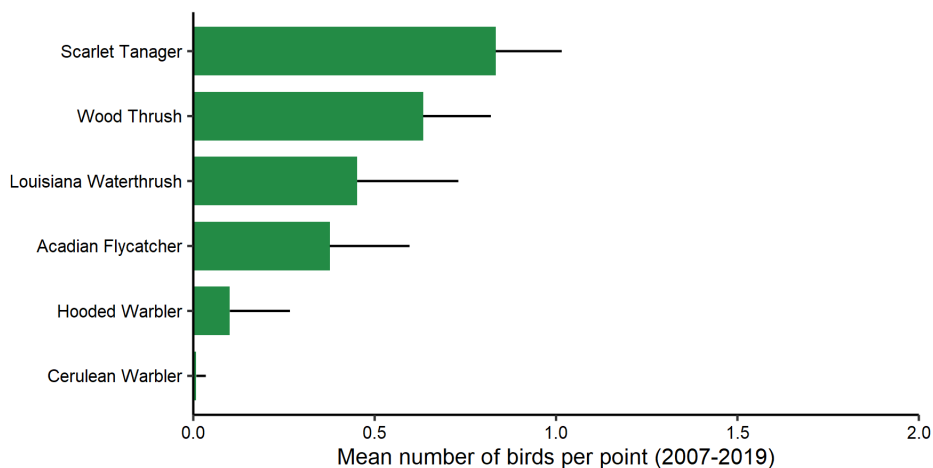


Figure 7. Abundance of streamside bird species of regional conservation stewardship (Panjabi et al. 2020) at Allegheny Portage Railroad National Historic Site point count stations from 2007–2019. Bars represent the mean unadjusted birds per point (+1SD) across all years of monitoring.

Trends in Abundance

Trends in unadjusted abundance were estimated for all 58 species in the target population. Trends in adjusted abundance were estimated for 24 species for which there were sufficient data for models to converge on annual estimates (Appendix 2). Examples of species-specific trends are shown below.

The Scarlet Tanager, the second most abundant species at Allegheny Portage Railroad NHS point stations and a species of regional conservation concern and stewardship appeared to be stable during the period of monitoring based on unadjusted and adjusted estimates (Figure 8, Appendix 2).

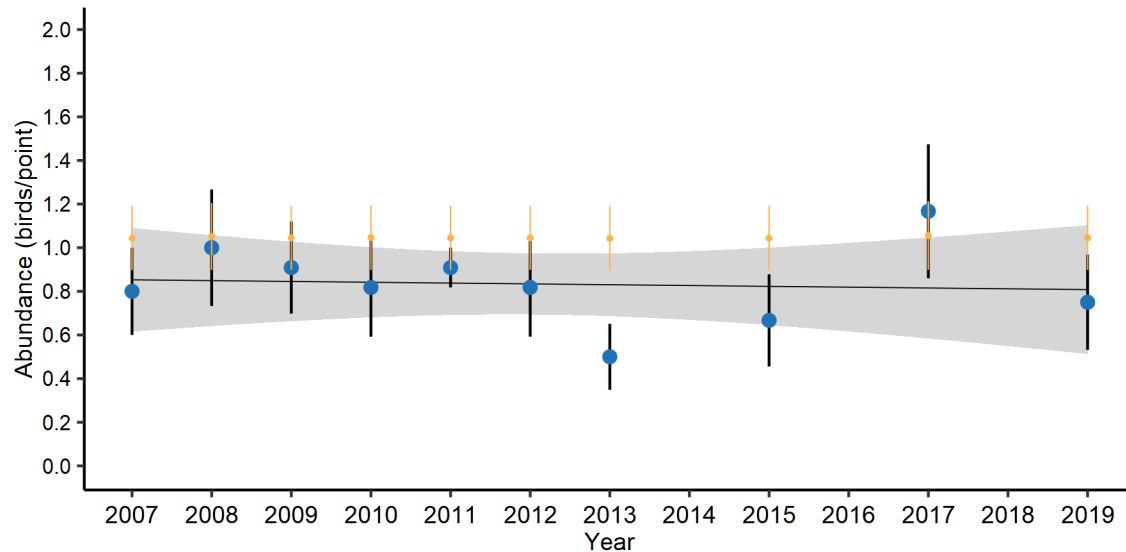


Figure 8. Scarlet Tanager abundance at Allegheny Portage Railroad National Historic Site point count stations from 2007–2019. Unadjusted (blue circles $\pm 1SD$) and adjusted (yellow circles $\pm SE$) abundance estimates shown. Linear trend (black horizontal line with $\pm SE$ gray shading) of unadjusted estimates suggests a stable population over time. Adjusted estimates also show evidence of a stable population over time (linear trend line not shown).

The Eastern Towhee, a species of conservation concern due to regional declines in recent decades (Sauer et al. 2020), showed a significant linear increase during the period of monitoring based on unadjusted estimates (Figure 9). However, there did not appear to be evidence of an increase based on the adjusted estimates (Figure 9) and the trend line slope was not significantly different from zero (Appendix 2).

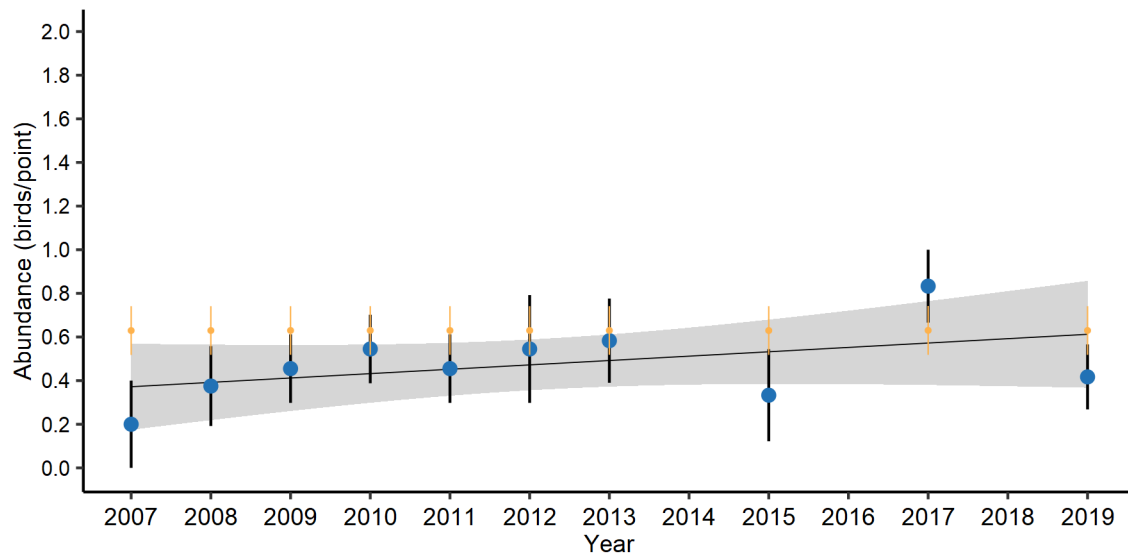


Figure 9. Eastern Towhee abundance at Allegheny Portage Railroad NHS point count stations from 2007–2019. Unadjusted (blue circles $\pm 1SD$) and adjusted (yellow circles $\pm SE$) abundance estimates shown. Linear trend (black horizontal line with $\pm SE$ gray shading) of unadjusted estimates suggests an increase in abundance over time. Adjusted estimates do not show evidence of change over time (linear trend line not shown).

