

# **Minnesota National Forest Breeding Bird Monitoring Program Annual Report 1995–2019**

Submitted by:

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## SUMMARY

- A total of 353 forest stands were surveyed for breeding birds including 160 and 191 stands (1029 survey points) in the Chippewa and Superior National Forests (NFs), respectively in 2019.
- Trends in relative abundance were calculated for 77 bird species (same as 2018), including 67 species in the Chippewa NF and 65 in the Superior NF for 25 years from 1995 to 2019. There were 36 additional species that were detected in Chippewa NF and 33 species in Superior NF that did not meet our inclusion criteria for trend analysis.
- In Chippewa NF, 52 species that met our inclusion criteria had stable or increasing trends over the past 25 years. Overall, 13 species trends were significantly increasing (15 in 2018), 15 species trends had significantly decreasing trends (15 in 2018), and 39 species trends (38 in 2018) that were relatively stable from 1995 to 2019.
- In Superior NF, 44 species that met our inclusion criteria had stable or increasing trends over the past 25 years. Of these, 13 species trends were significantly increasing (15 in 2018), 21 species had significantly decreasing trends (19 in 2018), and 31 species (30 in 2018) had relatively stable trends from 1995 to 2019.
- Five species increased in both the Chippewa and Superior NFs: Black-throated Green Warbler, Blue Jay, Nashville Warbler, Pine Warbler, and Red-breasted Nuthatch. With the exception of Nashville Warbler, these species tend to be associated with more mature forests.
- Eight species decreased in both NFs: Chipping Sparrow, Common Yellowthroat, Connecticut Warbler, Downy Woodpecker, Olive-sided Flycatcher, Red-eyed Vireo, Song Sparrow, Winter Wren. However, 19 species had significantly declining regional trends when the two National Forests were combined: American Crow, Black-capped Chickadee, Blue-headed Vireo, Chestnut-sided Warbler, Chipping Sparrow, Common Loon, Common Yellowthroat, Connecticut Warbler, Downy Woodpecker, Hermit Thrush, Magnolia Warbler, Mourning Warbler, Olive-sided Flycatcher, Red-eyed Vireo, Scarlet Tanager, Song Sparrow, Swamp Sparrow, Winter Wren, Yellow-bellied Flycatcher.
- Regional trends for guilds were mixed over the period from 1995-2019. Species associated with upland conifer, lowland conifer, mixed forest, canopy nesters, cavity nesters, and permanent resident species all significantly increased. Shrub nesting and short-distance migrant species significantly decreased, while deciduous forest, early-successional, ground nesting, and long-distance migrant species had no significant change.
- Connecticut Warbler has shown one of the most consistent declines of any species in the monitoring program and reached a new and disappointing low in 2018: for the first time in 24 years of monitoring, no Connecticut Warblers were detected in either Chippewa NF or Superior NF. However, in 2019 two Connecticut Warblers were observed in Chippewa NF.
- The overall trend results indicate the breeding bird species that are abundant enough to analyze have either increasing or stable trends. However, the declining trends for many lowland conifer birds species and aerial insectivores continue to be a concern.

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## OVERVIEW

Minnesota's National Forest Breeding Bird Monitoring Program has documented trends in forest bird abundances for 25 years. These data have provided insight into the impacts of forest management on breeding birds and helped inform the development of management policies and conservation initiatives. This report summarizes forest bird monitoring data gathered from 1995 through 2019. Here we summarize the current status of species trends and overall trends for migration, habitat, and nesting guilds. We focus our discussion on species of conservation importance in the state to provide an ecological context and discuss management implications of the observed patterns in the region for these species.

