



Landbird Population Trends for Seven Great Lakes Network National Parks

Natural Resource Report NPS/GLKN/NRR—2015/1091



ON THE COVER

Chestnut-sided Warbler (*Setophaga pensylvanica*) by William H. Majoros/Wikimedia Commons. Conducting point counts in forest, field, and river, NPS photos/T. Gostomski.

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Executive Summary

In recent decades, bird surveys in western Great Lakes national park units have documented avian communities for scientific, management, and interpretive purposes. Surveys targeted landbirds, particularly passerines and woodpeckers, during the peak of breeding season when detectability of birds is greatest due to territorial singing. The Great Lakes Network office has developed standard methods, which most parks have adopted, making data relatively comparable across the region. Seven of the nine Network parks have datasets spanning greater than five years that are analyzed in this report.

Data are collected by experienced observers annually in June, during early to mid-morning hours, in good weather conditions, at pre-selected points on hiking trails, roads, and, in one park, along rivers. Data from the counts are used to document the species assemblage and population changes over time. Analyses utilized regressions to focus on the trajectory of bird populations over time. Both empirical and density-estimate models were employed to determine the most reliable trends for species in each park where sufficient data were available. Empirical models use log-transformed observations from annual surveys. Density models use distance measurements to estimate the proportion of birds that were present but not detected; the estimates are often improved by including covariates such as weather data. Only one park had habitat association data available. Guilds of species assemblages were also analyzed, including migration strategy, habitat preference, and diet and foraging substrate. When compared to patterns among individual species, guild analyses can simplify complex avian community compositions and indicate how habitats may be influencing them.

Overall, there was little consistency in significant avian population trends across parks, although most species either corresponded to broader regional trends or had no clear pattern. Individual parks, each protected for unique ecological landscapes, often support avian communities that are distinctive in their particular mix of species and abundances. Within parks, trend models were very similar, indicating that observational techniques are adequate for most analytical purposes. However, distance-based density estimates gave a more statistically refined estimate of population trends and should be used for long-term analyses.

Two species showed strong increasing trends across Network parks (American Robin and Red-winged Blackbird), and another five species exhibited weaker increases (Northern Flicker, Alder Flycatcher, Red-breasted Nuthatch, Common Yellowthroat and Yellow-rumped Warbler). Only three species had strong declining trends across parks (American Crow, Chestnut-sided Warbler and Evening Grosbeak). The remainder of species is more appropriately considered on a park-by-park basis using local expertise. Individual results and discussion are presented for each park so findings can be incorporated into specific planning and management decisions.

Birds with a substantial proportion of fruit in their summer diet showed a general decline across parks. Declining frugivore populations indicate a possible change or decline in berry-producing plants in the region. Two guilds that included generally increasing species were wetland occupants and bark foragers. Otherwise there were no clear patterns within guilds; most notably there is no obvious cause for concern regarding Neotropical migrants, a group that has received a great deal of

attention in recent decades due to concerns of population stressors during migration and on wintering grounds.

It appears that most survey objectives are being accomplished in Network parks, but there are inconsistencies. However, the potential exists to improve both the surveys themselves and the methods of data management, the latter lending itself to finer levels of analyses. Some form of *post hoc* habitat designation for each survey point would add substantially to analyses and should be coordinated through the Network office for consistency. The most important recommendation is for greater quality control in data management, including use of standardized data entry and a strategy for double-checking all entries. This report is a benchmark for comparing avian communities in the protected park landscapes to those in habitats more directly impacted by human activities.

Acknowledgments

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List of Terms and Acronyms

APIS	Apostle Islands National Lakeshore (Wisconsin)
BBS	Breeding bird survey
GLKN	Great Lakes Inventory and Monitoring Network
GRPO	Grand Portage National Monument (Minnesota)
INDU	Indiana Dunes National Lakeshore (Indiana)
ISRO	Isle Royale National Park (Michigan)
NABBS	North American Breeding Bird Survey
NABCI	North American Bird Conservation Initiative
NPS	National Park Service
SACN	St. Croix National Scenic Riverway (Wisconsin/Minnesota)
SLBE	Sleeping Bear Dunes National Lakeshore (Michigan)
VOYA	Voyageurs National Park (Minnesota)

Introduction

The Great Lakes Inventory and Monitoring Network is composed of nine national park units in Michigan, Indiana, Wisconsin, and Minnesota (Figure 1). The parks span across two Bird Conservation Regions (Rich et al. 2004) and contain a wide variety of habitats including wetlands, prairie, savanna, lowland riparian forests, cedar swamps, and hardwood and conifer forests. The parks provide important breeding habitat for more than 100 species of landbirds, some of which are long-distance (Neotropical) migrants.

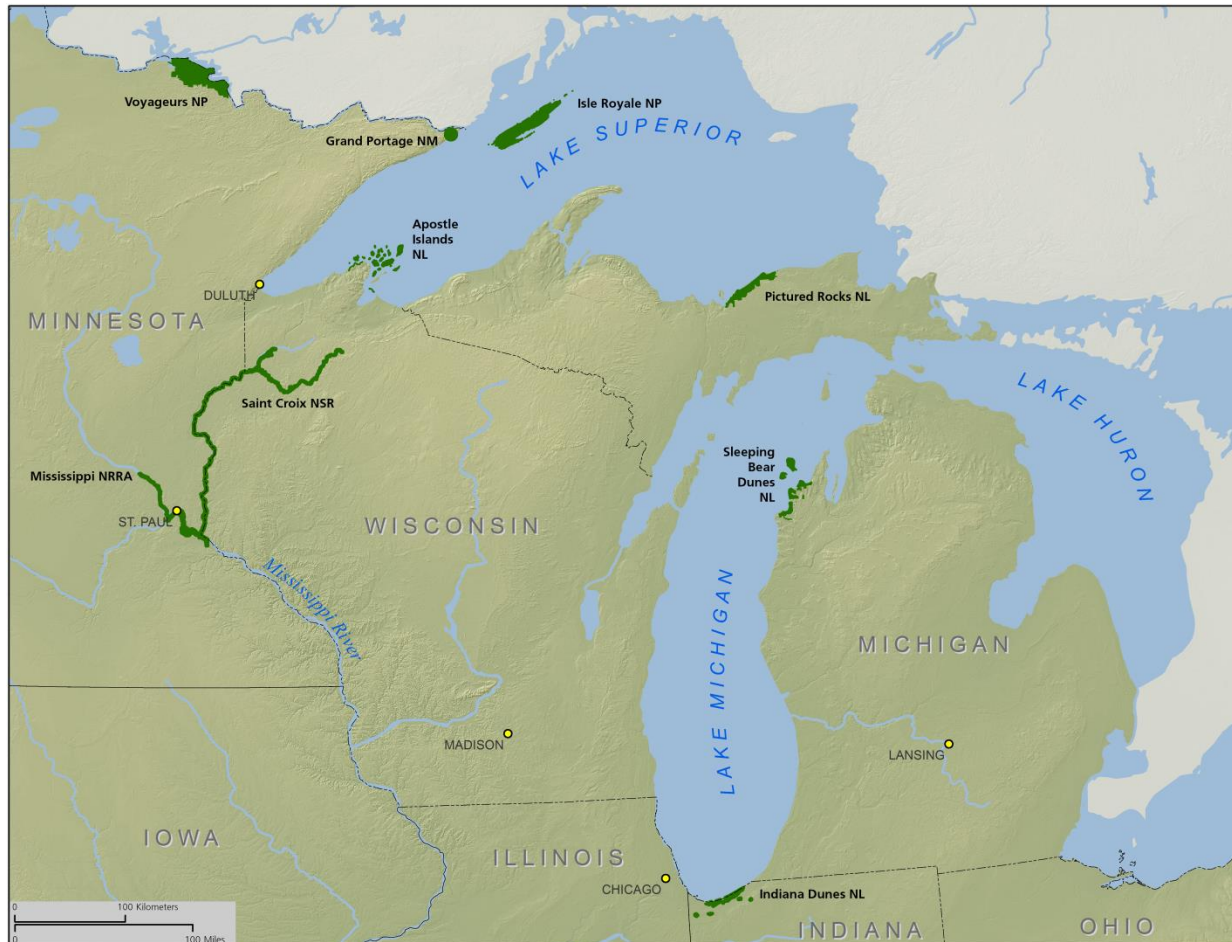


Figure 1. Locations of the nine national park units in the Great Lakes Inventory and Monitoring Network.

Six of the nine Great Lakes parks were monitoring songbirds prior to the creation of the Great Lakes Inventory and Monitoring (I&M) program in 2000 (Table 1). The longest-running monitoring program is at the St. Croix National Scenic Riverway (SACN), which began conducting surveys in 1982 (Maercklein 1999).

Table 1. Year of establishment and number of points for breeding bird surveys at Great Lakes Network parks.

Park	Year Established	No. of Points
Apostle Islands National Lakeshore	1990	106
Grand Portage National Monument	1999	38
Indiana Dunes National Lakeshore	1993	50
Isle Royale National Park	1994	130
Mississippi National River and Recreation Area	2009	?
Pictured Rocks National Lakeshore	2011	50
St. Croix National Scenic Riverway	1982	50
Sleeping Bear Dunes National Lakeshore	2004	40
Voyageurs National Park	1995	80

Landbird monitoring in the parks has typically followed standardized methods for point count studies (e.g., Ralph et al. 1995, Howe et al. 1997, Matsuoka et al. 2014). Though implementation has varied depending on a park’s monitoring objectives, all parks share the objectives of monitoring species trends and putting results into a regional context (Gostomski et al. 2010). Thus, count data that yield indices of relative abundance are sufficient to meet park goals. All parks followed similar guidelines for data collection, including: (1) completing all surveys during the month of June, (2) conducting counts between approximately ½-hr before sunrise and 4 hrs after sunrise, (3) not conducting counts during poor weather conditions that reduce detectability of birds (i.e., rain, wind >8–12 mph, fog), and (4) ensuring observers had appropriate skills and hearing ability to perceive and identify bird vocalizations. See Lind et al. (2005) for additional details.

After the Great Lakes I&M Network (GLKN) was established in 2000, discussions were held to identify critical resources (“vital signs”) for long-term monitoring; monitoring bird communities ranked fourth in priority among 46 potential vital signs for the GLKN parks. Monitoring landbirds ranked highly, in part, because of the extensive datasets already available, the popularity of birds among park visitors, and the endangered, threatened, and special concern status of some species at state and/or federal levels (Route and Elias 2007, Gostomski et al. 2010).

A Network monitoring protocol and standard operating procedures were developed to standardize data collection across the nine parks (Gostomski et al. 2010). The primary goals of the protocol were to (1) develop and use a standardized sampling method that is flexible enough to fit the unique sampling challenges at each park but still yield data that are comparable across parks and can be integrated at regional and national levels, and (2) develop and integrate quality control measures such

as training and certification for observers. Survey standards are based on techniques known to work well in forested habitats, yet across-park comparisons will be viewed cautiously given that each park initiated surveys independently, has unique and contrasting landscapes, and stratifies routes or data points in different ways.

Most parks had to make minor adjustments to their data collection methods to meet the standards set by the Network protocol. The most common adjustments were recording the minute-interval of each observation (Minute 0, Minute 1, Minute 2, up to Minute 9 for those doing 10-minute counts) so that data could be compared across parks regardless of count duration, and recording the distance to each bird in one of three distance-ring categories.

Specific questions we hope to address under this monitoring protocol include:

1. What are the long-term trends in population indices for priority landbird species or suites of birds?
2. What are the habitat associations of observed landbird species?
3. How do indices of population trends and habitat associations in the parks compare to those from other monitoring programs in the region?

This report provides analyses of long-term (≥ 5 yrs) monitoring data collected at seven of the nine GLKN parks. The number of years varies for each park, and two parks were not included because their monitoring programs were established recently and do not yet have sufficient data. We do not address all possible complications or biases associated with point count surveys (see Bibby et al. 2010 and Nichols et al. 2009 for discussions), but we endeavored to make reliable determinations regarding the status and trends of bird populations in western Great Lakes parks.

Methods

All nine GLKN parks are collecting annual breeding bird point count data. Seven parks have >10 yrs of data, and five of those have >15 yrs of data (Appendix A). For adequate statistical sample sizes, Network parks included in this report are: Apostle Islands National Lakeshore (APIS) and St. Croix National Scenic Riverway (SACN) in Wisconsin; Grand Portage National Monument (GRPO) and Voyageurs National Park (VOYA) in Minnesota; Indiana Dunes National Lakeshore (INDU) in Indiana; and Isle Royale National Park (ISRO) and Sleeping Bear Dunes National Lakeshore (SLBE) in Michigan. Songbird monitoring is relatively new at Mississippi National River and Recreation Area (Minnesota) and Pictured Rocks National Lakeshore (Michigan), each with <5 yrs of data, so these parks were not included in analyses.

Spatial and Temporal Allocation of Samples

Survey points at APIS, GRPO, ISRO, and VOYA are located along trails and generally account for both representative habitats in and geographic distribution across the parks so as to achieve spatial balance (Stevens and Olsen 2004). At SACN, points are located along both the Namekagon and St. Croix rivers for the entire length of the park, and surveys are conducted from an anchored canoe. At SLBE, points were proportionally stratified by habitat type. Survey points at INDU are located along a single roadside transect in accordance with North American Breeding Bird Survey (NABBS) methods (Sauer et al. 2014). Many point locations are permanently marked, as allowed for by individual park policies, but all are georeferenced, and observers use a GPS unit to ensure they are at the correct location prior to beginning a survey. Points are ≥ 250 m apart in forested areas and ≥ 500 m apart in grasslands to avoid double-counting of individual birds (Ralph et al. 1995, Matsuoka et al. 2014). Points are sampled annually, except at SACN where surveys are done on alternating river sections each year (details below). The survey duration varies by park, with 3-, 5-, and 10-minute intervals all used.

Lind et al. (2005) carried out retrospective power analyses for six existing Network programs and found that all programs had sufficient power to detect a 5% change in abundance of common species over moderate time frames (10–15 years). For less abundant or rare species, sufficient statistical power to detect a trend will require more years of monitoring. Although Lind et al. (2005) did not evaluate the number of samples required for a specified level of power, they concluded that most parks had a sufficient number of survey stations.

Point Count Methods, Park Objectives, and Data Arrangement

The Network's point count survey methods are described in detail in Knutson et al. (2010). In summary, we employ variable circular plot (VCP) counts that are conducted during the month of June after migrating birds have moved through the area and breeding species have begun establishing territories. Counts begin 30 minutes before sunrise and are finished no later than four hours after sunrise. Count duration varies by park, ranging from 3 to 10 minutes. Observations are recorded at one-minute intervals (noted as Minute 0, 1, 2, 3, ... up to Minute 9) to allow for comparisons between parks and to facilitate future analyses of detection probabilities (Etterson et al. 2009). For each observation, the data recorded are: the name of the bird using standardized four-letter codes

(Pyle and DeSante 2010), the time (minute-interval), the detection type (singing, calling, non-vocal sound [drumming grouse, tapping woodpeckers], observed, flyover), and the bird's distance from the point center in one of three categories: 0–50 m, 51–100 m, and >100 m. Park-specific variations are detailed below and often include a transition from original methods to a sampling design that incorporates the Network standards.

All parks made changes to their data collection methods in 2010 to align with the Network protocol, so current methods may not be the same as what is described for each park below.

Apostle Islands National Lakeshore

Standardization of points using recognized protocols was accomplished in 1995 (Van Stappen and Dallman 1996). Ten survey routes were established, with points placed along hiking trails on Devils Island (DE), Oak Island (OA), Outer Island North-South Trail (OU), Sand Island (SA), Stockton Island–Presque Isle (STPI), and Stockton Island–Trout Point (STTP), and off-trail along the Mainland portion of the park (MD), on Long Island (LO), in the Outer Island Hemlock Stand (OUHS), and on Raspberry Island (RA) (Figure 2). Routes were almost completely surveyed between 1995 and 2009, except in 1998 due to weather and again in 2006 due to staffing issues (Table A1). Counts were 10 mins in length and all birds detected within a 100 m radius were recorded. Relatively comprehensive datasets from 1995 through 2009 were used for analyses (Table A1).

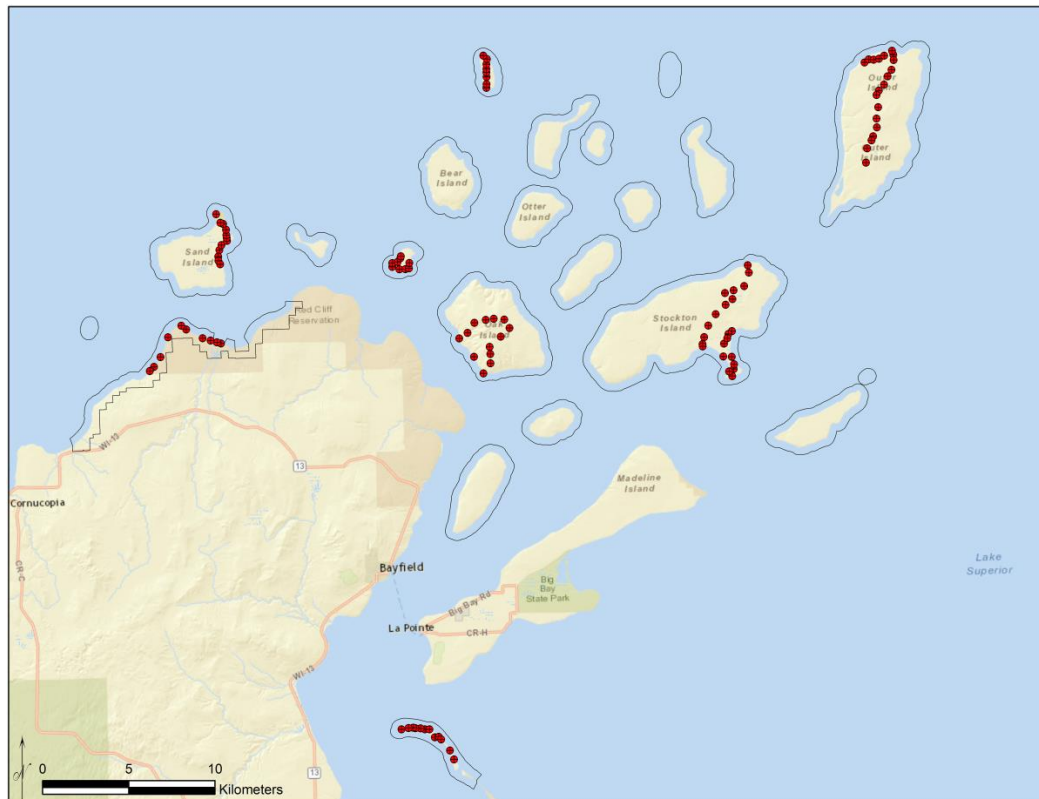


Figure 2. Locations of ten breeding bird survey routes at Apostle Islands National Lakeshore (Wisconsin), 1995–2009.

Grand Portage National Monument

The GRPO survey has been completed annually since 1999, though not all points were completed in the first year. A single route along the historic canoe portage from Lake Superior to the Pigeon River (Figure 3) covers 13.7 km (8.5 mi) and usually takes three days to complete. Unlimited distance counts were conducted for 10 mins at each point. Analyses included 2000–2014 data, with all points completed in all years except one point missing in 2014.

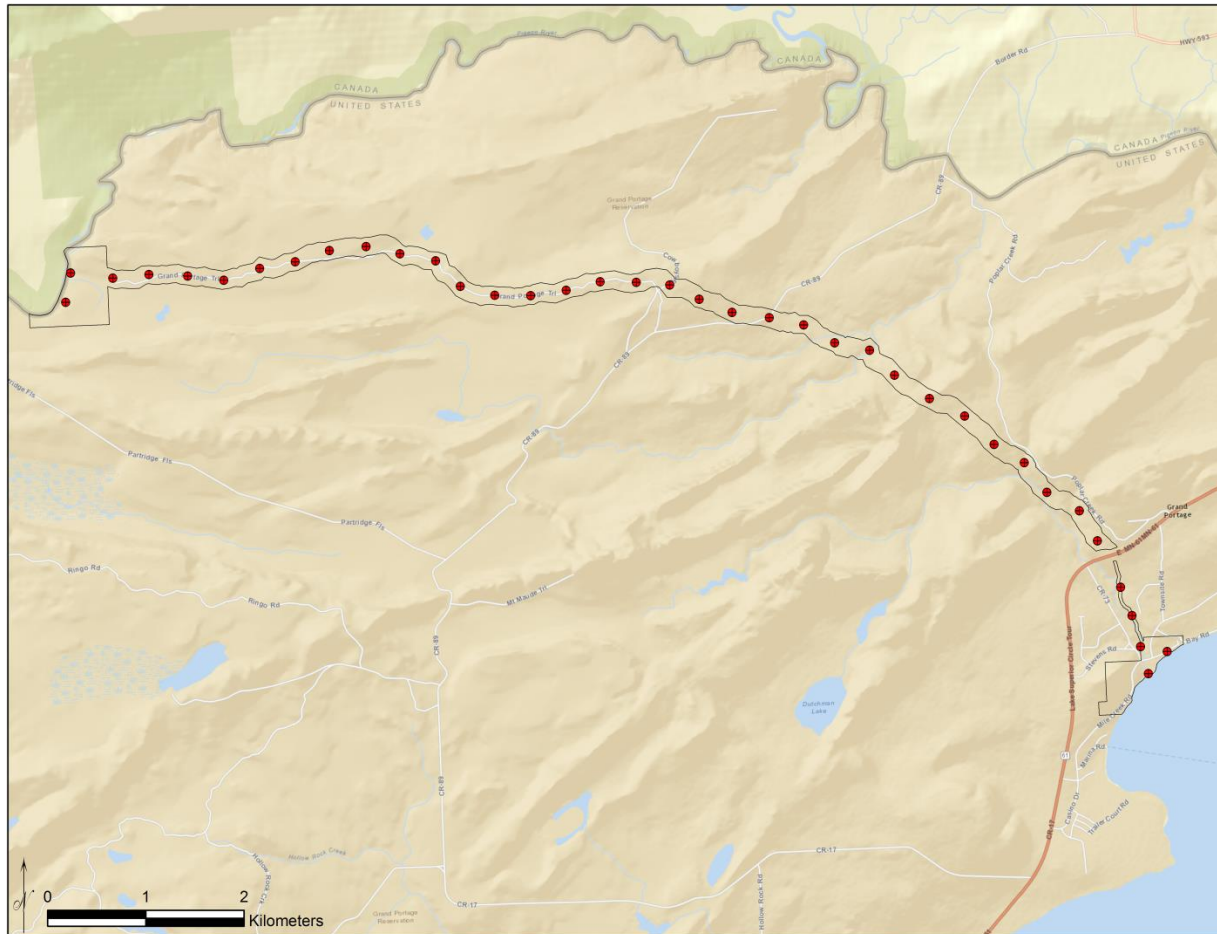


Figure 3. Breeding bird survey points are distributed at ≥ 250 m intervals along the 13.7 km portage trail at Grand Portage National Monument (Minnesota).

Indiana Dunes National Lakeshore

Indiana Dunes conducted 3-min counts at 50 roadside points in accordance with NABBS standards (Sauer et al. 2014) (Figure 4). This is the only roadside survey among the GLKN parks. Counts documented all birds detected within a 0.40 km (0.25 mi) radius.

Data discussed in this report were compiled from disparate sources. Annual species counts from 1993–2005 were available from a summary document on the INDU website (www.nps.gov/indu). Data from 2004 and 2008–2013 were provided in spreadsheets with varying levels of detail. Only 2004 included additional information on weather conditions. Only 35 of the 50 points were

completed in 2008, and coverage for other years must be assumed due to a lack of detailed data. No data were reported for 2006 or 2007.

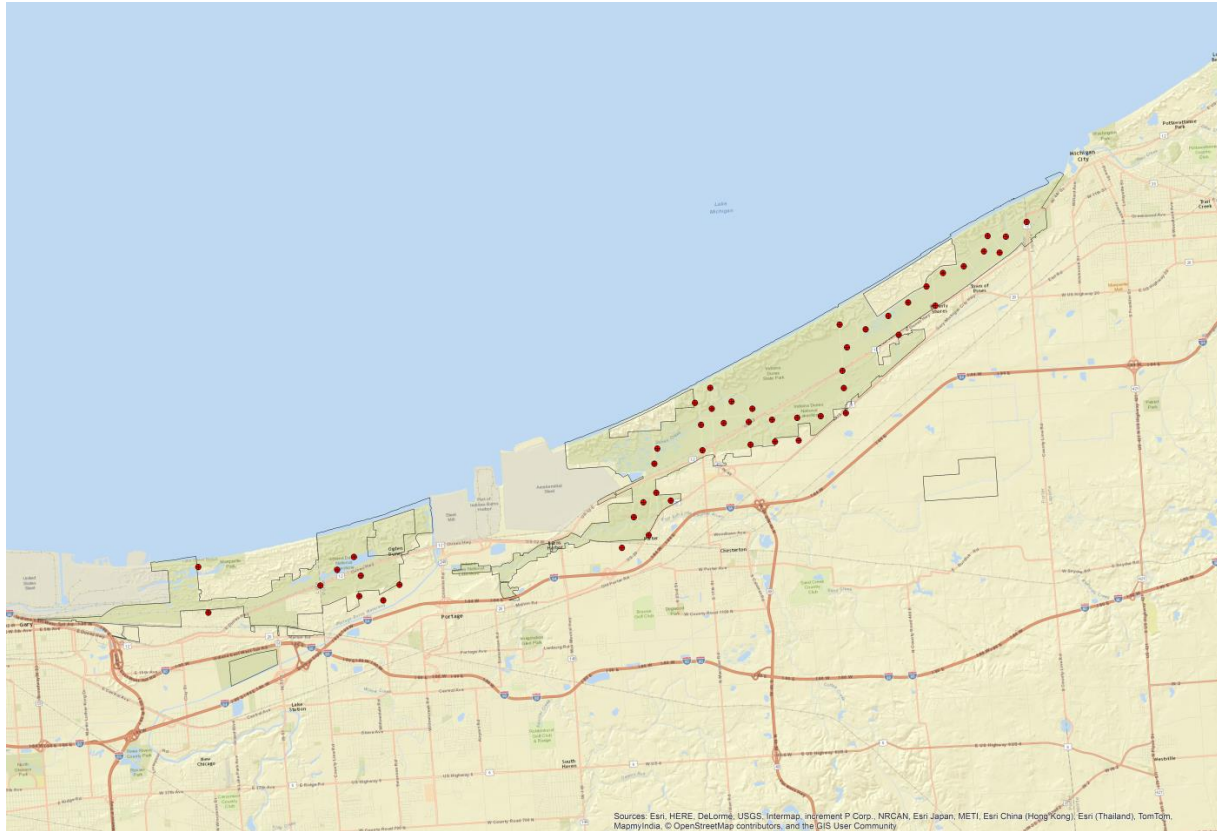


Figure 4. Location of breeding bird survey points at Indiana Dunes National Lakeshore (Indiana). This is North American Breeding Bird Survey route 35901.

Isle Royale National Park

Egan and Gostomski (2013) provided details on route establishment and survey techniques at ISRO. The eight routes vary in length, with a total of 130 points across the park: Passage Island (PASS; 4 points), Three Mile-Lane Cove (TMLC; 16), Chippewa Harbor-Lake Richie (CHLR; 16), Mt. Ojibway Loop (MTOJ; 19), Lake Richie-Greenstone (LRGR; 20), Ishpeming Trail (ISTR; 18), Feldtmann Lake Trail (FELK; 16) and Windigo-Sugar Mountain (WIND; 21) (Figure 5). Counts were 5 mins in length, divided into one-minute intervals. Routes were standardized in 1996, so our analyses included data from that point forward. Weather conditions occasionally resulted in fewer than 130 points surveyed. All routes were surveyed annually since 1996, and all those data were included here. Even with only one year of new data since Egan and Gostomski's (2013) analysis, the comprehensive goals of the Network project make inclusion of ISRO data important.

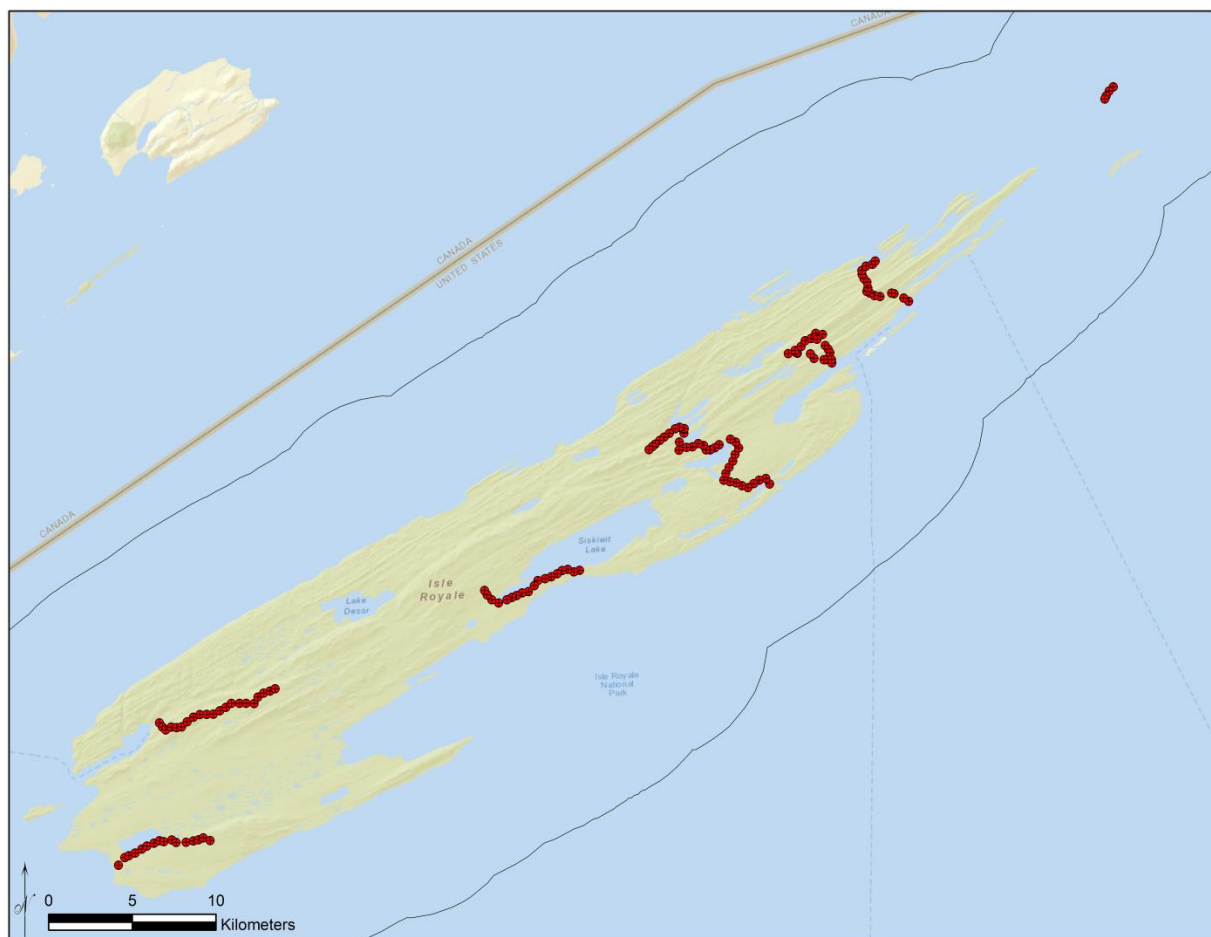


Figure 5. Locations of eight breeding bird survey routes at Isle Royale National Park (Michigan).

Saint Croix National Scenic Riverway

Six river-based bird survey routes are surveyed at SACN (Figure 6):

1. Upper Namekagon River (UNAM), from Namekagon Dam to Phipps Flowage;
2. Lower Namekagon River (LNAM), from County K Landing to Totogatic River;
3. Upper St. Croix River (USAC), from Gordon Dam to Riverside
4. St. Croix River North (SACN), from Highway 77/48 to Highway 70;
5. Middle St. Croix River (MSAC), from Raspberry Landing to Nevers Dam; and
6. Lower St. Croix River (LOSA), from St. Croix Falls to Stillwater.