The Hooded Warbler was one of three species showing a significant increase during the period of monitoring (Figure 10, Appendix 2) and the Black-throated Green Warbler and Blue-headed Vireo were two of the five species showing a significant decline (Figures 11–12, Appendix 2).

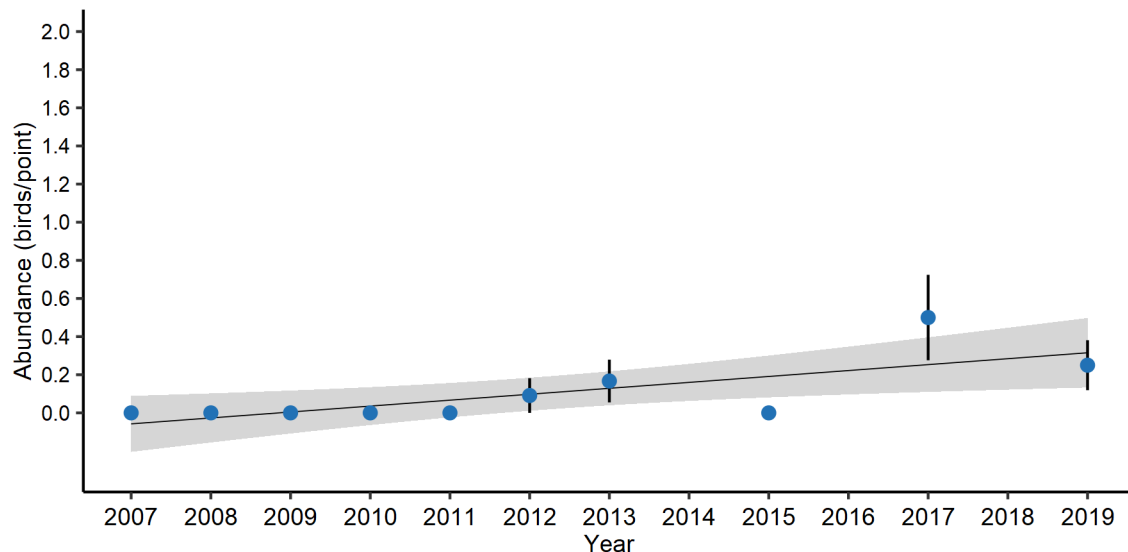


Figure 10. Hooded Warbler abundance at Allegheny Portage Railroad NHS point count stations from 2007–2019. Unadjusted (blue circles $\pm 1SD$) abundance estimates shown. Linear trend (black horizontal line with $\pm SE$ gray shading) of unadjusted estimates suggests an increase in abundance over time.

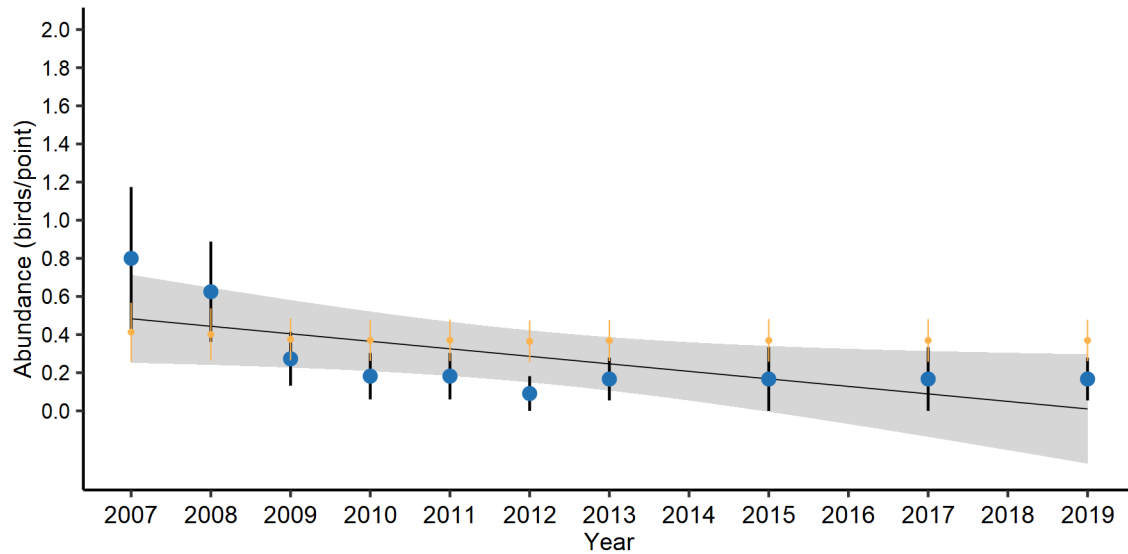


Figure 11. Black-throated Green Warbler abundance at Allegheny Portage Railroad NHS point count stations from 2007–2019. Unadjusted (blue circles ± 1 SD) and adjusted (yellow circles $\pm$ SE) abundance estimates shown. Linear trend (black horizontal line with $\pm$ SE gray shading) of unadjusted estimates suggests a decrease in abundance over time. Adjusted estimates do not show evidence of change over time (linear trend line not shown).

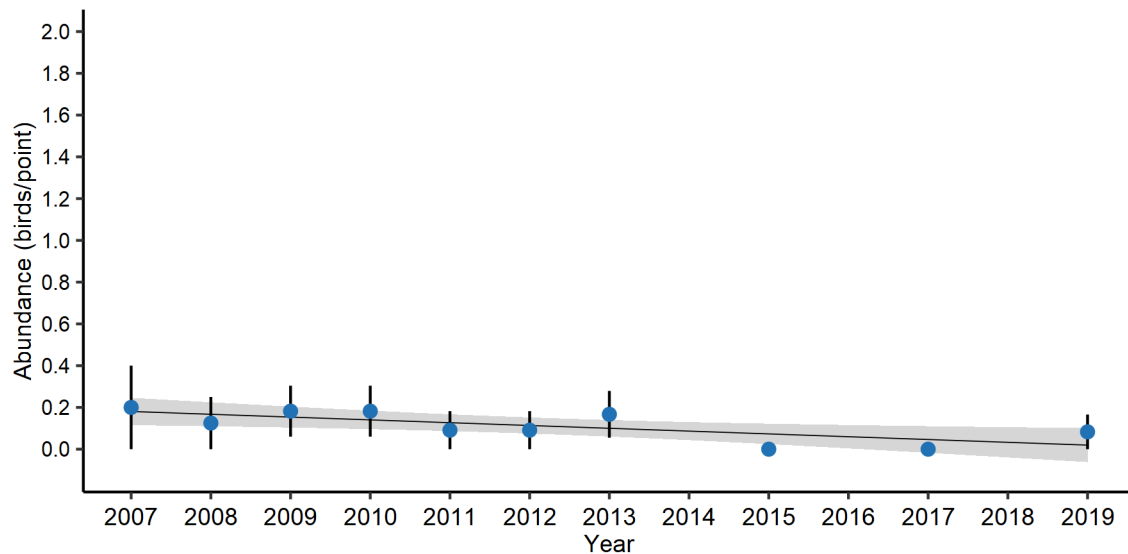


Figure 12. Blue-headed Vireo abundance at Allegheny Portage Railroad NHS point count stations from 2007–2019. Unadjusted (blue circles ± 1 SD) abundance estimates shown. Linear trend (black horizontal line with $\pm$ SE gray shading) of unadjusted estimates suggests a decrease in abundance over time.