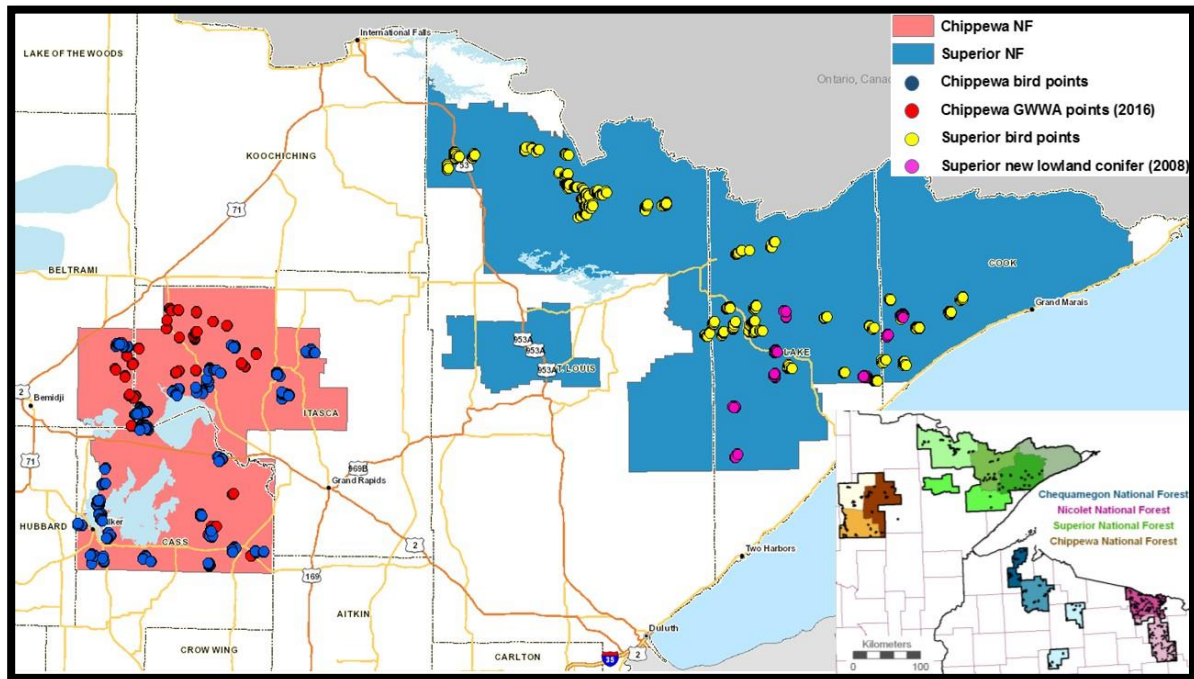
## INTRODUCTION

The breeding bird communities of the western Great Lakes region have among the richest diversity of breeding bird species in North America (Green 1995; Howe et al. 1997; Rich et al. 2004; Niemi et al. 2016). Maintaining avian diversity in forest ecosystems affords many benefits for forest health and productivity; diverse bird communities play a vital role in maintaining both the structure and function of ecosystems by providing numerous ecological services such as seed dispersal and pest control (Krieger 2001; Whelan et al. 2008; Philpott et al. 2009; Şekercioğlu et al. 2012; Şekercioğlu et al. 2017;). Further, because birds integrate environmental variables over space and time, changes in forest bird communities provide meaningful signals of local forest health or degradation (Niemi and McDonald 2004; Gnass Giese et al. 2015).

The USDA Forest Service manages 191 million acres in 44 states, comprising the largest amount of single-ownership breeding bird habitat in the United States. The ecological setting of Superior and Chippewa National Forests (NFs) is particularly important because they are located in a transition zone between boreal forest and eastern deciduous forest. These forests are characterized by a diverse mosaic of forest communities varying from upland pine and aspen-birch to lowland conifer and open shrub bog and provide important habitat for over 150 breeding bird species (Niemi et al. 2016). However, changes in climate, disturbance regimes, and land-use practices have led to significant changes in forest composition in the region, these ongoing changes are likely to have substantial consequences on avian populations and communities (Meynard and Quinn 2008; Eglinton and Pearce-Higgins 2012; Riordan and Rundel 2014; Grinde and Niemi 2016; Niemi et al. 2016;).

Adaptive forest management has the potential to mitigate impacts of climate and land use changes on bird communities by conserving and cultivating critical habitats. Moreover, actively integrating forest birds into forest management planning and implementation will help ensure the health and diversity of ecosystems while meeting society's needs. The development of successful adaptive management plans is contingent on understanding the long-term impacts of forest management on forest-dependent breeding bird species. The Minnesota National Forest Breeding Bird Monitoring Project was established in 1991 in the Chippewa and Superior NFs in response to the need for habitat specific regional population data. Currently, more than 350 stands (> 1,000 points) within the two NFs are surveyed annually during the breeding season (June 1 to July 10) using standardized, 10-min point counts (Fig. 1; see Appendix E for detailed designs and methods).