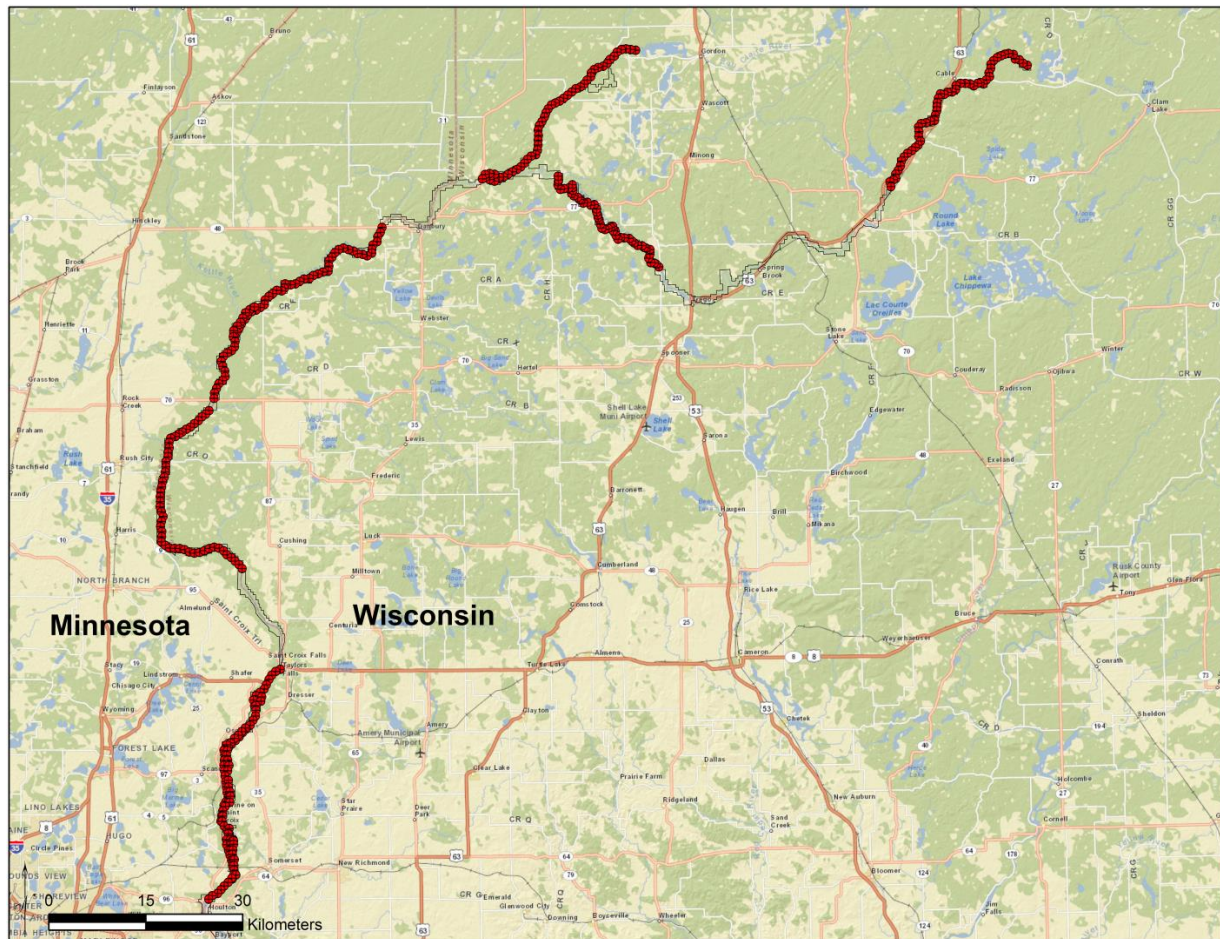


Figure 6. Six breeding bird survey river routes at St. Croix National Scenic Riverway (Wisconsin/Minnesota).

Routes with similar habitats and avian communities are SACN/MSAC/LOSA and UNAM/LNAM. The USAC route is unlike the other routes. Surveys along two of the routes (LOSA, LNAM) began in 1982 and 1983, respectively, but were not revisited until 1998. In order to more adequately cover park habitats and species not represented by the original routes, two additional routes were added in 2000 (SACN, UNAM), another in 2003 (USAC), and one more in 2012 (MSAC). With a range from 47 to 53 points along a given stretch, each route takes two mornings to complete. Unfortunately the “SACN” acronym is used both for the park and a route; except for this section of the report, SACN will always refer to the park.

Originally, 3-min, unlimited distance counts were conducted at each point by canoe or motorboat, with the boat allowed to drift in the current. Count duration increased to 5 mins in 2007. Standardization of the points and survey methods was accomplished using the Network protocol, and included anchoring the boat/canoe at fixed locations, using 6-minute counts, and placing each detection in one of three distance measurement categories (Gostomski et al. 2010).

A subset of surveyed routes and years was used to standardize data for regressions (Table A3). Removal of years or routes is not desirable because important data points are then missing from analyses. However, maintaining a relatively consistent set and number of annually surveyed points was important for analysis of equal survey effort across years. Only birds from 3-min counts were incorporated into trend analyses. Because of staggered annual route completion, trend analyses were divided into two strata: LOSA/LNAM and UNAM/SACN. In addition, regressions included both drifting (1998–2004) and anchored (2005–2014) point counts so that there were enough data points for adequate sample size. Data removed included those from 1982–1983 because the gap to 1998 was too long for useful speculation, and both 2000 and 2009 because each year was missing too many points. The USAC and MSAC routes were not included for two reasons: first, to extend data analyses as far back as possible using consistently surveyed routes, and second, with standardization of methods in 2008, these two routes can be included in future analyses that begin in that year and leave out prior data. This gives eight years of data for LOSA/LNAM and seven years of data for UNAM/SACN for current analyses (Table A3).

Sleeping Bear Dunes National Lakeshore

Sleeping Bear used 10-min surveys to sample 41 points along five routes within eight representative habitat types (Figure 7, Table A4). Points were distributed proportionately to the amount of habitat present in the park. Data were collected from 2004 to 2006 and 2009–2013. The latter time period included collection of additional data, including distance to birds, minute-by-minute categories of detection, and refined information on noise and weather (Gostomski et al. 2010). Otherwise survey methods for the two time periods were identical. The W-5 point (Peterson + Lasso) was removed from analysis because no surveys were completed there from 2004 to 2006.

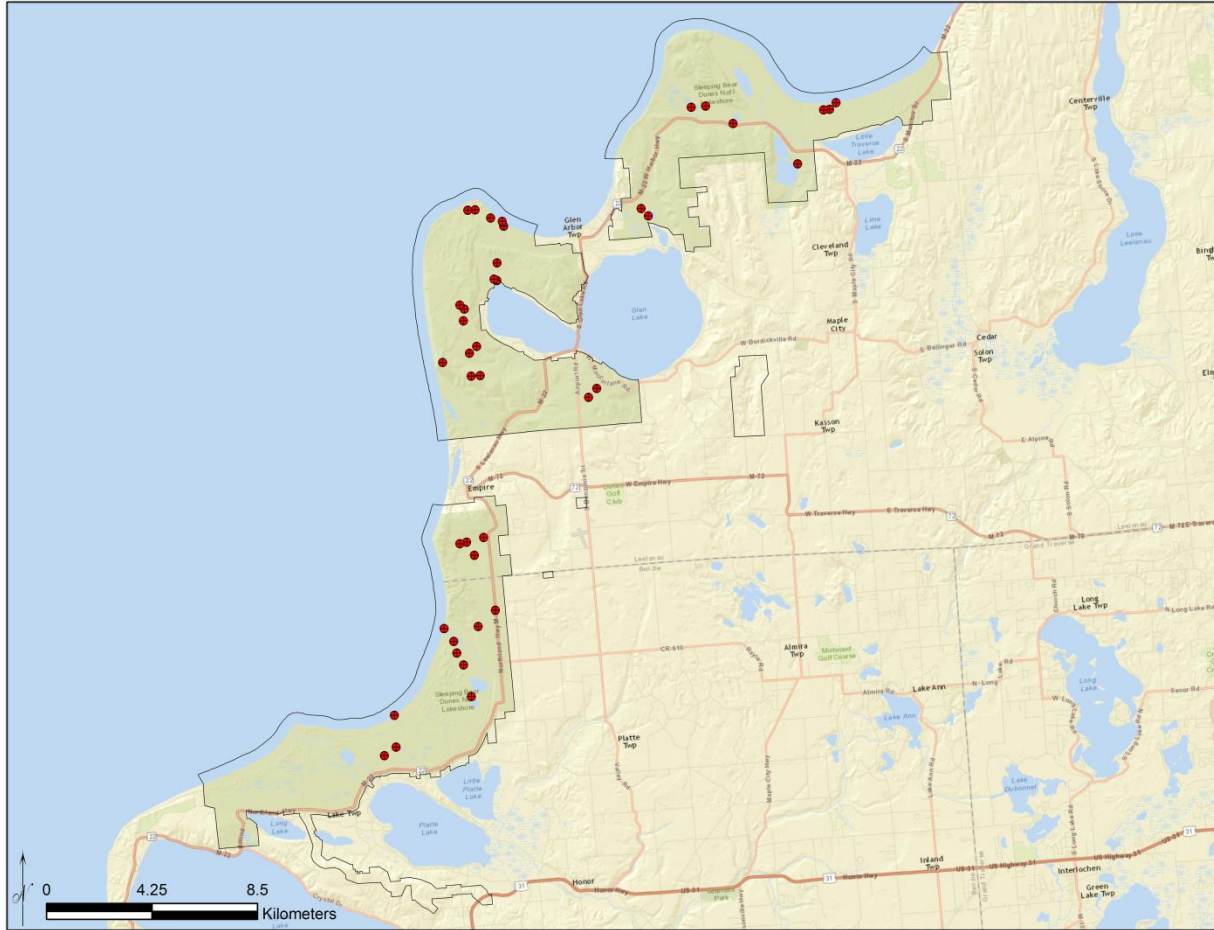


Figure 7. Locations of 41 breeding bird survey points at Sleeping Bear Dunes National Lakeshore (Michigan).

Voyageurs National Park

Grim et al. (1995) provided a detailed survey protocol and rationale for point count surveys at VOYA. Each route consists of 10 points, with 80 points officially listed for landbird monitoring (Gostomski et al. 2010).

Consistent data collection began in 1997 (Table A5). Counts were conducted for 10 mins, and data were separated into 3-, 5-, and 10-minute intervals. Distances were recorded either inside or outside of a 100 m radius. Ten routes appear to have been surveyed since initiation of the VOYA bird protocol: Anderson Bay Loop Trail (ABLT), Ash River Trail (ARTR), Blind Ash Bay Trail (BABT), Black Bay Ski Trail (BBST), Cruiser Lake Trail (CLT), Dryweed Island (DWI), Echo Bay Trail (EBTR), Lost Bay Portage Trail (LBPT), Rainy Lake Visitor Center (RLVC), and Kabetogama Lake Trail (KATR) (Figure 8).

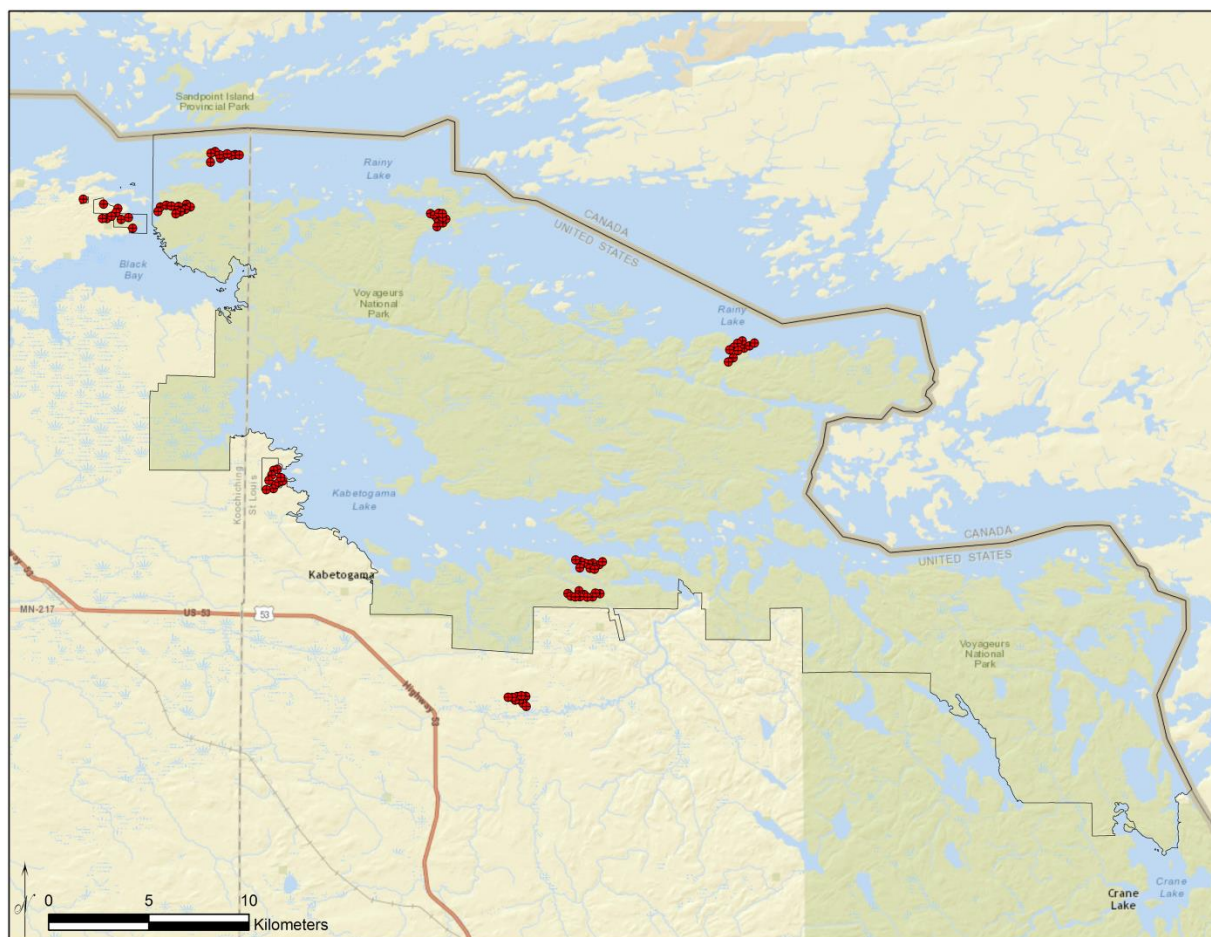


Figure 8. Locations of 80 breeding bird survey points (nine routes) at Voyageurs National Park (Minnesota).

Although ten routes have been surveyed since initiation of the survey in 1995, only eight routes have been regularly surveyed since 2004 (Table A5). Since 1997, four routes have been surveyed annually, with only one missing year (2011) for BABT. Implementation and consistency of surveying additional routes has been patchy. In order to take advantage of the most reliable and long-term data available, only the four most consistently surveyed routes were used in regression analyses: BABT, BBST, EBTR, and RLVC. Inclusion of additional routes would have led to 20%–40% of data missing from some years, and would probably require the removal of 2011 data entirely due to <50% coverage.

Analytical Methods

Trend analyses

For quality control, data were rearranged by year and species and scanned for errors. Problems were identified in all park datasets, and it was deemed prudent to remove all questionable records for reliability of results. Data were removed prior to analyses due to: (1) unclear or contradictory entries; (2) records without a number of birds listed; and (3) years or routes with substantial data missing,

which could alter trends. Following reformatting, data were imported to the statistical analysis program JMP® 11. Trend analyses only included data from the most consistently surveyed routes in each park (see Appendix A).

The basic question posed was whether there were linear relationships for bird abundances over time. Annual counts for each species were log-transformed ($\log [x+1]$) prior to normality and trend analyses (Nur et al. 1999, Southwood and Henderson 2000). The logarithmic transformation allows slope estimates from regressions to be interpreted as an instantaneous rate of change, or an average proportional change in the population over time. A Shapiro-Wilk goodness-of-fit was run for each species in all parks to test for normality of the data (see SAS 2013 for details). Analysis of Variance (ANOVA) and regression analyses were also calculated, with significance set at $\alpha = 0.05$. The log-transformed annual count for each species served as the dependent variable, and time (year) was the independent variable. Outliers, which can distort a trend, were determined from distribution box-plots and removed from regressions for species that met the normality test.

Density and detectability

Trend analyses often use empirical abundance data to model population change over time, but this method can lead to unreliable and biased predictions (Norvell et al. 2003, Buckland et al. 2004). Detection of a bird is related to the spatial coverage of the sampling unit, the bird's presence in the sampling unit, and the probability of detection, so that if availability of detection is not modelled a potentially poor result will be returned (Nichols et al. 2009). Detection varies by species, and for rare species with either cryptic behaviors or low abundances, detection may essentially be random (Buskirk and McDonald 1995). We used distance estimates to test differences between empirical regressions, as described above, and density-estimated regressions. Because time was not recorded uniformly in current datasets, we did not consider time-of-detection methods (Alldredge et al. 2007, Farnsworth et al. 2005).

The software package Distance 6.2 was used to estimate density and detectability of landbirds, along with guidelines from Thomas et al. (2010), Buckland et al. (2001, 2004) and Oedekoven et al. (2013). Assumptions of these analyses can be found in Buckland et al. (2001). Reformatted data were directly imported to the program without transformation. The non-random placement of survey routes in most parks (along trails or roads) may bias the ability to infer results to broader park landscapes. The influence of narrow roads and trails on the presence and relative abundance of birds should be limited, although edge species may be more common (Ralph et al. 1995). Data removed included flyover detections, unclear records, and individuals detected beyond 100 m. Estimating distances and detecting cryptic species and different individuals is difficult beyond 100 m in forested habitats (Bibby et al. 2000, Wolf et al. 1995), so although truncation reduces sample size it also improves estimates (Nichols et al. 2009). Records were binned in two categories of 0–50 m and 50–100 m. Only species with at least 75 observations across all years (number of years varies per park) were included in order to meet sample size requirements (Buckland et al. 2001).

The detection function and density in Distance 6.2 were modelled globally and incorporated into separate post-stratified estimates by year and habitat (Buckland et al. 2004). Global density was estimated as the mean of replicated stratum estimates, weighted by the total effort in the stratum.

Because data were binomial, only the half-normal key function model was available; goodness-of-fit tests were unavailable (Buckland et al. 2001). Three series expansions were used in the multiple-covariates distance sampling engine: cosine, simple polynomial, and hermite polynomial. The best-fitting model was inferred based on the lowest second-order Akaike's Information Criterion (AICc) result, provided the precision was reasonable (i.e., standard error not largely exceeding the estimate value) (Saracco et al. 2014). The AICc has a small-sample bias correction, yet will work well with large samples (Buckland et al. 2001). Empirical variance estimates were used in the model definition because errors terminated bootstrap analyses. Five covariates (temperature, wind, background noise, cloud cover, and observer) were included in models to determine their effect on detectability and improve model outputs, with iterative inclusion of covariates based on AICc (Oedekoven et al. 2013). Results with convergence failures were not considered. The density model results for each species were compared as a linear regression, when possible, to annual trends from the observational $\log(x+1)$ model.

Data available for analyses were different for each park. Density estimates for Grand Portage included 2004–2014 data, with 11 species having enough data to meet sample size requirements. For Voyageurs, nine species were analyzed from 2010–2013 data. No covariates were available for these two parks. At St. Croix, 25 species were available for analysis from 2009–2014 data. Covariates included temperature, sky conditions, wind, and background noise. Six species were analyzed from 2009–2013 data at Sleeping Bear Dunes, using all covariates except temperature. Habitat associations were not available for any park except Sleeping Bear Dunes. Due to a lack of data, distance analyses were not possible for Apostle Islands, Indiana Dunes, or Isle Royale.

Guilds

Investigators have used the concept of guilds or functional groups to simplify analysis of complex ecological communities (Holmes et al. 1979, Short 1983, Verner 1984). Initial guild analyses, using foraging and nesting strata to determine how habitat change was reflected in avian communities, were criticized as too simplistic or unrealistic because of differential species responses to environmental perturbation (Szaro 1986, Hawkins and MacMahon 1989). A key argument had been that natural history observations were unreliable for some species and local models were needed. Guilds may not be useful at small spatial scales (DeGraff and Chadwick 1984), yet at regional scales natural history classifications for guilds are often empirically supported (Mac Nally et al. 2008, Hart et al. 2012). Hart et al. (2012) found that models using land cover correlations performed better, although natural-history-based preferences, as employed in the current analyses, were often satisfactory. Generally, basic avian ecology and expert opinion can lead to a strong predictive guild model that avoids both overfitting and false relationships (Hawkins and MacMahon 1989, Mac Nally et al. 2008).

Placement in guilds was based on categories defined by DeGraff et al. (1985), Peterjohn and Sauer (1993), and Ehrlich et al. (1988):

- Migration (permanent resident, short-distance migrant, long-distance/Neotropical migrant);
- Habitat (grassland/open, wetland, successional/scrub, woodland, urban);
- Diet (frugivore, granivore, insectivore, omnivore); and

- Forage substrate (air, bark, ground, shrub/low canopy, high canopy).

Guild status for each species was confirmed or modified for the Great Lakes region using species profiles from the Birds of North America series (Cornell Lab of Ornithology 2015). Except for migration status, guilds were based on breeding season behaviors since these may dramatically change for some species due to food availability, changing competitive interactions, or different seasonal habitat occupancy (de Casenave et al. 2008). Four species were not included because of unique diet or feeding styles: Belted Kingfisher, Common Raven, Loggerhead Shrike, and Ruby-throated Hummingbird. Many species fit multiple categories within a guild, such as feeding both on the ground and in the low canopy, and thus acted as cross-references.

Park landscapes are often highly protected, with mostly natural or historic fragmentation, so the urban guild—comprised of generalist species that can succeed in both human and natural landscapes—may only apply to Indiana Dunes. Future analyses that include data from Mississippi National River and Recreation Area may lend themselves to a larger discussion about the urban guild.

Foraging technique was not included as a guild because definitions were difficult to determine clearly; for example, most passerines can be categorized as foragers or gleaners. DeGraff et al. (1985) defined a forager as a bird that consumes any food encountered on a substrate, while a gleaner chooses specific foods. Remsen and Robinson (1990) did not recognize a distinction in these behaviors. Since many insectivorous or granivorous birds are not known to choose particular categories of insects or seeds, a distinction in technique was not warranted. Diet and foraging substrate were more useful metrics that often reflected foraging techniques.

Guild trend calculations followed the same procedures as for individual species ($\log[x+1]$), using the sum of guild individuals detected annually. Only species with at least five years of data were included, indicating a regular breeding species in each park. Our generalized model was intended to assess whether ecologically similar species were responding to environmental conditions over time, or whether a more detailed model is required for GLKN guild analysis.

Results

Trend Analyses

Comprehensive summaries and figures for all statistical analyses in JMP, including distributions, goodness-of-fit tests, and regressions for all species from all parks have been provided to GLKN and are available upon request. Most non-normal distributions were due to limited annual presence of a species or skewed data from occasionally abundant or irruptive species. Regression results were generally not reported for these species since trends are probably not meaningful (Smith et al. 1995). However, most common or regularly occurring species showed normal distribution and stable trends when outliers were removed, although annual variability kept them from showing a significant trend. Species showing significant change ($P \leq 0.05$) are reported for each park in this section, as well as species showing trends worth consideration ($P \leq 0.10$). Trends were compared to state-listed birds (Wisconsin Natural Heritage Program 2014, Minnesota Department of Natural Resources 2013, Michigan Natural Features Inventory 2013, Indiana Division of Fish and Wildlife 2014) and broader analyses from across the United States (NABCI 2014). Results for all species, with standard errors for significant trends, are in Appendix B.

Apostle Islands National Lakeshore

One-hundred-six focal landbird species were analyzed at APIS to assess average proportional change per year. Seven species increased significantly and four species declined significantly (Table 2). An additional four species had potentially important trends. No conclusions could be made for 55 species, generally due to low abundance (Appendix Table B1).

Grand Portage National Monument

Eighty-six focal landbird species were analyzed from GRPO. Two species had significant increasing trends and seven species had significant declining trends (Table 3). Six additional species had potentially important trends. No conclusions could be made for 44 species, generally due to low abundance (Appendix Table B2).

Table 2. Regression trends (average proportional change per year) for species observed during 10-minute point counts at Apostle Islands National Lakeshore, 1995–2009. Only species with strong or significant trends are shown. **Species in bold** indicate $P \leq 0.05$. Data shown include r^2 , P , and total, mean, and log mean of individuals (with standard deviation) observed annually. Species listed as special concern (SC) in Wisconsin, and species common but in steep decline (SD) in the United States are noted.

Species	Trend	r^2	P	Total Individuals	Mean Individuals Annually	Log Mean Individuals (StDev)
Hermit Thrush	+ 0.04	0.42	0.0164	360	28	1.40 (0.25)
Blue Jay	+ 0.04	0.42	0.0167	509	39	1.54 (0.25)
Yellow-bellied Sapsucker*	+ 0.03	0.37	0.0348	152	12	0.96 (0.19)
Northern Parula	+ 0.02	0.43	0.0152	307	24	1.37 (0.16)
Ovenbird	+ 0.01	0.58	0.0026	1907	147	2.16 (0.08)
American Robin	+ 0.01	0.32	0.0432	338	26	1.42 (0.12)

Table 2 (continued). Regression trends (average proportional change per year) for species observed during 10-minute point counts at Apostle Islands National Lakeshore, 1995–2009. Only species with strong or significant trends are shown. Species in bold indicate $P \leq 0.05$. Data shown include r^2 , P , and total, mean, and log mean of individuals (with standard deviation) observed annually. Species listed as special concern (SC) in Wisconsin, and species common but in steep decline (SD) in the United States are noted.

Species	Trend	r^2	P	Total Individuals	Mean Individuals Annually	Log Mean Individuals (StDev)
Chipping Sparrow	+ 0.01	0.31	0.0491	287	22	1.35 (0.12)
Savannah Sparrow	+ 0.03	0.29	0.06	27	2.1	0.40 (0.29)
American Crow	+ 0.02	0.23	0.10	344	26	1.40 (0.20)
Swainson's Thrush* (SC)	+ 0.02	0.32	0.07	163	13	1.18 (0.14)
Chestnut-sided Warbler	- 0.02	0.28	0.06	199	15	1.18 (0.16)
Tree Swallow	- 0.04	0.32	0.0432	31	2.4	0.42 (0.32)
Common Grackle (SD)	- 0.04	0.37	0.0261	19	1.5	0.30 (0.29)
Brown Creeper	- 0.04	0.68	0.0005	67	5.2	0.73 (0.24)
Yellow-bellied Flycatcher (SC)	- 0.07	0.64	0.0011	49	3.8	0.52 (0.41)

* Outliers were removed from trend analyses for these species.

Table 3. Regression trends (average proportional change per year) for species observed during 10-minute point counts at Grand Portage National Monument, 2000–2014. Only species with strong or significant trends are shown. **Species in bold** indicate $P \leq 0.05$. Data shown include r^2 , P , and total, mean, and log mean of individuals (with standard deviation) observed annually. Species listed on the NABCI (2014) watch list (WL) in the United States are noted.

Species	Trend	r^2	P	Total Individuals	Mean Individuals Annually	Log Mean Individuals (StDev)
Yellow-rumped Warbler*	+ 0.03	0.28	0.0498	112	7.5	0.91 (0.22)
Nashville Warbler*	+ 0.01	0.38	0.0241	339	23	1.34 (0.12)
Alder Flycatcher	+ 0.01	0.21	0.08	108	7.2	0.90 (0.09)
Song Sparrow	+ 0.01	0.19	0.10	96	6.4	0.86 (0.08)
Veery	- 0.01	0.20	0.09	352	23	1.38 (0.10)
Mourning Warbler	- 0.02	0.20	0.09	237	16	1.19 (0.17)
Black-capped Chickadee	- 0.03	0.20	0.10	149	9.9	0.95 (0.30)
Blackburnian Warbler	- 0.03	0.25	0.06	221	15	1.14 (0.23)
Ovenbird	- 0.01	0.31	0.0326	920	61	1.79 (0.08)
Hermit Thrush	- 0.04	0.28	0.0406	65	4.3	0.58 (0.36)
Chestnut-sided Warbler	- 0.04	0.45	0.0065	182	12	1.06 (0.25)
Pileated Woodpecker	- 0.05	0.37	0.0170	97	6.5	0.70 (0.40)
Downy Woodpecker	- 0.05	0.38	0.0143	60	4	0.54 (0.39)
Least Flycatcher	- 0.05	0.44	0.0075	118	7.9	0.86 (0.31)
Evening Grosbeak¹ (WL)	- 0.07	0.40	0.0115	59	3.9	0.34 (0.49)

¹ EVGR does not fit normal distribution, but is included due to possible ecological importance of decline.

* Outliers were removed from trend analyses for these species.

Indiana Dunes National Lakeshore

Eighty-six landbird species were recorded at INDU. Six species had significantly increasing trends and three species had significantly declining trends (Table 4). Two additional species had potentially important declines. No conclusions could be made for 48 species, generally due to low abundance (Appendix Table B3).

Table 4. Regression trends (average proportional change per year) for species observed during 3-minute roadside point counts at Indiana Dunes National Lakeshore, 1993–2013. Only species with strong or significant trends shown. **Species in bold** indicate $P \leq 0.05$. Data shown include r^2 , P , and total, mean, and log mean of individuals (with standard deviation) observed annually. Species listed as endangered (EN) in Indiana and common but in steep decline (SD) in the United States are noted.

Species	Trend	r^2	P	Total Individuals	Mean Individuals Annually	Log Mean Individuals (StDev)
Red-bellied Woodpecker	+ 0.03	0.33	0.0101	108	5.7	0.73 (0.32)
Willow Flycatcher*	+ 0.02	0.36	0.0084	145	7.6	0.91 (0.21)
Marsh Wren (EN)	+ 0.02	0.23	0.0385	49	2.6	0.50 (0.24)
Warbling Vireo	+ 0.01	0.31	0.0137	65	3.4	0.62 (0.17)
Red-winged Blackbird	+ 0.01	0.21	0.0476	466	25	1.39 (0.13)
Chipping Sparrow*	+ 0.01	0.21	0.05	163	8.6	0.98 (0.13)
Ovenbird	- 0.02	0.20	0.06	58	3.1	0.54 (0.26)
Chimney Swift* (SD)	- 0.02	0.20	0.06	123	6.5	0.79 (0.29)
Veery	- 0.02	0.33	0.0107	74	3.9	0.65 (0.20)
Blue Jay*	- 0.02	0.52	0.0017	103	5.4	0.84 (0.13)
Cedar Waxwing	- 0.04	0.39	0.0043	249	13	0.92 (0.40)

* Outliers were removed from trend analyses for these species.

Isle Royale National Park

Eighty-eight focal species were analyzed for ISRO. Seven species increased significantly and five species declined significantly (Table 5). Five additional species had potentially important trends. No conclusions can be made for 43 species, generally due to low abundance (Appendix Table B4).

Table 5. Regression trends (average proportional change per year) for species observed during 5-minute point counts at Isle Royale National Park, 1996–2013. Only species with strong or significant trends shown. **Species in bold** indicate $P \leq 0.05$. Data shown include r^2 , P , and total, mean, and log mean of individuals (with standard deviation) observed annually. Species listed as common but in steep decline (SD) or a watch list (WL) in the United States are noted.

Species	Trend	r^2	P	Total Individuals	Mean Individuals Annually	Log Mean Individuals (StDev)
Alder Flycatcher	+ 0.03	0.55	0.0004	421	23	1.34 (0.21)
Red-winged Blackbird	+ 0.03	0.25	0.0365	47	2.6	0.44 (0.33)
American Robin	+ 0.02	0.54	0.0005	830	46	1.65 (0.15)
Common Yellowthroat	+ 0.02	0.40	0.0046	110	6.1	0.82 (0.17)
Red-breasted Nuthatch ¹	+ 0.02	0.38	0.0067	727	40	1.60 (0.13)
Swamp Sparrow *	+ 0.01	0.29	0.0303	172	9.6	1.05 (0.07)
Swainson's Thrush	+ 0.01	0.24	0.0399	265	15	1.18 (0.13)
Golden-crowned Kinglet*	+ 0.02	0.22	0.06	339	19	1.29 (0.18)
Nashville Warbler*	+ 0.01	0.21	0.07	2409	134	2.13 (0.10)
Brown Creeper*	- 0.01	0.19	0.09	365	20	1.35 (0.15)
Black-and-White Warbler*	- 0.01	0.20	0.07	204	11	1.09 (0.12)
Downy Woodpecker	- 0.02	0.17	0.09	183	10	0.98 (0.24)
American Crow	- 0.02	0.40	0.0047	477	27	1.41 (0.16)
Common Raven	- 0.03	0.61	0.0001	228	13	1.09 (0.21)
Chipping Sparrow	- 0.04	0.58	0.0002	196	11	1.00 (0.28)
Cape May Warbler (SD) ¹	- 0.06	0.54	0.0005	45	2.5	0.26 (0.45)
Evening Grosbeak (WL) ¹	- 0.06	0.58	0.0003	35	1.9	0.26 (0.40)

¹ Species do not fit normal distribution. RBNU included because of regularity of data and abundance across years; CMWA and EVGR included due to possible ecological importance of decline.

* Outliers were removed from trend analyses for these species.

St. Croix National Scenic Riverway

One-hundred focal landbird species were analyzed at SACN. Four species had significantly increasing trends and 22 species had significantly declining trends over the entire period of 1998–2014 (Table 6). Generally the positive trends were not matched across both sets of years/routes, while for declining species the trend direction was typically the same. Four species showed significant declines in both sets of years/routes: Black-capped Chickadee, Indigo Bunting, Mourning Warbler, and Black-and-white Warbler. No conclusions could be made for 25 species, generally due to low abundance (Table B5). When removing data from drifting surveys (pre-2005), the number of significant trends is reduced to four positive and six negative (Table 7).