Recalling that the slope of the linear model provides both the direction and magnitude of change, results for numerous species can be presented in a concise format using just this statistic. Trend estimates for the 20 most abundant species were summarized this way in Figure 13 and for all 58 target species in Appendix 3. Among the 20 most abundant species, one appears to be increasing, nine appear to be declining, and 10 appear stable during the period of monitoring based on unadjusted abundance estimates at Allegheny Portage Railroad NHS point count stations (Figure 10).

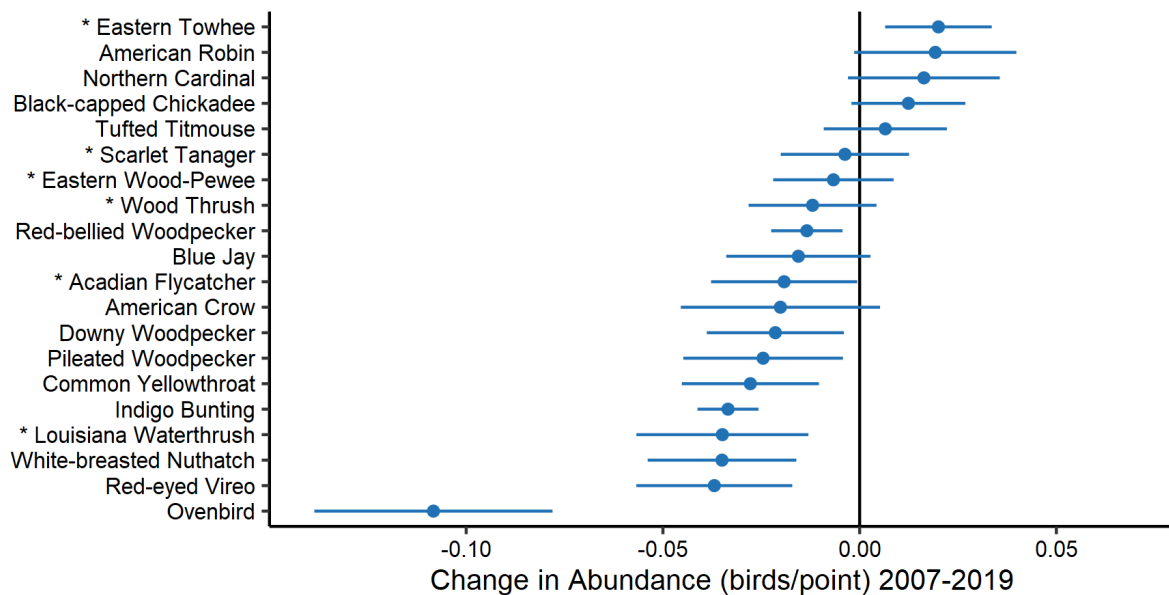


Figure 13. Trend estimates (slope $\pm$ SE of linear model regressing unadjusted abundance estimates against sampling year) for the twenty most abundant streamside bird species at Allegheny Portage Railroad National Historic Site point count stations from 2007–2019. Slope values >0 indicate a linear increase in abundance over time and values <0 indicate a linear decrease in abundance over time. Values where the SE of the estimate includes 0 indicate no change in abundance over time. *Species of regional conservation importance (Panjabi et al. 2020).

Discussion

This report summarizes the first 12 years of monitoring the streamside bird community at Allegheny Portage Railroad NHS extending the analyses in Marshall et al. (2013). During the 2007–2019 time period, one observer conducted 372 point count surveys and detected 2,759 individual birds at 17 point count stations within the park.

Allegheny Portage Railroad NHS contains a rich and diverse streamside bird community with a total 64 species detected; 58 of which are target species and presumed to be breeding in the park during summer months. The majority of the 20 most abundant species were forest-associated species including both forest interior species and forest generalist species but also a large number of species that thrive in human modified (in this case suburban) landscapes with sufficient tree and shrub cover. The influence of human development on the bird community was particularly evident at the Foot of Ten portion of the park.

None the less, 15 target species and six of the 20 most abundant species were of conservation importance in the Appalachian Mountains bird conservation region, highlighting the significance of even a relatively small park like Allegheny Portage Railroad NHS to avian conservation. Almost all the species of conservation importance at the park were species dependent on intact, mature, deciduous forest as habitat for nesting and breeding. Management actions that maintain and improve the condition of forested habitats in the park (and regionally) will likely be beneficial to maintaining these bird populations as well. The Eastern Towhee was the only abundant species of conservation importance that is associated with forest edges and early successional habitat.

Trends in unadjusted abundance over the period of monitoring were assessed for all 57 species in the defined target population (Appendix 2 and 3). Trends in adjusted abundance that take into account detection probability were estimated for 24 species for which there were sufficient data. Both estimates were included in this report to provide multiple lines of evidence when assessing population trends.

Out of 58 species in the target population, 40 species (69%) appear to be stable or increasing and 18 species (31%) appear to be declining during the period of monitoring (Table 6). The slope of either the unadjusted or adjusted abundance trend estimates (and typically both; Appendix 2) showed statistically significant positive trends for three species and negative trends for five species (Table 6).

Table 6. Summary of trends in unadjusted abundance for 58 bird species at Allegheny Portage Railroad National Historic Site point count stations from 2007–2019. Significant increases or decreases determined by a significant ($p < 0.05$) linear model slope of either the unadjusted or adjusted abundance estimates (Appendix 2).

Abundance Trend		Number of Species (% total)	Species
Symbol	Definition		
↑↑	Significant Increase	3 (5%)	Song Sparrow, Hooded Warbler, House Sparrow
↑	Increase	12 (21%)	–
↔	Stable	25 (43%)	–
↓	Decrease	13 (22%)	–
↓↓	Significant Decrease	5 (9%)	Ovenbird, Indigo Bunting, Northern Flicker, Blue-headed Vireo, Black-throated Green Warbler

The primary message from monitoring thus far appears to be that most species were stable or increasing in abundance at the park and were species associated with mature deciduous forest—the regional conservation priority.

Two of the declining species (Blue-headed Vireo and Black-throated Green Warbler) are species associated with Eastern hemlock (*Tsuga canadensis*) and have declined as the hemlock woolly adelgid (*Adelges tsugae*) continues to decimate hemlocks (e.g., Toenies et al. 2018). Continued management of hemlock stands is likely to benefit these species.

The apparent decline of the Ovenbird appears related, in part, to a particularly high abundance estimate in 2007 (the first year of monitoring) when only five point count stations were sampled, and two Ovenbirds were detected at each station. Since 2007, abundance has ranged between 0.4 and 1.0 birds per point. Additional monitoring should help determine the status and trends of Ovenbirds at Allegheny Portage Railroad NHS point count stations.

This report provides the first information regarding long-term population trends of breeding birds in Allegheny Portage Railroad NHS. Continued monitoring will provide new insights and future analyses will explore specific factors linked to population trends. As anthropogenic land use and climate change continue to reshape the Appalachian landscape, park managers will need this information to best allocate effort that aligns with regional conservation planning and other park priorities.

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Appendix 1. List of 130 bird species detected and total number of detections by park during implementation of the Eastern Rivers and Mountains Network Streamside Bird Monitoring Protocol 2007–2019.