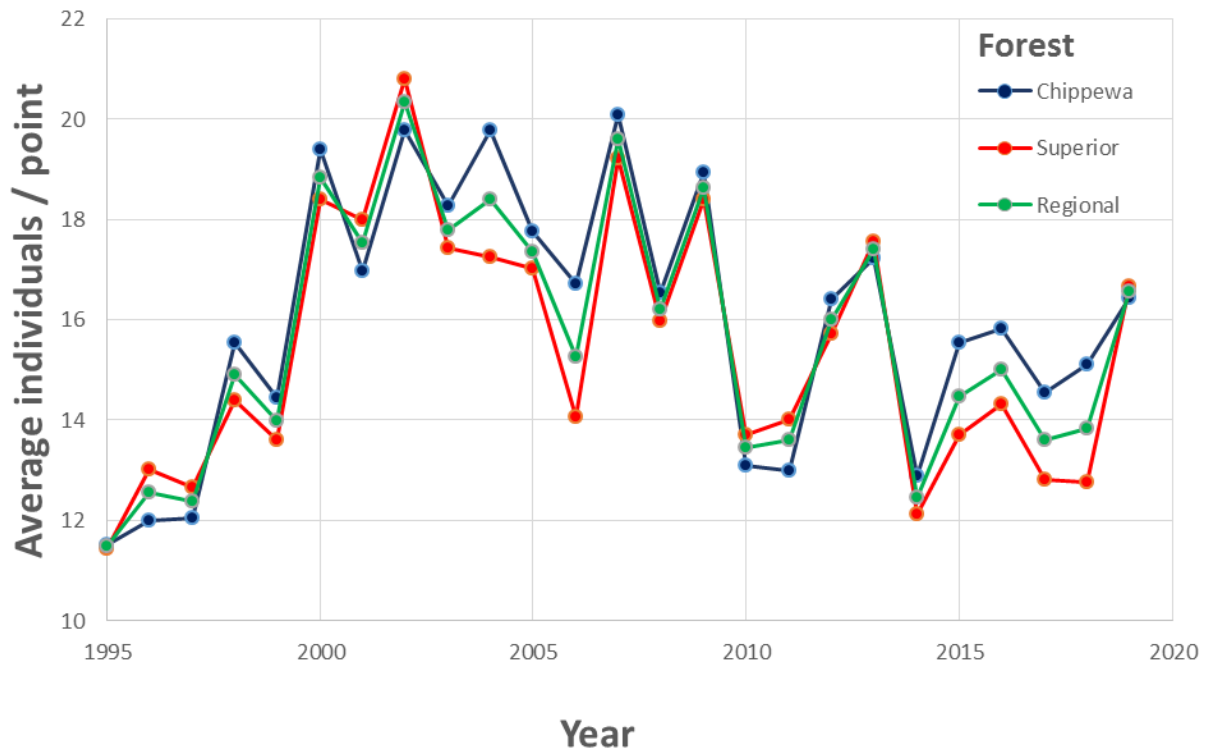
This monitoring program was designed 1) to establish a baseline inventory of local forest breeding bird assemblages, 2) to monitor population changes of forest bird species over time, and 3) to identify bird-habitat associations, particularly those relevant to forest management activities.



**Figure 1.** Locations of forest breeding bird point counts in northern Minnesota’s Chippewa and Superior National Forests. Approximately 1,000 individual points are annually sampled between the Chippewa and Superior NFs. Inset shows the regional scope of National Forests included in Niemi et al. (2016).

## RESULTS

Throughout the 25 field seasons of the Minnesota National Forest Breeding Bird Monitoring Project, we have detected over 359,000 individual birds of 165 species on approximately 22,000 10-minute point counts in the Chippewa and Superior NFs (Fig. 2). In 2019, we sampled 160 stands in the Chippewa NF and 191 in the Superior NF. Seventy-seven species were assessed for trends in at least one national forest, including 67 in the Chippewa NF and 65 in the Superior NF (Table 1). As monitoring has proceeded through the years, new species have met our criteria for inclusion in trend analyses on each national forest. The number of species assessed has increased steadily from 36 in 2000, when the criteria were first applied, to 77 in 2019. Regional trends were calculated for 55 species between the Chippewa and Superior NFs.



**Figure 2. Average number of individual birds detected per point each year in the Chippewa and Superior NFs. The 25 stands added to the Superior NF in 2008 and the 24 stands added to the Chippewa NF in 2016 were included in the summary.**

### Overview of Data Summaries

We summarize the current status of species trends and overall trends for migration, habitat, and nesting guilds. We focus our discussion on species of conservation importance in the state to provide an ecological context and discuss management implications of the observed patterns in the region for these species.

Appendix A includes trend graphs of calculated annual index for individual species within the Chippewa and Superior NFs, and regionally over the 25-year time period of the study. Appendix B is a complete statistical summary of the trend analysis including species, trend within each NF, regional trend (if possible), trend significance ( $P$ ), variation explained by trend ( $r^2$ ), and the number of stands ( $n$ ) in which the species was detected sufficiently to include in the trend calculation. The combination of trend significance and explained variation indicates the strength of the trend for each species within each NF and the region. While this monitoring program was designed to survey territorial forest songbirds, we detect several species that do not fit these criteria. For example, trends for non-forest dwelling species (e.g., Common Loon) and species with large territories (e.g., American Crow) should be interpreted with caution. However, because we conduct surveys using consistent methodology, data from such species may provide useful insights.