Table 6. Regression trends (average proportional change per year) for species observed during 3-minute point counts at St. Croix National Scenic Riverway, 1998–2014. Arranged by strongest trend and P-value (**bold** indicates $P \leq 0.05$). Data shown include r^2 , P, and total and mean individuals observed annually. ▪ = Non-normal distribution. Species listed as special concern (SC) in Wisconsin are noted. *Note: results must be viewed with caution; see discussion for details.*

LOSA-LNAM routes						UNAM-SACN routes				
Increasing Trends, n = 4	Trend	r^2	P	Total Individuals	Mean Individuals Annually	Trend	r^2	P	Total Individuals	Mean Individuals Annually
Tree Swallow	- 0.01	0.12	0.40	455	57	+ 0.03	0.60	0.0397	222	32
Yellow-throated Vireo	- 0.00	0.00	0.93	118	15	+ 0.03	0.56	0.0523	76	11
Warbling Vireo	+ 0.02	0.73	0.0072	211	26	- 0.05	0.49	0.08	18	2.6
Rose-breasted Grosbeak	+ 0.02	0.65	0.0162	220	28	- 0.02	0.31	0.19	197	28
Declining Trends, n = 22										
Red-eyed Vireo	- 0.02	0.72	0.0078	1063	133	- 0.02	0.46	0.09	967	138
American Crow	- 0.02	0.73	0.0067	484	60.5	- 0.01	0.20	0.32	253	36
Downy Woodpecker	- 0.03	0.50	0.0501	70	8.8	- 0.02	0.23	0.28	20	2.9
Belted Kingfisher	- 0.03	0.60	0.0231	51	6.4	- 0.03	0.11	0.46	38	5.4
Least Flycatcher (SC)	- 0.03	0.84	0.0013	150	19	- 0.01	0.07	0.58	90	13
Eastern Wood Pewee	- 0.01	0.21	0.26	180	23	- 0.04	0.72	0.0163	127	18
Black-capped Chickadee	- 0.03	0.88	0.0006	154	19	- 0.04	0.78	0.0079	92	13
Eastern Phoebe	- 0.04	0.79	0.0032	141	18	- 0.03	0.38	0.14	39	5.6
Ovenbird	- 0.01	0.07	0.52	249	31	- 0.04	0.98	<0.0001	377	54
Golden-winged Warbler (SC)	+ 0.01	0.08	0.50	40	5	- 0.05	0.58	0.0481	73	10
Chipping Sparrow	- 0.05	0.57	0.0315	71	8.9	- 0.05	0.33	0.18	26	3.7
Cedar Waxwing	- 0.05	0.67	0.0126	217	27	- 0.06	0.43	0.11	363	52
White-breasted Nuthatch	- 0.05	0.92	0.0002	194	24	+ 0.00	0.00	0.95	60	8.6
Winter Wren	▪	▪	▪	4	0.5	- 0.06	0.59	0.0447	61	8.7
Northern Parula	▪	▪	▪	2	0.25	- 0.06	0.68	0.0232	36	5.1
Indigo Bunting	- 0.05	0.59	0.0259	52	6.5	- 0.06	0.77	0.0091	33	4.7
Nashville Warbler	+ 0.01	0.08	0.49	22	2.8	- 0.06	0.82	0.0051	99	14
Mourning Warbler	- 0.03	0.55	0.0353	28	3.5	- 0.07	0.65	0.0279	39	5.6
Blue-gray Gnatcatcher	- 0.07	0.68	0.0120	84	11	▪	▪	▪	12	1.7
Black-and-White Warbler	- 0.03	0.64	0.0176	130	16	- 0.07	0.78	0.0087	115	16
Eastern Kingbird	- 0.02	0.45	0.07	80	10	- 0.08	0.64	0.0313	43	6.1

Table 7. Regression trends (average proportional change per year) for species with significant increases or declines during 3-minute *stationary* point counts at St. Croix National Scenic Riverway, 2005–2014. Only species with significant trends are shown ($P \leq 0.05$). Data shown include r^2 , P , and log mean of individuals (with standard deviation) observed annually. Watch list (WL) or state special concern species (SC) are noted.

Species	Trend	r^2	P	Log Mean Indivs. (StDev)	Routes
Common Grackle (WL)	+ 0.13	0.86	0.0228	0.72 (0.45)	UNAM-SACN
Yellow Warbler	+ 0.05	0.81	0.0388	1.59 (0.19)	UNAM-SACN
Gray Catbird	+ 0.04	0.98	0.0012	1.31 (0.14)	UNAM-SACN
Yellow-throated Vireo	+ 0.04	0.79	0.0452	1.08 (0.14)	UNAM-SACN
White-breasted Nuthatch	- 0.04	0.98	0.0116	1.14 (0.15)	LOSA-LNAM
Ovenbird	- 0.04	0.96	0.0033	1.62 (0.14)	UNAM-SACN
Swamp Sparrow	- 0.04	0.89	0.0159	1.17 (0.14)	UNAM-SACN
Golden-winged Warbler (SC, WL)	- 0.05	0.96	0.0215	0.82 (0.17)	LOSA-LNAM
Black-capped Chickadee	- 0.06	0.97	0.0024	1.07 (0.20)	UNAM-SACN
Indigo Bunting	- 0.08	0.85	0.0264	0.61 (0.29)	UNAM-SACN

Sleeping Bear Dunes National Lakeshore

Ninety-one focal landbird species were analyzed for trends at SLBE. Five species had significantly increasing trends and no species showed significant declines (Table 8). Three other species may be showing important trends. No conclusions could be made for 30 species, generally due to low abundance (Table B6).

Table 8. Regression trends (average proportional change per year) for species observed during 10-minute point counts at Sleeping Bear Dunes National Lakeshore, 2004–2006 and 2009–2013. Only species with strong or significant trends shown. **Species in bold** indicate $P \leq 0.05$. Data shown include r^2 , P , and total, mean, and log mean of individuals (with standard deviation) observed annually. Species on a watch list (WL) or listed as common but in steep decline (SD) in the United States are noted.

Species	Trend	r^2	P	Total Individuals	Mean Individuals Annually	Log Mean Individuals (StDev)
Veery (SD)	+ 0.07	0.63	0.0185	19	2.38	0.45 (0.30)
Eastern Meadowlark (SD)	+ 0.05	0.75	0.0055	95	11.88	1.08 (0.18)
Wood Thrush* (WL)	+ 0.03	0.77	0.0099	65	8.13	0.93 (0.17)
American Robin*	+ 0.03	0.59	0.0450	297	37.13	1.51 (0.06)
Red-eyed Vireo	+ 0.02	0.52	0.0436	350	43.75	1.64 (0.08)
Field Sparrow	+ 0.05	0.44	0.07	26	3.25	0.57 (0.24)
Bobolink (WL)	- 0.02	0.42	0.08	64	8	0.94 (0.12)
Gray Catbird	- 0.03	0.44	0.07	40	5	0.76 (0.14)

* Outliers were removed from trend analyses for these species.

Voyageurs National Park

Of 78 landbird species from four routes at VOYA, nine showed significant changes. One species significantly increased and eight significantly declined (Table 9). Five additional species had

potentially important trends. No conclusions could be made for 40 species, generally due to low abundance (Table B7).

Table 9. Regression trends (average proportional change per year) for species observed during 10-minute point counts at Voyageurs National Park, 1997–2013. Only species with strong or significant trends shown. **Species in bold** indicate $P \leq 0.05$. Data shown include r^2 , P , and total, mean, and log mean of individuals (with standard deviation) observed annually. Species on a watch list (WL) in the United States are noted.

Species	Trend	r^2	P	Total Individuals	Mean Individuals Annually	Log Mean Individuals (StDev)
Blue-headed Vireo	+ 0.02	0.25	0.0398	29	1.7	0.39 (0.20)
Yellow-rumped Warbler	+ 0.02	0.18	0.09	102	6	0.76 (0.28)
Canada Warbler ¹ (WL)	+ 0.02	0.18	0.09	90	5.3	0.76 (0.18)
Black-and-White Warbler	+ 0.01	0.20	0.07	320	19	1.29 (0.07)
Red-breasted Nuthatch *	+ 0.01	0.19	0.09	242	14	1.19 (0.14)
Blackburnian Warbler	- 0.01	0.22	0.06	352	21	1.32 (0.13)
Nashville Warbler	- 0.01	0.25	0.0402	951	56	1.74 (0.13)
Ovenbird *	- 0.01	0.55	0.0009	1424	84	1.94 (0.06)
American Crow *	- 0.02	0.34	0.0173	488	29	1.45 (0.16)
Mourning Warbler *	- 0.02	0.56	0.0008	249	15	1.20 (0.15)
Chestnut-sided Warbler *	- 0.02	0.60	0.0004	342	20	1.32 (0.12)
Rose-breasted Grosbeak	- 0.03	0.27	0.0320	63	3.7	0.56 (0.32)
Great Crested Flycatcher	- 0.03	0.64	0.0001	93	5.5	0.78 (0.18)
Evening Grosbeak ¹ (WL)	- 0.06	0.44	0.0036	45	2.6	0.26 (0.43)

¹CAWA does not fit normal distribution; included because of regularity of data and abundance across years. EVGR included due to possible ecological importance of decline.

* Outliers were removed from trend analyses for these species.

Density and Detectability

The density and logarithmic models returned very similar trends for most species in terms of direction and magnitude. A number of intuitive results gave confidence in distance analyses, such as quiet or thin-voiced species having a limited detection radius or loud species in open habitats having a high detection probability. When covariates were available, at least one covariate improved the model for all species. Sample sizes, based more on number of points surveyed annually than the number of years surveyed, were important in determining the number of species that could be analyzed and the strength of detectability estimates. Although three series expansions were used, there were no differences in AICc showing improvement on the half-normal model for most results. Figures in Appendix C show trend lines appearing similar, though the scale of the two y-axes, and therefore the slope, for models was different.

Observer data were not always available, and in many parks a single observer completes all points in a given year, making differences difficult to evaluate. Without exact distance measurements, observer differences could not be quantified, such as determining how observer experience or differences in hearing ability leads to a variable area effectively surveyed (Johnson 1995). A

comparison of four parks (GRPO, SACN, SLBE, VOYA) revealed strong differences in the number of birds recorded for each of three distance categories (0–50 m, 50–100 m, and >100 m) (Figure 9). Grand Portage and St. Croix had nearly opposite proportional categorization, while Sleeping Bear Dunes and Voyageurs had similar results.

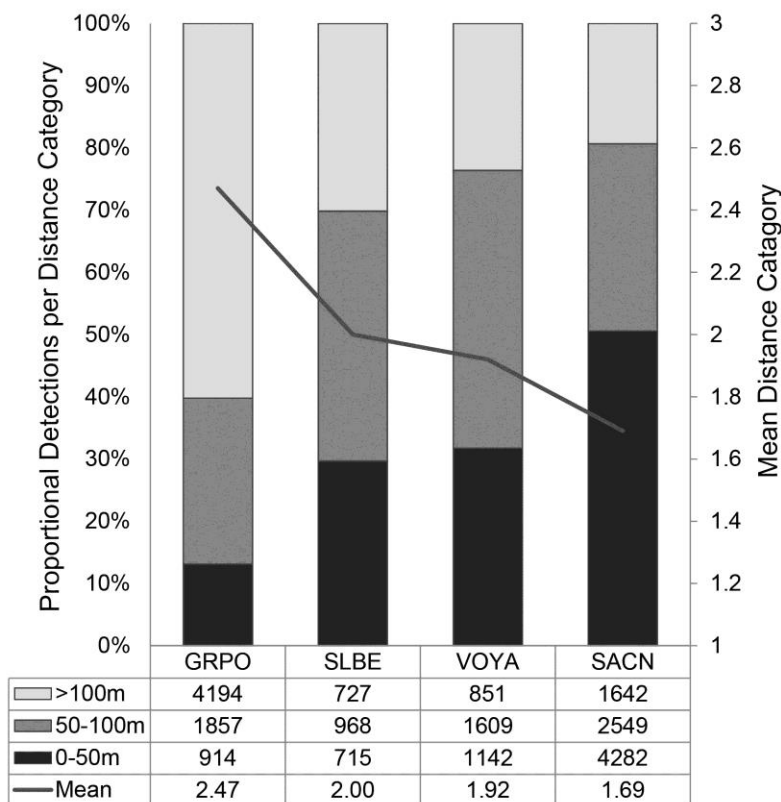


Figure 9. Proportional and mean categorization of distances to birds recorded at Grand Portage (GRPO), Sleeping Bear Dunes (SLBE), Voyageurs (VOYA), and St. Croix Riverway (SACN). Mean distance categories: 0–50 m (1), 50–100 m (2), and >100 m (3).

Distance estimates had some important limitations (binomial data with only two distance categories, small sample sizes, and no covariates available for some parks) and bias (non-random route placement). When models returned highly variable results it was generally due to limited data from small sample sizes. Technically, inferences of density apply only to the survey routes, not to broader park landscapes.

Grand Portage National Monument

Detection radii were generally very high compared to other parks, and no species could be considered abundant (Table C1, Figure C1). Three species (Blackburnian Warbler, Canada Warbler, Ovenbird) had notably different p-values, but none of these had a significant trend (Table C2). Only White-throated Sparrow had an important difference between models, with the density model showing a significant decline and the logarithmic model showing a non-significant decline (at $\alpha =$

0.05). This decline was driven by two years of relatively high density in 2004 and 2005, after which the trend was flat. Covariates were not available for Grand Portage. Detection radii of 100 m, with a 100% probability of detection, are not realistic and reflect a poor model fit for those species.

St. Croix National Scenic Riverway

All covariates were influential at St. Croix, with wind, background noise, and sky conditions each included in models for certain species (Table C3). Temperature improved detectability estimates for all species. Density trend analyses were not performed because temperature was not recorded in 2010, so only five years of data were available, and because routes were completed in opposite years and could not be combined into a single trend. Detection radii were generally near 50 m, with a range of 34 m for American Redstart to 73 m for Ovenbird, and probabilities of detecting species were low, with a range of 12% and 53% for these species, respectively (Table C3).

Sleeping Bear Dunes National Lakeshore

The most comprehensive analyses were done for Sleeping Bear Dunes, with data stratified by year and habitat. Observer was the most influential covariate, and noise was the only other one that improved models (Table C4). Mean detection radii were all above 50 m (range = 55–75 m), and detection probabilities ranged from 31%–56%. Density per hectare varied widely across years, habitats, and species, with a spike in both density and individuals for three species in 2013. Increased detectability in 2013 may have been due to reduced noise and cloud cover, although wind speed averaged higher (Figure C2).

While four of the six species analyzed had no statistically different trend result, the p-values were often very different (Table C5). Trends for Red-eyed Vireo were similar, but the decline was significant using density estimates. The only instance in any park of a species exhibiting opposing trends occurred for the Red-winged Blackbird at SLBE. Observational results showed an increasing trend, while density results showed a decline (Figure C3); neither trend was significant. Habitat associations for each species generally followed expected patterns, with density models giving greater clarity to association differences (Figure C4).

Voyageurs National Park

Detection radii for Voyageurs were generally high, ranging from 46 m for Chipping Sparrow to 91 m for both Ovenbird and Red-eyed Vireo (100 m radius for Veery should not be considered accurate), with detection probabilities matching the radii (Table C6). The two models returned very similar results for VOYA, with little divergence and no significant trends (Table C7, Figure C5).

Guilds

In most categories, little or no pattern was apparent from guild trends across all parks. The trends for each park were predominantly positive or negative, except for split patterns at Apostle Islands and Indiana Dunes. The wetland and bark foraging guilds both had generally positive trends, including two significant trends each. The short-distance migrant guild was also largely positive across all parks. Five guilds were composed of mostly declining trends: successional/scrub habitat, frugivores, and foragers in aerial, lower canopy/shrub, and upper canopy strata. The frugivore guild in particular showed significant declines across the region.

There was likely a strong correlation between dominant guilds, with the woodland-insectivore-Neotropical migrant guilds having many species in common. Separating guilds into subcategories, such as assessing woodland species by migration strategy, did not give useful results and are not reported. Results by table are divided into sub-regional strata within the Network: Wisconsin (Table 10), upper Michigan and Minnesota (Table 11), and lower Michigan and Indiana (Table 12).

Table 10. Trends for combined species within guilds at Apostle Islands National Lakeshore (n = 68) and St. Croix National Scenic Riverway (n = 74), including number of species (n), proportion of species within the guild, p-value, and trend. **Trends in bold** indicate $P \leq 0.05$.

Guild	Apostle Islands				St. Croix*			
	n	%	P	Trend	n	%	P	Trend
Breeding Habitat								
Grassland/Open	7	10 %	0.51	+ 0.003	4	5 %	0.0084	- 0.012
Wetland	8	12 %	0.0439	- 0.016	6	8 %	0.68	+ 0.002
Successional	16	24 %	0.12	- 0.007	23	31 %	0.0019	- 0.013
Urban	10	15 %	0.0023	+ 0.015	18	24 %	0.0266	- 0.018
Woodland	53	78 %	0.08	+ 0.003	55	74 %	0.0002	- 0.015
Diet								
Frugivore	4	6 %	0.14	- 0.018	6	8 %	0.0253	- 0.014
Granivore	6	9 %	0.45	+ 0.005	5	7 %	0.15	- 0.009
Omnivore	7	10 %	0.0003	+ 0.026	13	18 %	0.06	- 0.010
Insectivore	59	87 %	0.52	+ 0.001	59	80 %	<0.0001	- 0.019
Forage Substrate								
Air	12	18 %	0.0194	- 0.014	14	19 %	0.0013	- 0.039
Bark	10	15 %	0.048	+ 0.008	11	15 %	0.0011	- 0.025
Ground	23	34 %	<0.0001	+ 0.010	29	39 %	0.0081	- 0.009
Shrub/low canopy	29	43 %	0.92	- 0.00	30	41 %	0.0018	- 0.011
Upper canopy	13	19 %	0.27	+ 0.004	12	16 %	0.0035	- 0.015
Migration Strategy								
Resident	15	22 %	0.0275	+ 0.011	17	23 %	0.0019	- 0.018
Short-distance	20	29 %	0.23	+ 0.003	20	27 %	0.15	- 0.004
Long-distance	33	49 %	0.33	+ 0.002	38	51 %	<0.0001	- 0.022

* See discussion section for cautions regarding SACN data.

Apostle Islands National Lakeshore

Mixed guild trends occurred at Apostle Islands (Table 10). Aerial wetland foragers, particularly the Tree Swallow, had a strong influence on the declining trends. Red-winged Blackbird, Common Grackle, and Yellow-bellied Flycatcher were also important driving forces. Generalists were on the rise, particularly those that do well in urban situations. Residents and bark foragers both increased, though these categories were probably correlated due to nuthatches and woodpeckers. Ovenbirds were very common and had a significant trend, which strongly influenced all guilds it was in.

Grand Portage National Monument

Although most trends were negative, only the frugivore guild had a significant decline (Table 11). Downy Woodpecker, with a 5% annual decline, was probably the driver in the frugivore category,

with few observed annually in the past decade. The Downy Woodpecker frugivore designation would be limited to abundance of local fruits in the breeding season (Jackson and Oullet 2002), and is probably an imperfect classification. Declines of Veery, a common species in the park with a non-significant but low p-value, suggest frugivore declines could be a broader trend.

Indiana Dunes National Lakeshore

At Indiana Dunes, three guilds had significant negative trends and two had significant positive trends (Table 12). Wetland species increased overall, and the bark forager guild was driven by strong increases in the Red-bellied Woodpecker. Declines of frugivores were driven by Cedar Waxwing and Veery. Upper canopy foragers and resident species were generally declining, yet at least one species in each guild had a contradictory significant increasing trend. Blue Jay and Cedar Waxwing were important common influences across all three declining guilds.

Isle Royale National Park

Most trends were positive but not significant (Table 11). The wetland guild trend was significant, with three of the five species increasing (Alder Flycatcher, Red-winged Blackbird, Swamp Sparrow) and the other two with no distinct trend.

St. Croix National Scenic Riverway

Results from St. Croix showed unprecedented significant declines across many species and nearly all guilds (see Table 10). Only the wetland guild had a slight positive trend, although it was statistically irrelevant. However, these results are accompanied by a number of caveats—see Discussion for details.

Sleeping Bear Dunes National Lakeshore

Nearly all trends were positive yet none were significant (Table 12). Bark foragers and short-distance migrants had p-values suggesting ecologically important changes.

Voyageurs National Park

Seven guilds at Voyageurs had significant declining trends (Table 11). Two of these—grassland/open and successional—can be explained by the strong declines of a small number of species (American Crow for grassland/open and Mourning and Chestnut-sided Warblers for successional). The general declines for woodland, omnivore, insectivore, ground forager, and shrub/low canopy forager suggest broad changes have been occurring in the past 15–20 years.

Table 11. Trends for combined species within guilds at Isle Royale National Park (n = 61), Voyageurs National Park (n = 54), and Grand Portage National Monument (n = 52), including number of species (n), proportion of species within the guild, p-value and trend. **Trends in bold** indicate $P \leq 0.05$.

Guild	Isle Royale				Voyageurs				Grand Portage			
	n	%	P	Trend	n	%	P	Trend	n	%	P	Trend
Breeding Habitat												
Grassland/Open	3	5 %	0.11	- 0.010	4	7 %	0.0558	- 0.015	2	4 %	0.80	+ 0.003
Wetland	5	8 %	0.041	+ 0.014	4	7 %	0.91	+ 0.002	5	10 %	0.20	+ 0.008
Successional	11	18 %	0.39	+ 0.003	12	22 %	0.0117	- 0.010	10	19 %	0.42	- 0.004
Urban	8	13 %	0.44	+ 0.004	9	17 %	0.10	- 0.007	6	12 %	0.85	- 0.002
Woodland	53	87 %	0.48	+ 0.001	48	89 %	0.0243	- 0.008	45	87 %	0.54	- 0.002
Diet												
Frugivore	5	8 %	0.17	+ 0.005	5	9 %	0.27	- 0.008	5	10 %	0.0118	- 0.018
Granivore	5	8 %	0.12	- 0.013	5	9 %	0.19	+ 0.011	3	6 %	0.28	- 0.015
Omnivore	9	15 %	0.20	+ 0.006	8	15 %	0.0028	- 0.015	8	15 %	0.83	- 0.002
Insectivore	50	82 %	0.55	+ 0.001	44	81 %	0.0317	- 0.008	42	81 %	0.16	- 0.005
Forage Substrate												
Air	9	15 %	0.46	+ 0.003	8	15 %	0.62	- 0.004	7	13 %	0.95	-0.001
Bark	9	15 %	0.66	+ 0.002	9	17 %	0.63	+ 0.002	8	15 %	0.10	-0.012
Ground	22	36 %	0.68	+ 0.001	22	41 %	0.0087	- 0.010	21	40 %	0.44	-0.003
Shrub/low canopy	30	49 %	0.38	+ 0.002	26	48 %	0.0254	- 0.009	26	50 %	0.80	-0.001
Upper canopy	12	20 %	0.41	- 0.002	11	20 %	0.54	- 0.003	10	19 %	0.15	-0.007
Migration Strategy												
Resident	17	28 %	0.09	+ 0.007	15	28 %	0.46	- 0.003	15	29 %	0.49	- 0.007
Short-distance	14	23 %	0.20	+ 0.005	18	33 %	0.48	- 0.003	15	29 %	0.21	+ 0.007
Long-distance	30	49 %	0.92	+ 0.000	23	43 %	0.94	- 0.000	22	42 %	0.15	- 0.005

Table 12. Trends for combined species within guilds at Sleeping Bear Dunes National Lakeshore (n = 66) and Indiana Dunes National Lakeshore (n = 62), including number of species (n), proportion of species within the guild, p-value and trend. **Trends in bold** indicate $P \leq 0.05$.

Guild	Sleeping Bear Dunes				Indiana Dunes			
	<i>n</i>	%	<i>P</i>	<i>Trend</i>	<i>n</i>	%	<i>P</i>	<i>Trend</i>
Breeding Habitat								
Grassland/Open	11	17 %	0.19	+ 0.010	6	10 %	0.57	+ 0.002
Wetland	5	8 %	0.23	+ 0.015	8	13 %	0.0008	+ 0.014
Successional	21	32 %	0.22	+ 0.010	21	34 %	0.10	- 0.004
Urban	16	24 %	0.15	+ 0.014	19	31 %	0.29	- 0.003
Woodland	43	65 %	0.58	+ 0.004	39	63 %	0.31	- 0.003
Diet								
Frugivore	6	9 %	0.17	+ 0.020	6	10 %	0.0339	- 0.010
Granivore	8	12 %	0.98	+ 0.000	9	15 %	0.09	+ 0.004
Omnivore	12	18 %	0.71	+ 0.003	11	18 %	0.18	- 0.005
Insectivore	51	77 %	0.29	+ 0.006	47	76 %	0.77	+ 0.001
Forage Substrate								
Air	11	17 %	0.37	+ 0.020	14	23 %	0.14	- 0.008
Bark	9	14 %	0.07	+ 0.035	5	8 %	0.0110	+ 0.018
Ground	32	48 %	0.30	+ 0.007	30	48 %	0.60	- 0.002
Shrub/low canopy	24	36 %	0.37	+ 0.010	23	37 %	0.06	- 0.005
Upper canopy	9	14 %	0.14	+ 0.022	10	16 %	0.0124	- 0.006
Migration Strategy								
Resident	17	26 %	0.13	+ 0.017	17	27 %	0.0412	- 0.007
Short-distance	21	32 %	0.09	+ 0.017	18	29 %	0.08	+ 0.005
Long-distance	28	42 %	0.79	- 0.002	28	45 %	0.76	+ 0.001

Discussion

Each park in the Great Lakes Network contains unique ecological landscapes, which is reflected in the variability of avian communities and species' trends within the region. Few species are shared across all parks, and there is general inconsistency in trend patterns (Appendix D). Populations in one park can be significantly increasing while showing declines elsewhere (e.g., Ovenbird, Nashville Warbler, and Chipping Sparrow). As a result, most species or guilds should be considered on a park-by-park basis, with comparisons made between parks having similar habitats (e.g., Voyageurs–Grand Portage–Isle Royale) or with broader studies such as the North American Breeding Bird Survey. Although most park landscapes are managed for high ecological integrity that contrast with surrounding human-modified settings, survey results often reflect general regional trends for some species.

The majority of trends, both in terms of direction and magnitude, were very similar when comparing log-transformed observational estimates and density estimates. Only a few species demonstrated contradictory results between the models or did not share statistical significance for a trend. This is encouraging because parks often have staffing constraints or limited technical expertise, so monitoring changes with observational results is supported as a reasonable way to estimate short-term population fluctuations. Observational data collected prior to distance measurements may be accurate enough for cautious predictions regarding long-term trends, though it cannot be known if any particular trend is spurious (see Red-eyed Vireo at SLBE in the Park-specific Conclusions section below) or genuine (Thomas 1996). Overall, even though density modelling is more expensive and challenging (Diefenbach et al. 2007), field methods should continue to incorporate distances for a better approximation of long-term species trends.

Annual variation for a given species may be due to true population cycles, but detectability on the day of sampling also depends on both presence of a bird and the probability that it makes itself available for detection (Nichols et al. 2009). An important challenge in density analyses is the large sample size requirement. Yet for common species that show large fluctuations in annual survey numbers, determining precise trends can be difficult. Another important factor is coverage, where surveys with many survey points are more likely to detect trends of uncommon species, even when employing shorter counts (Lynch 1995).

Observational Regression Trends

Species like the American Robin and Red-winged Blackbird have been increasing strongly in most parks in the region. This follows a continent-wide pattern for robins, but Red-winged Blackbirds have been declining in many regions and states in recent decades (Sauer et al. 2014). Other species increasing across Network parks include Northern Flicker, Alder Flycatcher, Red-breasted Nuthatch, Common Yellowthroat, and Yellow-rumped Warbler.

Few species had a general trend of significant declines, although American Crow and Chestnut-sided Warbler fit this pattern. Evening Grosbeak has sharply declining trends in northern parks, with a peak occurring in the late 1990s. Many surveys began during this peak, so the downward trend for this uncommon species is probably due to a high starting point coupled with low sample sizes. Evening

Grosbeak trends are often associated with spruce budworm outbreaks, but this pattern may be a local phenomenon (Gillihan and Byers 2001). In addition, historic records (>100 years ago) of Evening Grosbeaks east of the Mississippi River were rare, so the western Great Lakes region may not offer high-quality year-round habitat. Because of these factors, the declines for this species probably do not reflect habitat conditions in the parks.

Many species that had both flat regression lines and a relatively high abundance can be interpreted as having a stable population within a park. Other species have such a high variability that a regression line does not fit the points well, as indicated in Appendix B by low r^2 and high P. Species not fitting normal distribution are typically too scarce, due to natural rarity or cryptic habits, for adequate trend interpretation (Lynch 1995). Unless a park provides critical habitat for rare species, limited effort should be expended implementing management actions for them.

Density and Detectability

Detection probabilities generally showed that half or fewer of the birds present during point counts were detected. This is a common result in forest and riparian point counts and can strongly impact population estimates (e.g., Somershoe et al. 2006, Norvell et al. 2003). Detectability of 100% is never realistic, even in open habitats, since breeding songbirds are often vocally or visually unavailable (Diefenbach et al. 2007, Buckland et al. 2001). In addition, detection probabilities are likely to change with observer, weather, or habitat differences (Barker and Sauer 1995).

Detection radii by species often changed dramatically in different parks. American Redstarts had a 34 m detection radius at SACN, 67 m at SLBE and 76 m at GRPO. Red-eyed Vireos had a 48 m radius at SACN, 75 m at SLBE and 91 m at VOYA. The reasons for the strong differences in number of birds detected in distance categories between GRPO and SACN could be related to (1) each park having common species with different detectability, (2) broad structural variation such as open forests versus shrubby riparian habitat, (3) attraction of insectivores to riparian areas with high food availability, (4) bird movements in response to observer presence, or (5) differential observer distance estimation, which cannot be tested with available data. Theoretically, the 50–100 m range should have greater numbers detected due to a four-fold increase in the area surveyed than the area in the inner ring, while beyond 100 m detectability should fall quickly for most species. As annual results are accrued in the future, distance analyses will become more widely available and robust for avian communities by using inclusive global estimates stratified by year or habitat. For across-park comparisons we limited analyses to the first 3-minutes of surveys, but parks with longer survey times could use Distance software to analyze additional species and improve their density estimates.

Covariate factors are usually not under an observer's control, yet they commonly influence detectability (Conn et al. 2004). Differences in observer, temperature, wind, noise, and sky cover improved models for all species. In cases where a single observer collected all data from a park in a given year, there may be a false correlation influencing the covariates since annual abundances or weather variations are linked to that observer. The importance of the temperature covariate was likely due to patterns of increasing daytime temperature while species generally decrease singing as the morning progresses.

Habitat-based comparisons of observations and density estimates show that stratification of points based on park habitats can be a good indicator of, and management tool for, proportional use by and density of birds. While SLBE designed a survey based on habitat, no other parks have a similar strategy (although APIS has since implemented a form of this, with a focus on wetlands). Ideally, each point should be located within a single habitat, so that association to species is straightforward (Howe et al. 1995).

As a comparative dataset, we began *post hoc* stratification of ISRO habitats to see if similar results were possible with a survey not originally designed to take habitat into account. We found that a majority of points broadly included two or more habitat types. Based on well-studied habitat associations for most species, this may be useful for managing or understanding local avian communities without having to redesign survey routes. Unfortunately, ISRO distance data did not allow for detectability to be estimated. For an example of how habitat data can enhance analyses, see the Sleeping Bear Dunes section below.

With heavily forested habitats across most GLKN parks, there is little latitude for improving on the current sampling protocol regarding distance data, such as increasing the number of distance bins or estimating exact distances to each bird. Although Norvell et al. (2003) implemented a highly controlled study with intensive training and professional ornithologists, they continued to find that observer bias influenced detectability. For survey observers to ensure high-quality results, accurate estimates for each distance category is crucial for minimizing error. Annual field practice should occur prior to counts, with range finders used during counts (Nichols et al. 2009).

Guilds

Contradictory problems arise with our current guild strata. A large majority of species are in both the woodland and insectivore guilds, tying together habitat and diet categories. Forage substrate and migration strategy guilds were more balanced. Some investigators caution against making too many small guilds (Verner 1984, Mac Nally et al. 2008), which is reasonable because one or two dominant species can drive the results. While large guilds increase sample sizes, they present problems for interpreting results in meaningful ways. Few guilds across parks had similar trends, supporting the idea that local results may not scale well to regional context (Hart et al. 2012). The only relatively clear commonalities were a decline in frugivores across many parks and increasing trends in wetland occupants and bark foragers. The decline of frugivores across Network parks prompts the question: Are berry-producing plants in decline generally? This supposition is strengthened by declines in omnivores with a large fruit component in their summer diet.

In recent decades there has been concern regarding the decline of Neotropical migrant populations, yet GLKN data show no clear trends related to migration strategies. Results for each park should be used by managers who are familiar with vegetation and disturbance history within the parks to investigate possible relationships between avian communities and landscape changes. Because of the relatively unimpacted or rehabilitated aspect of NPS lands, bird responses to habitat change in the parks may not be the same as responses outside the parks where fragmentation or human impacts have a greater role.