Table A1-1. Taxonomy follows Chesser et al. (2019). Four letter species codes from the Institute for Bird Populations (<https://www.birdpop.org/pages/birdSpeciesCodes.php>).

Order	Family	Common Name	Code	Scientific Name	ALPO	FONE	FRHI	DEWA	BLUE	NERI	GARI
Anseriformes	Anatidae	Canada Goose	CANG	<i>Branta canadensis</i>	0	0	0	27	0	34	0
Anseriformes	Anatidae	Mute Swan	MUSW	<i>Cygnus olor</i>	0	0	0	1	0	0	0
Anseriformes	Anatidae	Wood Duck	WODU	<i>Aix sponsa</i>	0	0	0	3	0	1	0
Anseriformes	Anatidae	American Black Duck*+	ABDU	<i>Anas rubripes</i>	0	0	0	1	0	0	0
Anseriformes	Anatidae	Mallard	MALL	<i>Anas platyrhynchos</i>	0	0	0	28	0	0	0
Anseriformes	Anatidae	Hooded Merganser	HOME	<i>Lophodytes cucullatus</i>	0	0	0	1	0	0	0
Anseriformes	Anatidae	Common Merganser	COME	<i>Mergus merganser</i>	0	0	0	5	0	0	0
Galliformes	Phasianidae	Ruffed Grouse	RUGR	<i>Bonasa umbellus</i>	0	0	0	0	7	3	0
Galliformes	Phasianidae	Wild Turkey	WITU	<i>Meleagris gallopavo</i>	0	10	4	30	2	8	0
Pelecaniformes	Ardeidae	Great Blue Heron	GBHE	<i>Ardea herodias</i>	0	0	0	32	1	0	0
Pelecaniformes	Ardeidae	Green Heron*+	GRHE	<i>Butorides virescens</i>	0	0	0	1	0	0	0
Cathartiformes	Cathartidae	Turkey Vulture	TUVU	<i>Cathartes aura</i>	0	0	2	41	1	9	1
Accipitriformes	Accipitridae	Bald Eagle	BAEA	<i>Haliaeetus leucocephalus</i>	0	0	0	8	0	0	1
Accipitriformes	Accipitridae	Sharp-shinned Hawk	SSHA	<i>Accipiter striatus</i>	0	0	0	1	0	1	1
Accipitriformes	Accipitridae	Cooper's Hawk	COHA	<i>Accipiter cooperii</i>	0	5	0	3	0	5	1

* Species of conservation importance: Regional Importance, as determined by Partners in Flight (Panjabi 2020).

+ Species of conservation importance: Regional Concern, as determined by Partners in Flight (Panjabi 2020).

^ Species of conservation importance: Regional Stewardship, as determined by Partners in Flight (Panjabi 2020).

Table A1-1 (continued). Taxonomy follows Chesser et al. (2019). Four letter species codes from the Institute for Bird Populations (<https://www.birdpop.org/pages/birdSpeciesCodes.php>).

Order	Family	Common Name	Code	Scientific Name	ALPO	FONE	FRHI	DEWA	BLUE	NERI	GARI
Accipitriformes	Accipitridae	Red-shouldered Hawk	RSHA	<i>Buteo lineatus</i>	1	3	14	14	0	17	5
Accipitriformes	Accipitridae	Broad-winged Hawk	BWHA	<i>Buteo platypterus</i>	3	4	3	26	0	2	0
Accipitriformes	Accipitridae	Red-tailed Hawk	RTHA	<i>Buteo jamaicensis</i>	4	5	0	21	2	2	0
Charadriiformes	Charadriidae	Killdeer	KILL	<i>Charadrius vociferus</i>	2	2	0	1	0	0	0
Charadriiformes	Scolopacidae	Spotted Sandpiper	SPSA	<i>Actitis macularius</i>	0	0	0	2	0	0	0
Columbiformes	Columbidae	Mourning Dove	MODO	<i>Zenaida macroura</i>	9	6	0	215	5	73	6
Cuculiformes	Cuculidae	Yellow-billed Cuckoo*+	YBCU	<i>Coccyzus americanus</i>	4	9	5	115	10	57	7
Cuculiformes	Cuculidae	Black-billed Cuckoo*+	BBUC	<i>Coccyzus erythrophthalmus</i>	0	1	1	17	0	0	0
Strigiformes	Strigidae	Eastern Screech-Owl*+	EASO	<i>Megascops asio</i>	0	0	0	0	1	1	0
Strigiformes	Strigidae	Great Horned Owl	GHOW	<i>Bubo virginianus</i>	0	1	0	5	0	0	0
Strigiformes	Strigidae	Barred Owl	BADO	<i>Strix varia</i>	0	1	1	4	0	14	3
Strigiformes	Strigidae	Northern Saw-whet Owl	NSWO	<i>Aegolius acadicus</i>	0	0	0	0	0	2	0
Apodiformes	Apodidae	Chimney Swift*+	CHSW	<i>Chaetura pelagica</i>	26	11	1	16	2	7	0
Apodiformes	Trochilidae	Ruby-throated Hummingbird	RTHU	<i>Archilochus colubris</i>	9	11	8	58	5	47	7
Coraciiformes	Alcedinidae	Belted Kingfisher*+	BEKI	<i>Megasceryle alcyon</i>	2	1	0	70	5	8	1
Piciformes	Picidae	Red-headed Woodpecker	RHOW	<i>Melanerpes erythrocephalus</i>	0	0	0	0	0	1	0
Piciformes	Picidae	Red-bellied Woodpecker	RBWO	<i>Melanerpes carolinus</i>	83	70	71	186	5	72	8
Piciformes	Picidae	Yellow-bellied Sapsucker	YBSA	<i>Sphyrapicus varius</i>	0	0	0	1	0	2	0
Piciformes	Picidae	Downy Woodpecker	DOWO	<i>Dryobates pubescens</i>	46	15	46	220	14	121	23

* Species of conservation importance: Regional Importance, as determined by Partners in Flight (Panjabi 2020).

+ Species of conservation importance: Regional Concern, as determined by Partners in Flight (Panjabi 2020).

^ Species of conservation importance: Regional Stewardship, as determined by Partners in Flight (Panjabi 2020).

Table A1-1 (continued). Taxonomy follows Chesser et al. (2019). Four letter species codes from the Institute for Bird Populations (<https://www.birdpop.org/pages/birdSpeciesCodes.php>).