Trend significance is a valuable way to look at large-scale patterns within and between NFs; however, the annual index influences the significance (how different is the trend from zero) of the trend line from

year to year. To help visualize patterns in trend index over time, we applied a heat map approach to annual indices for species and guilds in each NF (see Fig. 3; Fig. 4; Table 10; Appendix H; Appendix I). A stretched color scheme was applied to each species with red for low indices, yellow average, and green high; the color was applied to individual species to visualize the relative changes that have occurred over time, not the actual value of the index.

The U.S. Geological Survey’s Breeding Bird Survey (BBS) provides important information on trends at large geographic scales. The Minnesota National Forest Breeding Bird Monitoring Project was specifically designed to complement the BBS by strategically and systematically sampling forest habitat types away from edges associated with roads (where BBS routes are located) using standardized point-count methods. Comparing trends at multiple spatial scales provides ecological context for species trends observed in the NFs. For this reason, we compare NF species trends to BBS trends calculated for Bird Conservation Region 12 (BCR 12) and BBS survey-wide (North America; Table 10).

Appendix C describes the common name, scientific name, four-letter code used in field records, and a summary of the three major guilds included here: migration strategy, nest site, and vegetation type primarily used by the species. Appendices D and E identify the number of individuals observed for species excluded from trend analysis from 1995 to 2019 in Chippewa and Superior NFs, respectively. Appendix F is discussed in more detail below and includes results of trend analysis for lowland-conifer forests in the Superior NF, 2008–2019. Appendix G is a comprehensive overview of the study design and methods. Appendix H and Appendix I provide the estimated annual indices with a stretched color scheme for each species analyzed in Chippewa and Superior NFs, respectively, to visualize relative changes indices over time.

Chippewa National Forest																										
Common Name	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	
Canada Warbler	0.2	0.2	0.2	0.3	0.3	0.3	0.4	0.4	0.4	0.5	0.5	0.5	0.5	0.4	0.5	0.6	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Common Loon	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Connecticut Warbler	0.9	1.0	0.8	0.8	0.7	0.6	0.6	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.1	0.1	0.1	0.0
Golden-winged Warbler	0.5	0.5	0.5	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.5	0.6	0.6	0.6
Olive-sided Flycatcher	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.3	0.3	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.0	0.0
Purple Finch	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3
Veery	1.3	1.4	1.4	1.5	1.6	1.7	1.7	1.8	1.8	1.9	1.9	2.0	2.0	1.9	1.9	1.7	1.9	2.0	1.9	1.9	1.9	1.9	1.9	1.9	1.8	1.8
Winter Wren	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.6	0.6	0.7	0.6	0.6	0.6	0.6	0.5	0.5	0.5	0.5	0.4	0.4	0.4
Wood Thrush	0.2	0.2	0.2	0.1	0.3	0.3	0.4	0.4	0.4	0.4	0.5	0.4	0.4	0.4	0.5	0.4	0.4	0.5	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.5
Superior National Forest																										
Common Name	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	
Black-billed Cuckoo	0.0	0.0	0.1	0.3	0.2	0.2	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.2	0.2	0.1	0.1	0.1	0.0	0.0	-0.1	-0.1	
Black-throated Blue Warbler	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.3	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.3	0.3	
Canada Warbler	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.7	0.7	0.7	0.7	0.7	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.5	0.6	0.6
Cape May Warbler	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.5
Common Loon	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1
Connecticut Warbler	0.8	0.8	0.7	0.7	0.7	0.6	0.6	0.6	0.5	0.5	0.4	0.4	0.4	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1
Golden-winged Warbler	0.2	0.3	0.4	0.4	0.4	0.4	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.5	0.6	0.5	0.5	0.5	0.5	0.4	0.4	0.4	0.3	0.3
Olive-sided Flycatcher	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1
Purple Finch	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Veery	1.4	1.4	1.4	1.4	1.3	1.4	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.2	1.2	1.2	1.2	1.2	1.3	1.3	1.3	1.2	1.3	1.3	1.3
Winter Wren	0.6	0.6	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.7	0.8	0.8	0.7	0.7	0.7	0.7	0.6	0.6	0.6	0.6	0.6	0.5	0.5	0.5
Wood Thrush	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.3	0.4	0.3	0.2	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2

**Figure 3. Estimated annual indices from 1995–2019 for breeding bird species of state, national, or international conservation interest. A stretched color scheme was applied to each species with red for low indices, yellow average, and green high to visualize changes in indices over time.**