Guilds are often used to predict avian responses to habitat change by using a qualitative biotic index model (Croonquist and Brooks 1991, O’Connell et al. 2000, Marshall et al. 2013) or multivariate models (Mac Nally et al. 2008, Korňan et al. 2013). In both cases, models are frequently designed for specific regional conditions because generalist species with adaptable behaviors can fit into different guilds. These techniques may be useful in creating Network-specific guilds and increasing the utility of guild-based analyses. However, the objectives for future guild analyses must first be defined since none of the individual parks have guild-oriented goals.

Park-specific Conclusions

Apostle Islands National Lakeshore

The seven significantly increasing species at APIS have no continent-wide cause for concern, and the State of Wisconsin does not list them among their species of conservation concern (Rosenberg et al. 2014, Wisconsin Natural Heritage Program 2014). Even so, the Common Grackle, which is declining at APIS, is one of the most common species that are exhibiting declining trends in North America. The Yellow-bellied Flycatcher is showing the strongest decline at APIS, which reflects statewide patterns. A few state-listed species of concern are increasing (Swainson’s Thrush, Cape May Warbler, Canada Warbler), which may be due to protected habitats in the park. Conversely, a few other species of concern (Least Flycatcher, Black-throated Blue Warbler, Veery) have shallow declining trends, which may indicate that even protected areas cannot sustain source populations for some species that are broadly in decline.

Two of the primary objectives of APIS bird surveys—monitoring long-term trends and having data available for comparison to other studies—have been successfully accomplished. The park recently reassessed its monitoring objectives based on interest in determining how climate change influences avian communities (Jukkala and Burkman, in press). Recent modifications to the survey will require keeping prior and future statistical analyses separate. Results reported here are probably safe to apply across park landscapes because survey routes provide broad coverage of park habitats. Based on detailed vegetation surveys in 2011, three of the primary habitats are late successional and the other two are developing toward mid-successional conditions (Sanders and Grochowski 2012), which may explain the positive trends in Ovenbird and resident bark foragers.

Grand Portage National Monument

Among the strong or significant trends at GRPO, only the Evening Grosbeak is of broader concern due to its inclusion on the NABCI watch list (NABCI 2014). However, three trends worth watching are those for the resident Downy, Hairy, and Pileated woodpeckers, all of which are in significant decline (Hairy Woodpecker data do not meet normality so the trend is not shown). Two other woodpeckers—the Northern Flicker and Yellow-bellied Sapsucker, both migratory—appear stable or slightly increasing. However, the number of birds reported as “unknown” on surveys increased strongly over the same time period. If data from other park surveys holds true for GRPO, many of these unknowns are woodpeckers, which are notoriously difficult to identify based on drumming sounds alone. The Yellow-bellied Sapsucker has a distinctive drumming pattern, while Northern Flickers often give additional vocalizations that aid identifications, so declines in GRPO resident woodpeckers must be considered with caution. The narrow aspect of the park should allow general

inference of data across the entire park, and there were no indications of large-scale habitat influences on guild trends.

Indiana Dunes National Lakeshore

INDU has an avian community that is distinct from other Network parks, and with approximately 20 years of data, this is one of the longest running surveys in the Network. These data are fulfilling the park's monitoring goals by adding important information to the NABBS and determining trends for common breeding species. However, without data on habitats, minute of detection, distance to birds, or weather conditions, only limited analyses are possible. Survey points located in specific habitats, as suggested by Lind et al. (2005), would be useful for monitoring species that may be absent from roadsides, but this should not be done at the expense of continuing data collection on the original route.

Comparing trends from INDU to region-wide data (2002–2012) (Sauer et al. 2014), some species show similar patterns between the local scale and regional scales while others are contradictory. Of the significantly increasing species, Red-bellied Woodpecker and Chipping Sparrow have been increasing across most regions and states in the southern Great Lakes area. Willow Flycatcher and Warbling Vireo show some increasing and some declining trends across the region, while Marsh Wren and Red-winged Blackbird are uniformly declining. Marsh Wren stands out as a bird that seems to be doing well at INDU but is in trouble across its range.

Of the three INDU species with significant declining trends (Blue Jay, Veery, and Cedar Waxwing), the Blue Jay and Veery are similarly declining across most states and regions, although data for the Veery often have low confidence; the Cedar Waxwing is generally increasing across most states and regions. Declines of Cedar Waxwing and Blue Jay at INDU are interesting given the relative habitat flexibility of both species. Ovenbird and Chimney Swift are also showing declining trends at INDU, which may indicate problems in these populations. The Ovenbird is increasing in the northern parts of its western Great Lakes range, but is declining in the southern part of this range. However, the latter data have low confidence (Sauer et al. 2014). The Chimney Swift is uniformly declining across the western Great Lakes. Snags and small trees appear to be increasing at INDU (Sanders and Grochowski 2013), which may be important in the rise of Red-bellied Woodpeckers and the decline of upper canopy foragers.

Isle Royale National Park

Only the Swainson's Thrush was new to the list of significantly increasing species since the previous analysis (Egan and Gostomski 2013). There were no new additions to the declining list. The trends for several common species changed to non-significant values with only one additional year of data, revealing that caution and broader perspective are required when interpreting results for some species. Most strong or significant trends are in agreement with regional patterns, although Red-winged Blackbird and Golden-crowned Kinglet are doing better than most other populations in the western Great Lakes. Common Raven continues to be atypical when compared to regional trends, with significant declines in ISRO habitats where it should prosper. In general, conclusions from the prior analysis remain unchanged. Although habitat is not considered, routes cover broad areas of the

park and inference to broader populations is probably safe, if tentative. There were no indications of large-scale habitat influences to guild trends at ISRO.

St. Croix National Scenic Riverway

The large number of significantly declining trends at SACN stands apart from other western Great Lakes parks, states, and ecoregions. Indeed, to our knowledge there is no comparable North American dataset showing such pervasive significant declines in an avian community. This suggests either an important issue with the survey itself or that there has been a key change in riparian habitats. As a result, we will explore potential mechanisms in detail.

Forest changes are occurring within and near the riverway (Sanders and Grochowski 2014), but these changes do not show severe degradation or dramatic shifts in vegetation. Increased recruitment of black ash (*Fraxinus nigra*) in the park indicates that flooding has not been a major factor since 2007, but it is unlikely that limited flooding or high ash recruitment explains broad avian declines. An extreme wind event in 2011 had the effect of increasing snags, downed coarse woody material, tree density, and light reaching the forest floor (Sanders and Grochowski 2014). Under these conditions a sharp increase in early-successional bird species may be expected, but the opposite is revealed from surveys. If 2012–2014 data are excluded, nearly all trends remain in significant decline and appear to be influenced by particularly high values in the early years of the survey.

Another potential habitat factor may be land-use changes along the river corridor or adjacent landscapes. For instance, timber harvest has been an important disturbance factor (Kirschbaum and Gafvert 2013), yet the extent of harvest is probably limited in the vicinity of survey points. While the above landscape changes may have an interactive effect, it does not seem feasible that habitats are changing in the park in ways that can explain dramatic avian declines. Finally, with the same two experienced observers conducting the surveys since 1998, it is unlikely that observer differences are a problem. While the hearing of observers could be tested to ensure it is within acceptable ranges, the declines of highly detectable species and continued recording of high-pitched species suggests observer hearing loss is not a strong contributing factor.

The most likely explanation for the declines at SACN appears to be the change from floating counts to anchored counts in 2005. From 1998 to 2005, guilds showed comprehensive declines (eight guilds having significant declines and nine with non-significant declines), none of which had a significant relationship to river discharge rates (data not shown, all p -values ≥ 0.08). (Increased discharge rates would affect what area was actually sampled while drifting.) In contrast, from 2006 to 2014 there were no significant guild trends in either direction (all p -values ≥ 0.22), which is similar to other park trends. This illustrates the importance of changing the study design to anchored surveys that standardized the sample units.

For individual species, data since 2005 probably reflect true trends in the park. Using this shorter time frame, the two declining species with broader concerns are Golden-winged Warbler, of special concern in Wisconsin and on the NABCI watch list (NABCI 2014), and Common Grackle, a common species showing general declines (Sauer et al. 2014). Pre-2005 data should not be used for future analyses, though they remain useful for birdwatching checklists indicating presence of species

during breeding season. Density results for SACN use data collected since 2009 and are probably the most robust data for this park.

While the ideal for SACN was to survey the entire length of both rivers, the number of routes is probably maximized for realistic completion. Focus should remain on the six current routes, each of which have unique habitats present along them (Robin Maercklein, pers. comm.), with attempts to complete these routes completely and on schedule. The staggered biennial cycle of completing surveys introduces a few problems by lengthening the amount of time by which precise analyses can be made, requiring either separation of data (as in the current report) or use of more complex statistical techniques to combine data, and the influences of annual weather or population fluctuations may be more challenging to detect. However, it does allow more habitat types and a much larger number of points to be surveyed, and the strategy appears basically effective. Results apply to habitats adjacent to the rivers and probably not inland or upland locations.

Sleeping Bear Dunes National Lakeshore

Five species showed significant increasing trends in abundance at SLBE; no significant declining trends were identified. Comparisons with results both statewide (Michigan, Minnesota, and Wisconsin) and across bird conservation regions (Prairie Hardwood Transition and Boreal Hardwood Transition) over a comparable timespan (2001–2011) show American Robin and Red-eyed Vireo following increasing trends region-wide (Sauer et al. 2014). In contrast, Eastern Meadowlark, Veery, and Wood Thrush are all broadly declining across the western Great Lakes. The discrepancies in trends may indicate positive responses to protected park habitats. Two species that should be watched in the future are Bobolink and Gray Catbird, both relatively common and showing strong, though non-significant, declines that may be important. There were no indications of large-scale habitat influences to guild trends at SLBE.

With points proportionally habitat-stratified, results can be applied across the park, though there may be an edge influence due to surveys along roadsides. Using Distance analyses for six species with adequate sample sizes, we can make the following observations on habitat associations and detectability estimates:

American Redstart—Redstarts were detected in all habitats, but generally favored beech-maple forest, edges and shrubby habitat near water, which is typical (Sherry and Holmes 1997). The detection radius neared the outer 100 m range ring in fields, yet was between 55 and 65 m in forested habitats. Overall, the probability of observing redstarts shows that only about 45% are detected, and the population is stable or slightly increasing.

American Robin—Robins were also detected in all habitats, though they distinctly favored beech-maple forest. Both radius and probability of detection were stable across years and habitats, at around 67 m and 45%, respectively. Annual trends between observational and density models were similar, with a stable or slightly increasing population.

Ovenbird—Due to low numbers, Ovenbirds were not modelled particularly well, yet observational and density comparisons both show a stable population. Compared to

Ovenbirds in other parks, the radius and probability of detection were lower than expected from a bird with such a sharp, clear song. Beech-maple forest was strongly preferred and open habitats were avoided completely.

Red-eyed Vireo—Red-eyed Vireos were present in all habitats, but favored forests. Vireos occur in many forest types but are more common in the forest interior (Cimprich et al. 2000). Vireos at SLBE had a wide detection radius (75 m) and a 56% detection probability across habitats, which is a high detection value. Short-term trends (2009–2013) show a steep decline in both models, but only the density trend is significant. In contrast, the long-term trend (2004–2013) from the regression section shows vireos significantly increasing. This difference is explained in two ways. First, low numbers were observed in early years (2004–2006) and high numbers in later years (2012–2013), which combine to show a significant increase ($P = 0.04$) of about 1.6% annually. Second, removal of vireos beyond 100 m for density estimates sharply reduced the number of detections from 51 to 29 in 2012 and 56 to 31 in 2013, shifting the trend to a significant decline ($P = 0.01$) of about -1.4% annually. This suggests that results would have been misleading in the absence of sampling with distance bins. The decline in vireos is possibly part of long-term cyclical variation that should be followed in future surveys. There was no indication from NABBS results that Red-eyed Vireos were exhibiting steep declines in Michigan or regionally (Sauer et al. 2014).

Red-winged Blackbird—Red-winged Blackbirds favored field and wetland habitats, as expected (Yasukawa and Searcy 1995). Forest and dune habitats were avoided completely. Except for 2013, radius and probability of detection were very stable. Blackbirds had opposing trends between observational (positive) and density (negative) estimates—the only species in all parks to show this pattern. Although numbers observed in 2013 were not particularly low, density estimates suggested a sharp drop in the population. In the same time period there were declining trends for Red-winged Blackbirds in both the Boreal Hardwood Transition region and in Michigan (Sauer et al. 2014).

Song Sparrow—Song Sparrows were common in many SLBE habitats, particularly shrubby areas near water (Arcese et al. 2002). Observations were limited in forested settings. Detection radii and probability of observations were stable across years and habitats. Song Sparrow populations appeared to be stable or slightly increasing.

Voyageurs National Park

Blue-headed Vireo, a species typical of extensive mature forest with a complex understory (Morton and James 2014), was the only species showing a significant increasing trend. Generally, this species has become more abundant in recent decades, with significant population increases in Boreal Hardwood Transition (BHT) forest, and in Minnesota and Ontario (Sauer et al. 2014).

Of the declining species, all but one exhibit similar trends in Minnesota, Ontario, and in the BHT forest. Due to the protected landscapes at VOYA, it is likely that the park offers good habitat for these species and declines reflect broader trends. American Crow, in contrast to park trends, has been increasing since 2002 in the BHT and in Minnesota and Ontario. Observed patterns of avian

abundances from VOYA were similar to trends from ISRO, with high abundances in the mid-1990s (Egan and Gostomski 2013).

Declines within guilds at Voyageurs are suggestive of changing forest structure along survey routes. Yet it is difficult to assess what the changes may be since a general decline in woodland species implies gap creation, while the decline in open and successional species implies greater forest maturation. Recent landscape-level analyses show a small amount of landscape disturbance in the park (0.68%) from 2002–2007, and larger amounts in nearby areas of Minnesota (4.3%) and Ontario (7.1%) (Kirschbaum and Gafvert 2010). The largest disturbances in recent years, from natural fire and beaver dam blowout, occurred far from any survey routes.

Except for the four routes analyzed here, data collection has been inconsistent since 1997. This irregularity effectively halves the data available for some analyses. Our primary suggestion for VOYA is to consider the number of routes that can be effectively completed each year—it appears that six routes are more reasonable than eight. Routes follow short ski-trail loops because of a general lack of park trails, so results may not apply across park populations and may be strongly influenced by trail maintenance techniques.

Conclusions

Avian community trends show broad discrepancies across the region, which probably reflects the unique and variable landscapes occurring in each park. There was greater consistency within each park, particularly when considering species combined into guilds. Across GLKN parks, most species can be considered relatively stable or increasing, with only a few species exhibiting general declining trends: American Crow, Chestnut-sided Warbler, and Evening Grosbeak. Broadly increasing species include American Robin and Red-winged Blackbird, with a few more species sharing this pattern to a lesser degree. Species with strongly mixed trends—significantly increasing or declining, depending on the park—include Blue Jay, Hermit Thrush, Veery, Ovenbird, Nashville Warbler, and Chipping Sparrow. The majority of trend patterns in GLKN parks match findings from the continent-wide NABBS roadside surveys (Sauer et al. 2014).

Each park should consider how the trends determined here apply to local habitats and management goals. In particular, species that are state-listed or on the Partners in Flight Watch List have been determined to require management attention, either because they are already in jeopardy or have population traits suggesting that preemptive action could save considerable effort and expense by averting a significant decline (Rich et al. 2004). Conservation of healthy landscapes is already a priority in parks, but management decisions should consider influences to habitats used by species of concern. In this light, it is important to determine habitat use by species because it may help determine risk of local extirpations if climate change begins to strongly influence habitats.

Binomial distance estimates (using two range categories) for common species were a valuable improvement over observational results. Most species had no discernable difference in trend magnitude and direction between logarithmic and density models, although important differences were revealed for a small number of species. Therefore, observational index trends are valid surrogates for more refined analyses and can be used for annual reporting, while density trends should be used in synthesis reports (Conn et al. 2004).

Migration, habitat, and diet guilds appear to be a useful complementary support tool for interpreting long-term avian trends in GLKN parks, though the guild model could be refined for better effect. Fruit-eating species, including omnivores that have a substantial fruit component of summer diet, appear to be declining in many parks. Other guilds with weaker but consistently declining trends include successional habitat occupants and birds foraging aerially and in the upper canopy. Wetland and bark-foraging species were generally increasing, as were, to a lesser degree, short-distance migrants. Mechanisms for guild changes cannot be addressed with the bird survey data, but results should be considered for additional study or in conjunction with other surveys. Guilds should be compared to vegetation surveys as data become available for how park habitats are changing over time (Croonquist and Brooks 1991). Even preliminary data from vegetation plots were useful comparative tools to predict the reasons for changes in the avian community.

The priority list for GLKN includes 22 species requiring conservation attention (GLKN 2011). However, three of these species have not been recorded on any park survey (Henslow's Sparrow, Kirtland's Warbler, and Rusty Blackbird), and many other species on the list are found in such low

abundances that trends cannot be reliably ascertained in all or most parks. There are exceptions, such as SLBE having adequate sample sizes for grassland species like Bobolink, Field Sparrow, and Grasshopper Sparrow. But only five priority species are reliably sampled across parks: Least Flycatcher, Veery, Black-and-white Warbler, Black-throated Blue Warbler, and Canada Warbler (Appendix D). Therefore, to avoid the problem of managing for species that do not actually use parks, the list of priority species should be modified using criteria that includes not only Partners in Flight designations (including their list of common birds in steep decline), but also documented breeding presence in parks and abundance adequate enough to reliably track populations. Rare species could be on a “watch list” or receive targeted surveys if deemed important to actively manage. The Network list may be more useful to parks if priority species were stratified or ranked based on conservation concern and ability for park habitats to sustain them. The list should highlight species that can reliably indicate habitat change in parks and be reevaluated periodically for improvement and relevance (Beissinger et al. 2000). An important question for this list is whether parks are havens for a declining species or a marginal landscape unlikely to help avert a population crash.

Even though parks follow a common protocol (except INDU, which follows the NABBS protocol), variability based on detection probabilities, habitats, observers, and initial route establishment make direct park-to-park comparisons risky (Barker and Sauer 1995). Point counts can be used to good effect as an “early-warning system” to indicate when additional investigation is warranted or broad changes are occurring (Barker and Sauer 1995). Each park should consider these results using local expertise to determine if further study is needed. If rare species are of management concern they will require separate survey techniques or modifications to the current protocols (see Thompson 2004).

Prior to standardization, each park had its own approach for surveying birds. While techniques were generally similar, with compatible objectives, the lack of a cohesive protocol or strategy limited the ability for comparisons among these datasets. Current survey protocols are generally fulfilling monitoring goals defined by each park (Gostomski et al. 2010). Shared goals include assessment of community diversity and long-term trends, which are best met in different ways. The first can be accomplished using unlimited distance counts to detect the most species possible, while the second is best served by including additional effort such as distance estimates for refined calculations. Our findings stand as a benchmark for avian studies in GLKN parks prior to the Network protocol. Future synthesis reports, ideally done every five years for effective reevaluation, should focus on surveys occurring since standardization, using this report for comparison.

Management Recommendations

Quality Control

The most important recommendation centers on consistency of data management. Data are often recorded and entered differently from park to park, and even from year to year. This complicates analyses by forcing assumptions or removing data entirely. A great deal of effort is wasted when quality control problems compromise the utility of data. The most common problems found during analyses for this report and some basic strategies to help overcome them are:

1. Common across all parks was the **use of non-standard and/or inconsistent codes for site names and bird species**, even within the same dataset. Creative yet unintelligible codes are sometimes generated, and these data are generally removed from analysis to avoid misinterpreting results. *It is strongly advised that the most recent American Ornithologist's Union (AOU) standards are followed, as outlined in the Network's Standard Operating Procedure #5 (Knutson et al. 2010)*, and that spreadsheets and databases also include the common English name to avoid confusion among those who are entering data but may not be familiar with the codes.
2. Many park worksheets were **missing basic data**, including observer names, minute of detection, and transcription of the full species name, which can be double-checked against the code name. All data from field forms should be entered into worksheets and databases. All field sheets should be checked for accuracy on the same day as the survey.
3. Data entry is tedious and error-prone, particularly with the thousands of entries required for bird survey data. Data entry should be done slowly and methodically by personnel familiar with the survey and the datasheets. With two people, data entry can be split up, and double-checking of the other person's entries will help with quality control.

Reporting

Although all parks have objectives that include monitoring trends and comparing results to a broader geographic area, only ISRO has completed a peer-reviewed report to fulfill these goals. It is not clear how many parks produce internal reports about their annual surveys. The relatively recent formation of the GLKN office brings important resources for helping parks analyze and synthesize data, which is the goal of this report. It is advisable that all parks take advantage of this partnership by sharing data from annual surveys. Individual parks are likely to desire in-depth reports that address internal management goals, while meta-analyses can be handled by the GLKN office.

Improved Analyses

Current protocols should be followed closely to allow comparison across parks. However, the following may be useful if Network or park managers desire refinements in techniques, depending on goals.

1. Distance data: Additional covariates could improve results and indicate factors influential to species density and detectability (e.g., vegetation cover, habitat characteristics, time of

- day, behaviors of species of interest). However, only data deemed important should be collected so primary goals are not compromised. Smaller distance bins could improve analyses, separating each current bin into two (i.e., 0–25 m, 25–50 m, 50–75 m, 75–100 m), but this should only be implemented if current precision estimates are deemed too low; otherwise this would have limited utility.
2. Habitat designation: Greater understanding of habitat use by the birds in each park would make management actions more effective. Even broad *post hoc* designations for each point could be useful (Buckland et al. 2001, Ralph et al. 1995). Occasional updating of habitat definitions may illuminate the response of avian communities to vegetation changes. Habitat designations are particularly important to implement in order to fulfill the stated goal of associating species with habitats.
 3. Guilds utilized in the current analysis were basic and defined from studies of northern forests or general North American behaviors. Building a refined guild model for the western Great Lakes region may return more robust results. However, a north-south distinction exists within Network parks, particularly for migration strategies, so sub-regional guild analysis may be appropriate.
 4. In the next meta-analysis of GLKN data, time-to-detection or removal models should be compared to distance models (e.g., Alldredge et al. 2007, Farnsworth et al. 2005).

Survey Effort

For some parks, incomplete sampling of survey routes on a regular basis suggests an overextension of resources, either in time or personnel. Gaps in data can be statistically problematic, so consistent and comprehensive sampling is advised. Some parks should either reconsider the number of routes or, if avian surveys are a high priority, ensure adequate resources are allocated. If all established routes cannot be surveyed each year, managers should consider which routes are of primary importance based on habitats or representation of species of concern and make those a priority for annual sampling.

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Appendix A: Route Completion Details

Table A1. Breeding bird survey routes and number of annually completed survey points (106 total) at Apostle Islands National Lakeshore, 1995–2013. **Bold numbers** indicate data used in regression analyses. No data were collected in 2006 or 2011–2013.

Route*	Year															
	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
DE	8	8	8		8	13	8	8	8	8	8	No	8	8	8	8
LO	12	12	12	12	12	12	12	12	12	12	12	data	12	12	12	
OA	13	13	13		13	13	13	13	13	13	13		13	13	13	
OU	15	15	15	15	15	15	15	15	15	15	15		15	15	15	
OUHS	5	5	5	5	5	5	5	5	5	5	5		5	5	5	
MD	10	10	10	10	10	10	10	10	10	10	10		10	10	10	10
RA	9	9	9		9	9	9	9	9	9	9		9	8	9	8
SA	12	12	5	12	12	12	12	12	12	12	12		12	12	12	
STPI	10	10	10	10	10	10	10	10	10	10	10		10	10	10	
STTP	12	12	12	12	12	12	12	12	12	12	12		12	12	12	
Total	106	106	99	76	106	106	106	106	106	106	106		106	105	106	

* DE=Devils Island, LO=Long Island, OA=Oak Island, OU=Outer Island, OUHS=Outer Island Hemlock Stand, MD=Mainland Trail, RA=Raspberry Island, SA=Sand Island, STPI=Stockton Island, Presque Isle, STTP=Stockton Island, Trout Point Trail.

Table A2. Breeding bird survey routes and number of annually completed survey points (130 total) at Isle Royale National Park, 1994–2013. **Bold numbers** indicate data used in regression analyses.

Route*	Year																			
	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
PASS	6	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
TMLC	15	15	17	17	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
MTOJ	17	17	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19
CHLR			16	16	16	16	16	16	16	16	15	16	16	16	16	16	16	16	16	16
LRGR		9	20	16	20	20	19	20	20	20	20	20	20	20	20	20	20	20	20	20
ISTR	9	6	18	18	18	18	18	18	18	18	16	18	18	18	18	18	18	18	18	18
FELK	15	11	18	14	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
WIND	13	17	21	18	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21
Total	75	85	133	122	130	130	129	130	130	130	127	130	130	130	130	130	130	130	130	130

* PASS=Passage Island, TMLC=ThreeMile to Lane Cove Trail, MTOJ=Mt. Ojibway Loop, CHLR=Chippewa Harbor to Lake Richie, LRGR=Lake Richie to the Greenstone Ridge, ISTR=Ishpeming Trail, FELK=Feldtmann Lake, WIND=Windigo.

Table A3. Number of annual breeding bird survey points completed for routes at Saint Croix National Scenic Riverway, 1982–2013. **Bold numbers** indicate data used in regression analyses. Years with floating counts are distinguished from anchored counts. Length of count survey is also separated (** = 5-minute surveys were conducted in 2007).

Route*	Floating Counts									Anchored Counts									
	3-minute surveys									6-minute surveys									
	1982	1983	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007**	2008	2009	2010	2011	2012	2013	2014
LOSA	50		53	52		52		53		45		53		52		53		53	
LNAM		50	50	50		50		50		49		50				50		50	
UNAM					50		50		50		49		50		50	4	50		50
SACN					19		50		50		50		34		50		49		50
USAC								46		41		40		47		47		47	
MSAC																	50		50

* LOSA =Lower St. Croix River, from St. Croix Falls to Stillwater; LNAM=Lower Namekagon River, from County K Landing to Totogatic River; UNAM=Upper Namekagon River, from Namekagon Dam to Phipps Flowage; SACN=St. Croix River North, from Highway 77/48 to Highway 70; USAC= Upper St. Croix River, from Gordon Dam to Riverside; MSAC=Middle St. Croix River, from Raspberry Landing to Nevers Dam.

Table A4. Breeding bird survey points, by habitat, at Sleeping Bear Dunes National Lakeshore, 2004–2013. An “X” indicates points that were completed; dashes indicate points that were not completed.

	Location Name	Point	Year							
			2004	2005	2006	2009	2010	2011	2012	2013
Beech-Maple Forest	Shauger Hill	BM-1	X	X	X	X	X	X	X	X
	Shauger Hill	BM-2	X	X	X	X	X	X	X	X
	Burnham Road	BM-3	X	X	X	X	X	X	X	X
	Burnham Road	BM-4	X	X	X	X	X	X	X	X
	Treat Farm	BM-5	X	X	X	X	X	X	X	X
	Treat Farm	BM-6	X	X	X	X	X	X	X	X
	Scenic Drive #8	BM-7	X	X	X	X	X	X	X	X
Coastal Oak-Pine Forest	Good Harbor	CF-1/7**	X	X	X	X	X	X	X	X
	Good Harbor Bay	CF-2	X	X	X	X	X	X	X	X
	Otter Creek	CF-3	X	X	X	X	X	X	X	X
	Otter Creek	CF-4	X	X	X	X	X	X	X	X
	Peterson Road	CF-5	X	X	X	X	X	X	X	X
	Glen Haven	CF-6	X	X	X	X	X	X	X	X
Dunes	Dune Trail/Sleeping Bear Point*	D-1	X	X	X	X	X	X	X	X
	Dune Trail/Sleeping Bear Point*	D-2	X	X	X	X	X	X	X	X
	Cottonwood Trail	D-3	X	X	X	X	X	X	X	X
	Cottonwood Trail	D-4	X	X	X	X	X	X	X	X
	9/10 Overlook	D-5	X	X	X	X	X	X	X	X
	Scenic Drive #5	D-6	X	X	X	X	X	X	X	X
Fields	DH Day Field	F-1	X	X	X	X	X	X	X	X
	Norconk/Stormer Road*	F-2	X	X	X	X	X	X	X	X
	Aral Hills	F-3	X	X	X	--	X	X	X	X
	Kelderhouse Road	F-4	X	X	X	X	X	X	X	X
	Air Station	F-5	X	X	X	X	X	X	X	X
	Esch + M22	F-6	X	X	X	X	X	X	X	X
Edge	9-10 Parking Lot/Scenic Drive*	E-1	X	X	X	X	X	X	X	X
	School Lake	E-2	X	X	X	X	X	X	X	X
	Glen Haven/Maritime Museum*	E-3	X	X	X	X	X	X	X	X
	Mill Pond	E-4	X	X	X	X	X	X	X	X
Inland Lake	Tucker Lake	IL-1	X	X	X	X	X	X	X	X
	Bass Lake/Benzie	IL-2	X	X	X	X	X	X	X	X
	Narada Lake	IL-3	X	X	X	X	X	X	X	X
Shore/ Foredune	Glen Haven	SF-1	X	X	X	X	X	X	X	X
	Otter Creek	SF-2	X	X	X	X	X	X	X	X
	Peterson Road	SF-3	X	X	X	X	--	X	X	X
	Good Harbor	SF-4	X	X	X	X	X	X	X	X
Wetland	Mill Pond	W-1	X	X	X	X	X	X	X	X
	Westman Road	W-2	X	X	X	X	X	X	X	X
	Kelderhouse Road	W-3	X	X	X	X	X	X	X	X
	Otter Creek	W-4	--	X	X	X	X	X	X	X
	Peterson + Lasso	W-5	--	--	--	X	X	X	X	X

* = Site listed under two location names in the database but the point alpha-numeric is the same.

** = Good Harbor point CF-1 is sometimes listed as CF-7 in the park's worksheet.

Table A5. Breeding bird survey routes and number of annually completed survey points at Voyageurs National Park, 1996–2013. **Bold numbers** indicate data used in regression analyses; other routes were considered too incomplete for valid regressions.

Route*	Year																	
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
BBST		10	10	10	10	10	10	10	10	10	9	10	10	10	9	10	10	10
EBTR		10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
RLVC		10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
BABT		10	9	10	10	10	10	10	10	10	10	10	10	10	10		10	10
DWI				10	10	10	10	10	10	10		10	10	10	10		7	
LBPT				10	10	10		10		10	10	10		10	10		6	6
ABLT						10	10	10		10	9	10	1	10		8	10	10
KATR									10	10	10	10	10	10	10		10	10
CLT	7		10															
ARTR								10	10									
Total	7	40	59	60	60	70	60	80	70	80	68	80	61	80	69	38	73	66

* BBST=Black Bay Ski Trail, EBTR=Echo Bay Trail, RLVC=Rainy Lake Visitor Center, BABT=Blind Ash Bay Trail, DWI=Dryweed Island, LBPT=Lost Bay Portage Trail, ABLT=Anderson Bay Loop Trail, KATR=Kabetogama Lake Trail, CLT=Cruiser Lake Trail, ARTR=Ash River Ski Trail.

Appendix B: Regression Analysis Details

Table B1. Regression trends (average proportional change per year), r^2 , P and total and annual mean individuals observed during 10-minute point counts at Apostle Islands National Lakeshore, 1995–2009, arranged by trend and P-value. **Species in bold** indicate $P \leq 0.05$. Species listed as special concern (SC) in Wisconsin and species on a watch list (WL) or common but in steep decline (SD) in the United States are noted.