Order	Family	Common Name	Code	Scientific Name	ALPO	FONE	FRHI	DEWA	BLUE	NERI	GARI
Piciformes	Picidae	Hairy Woodpecker	HAWO	<i>Dryobates villosus</i>	9	13	14	113	14	65	10
Piciformes	Picidae	Northern Flicker*+	NOFL	<i>Colaptes auratus</i>	16	32	19	185	8	76	16
Piciformes	Picidae	Pileated Woodpecker	PIWO	<i>Dryocopus pileatus</i>	32	59	44	192	30	272	49
Passeriformes	Tyrannidae	Eastern Wood-Pewee*+	EAWP	<i>Contopus virens</i>	62	96	133	580	18	154	18
Passeriformes	Tyrannidae	Acadian Flycatcher*+^	ACFL	<i>Empidonax virens</i>	88	149	317	1046	297	3267	174
Passeriformes	Tyrannidae	Willow Flycatcher	WIFL	<i>Empidonax traillii</i>	0	1	0	3	0	0	0
Passeriformes	Tyrannidae	Least Flycatcher*+	LEFL	<i>Empidonax minimus</i>	0	1	0	1	0	0	0
Passeriformes	Tyrannidae	Eastern Phoebe	EAPH	<i>Sayornis phoebe</i>	21	11	2	481	34	419	54
Passeriformes	Tyrannidae	Great Crested Flycatcher	GCFL	<i>Myiarchus crinitus</i>	8	8	3	179	1	38	11
Passeriformes	Tyrannidae	Eastern Kingbird	EAKI	<i>Tyrannus tyrannus</i>	0	0	0	13	0	0	0
Passeriformes	Vireonidae	White-eyed Vireo	WEVI	<i>Vireo griseus</i>	0	2	0	0	0	0	0
Passeriformes	Vireonidae	Yellow-throated Vireo	YTVI	<i>Vireo flavifrons</i>	1	5	16	213	12	39	10
Passeriformes	Vireonidae	Blue-headed Vireo	BHVI	<i>Vireo solitarius</i>	23	44	1	316	51	510	63
Passeriformes	Vireonidae	Warbling Vireo	WAVI	<i>Vireo gilvus</i>	0	1	0	16	0	0	0
Passeriformes	Vireonidae	Red-eyed Vireo	REVI	<i>Vireo olivaceus</i>	464	436	352	3786	358	3281	191
Passeriformes	Corvidae	Blue Jay	BLJA	<i>Cyanocitta cristata</i>	66	85	61	829	44	469	60
Passeriformes	Corvidae	American Crow	AMCR	<i>Corvus brachyrhynchos</i>	87	144	136	546	27	409	96
Passeriformes	Corvidae	Fish Crow	FICR	<i>Corvus ossifragus</i>	0	0	0	1	0	0	0
Passeriformes	Corvidae	Common Raven	CORA	<i>Corvus corax</i>	2	6	4	53	2	24	3

* Species of conservation importance: Regional Importance, as determined by Partners in Flight (Panjabi 2020).

+ Species of conservation importance: Regional Concern, as determined by Partners in Flight (Panjabi 2020).

^ Species of conservation importance: Regional Stewardship, as determined by Partners in Flight (Panjabi 2020).

Table A1-1 (continued). Taxonomy follows Chesser et al. (2019). Four letter species codes from the Institute for Bird Populations (<https://www.birdpop.org/pages/birdSpeciesCodes.php>).

Order	Family	Common Name	Code	Scientific Name	ALPO	FONE	FRHI	DEWA	BLUE	NERI	GARI
Passeriformes	Hirundinidae	Tree Swallow	TRES	<i>Tachycineta bicolor</i>	0	0	0	36	0	6	0
Passeriformes	Hirundinidae	Northern Rough-winged Swallow	NRWS	<i>Stelgidopteryx serripennis</i>	0	0	0	8	0	0	2
Passeriformes	Hirundinidae	Barn Swallow*+	BARS	<i>Hirundo rustica</i>	0	0	0	10	0	0	0
Passeriformes	Paridae	Carolina Chickadee	CACH	<i>Poecile carolinensis</i>	0	3	42	0	77	399	56
Passeriformes	Paridae	Black-capped Chickadee	BCCH	<i>Poecile atricapillus</i>	37	88	0	477	3	3	1
Passeriformes	Paridae	Tufted Titmouse	TUTI	<i>Baeolophus bicolor</i>	111	116	123	628	62	729	81
Passeriformes	Sittidae	Red-breasted Nuthatch	RBNU	<i>Sitta canadensis</i>	0	0	0	5	0	0	0
Passeriformes	Sittidae	White-breasted Nuthatch	WBNU	<i>Sitta carolinensis</i>	54	65	31	176	11	111	11
Passeriformes	Certhiidae	Brown Creeper	BRCR	<i>Certhia americana</i>	0	51	4	174	6	7	1
Passeriformes	Troglodytidae	Carolina Wren	CARW	<i>Thryothorus ludovicianus</i>	31	14	62	76	32	235	50
Passeriformes	Troglodytidae	House Wren	HOWR	<i>Troglodytes aedon</i>	15	17	0	47	0	0	0
Passeriformes	Regulidae	Golden-crowned Kinglet	GCKI	<i>Regulus satrapa</i>	2	2	0	3	0	2	0
Passeriformes	Turdidae	Eastern Bluebird	EABL	<i>Sialia sialis</i>	1	0	8	12	0	2	0
Passeriformes	Turdidae	Veery	VEER	<i>Catharus fuscescens</i>	0	0	0	1525	0	5	0
Passeriformes	Turdidae	Swainson's Thrush	SWTH	<i>Catharus ustulatus</i>	0	0	0	0	0	1	0
Passeriformes	Turdidae	Hermit Thrush	HETH	<i>Catharus guttatus</i>	0	0	0	112	0	4	0
Passeriformes	Turdidae	Wood Thrush*+^	WOTH	<i>Hylocichla mustelina</i>	132	137	94	1509	210	2127	104
Passeriformes	Turdidae	American Robin	AMRO	<i>Turdus migratorius</i>	118	82	24	485	7	134	23
Passeriformes	Mimidae	Gray Catbird	GRCA	<i>Dumetella carolinensis</i>	55	61	0	823	2	54	3

* Species of conservation importance: Regional Importance, as determined by Partners in Flight (Panjabi 2020).

+ Species of conservation importance: Regional Concern, as determined by Partners in Flight (Panjabi 2020).

^ Species of conservation importance: Regional Stewardship, as determined by Partners in Flight (Panjabi 2020).

Table A1-1 (continued). Taxonomy follows Chesser et al. (2019). Four letter species codes from the Institute for Bird Populations (<https://www.birdpop.org/pages/birdSpeciesCodes.php>).

Order	Family	Common Name	Code	Scientific Name	ALPO	FONE	FRHI	DEWA	BLUE	NERI	GARI
Passeriformes	Mimidae	Northern Mockingbird	NOMO	<i>Mimus polyglottos</i>	0	0	0	0	0	1	1
Passeriformes	Mimidae	Brown Thrasher	BRTH	<i>Toxostoma rufum</i>	0	4	0	3	1	0	0
Passeriformes	Sturnidae	European Starling+	EUST	<i>Sturnus vulgaris</i>	4	3	0	5	0	5	0
Passeriformes	Bombycillidae	Cedar Waxwing	CEDW	<i>Bombycilla cedrorum</i>	19	35	2	354	3	35	15
Passeriformes	Parulidae	Blue-winged Warbler*^	BWWA	<i>Vermivora cyanoptera</i>	0	0	0	32	0	0	0
Passeriformes	Parulidae	Golden-winged Warbler*+	GWWA	<i>Vermivora chrysoptera</i>	0	9	0	0	0	0	0
Passeriformes	Parulidae	Northern Parula	NOPA	<i>Setophaga americana</i>	7	14	4	552	64	229	104
Passeriformes	Parulidae	Yellow Warbler	YEWA	<i>Setophaga petechia</i>	0	4	1	211	0	3	0
Passeriformes	Parulidae	Chestnut-sided Warbler	CSWA	<i>Setophaga pensylvanica</i>	1	88	0	26	0	5	0
Passeriformes	Parulidae	Magnolia Warbler	MAWA	<i>Setophaga magnolia</i>	0	22	0	3	0	2	0
Passeriformes	Parulidae	Black-throated Blue Warbler	BTBW	<i>Setophaga caerulescens</i>	1	3	0	15	1	166	9
Passeriformes	Parulidae	Yellow-rumped Warbler	YRWA	<i>Setophaga coronata</i>	0	1	0	1	0	0	2
Passeriformes	Parulidae	Black-throated Green Warbler	BTNW	<i>Setophaga virens</i>	49	58	2	1415	33	566	97
Passeriformes	Parulidae	Blackburnian Warbler	BLBW	<i>Setophaga fusca</i>	1	32	0	471	0	38	0
Passeriformes	Parulidae	Yellow-throated Warbler*^	YTWA	<i>Setophaga dominica</i>	0	0	18	0	33	149	28
Passeriformes	Parulidae	Pine Warbler	PIWA	<i>Setophaga pinus</i>	0	0	0	162	0	1	1
Passeriformes	Parulidae	Prairie Warbler*+	PRAW	<i>Setophaga discolor</i>	0	7	0	103	0	0	0
Passeriformes	Parulidae	Blackpoll Warbler	BLPW	<i>Setophaga striata</i>	0	1	0	0	0	6	1
Passeriformes	Parulidae	Cerulean Warbler*+^	CERW	<i>Setophaga cerulea</i>	1	14	1	17	4	19	6
Passeriformes	Parulidae	Black-and-white Warbler*+	BAWW	<i>Mniotilta varia</i>	0	4	0	327	51	807	68