Chippewa National Forest																									
Habitat Guilds	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Coniferous forest species	2.2	2.4	2.6	2.9	2.7	2.7	2.9	2.9	3.0	3.0	3.1	3.1	3.1	3.3	3.1	3.5	3.0	3.0	2.8	2.8	2.7	2.7	2.6	2.6	2.5
Deciduous forest species	12.0	12.8	12.9	13.1	14.3	14.9	15.4	15.9	16.2	16.7	16.6	16.7	16.5	16.5	15.8	14.8	15.6	15.9	15.0	14.8	14.8	14.6	14.5	14.2	14.0
Early-successional species	3.7	4.1	4.2	4.5	4.5	4.6	4.7	4.8	5.0	5.1	5.0	4.9	4.8	4.8	4.6	4.5	4.5	4.4	4.5	4.3	4.4	4.4	4.3	4.4	4.4
Lowland-conifer species	2.6	2.7	2.9	3.1	2.9	2.8	2.9	2.9	3.0	3.0	3.1	3.1	3.1	2.9	3.3	3.4	3.0	2.8	3.1	3.1	3.1	3.1	3.0	3.1	3.0
Mixed forest species	2.2	2.3	2.5	2.6	2.6	2.7	2.8	2.9	3.0	3.1	3.1	3.2	3.2	3.1	3.2	3.4	3.1	3.1	3.0	3.0	3.0	2.9	2.9	2.9	2.8
Migration Guilds	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Long-distance migrants	17.1	18.2	18.5	19.1	20.2	20.7	21.3	21.8	22.3	22.8	22.8	22.8	22.7	22.5	22.0	21.3	21.4	21.6	21.0	20.8	20.7	20.6	20.5	20.2	20.2
Permanent residents	1.7	1.9	2.0	2.3	2.3	2.4	2.5	2.6	2.7	2.8	2.9	2.9	2.9	2.8	2.9	2.9	2.8	2.7	2.7	2.7	2.6	2.6	2.5	2.5	2.4
Short-distance migrants	6.8	7.0	7.7	8.2	8.0	8.0	8.3	8.5	8.8	8.9	8.9	8.7	8.7	8.4	8.5	8.5	7.8	7.5	7.4	7.3	7.1	6.9	6.6	6.5	6.3
Nesting Guilds	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Canopy nesting species	4.8	5.2	5.5	5.8	5.7	5.8	6.0	6.1	6.3	6.3	6.4	6.4	6.3	6.4	6.2	6.5	5.9	5.9	5.7	5.7	5.6	5.5	5.4	5.3	5.2
Cavity nesting species	1.4	1.6	1.7	1.8	2.0	2.1	2.2	2.3	2.5	2.6	2.6	2.6	2.6	2.6	2.6	2.5	2.5	2.6	2.4	2.4	2.4	2.3	2.3	2.2	2.2
Ground nesting species	10.7	11.1	11.7	12.4	12.5	12.6	13.0	13.4	13.8	14.1	14.2	14.2	14.3	13.7	14.3	13.8	13.7	13.5	13.7	13.6	13.5	13.5	13.4	13.3	13.2
Nest parasites	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.3	0.3	0.5	0.3	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1
Shrub nesting species	8.6	9.2	9.2	9.5	10.2	10.5	10.8	11.0	11.2	11.4	11.3	11.2	11.0	10.9	10.2	9.9	9.8	9.8	9.3	9.0	8.9	8.8	8.6	8.4	8.2
Superior National Forest																									
Habitat Guilds	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Coniferous forest species	2.6	2.7	2.8	2.9	3.0	3.0	3.1	3.2	3.3	3.5	3.4	3.5	3.6	3.6	3.6	3.7	3.5	3.5	3.4	3.4	3.3	3.3	3.3	3.1	3.1
Deciduous forest species	10.6	10.9	11.4	11.5	12.0	12.3	12.6	12.8	13.1	13.2	13.2	13.1	12.8	12.4	12.2	11.9	11.7	11.5	11.4	11.3	11.2	11.1	10.8	11.0	10.8
Early-successional species	4.9	5.1	5.2	5.4	5.6	5.8	5.9	6.1	6.2	6.5	6.3	6.2	6.1	6.1	5.9	5.7	5.5	5.2	5.2	5.0	4.9	4.8	4.8	4.5	4.5
Lowland-conifer species	4.0	4.2	4.3	4.5	4.5	4.6	4.7	4.9	5.0	5.1	5.1	5.1	5.2	5.2	5.1	5.1	5.0	5.0	5.0	4.9	4.8	4.8	4.9	4.7	4.7
Mixed forest species	2.3	2.4	2.5	2.6	2.6	2.7	2.7	2.8	2.9	3.0	3.0	3.0	3.0	2.9	2.9	2.9	2.8	2.8	2.7	2.7	2.6	2.5	2.4	2.4	2.4
Migration Guilds	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Long-distance migrants	17.8	18.4	18.9	19.3	19.8	20.3	20.7	21.1	21.5	21.9	21.7	21.6	21.3	20.9	20.5	20.1	19.8	19.5	19.4	19.2	19.0	18.8	18.7	18.4	18.3
Permanent residents	1.8	2.0	2.1	2.2	2.3	2.4	2.5	2.7	2.8	2.9	2.9	3.0	3.0	3.0	2.9	2.9	2.8	2.8	2.7	2.7	2.7	2.6	2.6	2.5	2.5
Short-distance migrants	6.8	7.1	7.3	7.7	7.8	8.1	8.3	8.6	8.8	9.1	9.0	9.1	9.1	9.0	8.9	8.7	8.3	8.1	7.9	7.6	7.4	7.2	7.2	6.6	6.4
Nesting Guilds	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Canopy nesting species	3.8	4.0	4.1	4.3	4.3	4.5	4.6	4.7	4.9	5.0	5.0	5.1	5.2	5.2	5.2	5.3	5.1	5.2	5.0	5.0	4.9	4.9	4.9	4.7	4.7
Cavity nesting species	1.2	1.4	1.5	1.5	1.7	1.8	1.9	2.0	2.1	2.2	2.2	2.3	2.3	2.2	2.2	2.1	2.0	2.0	1.9	1.8	1.8	1.7	1.6	1.6	1.5
Ground nesting species	14.0	14.5	14.8	15.3	15.7	16.0	16.3	16.7	17.1	17.4	17.2	17.1	17.0	16.8	16.5	16.2	15.9	15.5	15.5	15.3	15.1	14.9	14.9	14.5	14.3
Shrub nesting species	7.4	7.6	7.8	8.0	8.3	8.6	8.7	8.9	9.1	9.3	9.1	9.0	8.8	8.6	8.4	8.1	7.9	7.7	7.5	7.4	7.3	7.1	7.1	6.8	6.7