Species	Trend	r^2	P	Total Individuals	Mean Individuals Annually
Hermit Thrush	+ 0.04	0.42	0.0164	360	28
Blue Jay	+ 0.04	0.42	0.0167	509	39
Yellow-bellied Sapsucker*	+ 0.03	0.37	0.0348	152	12
Northern Parula	+ 0.02	0.43	0.0152	307	24
Ovenbird	+ 0.01	0.58	0.0026	1907	147
American Robin	+ 0.01	0.32	0.0432	338	26
Chipping Sparrow	+ 0.01	0.31	0.0491	287	22
Savannah Sparrow	+ 0.03	0.29	0.06	27	2.1
American Crow	+ 0.02	0.23	0.10	344	26
Northern Flicker	+ 0.03	0.17	0.16	57	4.4
Swainson's Thrush* (SC)	+ 0.02	0.32	0.07	163	13
Red-breasted Nuthatch	+ 0.02	0.17	0.16	223	17
Cape May Warbler (SC, SD)	+ 0.02	0.10	0.29	21	1.6
American Goldfinch	+ 0.02	0.08	0.36	48	3.7
Red-eyed Vireo ¹	+ 0.01	0.20	0.13	1778	137
Yellow-rumped Warbler	+ 0.01	0.12	0.24	458	35
Eastern Wood Pewee	+ 0.01	0.11	0.27	102	7.8
Alder Flycatcher	+ 0.01	0.10	0.30	71	5.5
Canada Warbler* (SC, WL)	+ 0.01	0.09	0.33	85	6.5
Bay-breasted Warbler	+ 0.01	0.01	0.74	29	2.2
Common Yellowthroat*	+ 0.00	0.13	0.26	305	23
Black-throated Green Warbler*	+ 0.00	0.06	0.40	1296	100
White-throated Sparrow	+ 0.00	0.01	0.78	194	15
Black-capped Chickadee	+ 0.00	0.00	0.89	278	21
Swamp Sparrow	+ 0.00	0.00	0.90	26	2
Nashville Warbler	+ 0.00	0.00	0.95	851	65
Rose-breasted Grosbeak	+ 0.00	0.00	0.95	35	2.7
Downy Woodpecker	+ 0.00	0.00	0.96	23	1.8
Mourning Warbler*	+ 0.00	0.00	0.98	42	3.2
Black-and-White Warbler	+ 0.00	0.00	0.99	270	21
American Three-toed Woodpecker	▪	▪	▪	1	0.08
Baltimore Oriole	▪	▪	▪	3	0.23
Bank Swallow (SD)	▪	▪	▪	2	0.15
Barn Swallow	▪	▪	▪	21	1.6
Belted Kingfisher	▪	▪	▪	18	1.4
Black-backed Woodpecker (SC)	▪	▪	▪	2	0.15
Black-billed Cuckoo (SC, WL)	▪	▪	▪	19	1.5
Blackpoll Warbler (SD)	▪	▪	▪	2	0.15
Bobolink (SC, WL)	▪	▪	▪	3	0.23
Brown-headed Cowbird	▪	▪	▪	5	0.38

* Outliers were removed from trend analyses for these species.

¹ AMRE and REVI do not fit normal distribution; included because of regularity of data and abundance across years.

Table B1 (continued). Regression trends (average proportional change per year), r^2 , P and total and annual mean individuals observed during 10-minute point counts at Apostle Islands National Lakeshore, 1995–2009, arranged by trend and P-value. **Species in bold** indicate $P \leq 0.05$. Species listed as special concern (SC) in Wisconsin and species on a watch list (WL) or common but in steep decline (SD) in the United States are noted.

Species	Trend	r^2	P	Total Individuals	Mean Individuals Annually
Brown Thrasher (SC)	▪	▪	▪	2	0.15
Chimney Swift (SD)	▪	▪	▪	110	8.5
Clay-colored Sparrow	▪	▪	▪	10	0.77
Cliff Swallow	▪	▪	▪	1	0.08
Connecticut Warbler (SC, WL)	▪	▪	▪	14	1.1
Dark-eyed Junco	▪	▪	▪	6	0.46
Eastern Bluebird	▪	▪	▪	4	0.31
European Starling	▪	▪	▪	2	0.15
Evening Grosbeak (SC, WL)	▪	▪	▪	13	1
Field Sparrow (SC)	▪	▪	▪	1	0.08
Golden-crowned Kinglet	▪	▪	▪	44	3.4
Grasshopper Sparrow (SC, SD)	▪	▪	▪	1	0.08
Gray-cheeked Thrush	▪	▪	▪	1	0.08
Gray Catbird	▪	▪	▪	4	0.31
Great Crested Flycatcher	▪	▪	▪	20	1.5
House Wren	▪	▪	▪	1	0.08
Indigo Bunting	▪	▪	▪	2	0.15
Killdeer	▪	▪	▪	20	1.5
Lincoln's Sparrow	▪	▪	▪	8	0.62
Marsh Wren	▪	▪	▪	6	0.46
Mourning Dove	▪	▪	▪	1	0.08
Northern Cardinal	▪	▪	▪	1	0.08
Northern Waterthrush	▪	▪	▪	4	0.31
Olive-sided Flycatcher (SC, WL)	▪	▪	▪	9	0.69
Palm Warbler	▪	▪	▪	13	1
Purple Finch	▪	▪	▪	4	0.31
Pileated Woodpecker	▪	▪	▪	57	4.4
Pine Siskin (SD)	▪	▪	▪	13	1
Pine Warbler	▪	▪	▪	35	2.7
Philadelphia Vireo (SC)	▪	▪	▪	27	2.1
Red Crossbill (SC)	▪	▪	▪	5	0.38
Ruby-crowned Kinglet (SC)	▪	▪	▪	8	0.62
Ruby-throated Hummingbird	▪	▪	▪	11	0.85
Ruffed Grouse	▪	▪	▪	3	0.23
Scarlet Tanager	▪	▪	▪	16	1.2
Sedge Wren	▪	▪	▪	4	0.31
Tennessee Warbler	▪	▪	▪	12	0.92
Vesper Sparrow (SC)	▪	▪	▪	1	0.08
White-breasted Nuthatch	▪	▪	▪	19	1.5
Western Meadowlark (SC)	▪	▪	▪	1	0.08

* Outliers were removed from trend analyses for these species.

¹ AMRE and REVI do not fit normal distribution; included because of regularity of data and abundance across years.

Table B1 (continued). Regression trends (average proportional change per year), r^2 , P and total and annual mean individuals observed during 10-minute point counts at Apostle Islands National Lakeshore, 1995–2009, arranged by trend and P-value. **Species in bold** indicate $P \leq 0.05$. Species listed as special concern (SC) in Wisconsin and species on a watch list (WL) or common but in steep decline (SD) in the United States are noted.

Species	Trend	r^2	P	Total Individuals	Mean Individuals Annually
White-winged Crossbill (SC)	▪	▪	▪	9	0.69
Willow Flycatcher (SC)	▪	▪	▪	6	0.46
Wilson's Warbler (SC, SD)	▪	▪	▪	11	0.85
Wood Thrush (SC, WL)	▪	▪	▪	3	0.23
Yellow-throated Vireo	▪	▪	▪	2	0.15
Common Raven	- 0.00	0.00	0.91	43	3.3
Eastern Phoebe	- 0.00	0.00	0.89	23	1.8
Magnolia Warbler	- 0.00	0.01	0.76	205	16
Least Flycatcher* (SC)	- 0.01	0.04	0.52	118	9.1
Blackburnian Warbler*	- 0.01	0.05	0.49	180	14
Black-throated Blue Warbler (SC)	- 0.01	0.04	0.49	125	9.6
Eastern Kingbird	- 0.01	0.05	0.47	29	2.2
Veery (SC)	- 0.01	0.08	0.36	269	21
Song Sparrow	- 0.01	0.19	0.14	426	33
American Redstart ¹	- 0.01	0.20	0.13	847	65
Blue-headed Vireo	- 0.02	0.09	0.32	50	3.8
Winter Wren	- 0.02	0.16	0.17	285	22
Red-winged Blackbird	- 0.02	0.19	0.14	247	19
Chestnut-sided Warbler	- 0.02	0.28	0.06	199	15
Cedar Waxwing	- 0.03	0.08	0.36	163	13
Yellow Warbler	- 0.03	0.15	0.19	54	4.2
Hairy Woodpecker	- 0.03	0.17	0.17	45	3.5
Tree Swallow	- 0.04	0.32	0.0432	31	2.4
Common Grackle (SD)	- 0.04	0.37	0.0261	19	1.5
Brown Creeper	- 0.04	0.68	0.0005	67	5.2
Yellow-bellied Flycatcher (SC)	- 0.07	0.64	0.0011	49	3.8

* Outliers were removed from trend analyses for these species.

¹ AMRE and REVI do not fit normal distribution; included because of regularity of data and abundance across years.

Table B2. Regression trends (average proportional change per year), r^2 , P and total and mean individuals observed during 10-minute point counts at Grand Portage National Monument, 1999–2014, arranged by trend and P-value. **Species in bold** indicate $P \leq 0.05$. Species listed as special concern (SC) in Minnesota, species common but in steep decline (SD), or on the NABCI (2014) watch list (WL) in the United States are noted.

Species	Trend	r^2	P	Total Individuals	Mean Individuals Annually
Yellow-rumped Warbler*	+ 0.03	0.28	0.0498	112	7.5
Nashville Warbler*	+ 0.01	0.38	0.0241	339	23
Northern Flicker*	+ 0.03	0.19	0.12	101	6.7
Alder Flycatcher	+ 0.01	0.21	0.08	108	7.2
Song Sparrow	+ 0.01	0.19	0.10	96	6.4
Magnolia Warbler	+ 0.01	0.11	0.24	383	26
American Robin	+ 0.01	0.10	0.26	324	22
Winter Wren	+ 0.01	0.09	0.29	268	18
Purple Finch	+ 0.01	0.05	0.40	32	2.1
American Redstart*	+ 0.01	0.06	0.41	353	24
Yellow-bellied Sapsucker	+ 0.01	0.04	0.47	344	23
Brown Creeper*	+ 0.01	0.05	0.47	85	5.7
Blue Jay	+ 0.01	0.01	0.69	177	12
Common Yellowthroat*	+ 0.00	0.03	0.57	60	4
Canada Warbler (WL)	+ 0.00	0.01	0.67	167	11
White-throated Sparrow	+ 0.00	0.01	0.68	732	49
Swainson's Thrush	+ 0.00	0.01	0.70	268	18
Swamp Sparrow ¹	+ 0.00	0.01	0.76	46	3.1
American Goldfinch	+ 0.00	0.00	0.81	21	1.4
American Crow	+ 0.00	0.00	0.85	170	11
Black-and-White Warbler*	+ 0.00	0.00	0.90	124	8.3
American Bittern	▪	▪	▪	5	0.33
Bay-breasted Warbler	▪	▪	▪	2	0.13
Belted Kingfisher	▪	▪	▪	3	0.2
Black-billed Cuckoo (WL)	▪	▪	▪	7	0.47
Black-throated Blue Warbler	▪	▪	▪	13	0.87
Blue-headed Vireo	▪	▪	▪	31	2.1
Brown-headed Cowbird	▪	▪	▪	2	0.13
Cerulean Warbler (SC, WL)	▪	▪	▪	3	0.2
Chimney Swift (SD)	▪	▪	▪	4	0.27
Common Grackle (SD)	▪	▪	▪	9	0.6
Dark-eyed Junco	▪	▪	▪	1	0.07
Eastern Kingbird	▪	▪	▪	1	0.07
Eastern Phoebe	▪	▪	▪	11	0.73
Gray Catbird	▪	▪	▪	3	0.2
Gray Jay	▪	▪	▪	14	0.93
Great Crested Flycatcher	▪	▪	▪	10	0.67
Hairy Woodpecker	▪	▪	▪	38	2.5
House Wren	▪	▪	▪	2	0.13
Indigo Bunting	▪	▪	▪	3	0.2

¹ SWSP did not fit normal distribution; included because of regularity of data and abundance across years. EVGR included due to likely ecological importance of decline.

* Outliers were removed from trend analyses for these species.

Table B2 (continued). Regression trends (average proportional change per year), r^2 , P and total and mean individuals observed during 10-minute point counts at Grand Portage National Monument, 1999–2014, arranged by trend and P-value. **Species in bold** indicate $P \leq 0.05$. Species listed as special concern (SC) in Minnesota, species common but in steep decline (SD), or on the NABCI (2014) watch list (WL) in the United States are noted.

Species	Trend	r^2	P	Total Individuals	Mean Individuals Annually
Lincoln's Sparrow	▪	▪	▪	2	0.13
Mourning Dove	▪	▪	▪	1	0.07
Northern Cardinal	▪	▪	▪	2	0.13
Northern Waterthrush	▪	▪	▪	21	1.4
Orange-crowned Warbler	▪	▪	▪	1	0.07
Olive-sided Flycatcher (WL)	▪	▪	▪	2	0.13
Pine Siskin (SD)	▪	▪	▪	3	0.2
Pine Warbler	▪	▪	▪	1	0.07
Philadelphia Vireo	▪	▪	▪	6	0.4
Red-winged Blackbird	▪	▪	▪	4	0.27
Ruby-crowned Kinglet	▪	▪	▪	11	0.73
Ruby-throated Hummingbird	▪	▪	▪	33	2.2
Ruffed Grouse	▪	▪	▪	95	6.3
Scarlet Tanager	▪	▪	▪	7	0.47
Sedge Wren	▪	▪	▪	12	0.8
Tennessee Warbler	▪	▪	▪	2	0.13
Tree Swallow	▪	▪	▪	10	0.67
Warbling Vireo	▪	▪	▪	1	0.07
White-breasted Nuthatch	▪	▪	▪	8	0.53
White-winged Crossbill	▪	▪	▪	1	0.07
Wilson's Snipe	▪	▪	▪	7	0.47
Wilson's Warbler (SD)	▪	▪	▪	4	0.27
Wood Thrush	▪	▪	▪	1	0.07
Yellow-bellied Flycatcher	▪	▪	▪	44	2.9
Yellow Warbler	▪	▪	▪	2	0.13
Cedar Waxwing	- 0.00	0.00	0.96	86	5.7
Golden-crowned Kinglet	- 0.00	0.00	0.90	86	5.7
Red-breasted Nuthatch	- 0.00	0.00	0.88	252	17
Red-eyed Vireo	- 0.00	0.01	0.74	681	45
Black-throated Green Warbler*	- 0.00	0.02	0.58	516	34
Eastern Wood Pewee	- 0.01	0.03	0.57	23	1.5
Rose-breasted Grosbeak	- 0.01	0.05	0.42	97	6.5
Northern Parula	- 0.01	0.07	0.34	338	23
Veery	- 0.01	0.20	0.09	352	23
Common Raven	- 0.02	0.04	0.47	88	5.9
Chipping Sparrow	- 0.02	0.07	0.33	81	5.4
Mourning Warbler	- 0.02	0.20	0.09	237	16
Black-capped Chickadee	- 0.03	0.20	0.10	149	9.9
Blackburnian Warbler	- 0.03	0.25	0.06	221	15
Ovenbird	- 0.01	0.31	0.0326	920	61

¹ SWSP did not fit normal distribution; included because of regularity of data and abundance across years.

EVGR included due to likely ecological importance of decline.

* Outliers were removed from trend analyses for these species.

Table B2 (continued). Regression trends (average proportional change per year), r^2 , P and total and mean individuals observed during 10-minute point counts at Grand Portage National Monument, 1999–2014, arranged by trend and P-value. **Species in bold** indicate $P \leq 0.05$. Species listed as special concern (SC) in Minnesota, species common but in steep decline (SD), or on the NABCI (2014) watch list (WL) in the United States are noted.

Species	Trend	r^2	P	Total Individuals	Mean Individuals Annually
Hermit Thrush	- 0.04	0.28	0.0406	65	4.3
Chestnut-sided Warbler	- 0.04	0.45	0.0065	182	12
Pileated Woodpecker	- 0.05	0.37	0.0170	97	6.5
Downy Woodpecker	- 0.05	0.38	0.0143	60	4
Least Flycatcher	- 0.05	0.44	0.0075	118	7.9
Evening Grosbeak¹ (WL)	- 0.07	0.40	0.0115	59	3.9

¹ SWSP did not fit normal distribution; included because of regularity of data and abundance across years.

EVGR included due to likely ecological importance of decline.

* Outliers were removed from trend analyses for these species.

Table B3. Regression trends (average proportional change per year), r^2 , P and total and mean individuals observed during 3-minute roadside point counts at Indiana Dunes National Lakeshore, 1993–2013, arranged by trend and P-value. **Species in bold** indicate $P \leq 0.05$. Species listed as endangered (EN) or special concern (SC) in Indiana are noted.

Species	Trend	r^2	P	Total Individuals	Mean Individuals Annually
Red-bellied Woodpecker	+ 0.03	0.33	0.0101	108	5.7
Willow Flycatcher*	+ 0.02	0.36	0.0084	145	7.6
Marsh Wren (EN)	+ 0.02	0.23	0.0385	49	2.6
Warbling Vireo	+ 0.01	0.31	0.0137	65	3.4
Red-winged Blackbird	+ 0.01	0.21	0.0476	466	25
Chipping Sparrow*	+ 0.01	0.21	0.05	163	8.6
Common Grackle	+ 0.01	0.11	0.17	95	5
Barn Swallow	+ 0.01	0.09	0.22	134	7.1
Eastern Wood Pewee*	+ 0.01	0.09	0.23	179	9.4
Mourning Dove*	+ 0.01	0.06	0.33	87	4.6
Great Crested Flycatcher	+ 0.01	0.06	0.33	141	7.4
American Goldfinch*	+ 0.01	0.04	0.46	278	15
Yellow Warbler*	+ 0.00	0.07	0.29	462	24
Blue-gray Gnatcatcher*	+ 0.00	0.02	0.56	118	6.2
House Wren	+ 0.00	0.02	0.57	291	15
Common Yellowthroat	+ 0.00	0.01	0.64	374	20
Gray Catbird	+ 0.00	0.01	0.70	359	19
Downy Woodpecker	+ 0.00	0.00	0.89	60	3.2
Acadian Flycatcher	▪	▪	▪	47	2.5
Alder Flycatcher	▪	▪	▪	18	0.95
Baltimore Oriole	▪	▪	▪	19	1
Bank Swallow	▪	▪	▪	10	0.53
Belted Kingfisher	▪	▪	▪	4	0.21
Black-billed Cuckoo	▪	▪	▪	1	0.05
Black-throated Green Warbler	▪	▪	▪	4	0.21
Blue-winged Warbler	▪	▪	▪	9	0.47
Bobolink	▪	▪	▪	1	0.05
Brown Thrasher	▪	▪	▪	13	0.68
Canada Warbler	▪	▪	▪	1	0.05
Carolina Wren	▪	▪	▪	2	0.11
Cerulean Warbler (EN)	▪	▪	▪	19	1
Chestnut-sided Warbler	▪	▪	▪	22	1.15
Dickcissel	▪	▪	▪	2	0.11
Eastern Bluebird	▪	▪	▪	17	0.89
Eastern Kingbird	▪	▪	▪	16	0.84
Eastern Meadowlark	▪	▪	▪	3	0.16
Eastern Phoebe	▪	▪	▪	26	1.4
Field Sparrow	▪	▪	▪	71	3.7
Golden-winged Warbler (EN)	▪	▪	▪	1	0.05
Hairy Woodpecker	▪	▪	▪	4	0.21
Hooded Warbler (SC)	▪	▪	▪	24	1.3
House Finch	▪	▪	▪	28	1.5
Killdeer	▪	▪	▪	11	0.58

* Outliers were removed from trend analyses for these species.

Table B3 (continued). Regression trends (average proportional change per year), r^2 , P and total and mean individuals observed during 3-minute roadside point counts at Indiana Dunes National Lakeshore, 1993–2013, arranged by trend and P-value. **Species in bold** indicate $P \leq 0.05$. Species listed as endangered (EN) or special concern (SC) in Indiana are noted.

Species	Trend	r^2	P	Total Individuals	Mean Individuals Annually
Least Flycatcher	▪	▪	▪	6	0.32
Louisiana Waterthrush	▪	▪	▪	9	0.47
Mourning Warbler	▪	▪	▪	1	0.05
Northern Flicker	▪	▪	▪	11	0.58
Northern Parula	▪	▪	▪	1	0.05
Northern Rough-winged Swallow	▪	▪	▪	3	0.16
Pileated Woodpecker	▪	▪	▪	8	0.42
Prairie Warbler	▪	▪	▪	13	0.68
Purple Martin	▪	▪	▪	5	0.26
Red-headed Woodpecker	▪	▪	▪	4	0.21
Rock Pigeon	▪	▪	▪	13	0.68
Rose-breasted Grosbeak	▪	▪	▪	21	1.1
Ruby-throated Hummingbird	▪	▪	▪	14	0.74
Scarlet Tanager	▪	▪	▪	32	1.7
Sedge Wren (EN)	▪	▪	▪	4	0.21
Summer Tanager	▪	▪	▪	1	0.05
Swainson's Thrush	▪	▪	▪	1	0.05
Tree Swallow	▪	▪	▪	80	4.2
White-breasted Nuthatch	▪	▪	▪	45	2.4
White-eyed Vireo	▪	▪	▪	13	0.68
Yellow-billed Cuckoo	▪	▪	▪	1	0.05
Yellow-breasted Chat	▪	▪	▪	3	0.16
Yellow-throated Vireo	▪	▪	▪	65	3.4
American Redstart	- 0.00	0.00	0.98	229	12
Red-eyed Vireo*	- 0.00	0.00	0.96	315	17
Wood Thrush*	- 0.00	0.00	0.86	98	5.2
House Sparrow	- 0.00	0.00	0.80	110	5.8
Swamp Sparrow*	- 0.00	0.01	0.74	89	4.7
Indigo Bunting	- 0.00	0.02	0.59	215	11
American Robin	- 0.00	0.03	0.51	475	25
Eastern Towhee	- 0.00	0.03	0.48	182	9.6
Brown-headed Cowbird	- 0.00	0.03	0.47	301	15.8
Black-capped Chickadee*	- 0.00	0.06	0.33	101	5.3
Northern Cardinal	- 0.00	0.06	0.30	502	26
American Crow*	- 0.01	0.07	0.31	358	19
Tufted Titmouse	- 0.01	0.06	0.30	183	9.6
Song Sparrow*	- 0.01	0.10	0.21	259	14
European Starling	- 0.02	0.09	0.21	89	4.7
Ovenbird	- 0.02	0.20	0.06	58	3.1
Chimney Swift*	- 0.02	0.20	0.06	123	6.5
Veery	- 0.02	0.33	0.0107	74	3.9
Blue Jay*	- 0.02	0.52	0.0017	103	5.4
Cedar Waxwing	- 0.04	0.39	0.0043	249	13

* Outliers were removed from trend analyses for these species.

Table B4. Regression trends (average proportional change per year), r^2 , P and total and mean individuals observed during 5-minute point counts at Isle Royale National Park, 1996–2013, arranged by trend and P-value. **Species in bold** indicate $P \leq 0.05$. Species listed as special concern (SC) in Michigan and species common but in steep decline (SD) in the United States are noted.

Species	Trend	r^2	P	Total Individuals	Mean Individuals Annually
Alder Flycatcher	+ 0.03	0.55	0.0004	421	23
Red-winged Blackbird	+ 0.03	0.25	0.0365	47	2.6
American Robin	+ 0.02	0.54	0.0005	830	46
Common Yellowthroat	+ 0.02	0.40	0.0046	110	6.1
Red-breasted Nuthatch ¹	+ 0.02	0.38	0.0067	727	40
Swamp Sparrow*	+ 0.01	0.29	0.0303	172	9.6
Swainson's Thrush	+ 0.01	0.24	0.0399	265	15
Golden-crowned Kinglet*	+ 0.02	0.22	0.06	339	19
Northern Parula	+ 0.02	0.13	0.14	39	2.2
Nashville Warbler*	+ 0.01	0.21	0.07	2409	134
Blue Jay*	+ 0.01	0.15	0.12	735	41
Song Sparrow	+ 0.01	0.14	0.12	200	11
Hermit Thrush ¹	+ 0.01	0.13	0.14	1166	65
Northern Waterthrush*	+ 0.01	0.13	0.15	66	3.7
Northern Flicker*	+ 0.01	0.12	0.16	188	10
Hairy Woodpecker	+ 0.01	0.10	0.21	196	11
Black-throated Green Warbler*	+ 0.01	0.09	0.21	1245	69
Winter Wren	+ 0.01	0.09	0.22	2094	116
Yellow-bellied Flycatcher	+ 0.01	0.05	0.35	265	15
Mourning Warbler	+ 0.01	0.05	0.37	344	19
Wilson's Snipe*	+ 0.01	0.04	0.43	200	11
Pileated Woodpecker*	+ 0.01	0.05	0.44	195	11
White-throated Sparrow*	+ 0.00	0.13	0.20	2599	144
Yellow-rumped Warbler	+ 0.00	0.04	0.42	502	28
Magnolia Warbler	+ 0.00	0.03	0.46	986	55
Black-capped Chickadee	+ 0.00	0.01	0.67	633	35
Veery	+ 0.00	0.00	0.84	188	10
American Bittern (SC)	▪	▪	▪	25	1.4
American Goldfinch	▪	▪	▪	35	1.9
Barn Swallow	▪	▪	▪	1	0.06
Bay-breasted Warbler	▪	▪	▪	6	0.33
Belted Kingfisher	▪	▪	▪	15	0.83
Black-backed Woodpecker (SC)	▪	▪	▪	1	0.06
Black-billed Cuckoo	▪	▪	▪	15	0.83
Black-headed Grosbeak	▪	▪	▪	1	0.06
Blue-headed Vireo	▪	▪	▪	29	1.6
Brown Thrasher	▪	▪	▪	1	0.06
Chimney Swift (SD)	▪	▪	▪	24	1.3
Dark-eyed Junco	▪	▪	▪	4	0.22
Eastern Bluebird	▪	▪	▪	1	0.06

¹ Species do not fit normal distribution; HETH and RBNU included because of regularity of data and abundance across years; CMWA and EVGR included due to possible ecological importance of decline.

* Outliers were removed from trend analyses.

Table B4 (continued). Regression trends (average proportional change per year), r^2 , P and total and mean individuals observed during 5-minute point counts at Isle Royale National Park, 1996–2013, arranged by trend and P-value. **Species in bold** indicate $P \leq 0.05$. Species listed as special concern (SC) in Michigan and species common but in steep decline (SD) in the United States are noted.

Species	Trend	r^2	P	Total Individuals	Mean Individuals Annually
Eastern Kingbird	▪	▪	▪	2	0.11
Eastern Phoebe	▪	▪	▪	1	0.06
Eastern Wood Pewee	▪	▪	▪	12	0.67
Gray Catbird	▪	▪	▪	2	0.11
Gray Jay	▪	▪	▪	70	3.9
Great Crested Flycatcher	▪	▪	▪	6	0.33
Indigo Bunting	▪	▪	▪	28	1.6
Marsh Wren (SC)	▪	▪	▪	1	0.06
Mourning Dove	▪	▪	▪	1	0.06
Northern Cardinal	▪	▪	▪	2	0.11
Olive-sided Flycatcher	▪	▪	▪	17	0.94
Orange-crowned Warbler	▪	▪	▪	1	0.06
Palm Warbler	▪	▪	▪	3	0.17
Philadelphia Vireo	▪	▪	▪	2	0.11
Pine Siskin (SD)	▪	▪	▪	68	3.8
Pine Warbler	▪	▪	▪	5	0.28
Purple Finch	▪	▪	▪	21	1.2
Red Crossbill	▪	▪	▪	53	2.9
Rose-breasted Grosbeak	▪	▪	▪	27	1.5
Ruby-crowned Kinglet	▪	▪	▪	35	1.9
Scarlet Tanager	▪	▪	▪	25	1.4
Sedge Wren	▪	▪	▪	3	0.17
Tennessee Warbler	▪	▪	▪	14	0.78
White-breasted Nuthatch	▪	▪	▪	21	1.2
White-winged Crossbill	▪	▪	▪	70	3.9
Wood Thrush	▪	▪	▪	1	0.06
Yellow-bellied Sapsucker	▪	▪	▪	70	3.9
Yellow-billed Cuckoo (SD)	▪	▪	▪	1	0.06
Yellow-breasted Chat	▪	▪	▪	1	0.06
Yellow Warbler	▪	▪	▪	3	0.17
Common Grackle (SD)*	- 0.00	0.00	0.98	102	5.7
Blackburnian Warbler	- 0.00	0.00	0.97	175	9.7
Cedar Waxwing*	- 0.00	0.00	0.97	395	22
Black-throated Blue Warbler	- 0.00	0.00	0.88	147	8.2
Ovenbird	- 0.00	0.00	0.81	2472	137
Canada Warbler*	- 0.00	0.02	0.63	78	4.3
Red-eyed Vireo*	- 0.00	0.03	0.62	1620	90
Least Flycatcher	- 0.01	0.04	0.45	64	3.6
Chestnut-sided Warbler	- 0.01	0.12	0.15	861	48
American Redstart	- 0.01	0.15	0.11	491	27

¹ Species do not fit normal distribution; HETH and RBNU included because of regularity of data and abundance across years; CMWA and EVGR included due to possible ecological importance of decline.

* Outliers were removed from trend analyses.

Table B4 (continued). Regression trends (average proportional change per year), r^2 , P and total and mean individuals observed during 5-minute point counts at Isle Royale National Park, 1996–2013, arranged by trend and P-value. **Species in bold** indicate $P \leq 0.05$. Species listed as special concern (SC) in Michigan and species common but in steep decline (SD) in the United States are noted.

Species	Trend	r^2	P	Total Individuals	Mean Individuals Annually
Brown Creeper*	- 0.01	0.19	0.09	365	20
Black-and-White Warbler*	- 0.01	0.20	0.07	204	11
Downy Woodpecker	- 0.02	0.17	0.09	183	10
American Crow	- 0.02	0.40	0.0047	477	27
Common Raven	- 0.03	0.61	0.0001	228	13
Chipping Sparrow	- 0.04	0.58	0.0002	196	11
Cape May Warbler (SD) ¹	- 0.06	0.54	0.0005	45	2.5
Evening Grosbeak ¹	- 0.06	0.58	0.0003	35	1.9

¹ Species do not fit normal distribution; HETH and RBNU included because of regularity of data and abundance across years; CMWA and EVGR included due to possible ecological importance of decline.

* Outliers were removed from trend analyses.

Table B5. Regression trends (average proportional change per year) for species showing no significant change, including r^2 , P and total and mean individuals observed annually during 3-minute point counts at Saint Croix National Scenic Riverway, 1998–2014, arranged alphabetically by trend and P-value. Non-normal distribution indicated by “▪” symbol; species not occurring indicated by “n/a”. Species listed as threatened (THR) or special concern (SC) in Wisconsin and species that are on a watch list (WL) or common but in steep decline (SD) in the United States are noted. See discussion section for cautions regarding SACN data.

	LOSA-LNAM routes					UNAM-SACN routes				
	Trend	r^2	P	Total Individuals	Mean Individuals	Trend	r^2	P	Total Individuals	Mean Individuals
Increasing Trends, n = 10										
American Robin	+ 0.00	0.02	0.76	349	44	▪	▪	▪	240	35
Common Grackle (SD)	+ 0.03	0.36	0.12	101	13	+ 0.03	0.10	0.50	54	7.7
Eastern Towhee	+ 0.00	0.00	0.89	14	1.8	▪	▪	▪	4	0.57
Gray Catbird	+ 0.00	0.00	0.96	206	26	+ 0.01	0.13	0.42	149	21
Northern Waterthrush	▪	▪	▪	3	0.38	+ 0.02	0.06	0.61	21	3
Red-winged Blackbird	+ 0.01	0.14	0.36	238	30	+ 0.01	0.12	0.45	314	45
Rock Pigeon	+ 0.03	0.23	0.23	17	2.1	▪	▪	▪	3	0.43
Ruby-throated Hummingbird	▪	▪	▪	8	1	+ 0.01	0.04	0.66	10	1.4
Wood Thrush (SC, WL)	+ 0.01	0.20	0.26	21	2.6	+ 0.01	0.17	0.36	83	12
Yellow Warbler	+ 0.02	0.34	0.13	236	30	+ 0.02	0.32	0.19	272	39
Mixed or No Trends, n = 38										
Acadian Flycatcher (THR)	▪	▪	▪	1	0.13	▪	▪	▪	1	0.14
Alder Flycatcher	+ 0.01	0.03	0.70	33	4.1	- 0.01	0.21	0.30	83	12
Black-billed Cuckoo (SC, WL)	+ 0.00	0.02	0.76	12	1.5	▪	▪	▪	5	0.71
Blackpoll Warbler (SD)	▪	▪	▪	2	0.25	▪	▪	▪	2	0.29
Blue-winged Warbler (SC)	▪	▪	▪	1	0.13	▪	▪	▪	10	1.4
Brown Creeper	▪	▪	▪	1	0.13	▪	▪	▪	3	0.43
Brown-headed Cowbird	- 0.02	0.44	0.07	255	32	+ 0.00	0.01	0.87	71	10
Canada Warbler (SC, WL)	+ 0.03	0.38	0.10	47	5.9	- 0.01	0.33	0.23	73	10
Cape May Warbler (SC, SD)	n/a	n/a	n/a	n/a	n/a	▪	▪	▪	3	0.43
Cerulean Warbler (THR, WL)	▪	▪	▪	4	0.5	▪	▪	▪	1	0.14
Chestnut-sided Warbler	+ 0.01	0.06	0.55	191	24	- 0.01	0.43	0.15	380	54
Clay-colored Sparrow	▪	▪	▪	2	0.25	▪	▪	▪	1	0.14
Connecticut Warbler (SC)	▪	▪	▪	1	0.13	n/a	n/a	n/a	n/a	n/a
Eastern Bluebird	▪	▪	▪	7	0.88	▪	▪	▪	2	0.29
Evening Grosbeak (SC, WL)	▪	▪	▪	1	0.13	▪	▪	▪	5	0.71
Field Sparrow (SC, SD)	▪	▪	▪	3	0.38	n/a	n/a	n/a	n/a	n/a
Great Crested Flycatcher	+ 0.00	0.11	0.47	294	37	- 0.03	0.26	0.24	125	18
Hairy Woodpecker	+ 0.00	0.14	0.41	118	15	- 0.00	0.00	0.88	65	9.3

Table B5 (continued). Regression trends (average proportional change per year) for species showing no significant change, including r^2 , P and total and mean individuals observed annually during 3-minute point counts at Saint Croix National Scenic Riverway, 1998–2014, arranged alphabetically by trend and P-value. Non-normal distribution indicated by “▪” symbol; species not occurring indicated by “n/a”. Species listed as threatened (THR) or special concern (SC) in Wisconsin and species that are on a watch list (WL) or common but in steep decline (SD) in the United States are noted. See discussion section for cautions regarding SACN data.