* Species of conservation importance: Regional Importance, as determined by Partners in Flight (Panjabi 2020).

+ Species of conservation importance: Regional Concern, as determined by Partners in Flight (Panjabi 2020).

^ Species of conservation importance: Regional Stewardship, as determined by Partners in Flight (Panjabi 2020).

Table A1-1 (continued). Taxonomy follows Chesser et al. (2019). Four letter species codes from the Institute for Bird Populations (<https://www.birdpop.org/pages/birdSpeciesCodes.php>).

Order	Family	Common Name	Code	Scientific Name	ALPO	FONE	FRHI	DEWA	BLUE	NERI	GARI
Passeriformes	Parulidae	American Redstart	AMRE	<i>Setophaga ruticilla</i>	64	52	10	825	59	650	51
Passeriformes	Parulidae	Worm-eating Warbler*^	WEWA	<i>Helmitheros vermivorum</i>	0	0	0	360	78	234	4
Passeriformes	Parulidae	Swainson's Warbler*+	SWWA	<i>Limnothlypis swainsonii</i>	0	0	0	0	0	52	104
Passeriformes	Parulidae	Ovenbird	OVEN	<i>Seiurus aurocapilla</i>	155	149	103	5540	167	1609	158
Passeriformes	Parulidae	Louisiana Waterthrush*^	LOWA	<i>Parkesia motacilla</i>	74	30	143	1537	157	1431	157
Passeriformes	Parulidae	Kentucky Warbler*+	KEWA	<i>Geothlypis formosa</i>	0	0	1	4	2	5	0
Passeriformes	Parulidae	Common Yellowthroat	COYE	<i>Geothlypis trichas</i>	94	232	12	558	0	6	2
Passeriformes	Parulidae	Hooded Warbler*^	HOWA	<i>Setophaga citrina</i>	14	122	19	576	27	830	296
Passeriformes	Parulidae	Canada Warbler*+	CAWA	<i>Cardellina canadensis</i>	0	0	0	4	0	0	0
Passeriformes	Icteridae	Yellow-breasted Chat*+	YBCH	<i>Icteria virens</i>	0	1	0	0	0	0	0
Passeriformes	Passerellidae	Eastern Towhee*+	EATO	<i>Pipilo erythrophthalmus</i>	100	216	130	240	14	242	28
Passeriformes	Passerellidae	Chipping Sparrow*+	CHSP	<i>Spizella passerina</i>	6	16	3	240	0	6	6
Passeriformes	Passerellidae	Field Sparrow*+	FISP	<i>Spizella pusilla</i>	14	91	5	39	2	13	0
Passeriformes	Passerellidae	Vesper Sparrow	VESP	<i>Poocetes gramineus</i>	0	1	0	0	0	0	0
Passeriformes	Passerellidae	Savannah Sparrow	SAVS	<i>Passerculus sandwichensis</i>	0	7	0	0	0	0	0
Passeriformes	Passerellidae	Song Sparrow	SOSP	<i>Melospiza melodia</i>	64	117	41	347	1	34	9
Passeriformes	Passerellidae	Swamp Sparrow	SWSP	<i>Melospiza georgiana</i>	0	1	0	0	0	0	0
Passeriformes	Passerellidae	White-throated Sparrow	WTSP	<i>Zonotrichia albicollis</i>	0	0	0	6	0	0	0
Passeriformes	Passerellidae	Dark-eyed Junco	DEJU	<i>Junco hyemalis</i>	3	0	0	17	0	1	0
Passeriformes	Cardinalidae	Northern Cardinal	NOCA	<i>Cardinalis cardinalis</i>	74	84	120	197	33	304	56

* Species of conservation importance: Regional Importance, as determined by Partners in Flight (Panjabi 2020).

+ Species of conservation importance: Regional Concern, as determined by Partners in Flight (Panjabi 2020).

^ Species of conservation importance: Regional Stewardship, as determined by Partners in Flight (Panjabi 2020).

Table A1-1 (continued). Taxonomy follows Chesser et al. (2019). Four letter species codes from the Institute for Bird Populations (<https://www.birdpop.org/pages/birdSpeciesCodes.php>).

Order	Family	Common Name	Code	Scientific Name	ALPO	FONE	FRHI	DEWA	BLUE	NERI	GARI
Passeriformes	Cardinalidae	Rose-breasted Grosbeak*+	RBGR	<i>Pheucticus ludovicianus</i>	36	33	3	107	1	103	1
Passeriformes	Cardinalidae	Indigo Bunting	INBU	<i>Passerina cyanea</i>	64	186	58	242	14	204	30
Passeriformes	Icteridae	Red-winged Blackbird	RWBL	<i>Agelaius phoeniceus</i>	0	48	3	131	0	2	0
Passeriformes	Icteridae	Common Grackle*+	COGR	<i>Quiscalus quiscula</i>	24	4	2	204	0	11	1
Passeriformes	Icteridae	Brown-headed Cowbird	BHCO	<i>Molothrus ater</i>	16	23	19	405	1	23	9
Passeriformes	Icteridae	Orchard Oriole	OROR	<i>Icterus spurius</i>	0	0	0	2	0	0	0
Passeriformes	Icteridae	Baltimore Oriole	BAOR	<i>Icterus galbula</i>	5	11	3	263	2	39	0
Passeriformes	Fringillidae	Pine Siskin	PISI	<i>Spinus pinus</i>	0	0	0	1	0	0	0
Passeriformes	Fringillidae	American Goldfinch	AMGO	<i>Spinus tristis</i>	20	24	5	111	3	60	15
Passeriformes	Passeridae	House Sparrow	HOSP	<i>Passer domesticus</i>	21	0	0	2	0	0	0
Passeriformes	Cardinalidae	Scarlet Tanager*^	SCTA	<i>Piranga olivacea</i>	195	164	143	1429	173	1792	125
Passeriformes	Poliophtidae	Blue-gray Gnatcatcher	BGGN	<i>Poliophtila caerulea</i>	6	13	16	223	17	77	11
Passeriformes	Troglodytidae	Winter Wren	WIWR	<i>Troglodytes hiemalis</i>	2	1	0	133	0	25	13
Passeriformes	Fringillidae	Purple Finch	PUFI	<i>Haemorhous purpureus</i>	0	0	0	2	0	0	0
Passeriformes	Fringillidae	House Finch	HOFI	<i>Haemorhous mexicanus</i>	1	0	0	8	0	0	0
Passeriformes	Parulidae	Tennessee Warbler	TEWA	<i>Leiothlypis peregrina</i>	0	2	5	0	0	0	0
Passeriformes	Parulidae	Orange-crowned Warbler	OCWA	<i>Leiothlypis celata</i>	0	0	0	0	0	0	1
Passeriformes	Parulidae	Nashville Warbler	NAWA	<i>Leiothlypis ruficapilla</i>	0	0	0	1	0	0	0
Total Species					64	85	59	112	60	89	66
Total Detections					2759	3811	2518	33263	2307	23114	2560

* Species of conservation importance: Regional Importance, as determined by Partners in Flight (Panjabi 2020).