**Figure 4. Estimated annual indices from 1995–2019 for breeding bird habitat, migration, and nesting guilds. A stretched color scheme was applied to each species with red for low indices, yellow average, and green high to visualize changes in indices over time.**

**Chippewa NF Trends**

Sixty-seven species were tested this year for Chippewa NF; of these, 13 species had significantly increasing trends (Table 2; Table 3), 15 species had significantly declining trends (Table 4), and 39 species had non-significant trend indices (see Table 5; Appendix A).

**Increasing Species.** There were no new significantly increasing species trends in 2019 in Chippewa NF (Table 6); however, Mourning Dove and Wood Thrush changed from significantly increasing to non-significant in 2019. Importantly, two species of conservation concern showed significantly increasing trends in Chippewa NF again in 2019: Canada Warbler and Veery.

Canada Warbler inhabit a wide range of deciduous and coniferous forests but are most common in mixed coniferous-deciduous forests that are moist and have well-developed understory shrub layers (Reitsma et al. 2010; Grinde and Niemi 2016). This species is positively associated with natural disturbances such as wind or tree-fall gaps and outbreaks of invasive insects such as the eastern spruce budworm (*Choristoneura fumiferana*; Crawford and Jennings 1989; Hagan and Grove 1999; Mitchell 1999; Faccio 2003). Chippewa NF is at the southern edge of the Canada Warbler’s breeding range, and thus they are not widespread throughout the forest (n = 23; Appendix A). Observations of the species vary annually, but we expect the steady increase is associated with a combination of thinning, wind, and insect disturbances that have occurred in some stands. The significantly increasing trend for Canada Warbler in Chippewa NF is important; by comparison, BBS population trend estimates for Canada

Warblers indicate a –2.05% population decline nationally and –2.57% in BCR 12 since 1966 (Sauer et al. 2017; Fig. 3; Table 10). Because of the long-term population declines throughout their range, Canada Warbler was designated as “threatened” in Canada in 2010 and is included on the list of species of conservation concern at the national level in the United States (Butcher et al. 2007; U.S. Fish and Wildlife Service 2008; Environment Canada 2015).

Veery and Wood Thrush are designated as Species in Greatest Conservation Need (SGCN) by the Minnesota Department of Natural Resources (MNDNR; MNDNR 2015). Veery were listed as SGCN by the MNDNR because this species has shown long-term population declines (Sauer et al. 2017; Fig. 3; Table 10) and six percent of the total population breeds in Minnesota, which is the highest of any U.S. state (Pfanmuller 2012). Veery breed in a variety of cover types; however, forest stands with a well-developed understory of shrubs and small trees are a common feature, and research also suggests this species is sensitive to fragmentation (Robbins et al. 1989; Blake 1991). Veery will likely benefit from sustainable forest management that promotes larger forest stands and well-developed understories.