	LOSA-LNAM routes					UNAM-SACN routes				
	Trend	r^2	P	Total Individuals	Mean Individuals	Trend	r^2	P	Total Individuals	Mean Individuals
Mixed or No Trends, n = 38										
Hermit Thrush	▪	▪	▪	7	0.88	▪	▪	▪	9	1.3
House Finch	▪	▪	▪	2	0.25	n/a	n/a	n/a	n/a	n/a
House Sparrow	▪	▪	▪	1	0.13	n/a	n/a	n/a	n/a	n/a
Killdeer	▪	▪	▪	2	0.25	▪	▪	▪	1	0.14
Magnolia Warbler	n/a	n/a	n/a	n/a	n/a	▪	▪	▪	2	0.29
Marsh Wren	▪	▪	▪	7	0.88	n/a	n/a	n/a	n/a	n/a
Mourning Dove	- 0.02	0.31	0.15	99	12	+ 0.02	0.40	0.13	59	8.4
Purple Finch	n/a	n/a	n/a	n/a	n/a	▪	▪	▪	5	0.71
Purple Martin (SC)	n/a	n/a	n/a	n/a	n/a	▪	▪	▪	1	0.14
Red-bellied Woodpecker	- 0.00	0.01	0.85	138	17	+ 0.01	0.21	0.30	44	6.3
Red-breasted Nuthatch	- 0.01	0.07	0.53	24	3	+ 0.00	0.02	0.79	72	10
Ruffed Grouse	▪	▪	▪	3	0.38	▪	▪	▪	3	0.43
Song Sparrow	- 0.01	0.43	0.08	1174	147	+ 0.00	0.00	0.89	809	116
Swainson's Thrush (SC)	▪	▪	▪	1	0.13	n/a	n/a	n/a	n/a	n/a
Veery (SC)	- 0.01	0.36	0.12	413	52	+ 0.02	0.55	0.06	359	51
Willow Flycatcher	▪	▪	▪	1	0.13	n/a	n/a	n/a	n/a	n/a
Wilson's Snipe	n/a	n/a	n/a	n/a	n/a	▪	▪	▪	1	0.14
Yellow-bellied Sapsucker	- 0.02	0.11	0.41	44	5.5	+ 0.00	0.01	0.80	37	5.3
Yellow-headed Blackbird (SC)	▪	▪	▪	5	0.63	n/a	n/a	n/a	n/a	n/a
Yellow-rumped Warbler	▪	▪	▪	4	0.5	▪	▪	▪	13	1.9
Negative Trends, n = 27										
American Goldfinch	- 0.00	0.03	0.70	246	30	▪	▪	▪	76	11
American Redstart	- 0.02	0.31	0.15	208	26	- 0.01	0.05	0.62	229	33
Baltimore Oriole	- 0.01	0.06	0.57	400	50	- 0.00	0.01	0.87	100	14
Bank Swallow (SD)	- 0.06	0.30	0.16	1168	146	n/a	n/a	n/a	n/a	n/a
Barn Swallow	- 0.04	0.46	0.07	22	2.8	▪	▪	▪	2	0.29
Blackburnian Warbler	▪	▪	▪	3	0.38	- 0.06	0.37	0.14	28	4

Table B5 (continued). Regression trends (average proportional change per year) for species showing no significant change, including r^2 , P and total and mean individuals observed annually during 3-minute point counts at Saint Croix National Scenic Riverway, 1998–2014, arranged alphabetically by trend and P-value. Non-normal distribution indicated by “▪” symbol; species not occurring indicated by “n/a”. Species listed as threatened (THR) or special concern (SC) in Wisconsin and species that are on a watch list (WL) or common but in steep decline (SD) in the United States are noted. See discussion section for cautions regarding SACN data.

	LOSA-LNAM routes					UNAM-SACN routes				
	Trend	r^2	P	Total Individuals	Mean Individuals	Trend	r^2	P	Total Individuals	Mean Individuals
Negative Trends, n = 27										
Black-throated Green Warbler	n/a	n/a	n/a	n/a	n/a	- 0.03	0.20	0.31	7	1
Blue-headed Vireo	▪	▪	▪	4	0.5	- 0.02	0.28	0.22	16	2.3
Blue Jay	- 0.00	0.07	0.53	250	31	- 0.01	0.09	0.52	237	34
Brown Thrasher (SC)	- 0.02	0.17	0.31	10	1.3	▪	▪	▪	12	1.7
Chimney Swift (SD)	- 0.03	0.22	0.25	20	2.5	n/a	n/a	n/a	n/a	n/a
Cliff Swallow	- 0.02	0.02	0.72	476	60	▪	▪	▪	2	0.29
Common Raven	- 0.00	0.00	0.92	24	3	- 0.01	0.05	0.62	18	2.6
Common Yellowthroat	- 0.02	0.43	0.08	557	70	- 0.02	0.24	0.27	564	81
European Starling	- 0.02	0.09	0.48	26	3.3	▪	▪	▪	3	0.43
House Wren	- 0.03	0.39	0.10	95	12	▪	▪	▪	4	0.57
Louisiana Waterthrush (SC)	- 0.02	0.07	0.54	25	3.1	▪	▪	▪	10	1.4
Northern Cardinal	- 0.01	0.15	0.35	92	12	▪	▪	▪	3	0.43
Northern Flicker	- 0.00	0.03	0.68	88	11	- 0.02	0.11	0.48	80	11
Northern Rough-winged Swallow	- 0.03	0.42	0.08	271	34	- 0.05	0.41	0.12	17	2.4
Pileated Woodpecker	- 0.01	0.11	0.41	54	6.8	- 0.02	0.26	0.25	34	4.9
Pine Warbler	- 0.01	0.09	0.48	75	9.4	- 0.01	0.22	0.35	59	8.4
Prothonotary Warbler (SC, WL)	- 0.01	0.05	0.59	216	27	n/a	n/a	n/a	n/a	n/a
Scarlet Tanager	- 0.03	0.38	0.11	131	16	- 0.02	0.44	0.11	47	6.7
Swamp Sparrow	- 0.01	0.21	0.25	44	5.5	- 0.01	0.15	0.40	96	14
White-throated Sparrow	▪	▪	▪	1	0.13	- 0.00	0.22	0.29	151	22
Yellow-billed Cuckoo (SC, SD)	▪	▪	▪	28	3.5	- 0.05	0.26	0.25	27	3.9

Table B6. Regression trends (average proportional change per year), r^2 , P and total and mean individuals observed during 10-minute point counts at Sleeping Bear Dunes National Lakeshore, 2004–2006 and 2009–2013, arranged by trend and P-value. **Species in bold** indicate $P \leq 0.05$. Species listed as special concern (SC) in Michigan, species common but in steep decline (SD), or on the NABCI (2014) watch list (WL) in the United States are noted.

Species	Trend	r^2	P	Total Individuals	Mean Individuals Annually
Veery (SD)	+ 0.07	0.63	0.0185	19	2.38
Eastern Meadowlark (SD)	+ 0.05	0.75	0.0055	95	11.88
Wood Thrush* (WL)	+ 0.03	0.77	0.0099	65	8.13
American Robin*	+ 0.03	0.59	0.0450	297	37.13
Red-eyed Vireo	+ 0.02	0.52	0.0436	350	43.75
Field Sparrow	+ 0.05	0.44	0.07	26	3.25
Hairy Woodpecker	+ 0.05	0.37	0.11	16	2
Eastern Bluebird	+ 0.04	0.37	0.11	49	6.13
Eastern Towhee	+ 0.04	0.31	0.15	24	3
Cedar Waxwing	+ 0.04	0.20	0.26	105	13.13
Black-capped Chickadee	+ 0.03	0.36	0.12	72	9
Red-bellied Woodpecker	+ 0.03	0.30	0.16	14	1.75
Pine Warbler	+ 0.03	0.21	0.25	54	6.75
Yellow-rumped Warbler	+ 0.03	0.10	0.44	28	3.5
Bank Swallow	+ 0.03	0.04	0.62	48	6
American Redstart*	+ 0.02	0.42	0.11	132	16.5
Red-winged Blackbird	+ 0.02	0.29	0.17	300	37.5
Common Yellowthroat	+ 0.02	0.23	0.23	98	12.25
Eastern Wood Pewee	+ 0.02	0.19	0.28	97	12.13
Rose-breasted Grosbeak	+ 0.02	0.16	0.32	104	13
Yellow Warbler	+ 0.02	0.16	0.33	54	6.75
Pileated Woodpecker	+ 0.02	0.12	0.40	15	1.88
Northern Flicker	+ 0.02	0.11	0.43	59	7.38
Song Sparrow	+ 0.01	0.16	0.33	168	21
Least Flycatcher	+ 0.01	0.06	0.56	51	6.38
Chipping Sparrow*	+ 0.01	0.05	0.62	103	12.88
White-throated Sparrow	+ 0.01	0.04	0.64	15	1.88
Hermit Thrush	+ 0.01	0.03	0.69	36	4.5
Great Crested Flycatcher	+ 0.01	0.02	0.74	57	7.13
Yellow-throated Vireo	+ 0.01	0.02	0.75	17	2.13
Indigo Bunting	+ 0.00	0.02	0.77	71	8.88
Grasshopper Sparrow* (SC)	+ 0.00	0.01	0.82	14	1.75
Ovenbird*	+ 0.00	0.01	0.84	187	23.38
Vesper Sparrow	+ 0.00	0.00	0.88	68	8.5
Red-breasted Nuthatch	+ 0.00	0.00	0.92	18	2.25
Blue Jay	+ 0.00	0.00	0.94	133	16.6
Black-and-White Warbler	▪	▪	▪	7	0.88
Blue-headed Vireo	▪	▪	▪	4	0.5
Brown-headed Cowbird	▪	▪	▪	10	1.25
Brown Creeper	▪	▪	▪	6	0.75

* Outliers were removed from trend analyses for these species.

Table B6 (continued). Regression trends (average proportional change per year), r^2 , P and total and mean individuals observed during 10-minute point counts at Sleeping Bear Dunes National Lakeshore, 2004–2006 and 2009–2013, arranged by trend and P-value. **Species in bold** indicate $P \leq 0.05$. Species listed as special concern (SC) in Michigan, species common but in steep decline (SD), or on the NABCI (2014) watch list (WL) in the United States are noted.

Species	Trend	r^2	P	Total Individuals	Mean Individuals Annually
Canada Warbler (WL)	•	•	•	1	1.13
Chestnut-sided Warbler	•	•	•	8	1
Chimney Swift (SD)	•	•	•	6	0.75
Clay-colored Sparrow	•	•	•	1	0.13
Dickcissel (SC)	•	•	•	6	0.75
Downy Woodpecker	•	•	•	11	1.38
House Finch	•	•	•	6	0.75
Magnolia Warbler	•	•	•	2	0.25
Mourning Warbler	•	•	•	1	0.13
Nashville Warbler	•	•	•	17	2.13
Northern Mockingbird	•	•	•	1	0.13
Northern Parula	•	•	•	1	0.13
Northern Waterthrush	•	•	•	4	0.5
Olive-sided Flycatcher (WL)	•	•	•	1	0.13
Prairie Warbler (WL)	•	•	•	10	1.25
Purple Finch	•	•	•	1	0.13
Red-headed Woodpecker (WL)	•	•	•	1	0.13
Ruby-throated Hummingbird	•	•	•	9	1.13
Savannah Sparrow	•	•	•	2	0.25
Sedge Wren	•	•	•	5	0.63
Swainson's Thrush	•	•	•	1	0.13
Tufted Titmouse	•	•	•	5	0.63
White-breasted Nuthatch	•	•	•	15	1.88
Winter Wren	•	•	•	9	1.13
Yellow-bellied Sapsucker	•	•	•	7	0.88
Yellow-billed Cuckoo (SD)	•	•	•	18	2.25
Warbling Vireo	- 0.00	0.00	0.99	30	3.75
Brown Thrasher	- 0.00	0.00	0.98	29	3.63
Mourning Dove	- 0.00	0.00	0.93	177	22.13
Common Grackle* (SD)	- 0.00	0.01	0.83	87	10.88
European Starling	- 0.01	0.01	0.87	68	8.5
Black-throated Green Warbler	- 0.01	0.01	0.79	35	4.38
Swamp Sparrow	- 0.01	0.02	0.77	35	4.38
Common Raven	- 0.01	0.02	0.77	45	5.63
Tree Swallow	- 0.01	0.02	0.76	113	14.13
Baltimore Oriole	- 0.01	0.03	0.67	80	10
Eastern Kingbird*	- 0.01	0.04	0.66	76	9.5
Scarlet Tanager	- 0.01	0.04	0.62	90	11.25
Alder Flycatcher*	- 0.01	0.08	0.60	14	1.75
American Crow	- 0.01	0.20	0.27	204	25.5

* Outliers were removed from trend analyses for these species.

Table B6 (continued). Regression trends (average proportional change per year), r^2 , P and total and mean individuals observed during 10-minute point counts at Sleeping Bear Dunes National Lakeshore, 2004–2006 and 2009–2013, arranged by trend and P-value. **Species in bold** indicate $P \leq 0.05$. Species listed as special concern (SC) in Michigan, species common but in steep decline (SD), or on the NABCI (2014) watch list (WL) in the United States are noted.

Species	Trend	r^2	P	Total Individuals	Mean Individuals Annually
Eastern Phoebe	- 0.02	0.05	0.59	17	2.13
Barn Swallow	- 0.02	0.06	0.56	19	2.38
Upland Sandpiper	- 0.02	0.07	0.52	21	2.63
American Goldfinch	- 0.02	0.17	0.32	108	13.5
Northern Cardinal	- 0.02	0.17	0.32	17	2.13
Bobolink (WL)	- 0.02	0.42	0.08	64	8
Gray Catbird	- 0.03	0.44	0.07	40	5
House Wren	- 0.03	0.12	0.40	23	2.88
Belted Kingfisher	- 0.04	0.27	0.19	14	1.75
Black-throated Blue Warbler	- 0.05	0.35	0.12	11	1.38
Black-billed Cuckoo (WL)	- 0.08	0.33	0.14	31	3.88

* Outliers were removed from trend analyses for these species.

Table B7. Regression trends (average proportional change per year), r^2 , P and total and mean individuals observed during 10-minute point counts at Voyageurs National Park, 1997–2013, arranged by trend and P-value. **Species in bold** indicate $P \leq 0.05$. Species listed as common but in steep decline (SD), or on the NABCI (2014) watch list (WL) in the United States are noted.

Species	Trend	r^2	P	Total Individuals	Mean Individuals Annually
Blue-headed Vireo	+ 0.02	0.25	0.0398	29	1.7
Common Grackle (SD)	+ 0.03	0.09	0.23	73	4.3
Yellow-rumped Warbler	+ 0.02	0.18	0.09	102	6
Canada Warbler ¹ (WL)	+ 0.02	0.18	0.09	90	5.3
Black-and-White Warbler	+ 0.01	0.20	0.07	320	19
Red-breasted Nuthatch*	+ 0.01	0.19	0.09	242	14
Common Raven	+ 0.01	0.04	0.42	95	5.6
Hermit Thrush	+ 0.01	0.04	0.44	253	15
Winter Wren	+ 0.01	0.03	0.54	208	12
Black-throated Green Warbler*	+ 0.00	0.03	0.56	193	11
Least Flycatcher	+ 0.00	0.01	0.68	266	16
Common Yellowthroat	+ 0.00	0.01	0.73	106	6.2
Northern Flicker*	+ 0.00	0.00	0.87	117	6.9
Alder Flycatcher	▪	▪	▪	3	0.18
American Bittern	▪	▪	▪	23	1.4
American Goldfinch	▪	▪	▪	28	1.6
American Redstart	▪	▪	▪	63	3.7
Baltimore Oriole	▪	▪	▪	4	0.24
Bay-breasted Warbler	▪	▪	▪	1	0.06
Belted Kingfisher	▪	▪	▪	1	0.06
Black-throated Blue Warbler	▪	▪	▪	1	0.06
Blue-winged Warbler	▪	▪	▪	7	0.41
Brown-headed Cowbird	▪	▪	▪	12	0.71
Cape May Warbler (SD)	▪	▪	▪	7	0.41
Cedar Waxwing	▪	▪	▪	125	7.4
Downy Woodpecker	▪	▪	▪	19	1.1
Eastern Kingbird	▪	▪	▪	7	0.41
Eastern Phoebe	▪	▪	▪	8	0.47
European Starling	▪	▪	▪	1	0.06
Golden-crowned Kinglet	▪	▪	▪	13	0.76
Gray Jay	▪	▪	▪	21	1.2
Indigo Bunting	▪	▪	▪	3	0.18
Northern Waterthrush	▪	▪	▪	7	0.41
Olive-sided Flycatcher (WL)	▪	▪	▪	1	0.06
Palm Warbler	▪	▪	▪	1	0.06
Philadelphia Vireo	▪	▪	▪	1	0.06
Pileated Woodpecker	▪	▪	▪	58	3.4
Pine Siskin (SD)	▪	▪	▪	1	0.06
Pine Warbler	▪	▪	▪	35	2.1
Purple Finch	▪	▪	▪	30	1.8
Red-headed Woodpecker (WL)	▪	▪	▪	2	0.12

¹ BCCH and CAWA do not fit normal distribution; included because of regularity of data and abundance across years. EVGR included due to likely ecological importance of decline.

* Outliers were removed from trend analyses for these species.

Table B7 (continued). Regression trends (average proportional change per year), r^2 , P and total and mean individuals observed during 10-minute point counts at Voyageurs National Park, 1997–2013, arranged by trend and P-value. **Species in bold** indicate $P \leq 0.05$. Species listed as common but in steep decline (SD), or on the NABCI (2014) watch list (WL) in the United States are noted.

Species	Trend	r^2	P	Total Individuals	Mean Individuals Annually
Red Crossbill	▪	▪	▪	21	1.2
Ruby-crowned Kinglet	▪	▪	▪	23	1.4
Ruby-throated Hummingbird	▪	▪	▪	22	1.3
Ruffed Grouse	▪	▪	▪	35	2.1
Scarlet Tanager	▪	▪	▪	32	1.9
Swainson's Thrush	▪	▪	▪	12	0.71
Tennessee Warbler	▪	▪	▪	10	0.59
Tree Swallow	▪	▪	▪	19	1.1
White-breasted Nuthatch	▪	▪	▪	8	0.47
Wilson's Snipe	▪	▪	▪	1	0.06
Yellow-bellied Flycatcher	▪	▪	▪	4	0.24
Yellow Warbler	▪	▪	▪	3	0.18
Brown Creeper	- 0.00	0.00	0.97	87	5.1
Eastern Wood Pewee	- 0.00	0.00	0.93	100	5.9
Swamp Sparrow	- 0.00	0.00	0.85	53	3.1
Hairy Woodpecker	- 0.00	0.00	0.81	32	1.9
Blue Jay	- 0.00	0.01	0.78	281	17
American Robin	- 0.00	0.01	0.77	233	14
Magnolia Warbler*	- 0.00	0.01	0.75	245	14
Chipping Sparrow*	- 0.00	0.02	0.65	272	16
Black-capped Chickadee ¹	- 0.00	0.02	0.60	189	11
Red-eyed Vireo*	- 0.00	0.06	0.37	1381	81
Northern Parula*	- 0.00	0.14	0.17	226	13
Song Sparrow	- 0.01	0.01	0.69	39	2.3
Yellow-bellied Sapsucker	- 0.01	0.05	0.41	251	15
White-throated Sparrow	- 0.01	0.14	0.15	1174	69
Veery*	- 0.01	0.14	0.15	341	20
Blackburnian Warbler	- 0.01	0.22	0.06	352	21
Red-winged Blackbird*	- 0.02	0.08	0.28	135	7.9
Nashville Warbler	- 0.01	0.25	0.0402	951	56
Ovenbird*	- 0.01	0.55	0.0009	1424	84
American Crow*	- 0.02	0.34	0.0173	488	29
Mourning Warbler*	- 0.02	0.56	0.0008	249	15
Chestnut-sided Warbler*	- 0.02	0.60	0.0004	342	20
Rose-breasted Grosbeak	- 0.03	0.27	0.0320	63	3.7
Great Crested Flycatcher	- 0.03	0.64	0.0001	93	5.5
Evening Grosbeak ¹ (WL)	- 0.06	0.44	0.0036	45	2.6

¹ BCCH and CAWA do not fit normal distribution; included because of regularity of data and abundance across years. EVGR included due to likely ecological importance of decline.

* Outliers were removed from trend analyses for these species.

Appendix C: Distance Analysis Details

Terms defined from Buckland et al. (2001) include density of animals in the area (D), encounter rate for observed objects per transect effort (n/K), effective detection radius (EDR), and the probability that an object is observed in the area (p). Area equals one hectare; EDR is the radius around a point where as many objects beyond the radius are detected as those remaining undetected within the radius; AICc is the lowest Akaike's Information Criterion result based on iterative covariate inclusion and realistic standard error.

Table C1. Results from distance-detectability models of point count surveys at Grand Portage National Monument, including estimates of density per hectare (D) with standard error (SE), encounter rate (n/K, or observations per unit of effort), global detection radius (EDR) in meters, global probability of observing a bird (p) per hectare, and individuals observed. All models were Half-normal.

<i>American Redstart</i>				<i>Blackburnian Warbler</i>			
Year	D (SE)	n/K	Observed	Year	D (SE)	n/K	Observed
2004	0.030 (0.009)	0.055	23	2004	0.021 (0.008)	0.026	11
2005	0.014 (0.005)	0.026	11	2005	0.006 (0.003)	0.007	3
2006	0.026 (0.009)	0.048	20	2006	0.025 (0.008)	0.031	13
2007	0.038 (0.010)	0.069	29	2007	0.044 (0.012)	0.055	23
2008	0.045 (0.012)	0.081	34	2008	0.017 (0.007)	0.022	9
2009	0.034 (0.009)	0.062	26	2009	0.015 (0.006)	0.019	8
2010	0.017 (0.006)	0.031	13	2010	0.010 (0.005)	0.012	5
2011	0.020 (0.006)	0.036	15	2011	0.019 (0.007)	0.024	10
2012	0.025 (0.008)	0.045	19	2012	0.011 (0.005)	0.014	6
2013	0.014 (0.005)	0.026	11	2013	0.015 (0.006)	0.019	8
2014	0.029 (0.010)	0.053	22	2014	0.019 (0.007)	0.024	10
Global	0.027		223	Global	0.018		106
(AICc: 296.43, EDR: 76.1, p: 0.580)				(AICc: 148.83, EDR: 63.0, p: 0.397)			
<i>Black-throated Green Warbler</i>				<i>Canada Warbler</i>			
Year	D (SE)	n/K	Observed	Year	D (SE)	n/K	Observed
2004	0.008 (0.003)	0.026	11	2004	0.004 (0.002)	0.010	4
2005	0.011 (0.004)	0.036	15	2005	0.007 (0.003)	0.017	7
2006	0.008 (0.003)	0.026	11	2006	0.008 (0.003)	0.019	8
2007	0.010 (0.003)	0.031	13	2007	0.011 (0.004)	0.026	11
2008	0.012 (0.004)	0.038	16	2008	0.010 (0.004)	0.024	10
2009	0.008 (0.003)	0.026	11	2009	0.005 (0.002)	0.012	5
2010	0.009 (0.004)	0.029	12	2010	0.003 (0.002)	0.007	3
2011	0.004 (0.002)	0.012	5	2011	0.002 (0.002)	0.005	2
2012	0.006 (0.003)	0.019	8	2012	0.008 (0.004)	0.019	8
2013	0.005 (0.003)	0.017	7	2013	0.008 (0.003)	0.019	8
2014	0.009 (0.004)	0.029	12	2014	0.014 (0.006)	0.036	15
Global	0.008		121	Global	0.007		81
(AICc: 122.19, EDR: 100, p: 1.0)				(AICc: 100.50, EDR: 89.2, p: 0.80)			

Table C1 (continued). Results from distance-detectability models of point count surveys at Grand Portage National Monument, including estimates of density per hectare (D) with standard error (SE), encounter rate (n/K, or observations per unit of effort), global detection radius (EDR) in meters, global probability of observing a bird (p) per hectare, and individuals observed. All models were Half-normal.

<i>Magnolia Warbler</i>				<i>Nashville Warbler</i>			
Year	D (SE)	n/K	Observed	Year	D (SE)	n/K	Observed
2004	0.008 (0.003)	0.026	11	2004	0.006 (0.002)	0.019	8
2005	0.010 (0.004)	0.031	13	2005	0.004 (0.002)	0.012	5
2006	0.007 (0.003)	0.022	9	2006	0.009 (0.003)	0.029	12
2007	0.016 (0.005)	0.050	21	2007	0.011 (0.004)	0.033	14
2008	0.016 (0.005)	0.050	21	2008	0.018 (0.005)	0.055	23
2009	0.014 (0.005)	0.045	19	2009	0.021 (0.006)	0.067	28
2010	0.014 (0.005)	0.045	19	2010	0.010 (0.004)	0.031	13
2011	0.007 (0.003)	0.022	9	2011	0.005 (0.002)	0.014	6
2012	0.010 (0.003)	0.031	13	2012	0.009 (0.003)	0.029	12
2013	0.011 (0.004)	0.033	14	2013	0.007 (0.003)	0.022	9
2014	0.016 (0.005)	0.050	21	2014	0.017 (0.005)	0.053	22
Global	0.012		170	Global	0.011		152
(AICc: 189.92, EDR: 100, p: 1.0)				(AICc: 170.78, EDR: 100, p: 1.0)			
<i>Northern Parula</i>				<i>Ovenbird</i>			
Year	D (SE)	n/K	Observed	Year	D (SE)	n/K	Observed
2004	0.009 (0.003)	0.029	12	2004	0.030 (0.008)	0.096	40
2005	0.005 (0.002)	0.017	7	2005	0.021 (0.006)	0.065	27
2006	0.002 (0.001)	0.007	3	2006	0.003 (0.002)	0.010	4
2007	0.012 (0.004)	0.038	16	2007	0.008 (0.003)	0.024	10
2008	0.010 (0.003)	0.031	13	2008	0.011 (0.004)	0.036	15
2009	0.008 (0.003)	0.024	10	2009	0.012 (0.004)	0.038	16
2010	0.006 (0.002)	0.019	8	2010	0.007 (0.003)	0.022	9
2011	0.009 (0.003)	0.029	12	2011	0.003 (0.002)	0.010	4
2012	0.010 (0.004)	0.031	13	2012	0.008 (0.003)	0.026	11
2013	0.008 (0.003)	0.026	11	2013	0.009 (0.003)	0.029	12
2014	0.014 (0.005)	0.043	18	2014	0.018 (0.005)	0.057	24
Global	0.009		123	Global	0.012		172
(AICc: 136.52, EDR: 100, p: 1.0)				(AICc: 182.28, EDR: 100, p: 1.0)			
<i>Red-eyed Vireo</i>				<i>White-throated Sparrow</i>			
Year	D (SE)	n/K	Observed	Year	D (SE)	n/K	Observed
2004	0.020 (0.006)	0.062	26	2004	0.033 (0.010)	0.053	22
2005	0.013 (0.005)	0.041	17	2005	0.033 (0.012)	0.053	22
2006	0.003 (0.002)	0.010	4	2006	0.009 (0.004)	0.014	6
2007	0.018 (0.006)	0.057	24	2007	0.018 (0.007)	0.029	12
2008	0.018 (0.005)	0.055	23	2008	0.006 (0.003)	0.010	4
2009	0.014 (0.005)	0.043	18	2009	0.012 (0.005)	0.019	8
2010	0.006 (0.002)	0.019	8	2010	0.013 (0.005)	0.022	9
2011	0.005 (0.003)	0.017	7	2011	0.007 (0.004)	0.012	5
2012	0.008 (0.003)	0.026	11	2012	0.016 (0.006)	0.026	11
2013	0.005 (0.002)	0.014	6	2013	0.010 (0.005)	0.017	7
2014	0.011 (0.004)	0.036	15	2014	0.010 (0.005)	0.017	7
Global	0.011		159	Global	0.015		113
(AICc: 161.62, EDR: 100, p: 1.0)				(AICc: 154.76, EDR: 71.4, p: 0.510)			

Table C1 (continued). Results from distance-detectability models of point count surveys at Grand Portage National Monument, including estimates of density per hectare (D) with standard error (SE), encounter rate (n/K, or observations per unit of effort), global detection radius (EDR) in meters, global probability of observing a bird (p) per hectare, and individuals observed. All models were Half-normal.

<i>Yellow-bellied Sapsucker</i>			
Year	D (SE)	n/K	Observed
2004	0.010 (0.005)	0.017	7
2005	0.017 (0.007)	0.029	12
2006	0.007 (0.003)	0.012	5
2007	0.011 (0.005)	0.019	8
2008	0.006 (0.003)	0.010	4
2009	0.018 (0.007)	0.031	13
2010	0.018 (0.006)	0.031	13
2011	0.007 (0.004)	0.012	5
2012	0.007 (0.004)	0.012	5
2013	0.013 (0.005)	0.022	9
2014	0.011 (0.005)	0.019	8
Global	0.012		89
(AICc: 121.34, EDR: 73.2, p: 0.536)			

Table C2. Trend comparisons for n(log+1) indices and density estimates for common species at Grand Portage National Monument, from annual surveys in 2004–2014. **Bold** = significant trend.

Species by model		P	r ²
American Redstart	n(log+1)	0.535	0.044
	Density	0.521	0.047
Blackburnian Warbler	n(log+1)	0.799	0.008
	Density	0.518	0.048
Black-throated Green Warbler	n(log+1)	0.110	0.258
	Density	0.123	0.244
Canada Warbler	n(log+1)	0.657	0.023
	Density	0.473	0.059
Magnolia Warbler	n(log+1)	0.447	0.066
	Density	0.412	0.076
Nashville Warbler	n(log+1)	0.407	0.078
	Density	0.456	0.063
Northern Parula	n(log+1)	0.170	0.198
	Density	0.148	0.217
Ovenbird	n(log+1)	0.502	0.052
	Density	0.230	0.155
Red-eyed Vireo	n(log+1)	0.263	0.136
	Density	0.116	0.251
White-throated Sparrow	n(log+1)	0.093	0.281
	Density	0.0346	0.407
Yellow-bellied Sapsucker	n(log+1)	0.954	0.000
	Density	0.893	0.002

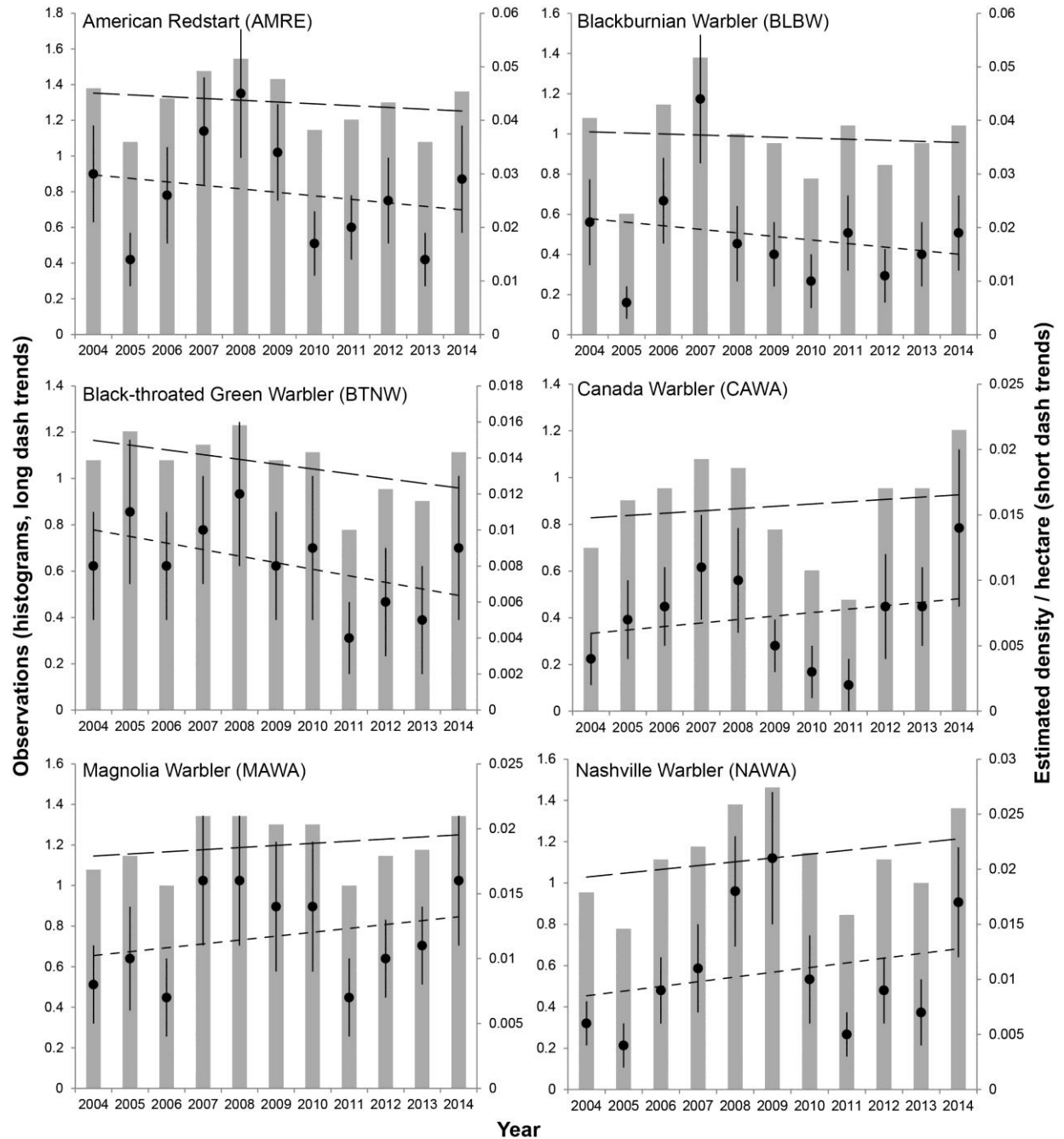


Figure C1. Trend comparisons for $n(\log+1)$ indices (long dash) and density estimates (short dash) for common species at Grand Portage National Monument during annual surveys, 2004–2014. Density estimates include standard error bars. Note changing scales on y-axes.