+ Species of conservation importance: Regional Concern, as determined by Partners in Flight (Panjabi 2020).

^ Species of conservation importance: Regional Stewardship, as determined by Partners in Flight (Panjabi 2020).

Appendix 2. Abundance and trend estimate for 58 bird species detected at Allegheny Portage Railroad National Historic Site point count stations 2007–2019.

Table A2-1. Trend estimate based on slope of linear model regressing abundance estimate against sampling year. Species sorted from highest to lowest unadjusted abundance estimates. Scientific names in Appendix 1. [SD, standard deviation; SE, standard error; p, p-value].

Common Name	Unadjusted Abundance (mean)	Unadjusted Abundance (1SD)	Unadjusted Linear Trend	Unadjusted Linear Trend (SE)	Unadjusted Linear Trend (p)	Adjusted Abundance (mean)	Adjusted Abundance (1SD)	Adjusted Linear Trend	Adjusted Linear Trend (SE)	Adjusted Linear Trend (p)
Red-eyed Vireo	1.707	0.264	-0.037	0.020	0.099	2.082	0.201	0.000	0.000	0.082
Scarlet Tanager*	0.834	0.182	-0.004	0.016	0.824	1.033	0.142	0.000	0.000	0.661
Ovenbird	0.727	0.542	-0.108	0.030	0.007	0.895	0.133	0.000	0.000	0.509
Tufted Titmouse	0.653	0.176	0.007	0.016	0.688	1.674	0.465	0.000	0.000	0.918
Wood Thrush*	0.634	0.187	-0.012	0.016	0.483	0.894	0.152	0.000	0.000	0.419
American Robin	0.556	0.241	0.019	0.021	0.378	0.650	0.110	0.000	0.001	0.966
American Crow	0.479	0.292	-0.020	0.025	0.450	1.512	0.540	-0.025	0.038	0.530
Eastern Towhee*	0.474	0.170	0.020	0.014	0.177	0.629	0.111	0.000	0.000	0.262
Common Yellowthroat	0.472	0.222	-0.028	0.017	0.150	0.506	0.086	0.000	0.000	0.168
Red-bellied Woodpecker	0.471	0.114	-0.013	0.009	0.177	0.809	0.205	0.000	0.000	0.081
Louisiana Waterthrush*	0.452	0.279	-0.035	0.022	0.149	0.776	0.218	-0.002	0.002	0.188
Blue Jay	0.391	0.213	-0.016	0.018	0.420	1.739	0.590	-0.001	0.001	0.250
Downy Woodpecker	0.385	0.211	-0.021	0.017	0.254	1.912	0.571	-0.001	0.001	0.319
Acadian Flycatcher*	0.376	0.220	-0.019	0.019	0.332	0.401	0.071	0.000	0.000	0.345
Eastern Wood-Pewee*	0.373	0.172	-0.007	0.015	0.675	0.458	0.097	0.000	0.000	0.786
Northern Cardinal	0.370	0.224	0.016	0.019	0.422	0.597	0.144	0.001	0.001	0.390

* Species of regional conservation importance (Panjabi et al. 2020).

Table A2-1 (continued). Trend estimate based on slope of linear model regressing abundance estimate against sampling year. Species sorted from highest to lowest unadjusted abundance estimates. Scientific names in Appendix 1. [SD, standard deviation; SE, standard error; p, p-value].

Common Name	Unadjusted Abundance (mean)	Unadjusted Abundance (1SD)	Unadjusted Linear Trend	Unadjusted Linear Trend (SE)	Unadjusted Linear Trend (p)	Adjusted Abundance (mean)	Adjusted Abundance (1SD)	Adjusted Linear Trend	Adjusted Linear Trend (SE)	Adjusted Linear Trend (p)
White-breasted Nuthatch	0.365	0.251	-0.035	0.019	0.101	0.711	0.258	-0.018	0.009	0.081
Indigo Bunting	0.343	0.157	-0.033	0.008	0.003	0.466	0.104	-0.001	0.000	0.004
Black-capped Chickadee	0.293	0.168	0.012	0.014	0.417	1.795	0.626	0.000	0.000	0.463
Pileated Woodpecker	0.287	0.245	-0.025	0.020	0.261	—	—	—	—	—
American Redstart	0.284	0.228	0.035	0.016	0.067	0.386	0.080	0.001	0.000	0.064
Black-throated Green Warbler	0.282	0.235	-0.039	0.016	0.038	0.372	0.102	-0.003	0.001	0.041
Gray Catbird	0.273	0.221	0.017	0.019	0.397	0.323	0.078	0.005	0.006	0.448
Song Sparrow	0.225	0.180	0.039	0.009	0.002	0.237	0.055	0.000	0.000	0.055
Rose-breasted Grosbeak*	0.203	0.184	-0.030	0.013	0.050	—	—	—	—	—
Carolina Wren	0.148	0.151	0.024	0.011	0.056	—	—	—	—	—
House Sparrow	0.142	0.242	0.043	0.016	0.026	—	—	—	—	—
Eastern Phoebe	0.140	0.106	-0.009	0.009	0.334	0.229	0.101	0.000	0.000	0.333
Northern Flicker*	0.132	0.128	-0.024	0.008	0.012	—	—	—	—	—
Common Grackle*	0.130	0.255	0.032	0.020	0.148	—	—	—	—	—
Blue-headed Vireo	0.112	0.073	-0.013	0.005	0.018	—	—	—	—	—
Brown-headed Cowbird	0.109	0.127	-0.010	0.011	0.407	—	—	—	—	—
Hooded Warbler*	0.101	0.166	0.031	0.010	0.015	—	—	—	—	—
American Goldfinch	0.088	0.105	0.012	0.008	0.201	—	—	—	—	—
Cedar Waxwing	0.074	0.071	-0.002	0.006	0.749	—	—	—	—	—

* Species of regional conservation importance (Panjabi et al. 2020).

Table A2-1 (continued). Trend estimate based on slope of linear model regressing abundance estimate against sampling year. Species sorted from highest to lowest unadjusted abundance estimates. Scientific names in Appendix 1. [SD, standard deviation; SE, standard error; p, p-value].