**Decreasing Species.** Only the Golden-crowned Kinglet showed a new significantly decreasing trend this year in Chippewa NF (Appendix A; Table 6). Two species have shown significantly decreasing trends for at least eight years through 2019: Connecticut Warbler and Song Sparrow. Chipping Sparrow, Least Flycatcher, and Winter Wren have had declining trends for six years, and American Robin had a declining trend for the past five years. Olive-sided Flycatcher, Red-eyed Vireo, Brown-headed Cowbird, Common Yellowthroat, and Scarlet Tanager have been declining for the past three years. Three of these species are designated as SGCN: Connecticut Warbler, Olive-sided Flycatcher, and Winter Wren (Fig. 3; MNDNR 2015). Conservation considerations for these species are summarized below in the “Regional Trends” section.

**Non-forest (Golden-winged Warbler) Stands.** In 2016, 25 stands (75 point counts) were added as part of the NFB surveys to focus on non-forested habitat types that are important for many early-successional bird species. In 2019, a total of 1,033 individuals of 61 species were detected in these stands (individuals that were observed flying over and outside of 100 meters were removed). The most abundant species (mean observations/stand) were Nashville Warbler (4.6), Veery (4.0), Common Yellowthroat (3.6), Chestnut-sided Warbler (2.7), and Ovenbird (2.3; Table 7). A total of 45 Golden-winged Warblers were detected at 22 of the 25 surveyed stands, an average of 1.8 per stand (Table 7).

### **Superior NF Trends**

Sixty-five species were tested for trends in 2019 in Superior NF; of these, 13 species had significantly increasing trends (Table 2; Table 3), 21 species had significantly decreasing trends (Table 4), and 31 species had non-significant trends (see Table 5; Appendix A).

**Increasing Species.** American Redstart showed a new significantly increasing trend in 2019 (Table 6). Notably, two species designated as SGCN (MNDNR 2015) show significantly increasing trends in Superior NF: Cape May Warbler and Purple Finch (Table 2).

Cape May Warbler was listed as an SGCN due to steep population declines throughout their range (MNDNR 2015). This species also faces several threats, including high mortality during migration, habitat loss, and narrow thermal preferences (MNDNR 2015; Pfanmuller et al. 2017). BBS population trends showed a –2.51% decline at the national scale but have been relatively stable (–0.15%) in BCR 12 (Sauer et al. 2017; Fig. 3; Table 10). Cape May Warblers are most abundant in a variety of medium- to old-aged coniferous habitats with spruce and balsam fir. They are considered spruce budworm specialists, and

populations fluctuate widely with spruce budworm outbreaks; recent increases in this species are likely due to local spruce budworm outbreaks that have been occurring in and around Superior NF since 2010 (Sturtevant et al. 2013). Maintaining healthy coniferous forests across the landscape and increasing conifer components in existing forest stands, especially in the northern portions of the state, will be beneficial to the long-term conservation of this species.

Purple Finch have experienced a statistically valid decline documented by the BBS that indicates a  $-1.23\%$  decline at the national scale and  $-1.87\%$  decline in BCR 12 since 1966 (Sauer et al. 2017; Table 10). This species uses a variety of habitat types including bogs, upland coniferous forests, pine forests, pine-oak barrens, lowland coniferous forests, and northern mixed forest types (Niemi et al. 2016). The reasons for the population declines in Minnesota are unknown, but changes in climate and high collision risks have been proposed. In Ontario, Cadman et al. (2007) suggested that the recent Purple Finch declines were linked to low spruce budworm populations. If this is the case, it may be a reason why the species is increasing in Superior NF.

**Decreasing Species.** Four species showed new significantly decreasing trends this year in Superior NF: Black-billed Cuckoo, Black-capped Chickadee, Lincoln's Sparrow, and Olive-sided Flycatcher (Appendix A; Table 6). Common Loon, Connecticut Warbler, Swainson's Thrush, and Yellow-bellied Flycatcher have shown declining trends for the last eight years. American Crow, Chipping Sparrow, Downy Woodpecker, Mourning Warbler, and Red-eyed Vireo have been declining for six years, Hermit Thrush has declined for the last five years, and Song Sparrow and Chestnut-sided Warbler have been declining for three years. Winter Wren was significantly declining in 2016, returned to a non-significant trend in 2017, but has returned to a significant decline in 2018 and 2019.

Six of these species are designated as SGCN: Black-billed Cuckoo, Common Loon, Connecticut Warbler, Olive-sided Flycatcher, Veery, and Winter Wren (MNDNR 2015). Common Loons are not well surveyed by point counts so trend indices for Superior NF should be interpreted with caution. Veery indices have been consistently declining in Superior NF over time (Fig. 3; Appendix A). This species is commonly found in regenerating stands that have a well-developed understory of shrubs and small trees (Pfanmuller et al. 2017). This suggests the decline in aspen harvests that have occurred in forests may be associated with declines in the population (Niemi et al. 2016). Conservation considerations for Connecticut Warbler and Winter Wren are summarized below in the "Regional Trends" section.