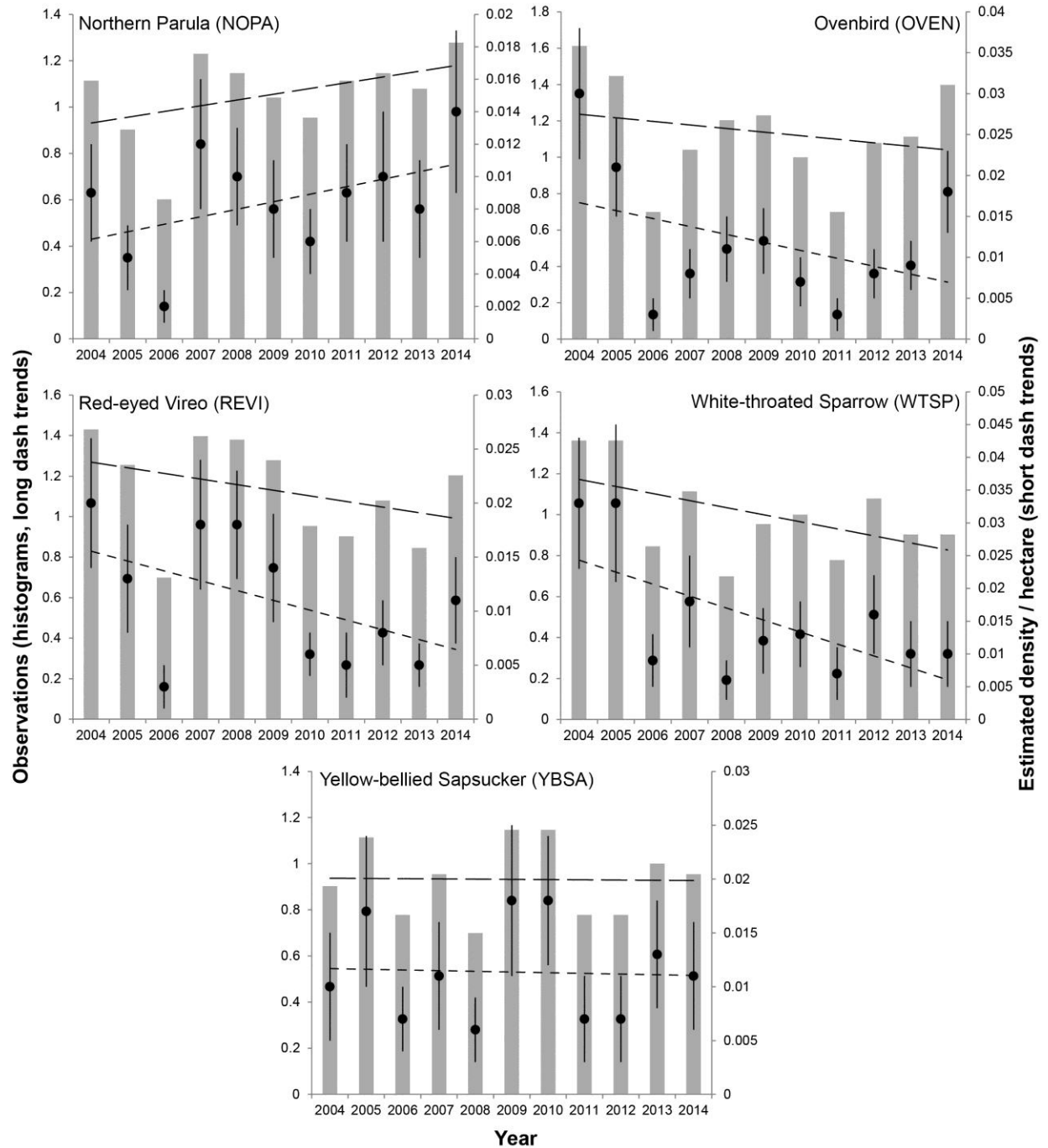


Figure C1 (continued). Trend comparisons for $n(\log+1)$ indices (long dash) and density estimates (short dash) for common species at Grand Portage National Monument during annual surveys, 2004–2014. Density estimates include standard error bars. Note changing scales on y-axes.

Table C3. Results from distance-detectability models of point count surveys at Saint Croix National Scenic Riverway, including estimates of density per hectare (D) with standard error (SE), encounter rate (n/K, or observations per unit of effort), global detection radius (EDR) in meters, global probability of observing a bird (p) per hectare, and individuals observed. All models were Half-normal.

<i>American Goldfinch</i>				<i>American Redstart</i>			
Year	D (SE)	n/K	Observed	Year	D (SE)	n/K	Observed
2009	0.112 (0.031)	0.047	38	2009	0.147 (0.033)	0.055	44
2011	0.102 (0.024)	0.068	55	2011	0.164 (0.034)	0.064	52
2012	0.027 (0.011)	0.016	13	2012	**0.269 (0.528)	0.076	61
2013	0.055 (0.023)	0.026	21	2013	**0.105 (0.216)	0.050	40
2014	0.014 (0.009)	0.006	5	2014	0.227 (0.042)	0.086	69
Global	0.052		132	Global	0.152		266
(Covariates: Temperature, Wind; AICc: 148.22, EDR: 40.9, p: 0.167)				(Covariates: Temperature, Sky; AICc: 213.19, EDR: 33.9, p: 0.115)			
<i>American Robin</i>				<i>Baltimore Oriole</i>			
Year	D (SE)	n/K	Observed	Year	D (SE)	n/K	Observed
2009	0.081 (0.016)	0.083	67	2009	0.077 (0.017)	0.057	46
2011	0.109 (0.020)	0.104	84	2011	0.105 (0.019)	0.078	63
2012	0.083 (0.016)	0.081	65	2012	0.061 (0.014)	0.047	38
2013	0.072 (0.014)	0.069	56	2013	0.063 (0.014)	0.048	39
2014	0.039 (0.010)	0.038	31	2014	0.029 (0.009)	0.021	17
Global	0.064		303	Global	0.056		203
(Covariate: Temperature; AICc: 416.41, EDR: 55.8, p: 0.311)				(Covariate: Temperature; AICc: 265.88, EDR: 49.0, p: 0.240)			
<i>Black-and-White Warbler</i>				<i>Black-capped Chickadee</i>			
Year	D (SE)	n/K	Observed	Year	D (SE)	n/K	Observed
2009	0.042 (0.015)	0.017	14	2009	0.018 (0.010)	0.010	8
2011	0.111 (0.026)	0.048	39	2011	0.058 (0.020)	0.026	21
2012	0.030 (0.013)	0.012	10	2012	0.063 (0.022)	0.025	20
2013	0.038 (0.015)	0.016	13	2013	0.041 (0.014)	0.022	18
2014	0.018 (0.010)	0.074	6	2014	0.030 (0.018)	0.010	8
Global	0.040		82	Global	0.035		75
(Covariate: Temperature; AICc: 75.64, EDR: 36.8, p: 0.135)				(Covariates: Temperature, Noise; AICc: 78.15, EDR: 37.5, p: 0.141)			
<i>Brown-headed Cowbird</i>				<i>Blue Jay</i>			
Year	D (SE)	n/K	Observed	Year	D (SE)	n/K	Observed
2009	0.090 (0.024)	0.059	48	2009	**0.031 (0.121)	0.032	26
2011	0.102 (0.079)	0.050	40	2011	0.055 (0.010)	0.084	68
2012	**0.077 (0.168)	0.025	20	2012	**0.029 (0.132)	0.024	19
2013	0.027 (0.011)	0.022	18	2013	**0.022 (0.106)	0.026	21
2014	0.015 (0.008)	0.010	8	2014	0.019 (0.005)	0.035	28
Global	0.052		134	Global	0.026		162
(Covariates: Temperature, Sky, Wind; AICc: 168.09, EDR: 41.3, p: 0.170)				(Covariates: Temperature, Sky; AICc: 223.12, EDR: 64.2, p: 0.412)			

*2010 missing since temperature was not recorded

** SE > density

Table C3 (continued). Results from distance-detectability models of point count surveys at Saint Croix National Scenic Riverway, including estimates of density per hectare (D) with standard error (SE), encounter rate (n/K, or observations per unit of effort), global detection radius (EDR) in meters, global probability of observing a bird (p) per hectare, and individuals observed. All models were Half-normal.

<i>Common Yellowthroat</i>				<i>Chestnut-sided Warbler</i>			
Year	D (SE)	n/K	Observed	Year	D (SE)	n/K	Observed
2009	0.188 (0.064)	0.145	117	2009	0.069 (0.018)	0.045	36
2011	0.253 (0.062)	0.187	151	2011	0.129 (0.026)	0.078	63
2012	0.185 (0.027)	0.147	119	2012	0.128 (0.027)	0.079	64
2013	0.130 (0.021)	0.103	83	2013	0.068 (0.017)	0.042	34
2014	0.113 (0.019)	0.089	72	2014	0.104 (0.022)	0.063	51
Global	0.145		542	Global	0.083		248
(Covariates: Temperature, Noise; AICc: 710.90, EDR: 49.6, p: 0.246)				(Covariate: Temperature; AICc: 296.89, EDR: 44.3, p: 0.196)			
<i>Great Crested Flycatcher</i>				<i>Gray Catbird</i>			
Year	D (SE)	n/K	Observed	Year	D (SE)	n/K	Observed
2009	0.037 (0.009)	0.048	39	2009	0.120 (0.029)	0.051	41
2011	0.065 (0.012)	0.073	59	2011	0.137 (0.030)	0.068	55
2012	0.026 (0.007)	0.030	24	2012	0.080 (0.021)	0.042	34
2013	0.027 (0.008)	0.036	29	2013	0.112 (0.022)	0.078	63
2014	0.024 (0.006)	0.035	28	2014	0.126 (0.027)	0.064	52
Global	0.030		179	Global	0.096		245
(Covariates: Temperature, Noise; AICc: 246.99, EDR: 62.8, p: 0.395)				(Covariates: Temperature, Sky; AICc: 273.48, EDR: 41.0, p: 0.168)			
<i>Hairy Woodpecker</i>				<i>Least Flycatcher</i>			
Year	D (SE)	n/K	Observed	Year	D (SE)	n/K	Observed
2009	**0.042 (0.352)	0.026	21	2009	0.033 (0.011)	0.022	18
2011	0.061 (0.015)	0.042	34	2011	0.043 (0.014)	0.029	23
2012	0.028 (0.012)	0.016	13	2012	0.041 (0.013)	0.029	23
2013	0.042 (0.012)	0.031	25	2013	0.030 (0.010)	0.020	16
2014	0.038 (0.014)	0.024	19	2014	0.031 (0.011)	0.021	17
Global	0.0353		112	Global	0.030		97
(Covariates: Temperature, Noise; AICc: 143.94, EDR: 45.7, p: 0.209)				(Covariate: Temperature; AICc: 123.81, EDR: 46.3, p: 0.214)			
<i>Ovenbird</i>				<i>Rose-breasted Grosbeak</i>			
Year	D (SE)	n/K	Observed	Year	D (SE)	n/K	Observed
2009	0.016 (0.005)	0.027	22	2009	0.043 (0.011)	0.037	30
2011	0.043 (0.008)	0.072	58	2011	0.091 (0.017)	0.078	63
2012	0.033 (0.007)	0.056	45	2012	0.058 (0.014)	0.047	38
2013	0.025 (0.006)	0.042	34	2013	0.061 (0.014)	0.050	40
2014	0.034 (0.007)	0.057	46	2014	0.032 (0.009)	0.027	22
Global	0.025		205	Global	0.047		193
(Covariate: Temperature; AICc: 279.13, EDR: 73.1, p: 0.534)				(Covariate: Temperature; AICc: 260.40, EDR: 51.7, p: 0.267)			

** SE > density

Table C3 (continued). Results from distance-detectability models of point count surveys at Saint Croix National Scenic Riverway, including estimates of density per hectare (D) with standard error (SE), encounter rate (n/K, or observations per unit of effort), global detection radius (EDR) in meters, global probability of observing a bird (p) per hectare, and individuals observed. All models were Half-normal.

<i>Red-eyed Vireo</i>				<i>Red-winged Blackbird</i>			
Year	D (SE)	n/K	Observed	Year	D (SE)	n/K	Observed
2009	0.256 (0.039)	0.181	146	2009	0.095 (0.028)	0.087	70
2011	0.424 (0.051)	0.274	221	2011	0.062 (0.016)	0.069	56
2012	0.264 (0.093)	0.176	142	2012	0.027 (0.008)	0.031	25
2013	0.232 (0.030)	0.195	157	2013	0.038 (0.011)	0.036	29
2014	0.284 (0.033)	0.233	188	2014	0.050 (0.013)	0.045	36
Global	0.243		854	Global	0.045		216
(Covariates: Temperature, Sky, Wind; AICc: 1097.4, EDR: 48.0, p: 0.231)				(Covariates: Temperature, Wind; AICc: 300.84, EDR: 56.1, p: 0.314)			
<i>Song Sparrow</i>				<i>Tree Swallow</i>			
Year	D (SE)	n/K	Observed	Year	D (SE)	n/K	Observed
2009	0.373 (0.047)	0.249	201	2009	0.149 (0.033)	0.098	79
2011	0.466 (0.051)	0.304	245	2011	0.169 (0.037)	0.100	81
2012	0.378 (0.043)	0.253	204	2012	0.020 (0.012)	0.010	8
2013	0.302 (0.037)	0.198	160	2013	0.013 (0.008)	0.009	7
2014	0.323 (0.040)	0.218	176	2014	0.016 (0.011)	0.020	16
Global	0.307		986	Global	0.061		191
(Covariate: Temperature; AICc: 1211.5, EDR: 45.9, p: 0.211)				(Covariates: Temperature, Wind, Noise; AICc: 237.54, EDR: 45.3, p: 0.205)			
<i>Veery</i>				<i>Warbling Vireo</i>			
Year	D (SE)	n/K	Observed	Year	D (SE)	n/K	Observed
2009	0.070 (0.017)	0.055	44	2009	0.037 (0.011)	0.031	25
2011	0.153 (0.026)	0.124	100	2011	0.054 (0.013)	0.043	35
2012	0.124 (0.021)	0.100	80	2012	0.000 (0.000)	0.000	0
2013	0.126 (0.022)	0.100	81	2013	0.055 (0.014)	0.045	36
2014	0.119 (0.020)	0.095	77	2014	0.005 (0.003)	0.004	3
Global	0.099		382	Global	0.030		99
(Covariate: Temperature; AICc: 506.66, EDR: 50.4, p: 0.254)				(Covariate: Temperature; AICc: 134.90, EDR: 50.8, p: 0.258)			
<i>White-breasted Nuthatch</i>				<i>Yellow Warbler</i>			
Year	D (SE)	n/K	Observed	Year	D (SE)	n/K	Observed
2009	0.057 (0.018)	0.031	25	2009	0.068 (0.016)	0.046	37
2011	0.063 (0.018)	0.035	28	2011	0.141 (0.025)	0.100	81
2012	0.064 (0.017)	0.037	30	2012	0.139 (0.028)	0.093	75
2013	0.027 (0.011)	0.015	12	2013	0.092 (0.019)	0.063	51
2014	0.029 (0.011)	0.016	13	2014	0.149 (0.026)	0.102	82
Global	0.040		108	Global	0.098		326
(Covariate: Temperature; AICc: 124.22, EDR: 42.2, p: 0.178)				(Covariate: Temperature; AICc: 409.77, EDR: 46.7, p: 0.218)			

Table C3 (continued). Results from distance-detectability models of point count surveys at Saint Croix National Scenic Riverway, including estimates of density per hectare (D) with standard error (SE), encounter rate (n/K, or observations per unit of effort), global detection radius (EDR) in meters, global probability of observing a bird (p) per hectare, and individuals observed. All models were Half-normal.

<i>Yellow-throated Vireo</i>			
Year	D (SE)	n/K	Observed
2009	0.028 (0.008)	0.029	23
2011	0.033 (0.009)	0.030	24
2012	0.045 (0.010)	0.045	36
2013	0.018 (0.006)	0.017	14
2014	0.030 (0.008)	0.031	25
Global	0.026		122
(Covariate: Temperature; AICc: 170.77, EDR: 55.9, p: 0.313)			

Table C4. Results from distance-detectability models of point count surveys at Sleeping Bear Dunes National Lakeshore, including estimates of density per hectare (D) with standard error (SE), encounter rate (n/K, or observations per unit of effort), estimated detection radius (EDR) in meters, probability of observing a bird (p) per hectare, and individuals observed. All models were Half-normal/cosine.

Species by year and habitat	D (SE)	n/K	EDR (m)	p	Observed
<i>American Redstart</i>					
2009	0.062 (0.025)	0.059	55.0	0.30	12
2010	0.062 (0.024)	0.059	55.0	0.30	12
2011	0.051 (0.021)	0.049	55.0	0.30	10
2012	0.077 (0.028)	0.073	55.0	0.30	15
2013	0.069 (0.018)	0.210	98.5	0.97	43
Beech-maple forest	0.095 (0.033)	0.127	65.3	0.43	26
Coastal oak-pine forest	0.010 (0.010)	0.010	55.0	0.30	2
Dune	0.010 (0.008)	0.020	79.0	0.62	4
Edge	0.078 (0.028)	0.098	63.1	0.40	20
Field	0.005 (0.004)	0.015	98.5	0.97	3
Inland lake	0.040 (0.020)	0.059	67.9	0.46	12
Shore-foredune	0.013 (0.010)	0.020	67.9	0.46	4
Wetland	0.069 (0.027)	0.102	68.7	0.47	21
Global (annual mean)	0.064		66.7	0.45	92
(Covariate: observer; AICc: 119.96)					
<i>American Robin</i>					
2009	0.077 (0.023)	0.102	64.9	0.42	21
2010	0.092 (0.024)	0.122	64.9	0.42	25
2011	0.107 (0.031)	0.141	64.9	0.42	29
2012	0.074 (0.023)	0.098	64.9	0.42	20
2013	0.124 (0.040)	0.215	74.1	0.55	44
Beech-maple forest	0.154 (0.043)	0.220	67.4	0.45	45
Coastal oak-pine forest	0.060 (0.020)	0.088	68.5	0.47	18
Dune	0.022 (0.013)	0.029	64.9	0.42	6
Edge	0.060 (0.021)	0.083	66.3	0.44	17
Field	0.036 (0.017)	0.049	65.6	0.43	10
Inland lake	0.055 (0.025)	0.083	69.3	0.48	17
Shore-foredune	*0.004 (0.005)	0.005	64.9	0.42	1
Wetland	0.084 (0.029)	0.122	67.8	0.46	25
Global (annual mean)	0.095		67.4	0.45	139
(Covariate: observer; AICc: 193.99)					

* density < SE

Table C4 (continued). Results from distance-detectability models of point count surveys at Sleeping Bear Dunes National Lakeshore, including estimates of density per hectare (D) with standard error (SE), encounter rate (n/K, or observations per unit of effort), estimated detection radius (EDR) in meters, probability of observing a bird (p) per hectare, and individuals observed. All models were Half-normal/cosine.

Species by year and habitat	D (SE)	n/K	EDR (m)	p	Observed
<i>Ovenbird**</i>					
2009	0.041 (0.015)	0.063	70.0	0.49	14
2010	0.054 (0.017)	0.083	70.0	0.49	18
2011	0.054 (0.019)	0.083	70.0	0.49	10
2012	0.025 (0.012)	0.039	70.0	0.49	8
2013	0.073 (0.026)	0.093	63.8	0.41	25
Beech-maple forest	--	--	--	--	45
Coastal oak-pine forest	--	--	--	--	15
Dune	--	--	--	--	0
Edge	--	--	--	--	5
Field	--	--	--	--	0
Inland lake	--	--	--	--	0
Shore-foredune	--	--	--	--	0
Wetland	--	--	--	--	10
Global (annual mean)	0.049		68.2	0.47	75
(Covariate: observer; AICc: 105.24)					
**No habitat model was adequate for Ovenbird.					
<i>Red-eyed Vireo</i>					
2009	0.125 (0.034)	0.224	75.5	0.57	46
2010	0.124 (0.030)	0.200	71.6	0.51	41
2011	0.102 (0.026)	0.156	70.0	0.49	32
2012	0.080 (0.023)	0.141	75.2	0.57	29
2013	0.079 (0.022)	0.180	85.3	0.73	37
Beech-maple forest	0.156 (0.032)	0.288	76.7	0.59	59
Coastal oak-pine forest	0.127 (0.034)	0.180	67.2	0.45	37
Dune	0.036 (0.020)	0.078	83.0	0.69	16
Edge	0.043 (0.017)	0.083	78.2	0.61	17
Field	0.036 (0.014)	0.063	75.3	0.57	13
Inland lake	0.039 (0.015)	0.078	80.1	0.64	16
Shore-foredune	0.015 (0.010)	0.024	72.2	0.52	5
Wetland	0.058 (0.018)	0.107	76.7	0.59	22
Global (annual mean)	0.102		75.1	0.56	185
(Covariate: noise; AICc: 239.51)					

Table C4 (continued). Results from distance-detectability models of point count surveys at Sleeping Bear Dunes National Lakeshore, including estimates of density per hectare (D) with standard error (SE), encounter rate (n/K, or observations per unit of effort), estimated detection radius (EDR) in meters, probability of observing a bird (p) per hectare, and individuals observed. All models were Half-normal/cosine.

Species by year and habitat	D (SE)	n/K	EDR (m)	p	Observed
<i>Red-winged Blackbird</i>					
2009	0.106 (0.048)	0.088	51.3	0.26	18
2010	0.141 (0.056)	0.117	51.3	0.26	24
2011	0.147 (0.054)	0.122	51.3	0.26	25
2012	0.177 (0.067)	0.146	51.3	0.26	30
2013	0.034 (0.015)	0.107	99.9	1.00	22
Beech-maple forest	--	--	--	--	0
Coastal oak-pine forest	--	--	--	--	0
Dune	--	--	--	--	0
Edge	0.018 (0.016)	0.015	51.3	0.26	3
Field	0.226 (0.068)	0.205	53.7	0.29	42
Inland lake	0.096 (0.044)	0.112	60.8	0.37	23
Shore-foredune	--	--	--	--	0
Wetland	0.266 (0.074)	0.249	54.6	0.30	51
Global (annual mean)	0.121		55.2	0.31	119
(Covariate: observer; AICc: 156.68)					
<i>Song Sparrow</i>					
2009	0.041 (0.015)	0.063	70.0	0.49	13
2010	0.054 (0.017)	0.083	70.0	0.49	17
2011	0.054 (0.019)	0.083	70.0	0.49	17
2012	0.025 (0.012)	0.039	70.0	0.49	8
2013	0.073 (0.026)	0.093	63.8	0.41	19
Beech-maple forest	--	--	--	--	0
Coastal oak-pine forest	0.007 (0.006)	0.010	66.7	0.44	2
Dune	0.043 (0.016)	0.063	68.9	0.47	13
Edge	0.043 (0.016)	0.063	68.4	0.47	13
Field	0.034 (0.015)	0.049	67.9	0.46	10
Inland lake	0.019 (0.011)	0.029	70.0	0.49	6
Shore-foredune	0.054 (0.021)	0.078	67.9	0.46	16
Wetland	0.048 (0.019)	0.068	67.6	0.46	14
Global (annual mean)	0.049		68.2	0.47	74
(Covariate: observer; AICc: 105.24)					

Table C5. Trend comparisons for n(log+1) indices and density estimates for common species at Sleeping Bear Dunes National Lakeshore during annual surveys, 2009–2013.

Significant trend in bold. Note: there were no distribution outliers in these data.

Species by model		P	r ²
American Redstart	n(log+1)	0.143	0.564
	Density	0.417	0.227
American Robin	n(log+1)	0.256	0.395
	Density	0.313	0.328
Ovenbird	n(log+1)	0.833	0.017
	Density	0.610	0.097
Red-eyed Vireo	n(log+1)	0.218	0.446
	Density	*0.011	0.913
Red-winged Blackbird*	n(log+1)	0.360	0.279
	Density	0.610	0.100
Song Sparrow	n(log+1)	0.987	0.000
	Density	0.610	0.100

*Opposing trend directions, see Figure C3.

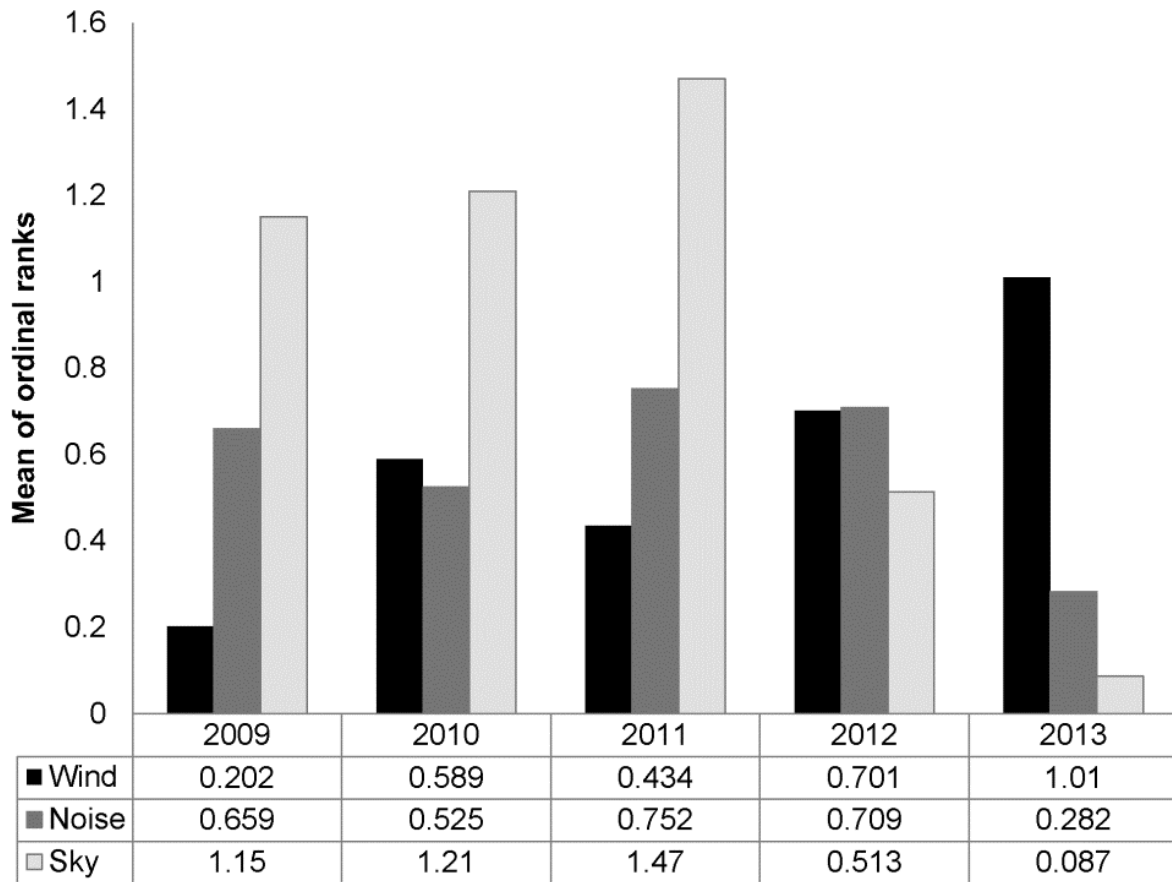


Figure C2. Annual variation in wind, noise and sky cover/clouds, reported as annual means of ordinal ranking, on bird surveys at Sleeping Bear Dunes National Lakeshore. Higher numbers indicate louder or cloudier conditions.

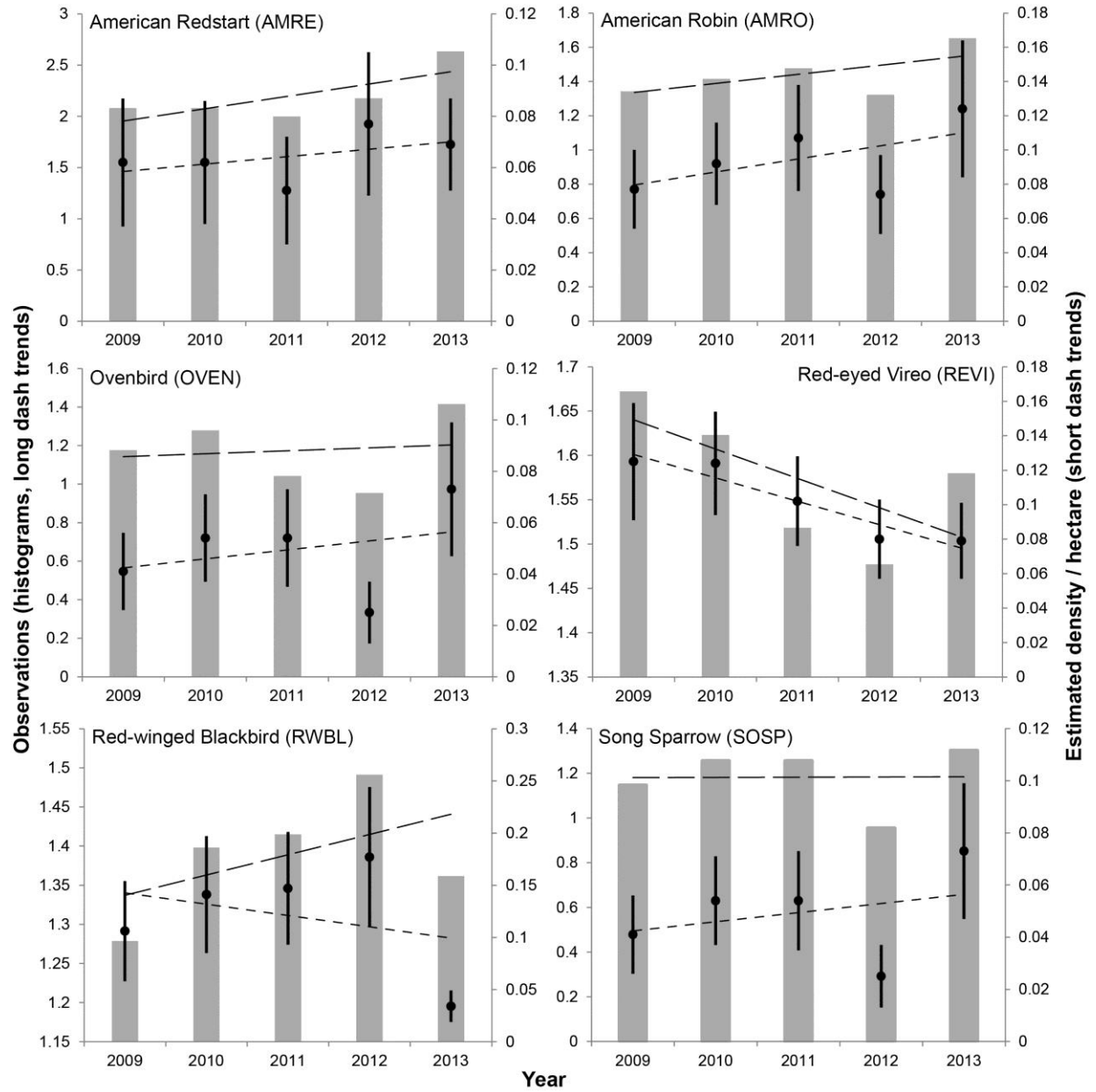


Figure C3. Observations and estimated density per hectare, by year, of common species at Sleeping Bear Dunes National Lakeshore. Density estimates includes standard error bars. Trends are included for observations (long dash) and densities (short dash). Note scale changes on y-axes.