Common Name	Unadjusted Abundance (mean)	Unadjusted Abundance (1SD)	Unadjusted Linear Trend	Unadjusted Linear Trend (SE)	Unadjusted Linear Trend (p)	Adjusted Abundance (mean)	Adjusted Abundance (1SD)	Adjusted Linear Trend	Adjusted Linear Trend (SE)	Adjusted Linear Trend (p)
Great Crested Flycatcher	0.063	0.076	-0.006	0.006	0.374	—	—	—	—	—
Field Sparrow*	0.057	0.050	-0.007	0.004	0.084	—	—	—	—	—
Northern Parula	0.053	0.074	-0.004	0.007	0.580	—	—	—	—	—
Hairy Woodpecker	0.043	0.060	0.008	0.005	0.119	—	—	—	—	—
Blue-gray Gnatcatcher	0.038	0.064	0.001	0.006	0.803	—	—	—	—	—
Ruby-throated Hummingbird	0.036	0.063	-0.004	0.006	0.534	—	—	—	—	—
House Wren	0.033	0.070	0.007	0.006	0.266	—	—	—	—	—
Yellow-billed Cuckoo*	0.026	0.041	0.004	0.003	0.288	—	—	—	—	—
Baltimore Oriole	0.025	0.056	0.008	0.004	0.114	—	—	—	—	—
Chipping Sparrow*	0.025	0.056	0.004	0.005	0.432	—	—	—	—	—
Golden-crowned Kinglet	0.022	0.046	-0.004	0.004	0.286	—	—	—	—	—
House Finch	0.017	0.053	0.003	0.005	0.469	—	—	—	—	—
Common Raven	0.013	0.040	-0.004	0.003	0.297	—	—	—	—	—
Blackburnian Warbler	0.009	0.029	0.000	0.003	0.980	—	—	—	—	—
Black-throated Blue Warbler	0.009	0.029	-0.002	0.002	0.438	—	—	—	—	—
Chestnut-sided Warbler	0.009	0.029	0.000	0.003	0.980	—	—	—	—	—
Eastern Bluebird	0.009	0.029	-0.001	0.003	0.603	—	—	—	—	—
Winter Wren	0.009	0.029	-0.001	0.003	0.603	—	—	—	—	—
Yellow-throated Vireo	0.009	0.029	-0.001	0.003	0.603	—	—	—	—	—

* Species of regional conservation importance (Panjabi et al. 2020).

Table A2-1 (continued). Trend estimate based on slope of linear model regressing abundance estimate against sampling year. Species sorted from highest to lowest unadjusted abundance estimates. Scientific names in Appendix 1. [SD, standard deviation; SE, standard error; p, p-value].

Common Name	Unadjusted Abundance (mean)	Unadjusted Abundance (1SD)	Unadjusted Linear Trend	Unadjusted Linear Trend (SE)	Unadjusted Linear Trend (p)	Adjusted Abundance (mean)	Adjusted Abundance (1SD)	Adjusted Linear Trend	Adjusted Linear Trend (SE)	Adjusted Linear Trend (p)
Cerulean Warbler*	0.008	0.026	0.004	0.002	0.057	–	–	–	–	–
Chimney Swift*	0.008	0.026	0.001	0.002	0.825	–	–	–	–	–
Dark-eyed Junco	0.008	0.026	0.004	0.002	0.057	–	–	–	–	–

* Species of regional conservation importance (Panjabi et al. 2020).

Appendix 3. Trend estimate for 58 target bird species detected at Allegheny Portage Railroad National Historic Site point count stations 2007–2019.

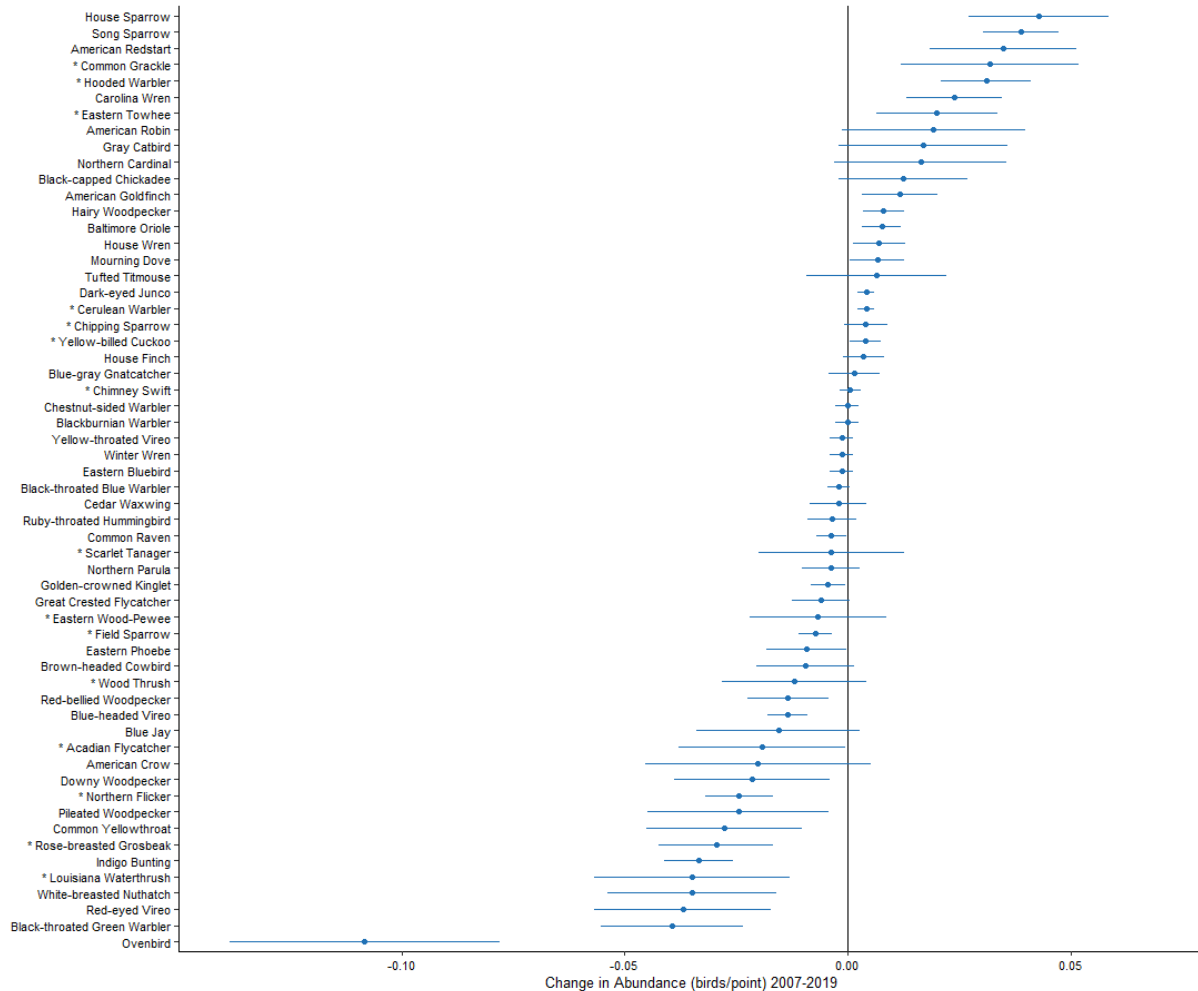


Figure A3-1. Slope $\pm$ standard error of linear model regressing unadjusted abundance estimates against sampling year. *Species of regional conservation importance (Panjabi et al. 2020). Scientific names in Appendix 1.

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National Park Service
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