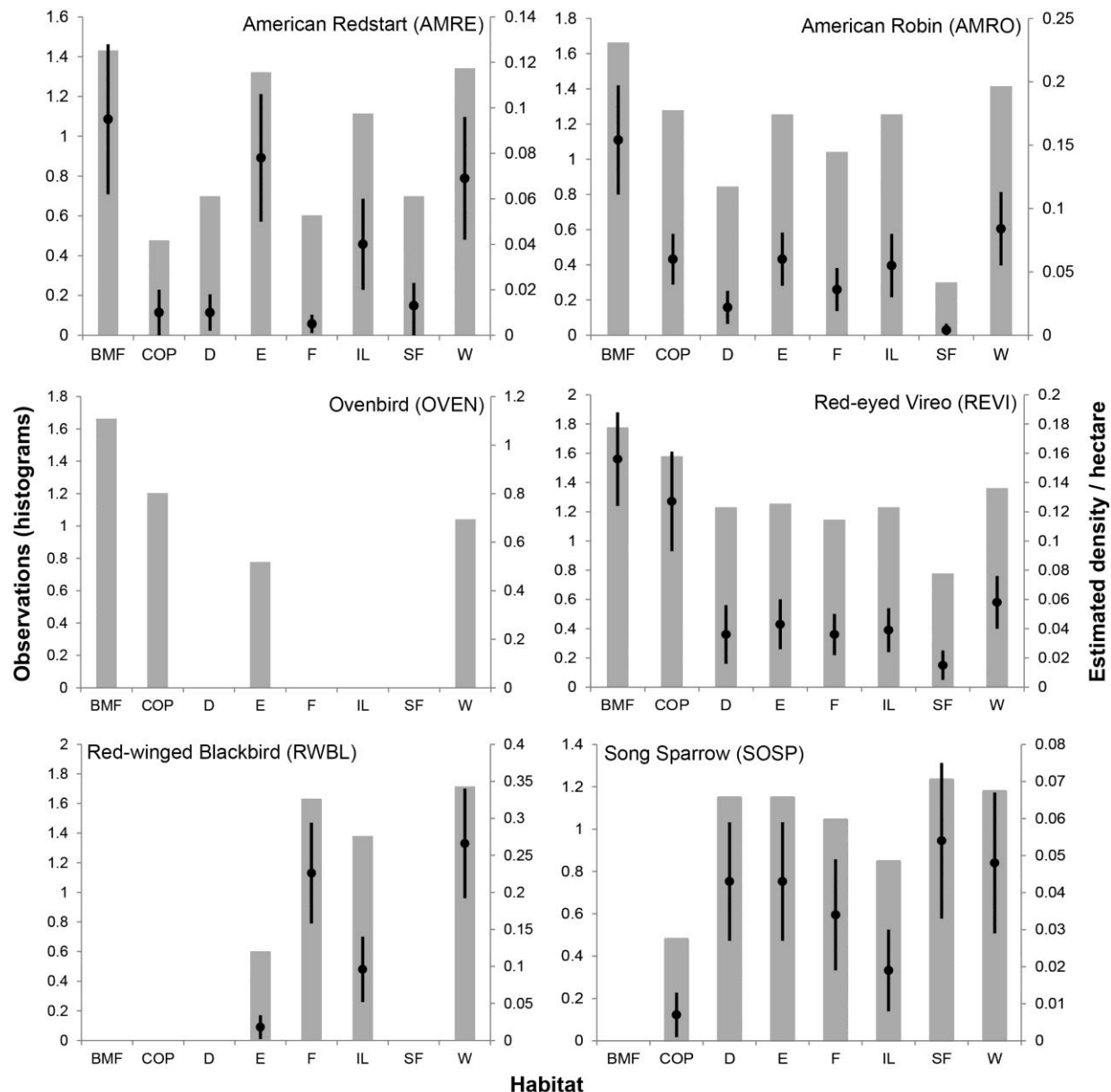


Figure C4. Observations and estimated density per hectare of common species, by habitat, of common species at Sleeping Bear Dunes National Lakeshore. Density estimates include standard error bars. Trends are included for observations (long dash) and densities (short dash). Note scale changes on y-axes. Habitats include beech-maple forest (BMF), coastal oak-pine forest (COP), dunes (D), edge (E), fields (F), inland lake (IL), shore and foredune (SF), and wetland (W). No density model was adequate for Ovenbird.

Table C6. Distance-detectability model results from point count surveys at Voyageurs National Park, including estimates of density per hectare (D) with standard error (SE), encounter rate (n/K, or observations per unit of effort), global detection radius (EDR) in meters, global probability of observing a bird (p) per hectare, and individuals observed. All models were Half-normal.

<i>Black-and-White Warbler</i>				<i>Blackburnian Warbler</i>			
Year	D (SE)	n/K	Observed	Year	D (SE)	n/K	Observed
2010	0.139 (0.032)	0.113	28	2010	0.168 (0.037)	0.117	29
2011	0.109 (0.029)	0.089	22	2011	0.098 (0.027)	0.069	17
2012	0.149 (0.035)	0.121	30	2012	0.185 (0.039)	0.130	32
2013	0.104 (0.030)	0.085	21	2013	0.197 (0.047)	0.138	34
Global	0.125		101	Global	0.162		112
(AICc: 135.80, EDR: 51.0, p: 0.260)				(AICc: 142.70, EDR: 47.2, p: 0.223)			
<i>Chipping Sparrow</i>				<i>Nashville Warbler</i>			
Year	D (SE)	n/K	Observed	Year	D (SE)	n/K	Observed
2010	0.191 (0.045)	0.126	31	2010	0.182 (0.031)	0.401	99
2011	0.111 (0.031)	0.073	18	2011	0.072 (0.016)	0.158	39
2012	0.216 (0.050)	0.142	35	2012	0.194 (0.033)	0.425	105
2013	0.080 (0.031)	0.053	13	2013	0.101 (0.021)	0.223	55
Global	0.150		97	Global	0.137		298
(AICc: 120.38, EDR: 45.7, p: 0.209)				(AICc: 378.06, EDR: 83.6, p: 0.699)			
<i>Ovenbird</i>				<i>Red-breasted Nuthatch</i>			
Year	D (SE)	n/K	Observed	Year	D (SE)	n/K	Observed
2010	0.079 (0.016)	0.206	51	2010	0.099 (0.025)	0.113	28
2011	0.056 (0.015)	0.146	36	2011	0.043 (0.014)	0.049	12
2012	0.104 (0.022)	0.271	67	2012	0.131 (0.030)	0.150	37
2013	0.112 (0.023)	0.292	72	2013	0.068 (0.020)	0.077	19
Global	0.088		226	Global	0.085		96
(AICc: 273.22, EDR: 91.0, p: 0.828)				(AICc: 135.09, EDR: 60.2, p: 0.363)			
<i>Red-eyed Vireo</i>				<i>Veery</i>			
Year	D (SE)	n/K	Observed	Year	D (SE)	n/K	Observed
2010	0.135 (0.025)	0.352	87	2010	0.035 (0.012)	0.109	27
2011	0.075 (0.017)	0.194	48	2011	0.021 (0.008)	0.065	16
2012	0.151 (0.027)	0.393	97	2012	0.028 (0.010)	0.089	22
2013	0.083 (0.017)	0.215	53	2013	0.018 (0.008)	0.057	14
Global	0.111		285	Global	0.025		79
(AICc: 344.07, EDR: 91.0, p: 0.828)				(AICc: 87.06, EDR: 100, p: 1.0)			
<i>White-throated Sparrow</i>							
Year	D (SE)	n/K	Observed				
2010	0.122 (0.025)	0.259	64				
2011	0.090 (0.020)	0.190	47				
2012	0.150 (0.029)	0.320	79				
2013	0.112 (0.024)	0.239	59				
Global	0.119		249				
(AICc: 319.00, EDR: 82.3, p: 0.677)							

Table C7. Trend comparisons for $n(\log+1)$ indices and density estimates for common species at Voyageurs National Park during annual surveys, 2010–2013.

Species by model		p	r ²
Black-and-White Warbler	$n(\log+1)$	0.595	0.164
	Density	0.621	0.144
Blackburnian Warbler	$n(\log+1)$	0.546	0.206
	Density	0.493	0.257
Chipping Sparrow	$n(\log+1)$	0.464	0.287
	Density	0.543	0.209
Nashville Warbler	$n(\log+1)$	0.790	0.044
	Density	0.740	0.068
Ovenbird	$n(\log+1)$	0.319	0.464
	Density	0.253	0.558
Red-breasted Nuthatch	$n(\log+1)$	0.988	0.000
	Density	0.983	0.000
Red-eyed Vireo	$n(\log+1)$	0.712	0.083
	Density	0.726	0.075
Veery	$n(\log+1)$	0.286	0.510
	Density	0.252	0.560
White-throated Sparrow	$n(\log+1)$	0.835	0.027
	Density	0.684	0.010

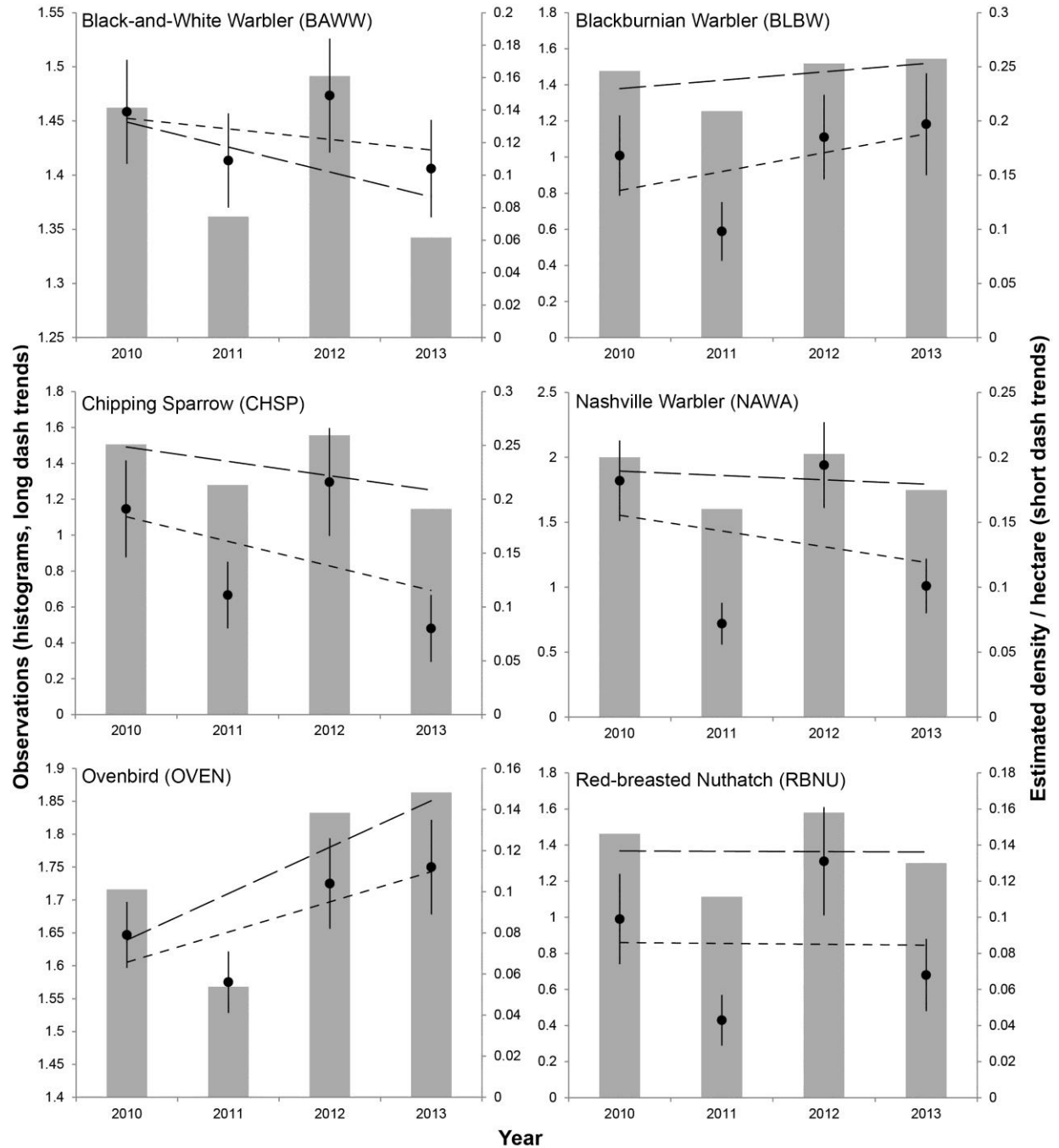


Figure C5. Trend comparisons for $n(\log+1)$ indices and density estimates for common species at Voyageurs National Park during annual surveys, 2010–2013. Density estimates includes standard error bars. Trends are included for observations (long dash) and densities (short dash). Note changing scales on y-axes.

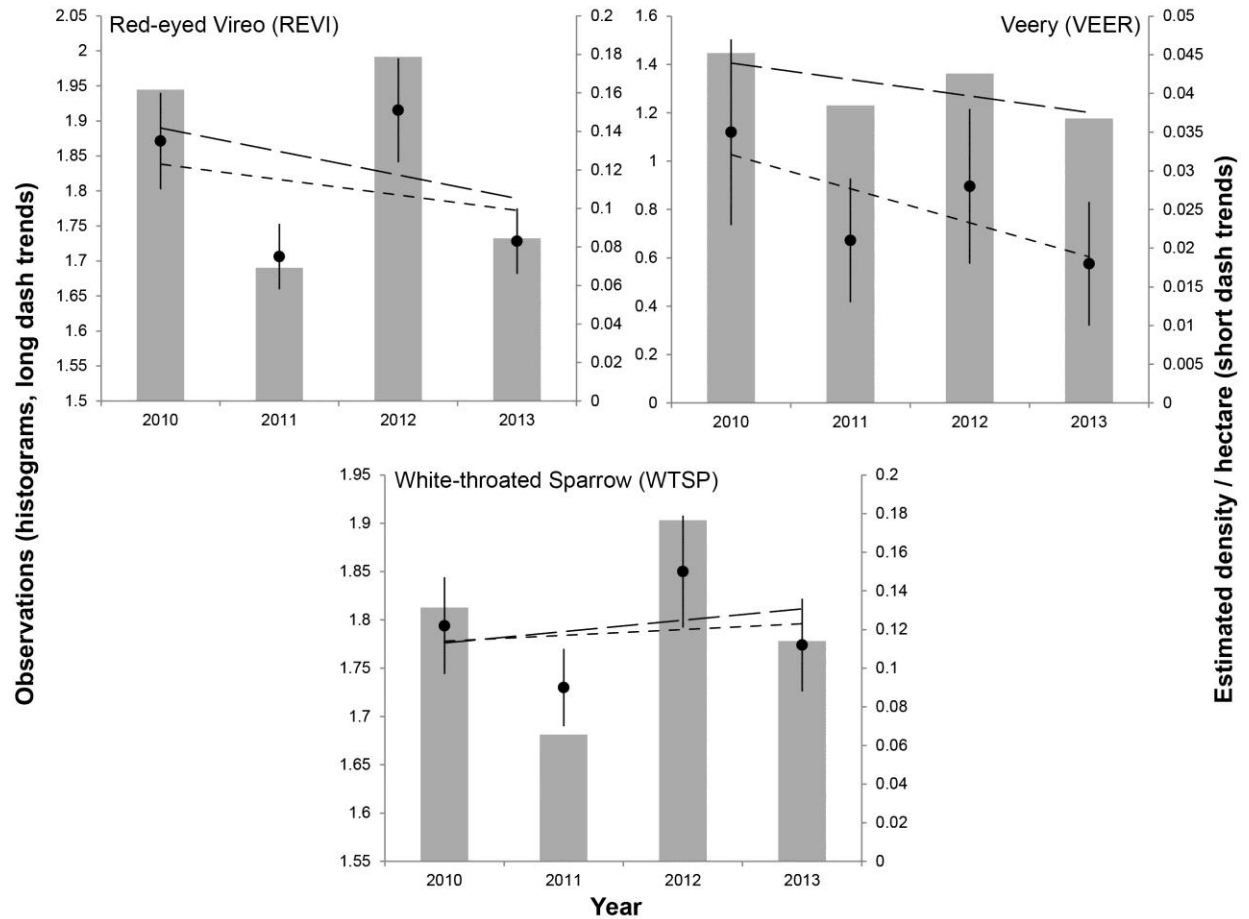


Figure C5 (continued). Trend comparisons for $n(\log+1)$ indices and density estimates for common species at Voyageurs National Park during annual surveys, 2010–2013. Density estimates include standard error bars. Trends are included for observations (long dash) and densities (short dash). Note changing scales on y-axes.

Appendix D: Taxonomic Species List

Table D. Taxonomic list and trend summary of landbirds reported during point count surveys in six Great Lakes Network parks (does not include SACN; see text for those data). A “•” indicates low abundance, blank cells indicate species not recorded, and boxes indicate priority species for GLKN.

Species	Park					
	VOYA	GRPO	ISRO	APIS	SLBE	INDU
Ruffed Grouse (<i>Bonasa umbellus</i>)	•	•		•		
American Bittern (<i>Botaurus lentiginosus</i>)	•	•	•			
Killdeer (<i>Charadrius vociferus</i>)				•		•
Wilson's Snipe (<i>Gallinago delicata</i>)	•	•	+ 0.01			
Rock Pigeon (<i>Columba livia</i>)						•
Mourning Dove (<i>Zenaida macroura</i>)		•	•	•	- 0.00	+ 0.01
Yellow-billed Cuckoo (<i>Coccyzus americanus</i>)			•		•	•
Black-billed Cuckoo (<i>Coccyzus erythrophthalmus</i>)		•	•	•	- 0.08	•
Common Nighthawk (<i>Chordeiles minor</i>)						
Chimney Swift (<i>Chaetura pelagica</i>)		•	•	•	•	- 0.02
Ruby-throated Hummingbird (<i>Archilochus colubris</i>)	•	•		•	•	•
Belted Kingfisher (<i>Megaceryle alcyon</i>)	•	•	•	•	- 0.04	•
Red-headed Woodpecker (<i>Melanerpes erythrocephalus</i>)	•				•	•
Red-bellied Woodpecker (<i>Melanerpes carolinus</i>)					+ 0.03	+ 0.03
Yellow-bellied Sapsucker (<i>Sphyrapicus varius</i>)	- 0.01	+ 0.01	•	+ 0.03	•	
Downy Woodpecker (<i>Picoides pubescens</i>)	•	- 0.05	- 0.02	+ 0.00	•	+ 0.00
Hairy Woodpecker (<i>Picoides villosus</i>)	- 0.00	•	+ 0.01	- 0.03	+ 0.05	•
American Three-toed Woodpecker (<i>Picoides dorsalis</i>)				•		
Black-backed Woodpecker (<i>Picoides arcticus</i>)			•	•		
Northern Flicker (<i>Colaptes auratus</i>)	+ 0.00	+ 0.03	+ 0.01	+ 0.03	+ 0.02	•
Pileated Woodpecker (<i>Dryocopus pileatus</i>)	•	- 0.05	+ 0.01	•	+ 0.02	•
Olive-sided Flycatcher (<i>Contopus cooperi</i>)	•	•	•	•	•	
Eastern Wood-Pewee (<i>Contopus virens</i>)	- 0.00	- 0.01	•	+ 0.01	+ 0.02	+ 0.01
Yellow-bellied Flycatcher (<i>Empidonax flaviventris</i>)	•	•	+ 0.01	- 0.07		
Acadian Flycatcher (<i>Empidonax virescens</i>)						•
Willow Flycatcher (<i>Empidonax traillii</i>)				•		+ 0.02
Alder Flycatcher (<i>Empidonax alnorum</i>)	•	+ 0.01	+ 0.03	+ 0.01	- 0.01	•
Least Flycatcher (<i>Empidonax minimus</i>)	+ 0.00	- 0.05	- 0.01	- 0.01	+ 0.01	•
Eastern Phoebe (<i>Sayornis phoebe</i>)	•	•	•	- 0.00	- 0.02	•
Great Crested Flycatcher (<i>Myiarchus crinitus</i>)	- 0.03	•	•	•	+ 0.01	+ 0.01
Eastern Kingbird (<i>Tyrannus tyrannus</i>)	•	•	•	- 0.01	- 0.01	•
White-eyed Vireo (<i>Vireo griseus</i>)						•
Blue-headed Vireo (<i>Vireo solitarius</i>)	+ 0.02	•	•	- 0.02	•	
Yellow-throated Vireo (<i>Vireo flavifrons</i>)				•	+ 0.01	•
Warbling Vireo (<i>Vireo gilvus</i>)		•			- 0.00	+ 0.01

Table D (continued). Taxonomic list and trend summary of landbirds reported during point count surveys in six Great Lakes Network parks (does not include SACN; see text for those data). A “▪” indicates low abundance, blank cells indicate species not recorded, and boxes indicate priority species for GLKN.

Species	Park					
	VOYA	GRPO	ISRO	APIS	SLBE	INDU
Philadelphia Vireo (<i>Vireo philadelphicus</i>)	▪	▪	▪	▪		
Red-eyed Vireo (<i>Vireo olivaceus</i>)	- 0.00	- 0.00	- 0.00	+ 0.01	+ 0.02	- 0.00
Blue Jay (<i>Cyanocitta cristata</i>)	- 0.00	+ 0.01	+ 0.01	+ 0.04	+ 0.00	- 0.02
Gray Jay (<i>Perisoreus canadensis</i>)	▪	▪	▪			
Common Raven (<i>Corvus corax</i>)	+ 0.01	- 0.02	- 0.03	- 0.00	- 0.01	
American Crow (<i>Corvus brachyrhynchos</i>)	- 0.02	+ 0.00	- 0.02	+ 0.02	- 0.01	- 0.01
Purple Martin (<i>Progne subis</i>)						▪
Tree Swallow (<i>Tachycineta bicolor</i>)	▪	▪		- 0.04	- 0.01	▪
Bank Swallow (<i>Riparia riparia</i>)				▪	+ 0.03	▪
Northern Rough-winged Swallow (<i>Stelgidopteryx serripennis</i>)						▪
Cliff Swallow (<i>Petrochelidon pyrrhonota</i>)				▪		
Barn Swallow (<i>Hirundo rustica</i>)			▪	▪	- 0.02	+ 0.01
Black-capped Chickadee (<i>Poecile atricapillus</i>)	- 0.00	- 0.03	+ 0.00	+ 0.00	+ 0.03	- 0.00
Tufted Titmouse (<i>Baeolophus bicolor</i>)					▪	- 0.01
Red-breasted Nuthatch (<i>Sitta canadensis</i>)	+ 0.01	- 0.00	+ 0.02	+ 0.02	+ 0.00	
White-breasted Nuthatch (<i>Sitta carolinensis</i>)	▪	▪	▪	▪	▪	▪
Brown Creeper (<i>Certhia americana</i>)	- 0.00	+ 0.01	- 0.01	- 0.04	▪	
Carolina Wren (<i>Thryothorus ludovicianus</i>)						▪
House Wren (<i>Troglodytes aedon</i>)		▪		▪	- 0.03	+ 0.00
Winter Wren (<i>Troglodytes hiemalis</i>)	+ 0.01	+ 0.01	+ 0.01	- 0.02	▪	
Sedge Wren (<i>Cistothorus platensis</i>)		▪	▪	▪	▪	▪
Marsh Wren (<i>Cistothorus palustris</i>)			▪	▪		+ 0.02
Blue-gray Gnatcatcher (<i>Poliophtila caerulea</i>)						+ 0.00
Golden-crowned Kinglet (<i>Regulus satrapa</i>)	▪	- 0.00	+ 0.02	▪		
Ruby-crowned Kinglet (<i>Regulus calendula</i>)	▪	▪	▪	▪		
Eastern Bluebird (<i>Sialia sialis</i>)			▪	▪	+ 0.04	▪
Wood Thrush (<i>Hylocichla mustelina</i>)		▪	▪	▪	+ 0.03	- 0.00
Veery (<i>Catharus fuscescens</i>)	- 0.01	- 0.01	+ 0.00	- 0.01	+ 0.07	- 0.02
Hermit Thrush (<i>Catharus guttatus</i>)	+ 0.01	- 0.04	+ 0.01	+ 0.04	+ 0.01	
Gray-cheeked Thrush (<i>Catharus minimus</i>)				▪		
Swainson's Thrush (<i>Catharus ustulatus</i>)	▪	+ 0.00	+ 0.01	+ 0.02	▪	▪
American Robin (<i>Turdus migratorius</i>)	- 0.00	+ 0.01	+ 0.02	+ 0.01	+ 0.03	- 0.00
Northern Mockingbird (<i>Mimus polyglottos</i>)					▪	
Gray Catbird (<i>Dumetella carolinensis</i>)		▪	▪	▪	- 0.03	+ 0.00
Brown Thrasher (<i>Toxostoma rufum</i>)			▪	▪	- 0.00	▪
European Starling (<i>Sturnus vulgaris</i>)	▪			▪	- 0.01	- 0.02
Cedar Waxwing (<i>Bombycilla cedrorum</i>)	▪	- 0.00	- 0.00	- 0.03	+ 0.04	- 0.04

Table D (continued). Taxonomic list and trend summary of landbirds reported during point count surveys in six Great Lakes Network parks (does not include SACN; see text for those data). A “▪” indicates low abundance, blank cells indicate species not recorded, and boxes indicate priority species for GLKN.

Species	Park					
	VOYA	GRPO	ISRO	APIS	SLBE	INDU
Ovenbird (<i>Seiurus aurocapilla</i>)	- 0.01	- 0.01	- 0.00	+ 0.01	+ 0.00	- 0.02
Louisiana Waterthrush (<i>Parkesia motacilla</i>)						▪
Northern Waterthrush (<i>Parkesia noveboracensis</i>)	▪	▪	+ 0.01	▪	▪	
Black-and-White Warbler (<i>Mniotilta varia</i>)	+ 0.01	+ 0.00	- 0.01	+ 0.00	▪	
Golden-winged Warbler (<i>Vermivora chrysoptera</i>)						▪
Blue-winged Warbler (<i>Vermivora cyanoptera</i>)	▪					▪
Orange-crowned Warbler (<i>Oreothlypis celata</i>)		▪	▪			
Tennessee Warbler (<i>Oreothlypis peregrina</i>)	▪	▪	▪	▪		
Nashville Warbler (<i>Oreothlypis ruficapilla</i>)	- 0.01	+ 0.01	+ 0.01	+ 0.00	▪	
Connecticut Warbler (<i>Oporornis agilis</i>)				▪		
Mourning Warbler (<i>Geothlypis philadelphia</i>)	- 0.02	- 0.02	+ 0.01	+ 0.00	▪	▪
Common Yellowthroat (<i>Geothlypis trichas</i>)	+ 0.00	+ 0.00	+ 0.02	+ 0.00	+ 0.02	+ 0.00
Hooded Warbler (<i>Setophaga citrina</i>)						▪
American Redstart (<i>Setophaga ruticilla</i>)	▪	+ 0.01	- 0.01	- 0.01	+ 0.02	- 0.00
Cape May Warbler (<i>Setophaga tigrina</i>)	▪		- 0.06	+ 0.02		
Cerulean Warbler (<i>Setophaga cerulea</i>)		▪				▪
Northern Parula (<i>Setophaga americana</i>)	- 0.00	- 0.01	+ 0.02	+ 0.02	▪	▪
Magnolia Warbler (<i>Setophaga magnolia</i>)	- 0.00	+ 0.01	+ 0.00	- 0.00	▪	
Blackburnian Warbler (<i>Setophaga fusca</i>)	- 0.01	- 0.03	- 0.00	- 0.01		
Yellow Warbler (<i>Setophaga petechia</i>)	▪	▪	▪	- 0.03	+ 0.02	+ 0.00
Chestnut-sided Warbler (<i>Setophaga pensylvanica</i>)	- 0.02	- 0.04	- 0.01	- 0.02	▪	▪
Black-throated Blue Warbler (<i>Setophaga caerulescens</i>)	▪	▪	- 0.00	- 0.01	- 0.05	
Blackpoll Warbler (<i>Setophaga striata</i>)				▪		
Bay-breasted Warbler (<i>Setophaga castanea</i>)	▪	▪	▪	+ 0.01		
Pine Warbler (<i>Setophaga pinus</i>)	▪	▪	▪	▪	+ 0.03	
Prairie Warbler (<i>Setophaga discolor</i>)					▪	▪
Palm Warbler (<i>Setophaga palmarum</i>)	▪		▪	▪		
Yellow-rumped Warbler (<i>Setophaga coronata</i>)	+ 0.02	+ 0.03	+ 0.00	+ 0.01	+ 0.03	
Black-throated Green Warbler (<i>Setophaga virens</i>)	+ 0.00	- 0.00	+ 0.01	+ 0.00	- 0.01	▪
Wilson's Warbler (<i>Cardellina pusilla</i>)		▪		▪		
Canada Warbler (<i>Cardellina canadensis</i>)	+ 0.02	+ 0.00	- 0.00	+ 0.01	▪	▪
Yellow-breasted Chat (<i>Icteria virens</i>)			▪			▪
Eastern Towhee (<i>Pipilo erythrophthalmus</i>)					+ 0.04	- 0.00
Field Sparrow (<i>Spizella pusilla</i>)				▪	+ 0.05	▪
Clay-colored Sparrow (<i>Spizella pallida</i>)				▪	▪	
Chipping Sparrow (<i>Spizella passerina</i>)	- 0.00	- 0.02	- 0.04	+ 0.01	+ 0.01	+ 0.01

Table D (continued). Taxonomic list and trend summary of landbirds reported during point count surveys in six Great Lakes Network parks (does not include SACN; see text for those data). A “▪” indicates low abundance, blank cells indicate species not recorded, and boxes indicate priority species for GLKN.

Species	Park					
	VOYA	GRPO	ISRO	APIS	SLBE	INDU
Savannah Sparrow (<i>Passerculus sandwichensis</i>)				+ 0.03	▪	
Vesper Sparrow (<i>Pooecetes gramineus</i>)				▪	+ 0.00	
Grasshopper Sparrow (<i>Ammodramus savannarum</i>)				▪	+ 0.00	
Song Sparrow (<i>Melospiza melodia</i>)	- 0.01	+ 0.01	+ 0.01	- 0.01	+ 0.01	- 0.01
Lincoln's Sparrow (<i>Melospiza lincolni</i>)		▪		▪		
Swamp Sparrow (<i>Melospiza georgiana</i>)	- 0.00	+ 0.00	+ 0.01	+ 0.00	- 0.01	- 0.00
Dark-eyed Junco (<i>Junco hyemalis</i>)		▪	▪	▪		
White-throated Sparrow (<i>Zonotrichia albicollis</i>)	- 0.01	+ 0.00	+ 0.00	+ 0.00	+ 0.01	
Summer Tanager (<i>Piranga rubra</i>)						▪
Scarlet Tanager (<i>Piranga olivacea</i>)	▪	▪	▪	▪	- 0.01	▪
Northern Cardinal (<i>Paroaria capitata</i>)		▪	▪	▪	- 0.02	- 0.00
Black-headed Grosbeak (<i>Pheucticus melanocephalus</i>)			▪			
Rose-breasted Grosbeak (<i>Pheucticus ludovicianus</i>)	- 0.03	- 0.01	▪	+ 0.00	+ 0.02	▪
Dickcissel (<i>Spiza americana</i>)					▪	▪
Indigo Bunting (<i>Passerina cyanea</i>)	▪	▪	▪	▪	+ 0.00	- 0.00
Common Grackle (<i>Quiscalus quiscula</i>)	+ 0.03	▪	- 0.00	- 0.04	- 0.00	+ 0.01
Red-winged Blackbird (<i>Agelaius phoeniceus</i>)	- 0.02	▪	+ 0.03	- 0.02	+ 0.02	+ 0.01
Yellow-headed Blackbird (<i>Xanthocephalus xanthocephalus</i>)						
Brown-headed Cowbird (<i>Molothrus ater</i>)	▪	▪		▪	▪	- 0.00
Bobolink (<i>Dolichonyx oryzivorus</i>)				▪	- 0.02	▪
Western Meadowlark (<i>Sturnella neglecta</i>)				▪		
Eastern Meadowlark (<i>Sturnella magna</i>)					+ 0.05	▪
Baltimore Oriole (<i>Icterus galbula</i>)	▪			▪	- 0.01	▪
Evening Grosbeak (<i>Coccothraustes vespertinus</i>)	- 0.06	- 0.07	- 0.06	▪		
Purple Finch (<i>Haemorhous purpureus</i>)	▪	+ 0.01	▪	▪	▪	
House Finch (<i>Haemorhous mexicanus</i>)					▪	▪
Red Crossbill (<i>Loxia curvirostra</i>)	▪		▪	▪		
White-winged Crossbill (<i>Loxia leucoptera</i>)		▪	▪	▪		
Pine Siskin (<i>Spinus pinus</i>)	▪	▪	▪	▪		
American Goldfinch (<i>Spinus tristis</i>)	▪	+ 0.00	▪	+ 0.02	- 0.02	+ 0.01
House Sparrow (<i>Passer domesticus</i>)						- 0.00

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

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