**Lowland-conifer Forest Stands.** We completed a separate trend analysis for lowland conifer stands in the Superior NF from 2008 to 2019 (Table 8; Appendix F). Forty-two stands primarily composed of black spruce, tamarack, or mixed swamp conifer are sampled annually in the Superior NF and were included in this analysis. Mixed swamp conifer is dominated by northern white cedar, balsam fir, and black spruce, though occasionally mixed with tamarack, paper birch, and black ash. Twenty-five of the 42 stands were added to the sampling design in 2008 and are primarily productive black spruce forests. Nineteen species that are associated with conifer or lowland-conifer for breeding habitat were included in the analysis. Not surprisingly, the results of the lowland conifer analyses differed from the forest-scale trends due to the shortened time-series and restricted forest types. However, we believe that focusing on conifer-associated species in these stands can provide valuable insights for management over time (Table 8; Appendix B). Results indicate that Cape May Warbler, Dark-eyed Junco, Tennessee Warbler, and Yellow-bellied Flycatcher are significantly increasing while Canada Jay, Common Raven, and Winter Wren had trends that are significantly decreasing in lowland-conifer forests from 2008 to 2019 (Table 8; Appendix B).

### **Regional Trends - Pooled National Forests**

We calculated a regional trend that combines data from both Chippewa and Superior NFs for 55 species in 2019. Fifteen species were increasing significantly (Table 2) and 19 species were decreasing significantly (Table 4).

***Increasing Species.*** The 14 species that had increasing regional trends in 2018 were significant in 2019 except for the Yellow-rumped Warbler which moved to a non-significant trend in 2019. Additionally, new region-wide increases were detected in Hairy Woodpecker and Purple Finch (Table 6).

***Decreasing Species.*** New regional declines were identified in Black-capped Chickadee, Magnolia Warbler, and Swamp Sparrow (Table 6). Species that had continued regional declines included American Crow, Blue-headed Vireo, Chestnut-sided Warbler, Chipping Sparrow, Common Loon, Common Yellowthroat, Connecticut Warbler, Downy Woodpecker, Hermit Thrush, Mourning Warbler, Olive-sided Flycatcher, Red-eyed Vireo, Scarlet Tanager, Song Sparrow, Winter Wren, and Yellow-bellied Flycatcher. Of these, four species are identified as SGCN by the MNDNR: Common Loon, Connecticut Warbler, Olive-sided Flycatcher, and Winter Wren (MNDNR 2015).

Connecticut Warbler has shown one of the most consistent declines of any species in the monitoring program. The 2018 field season was the first time there were no Connecticut Warbler detections in either NF; however, there were two detections in 2019 (Fig. 3). Connecticut Warbler is one of the rarest and most narrowly distributed wood warblers in the northern coniferous forest. In Minnesota, the species is most common in mature, lowland coniferous forests comprised of widely scattered black spruce and tamarack trees. An understory of sphagnum moss and low shrub understory of Labrador tea and swamp laurel is also a frequent habitat characteristic (Pfanmuller et al. 2017). The restricted breeding range and specific habitat requirements coupled with a small and declining population led to multiple conservation designations by multiple agencies. It is listed as a Yellow Watch List species, a designation reserved for species that “require constant care and long-term assessment” by Partners in Flight (PIF; Rosenberg et al. 2016). MNDNR identified population declines, habitat loss, and habitat fragmentation as the stressors for the species that lead to their designation of SGCN (MNDNR 2015). Connecticut Warbler is also designated a Sensitive Species on both the Chippewa and Superior National Forests (USDA Forest Service 2012).

Connecticut Warblers have experienced statistically valid declines at all spatial scales, including  $-8.17\%$  in Chippewa NF,  $-7.43\%$  in Superior NF,  $-8.01\%$  in regional trend estimates, and BBS trends that indicate a  $-2.86\%$  decline in BCR 12 and a  $-1.93\%$  decline at the national scale (Sauer et al. 2017; Fig. 3; Table 10). The reasons for these steep declines are unknown, and detailed studies to assess demographic information as well as full life-cycle analyses are needed. Niemi et al. (2016) also highlighted the need to protect and conserve large tracts of black spruce-tamarack forests and emphasized the importance of selecting stands found adjacent to upland coniferous stands, which also provide suitable habitat for this species.

Olive-sided Flycatchers have shown a relatively consistent decline in both forests since 2008 (Fig. 3). Habitat loss and degradation on both breeding and non-breeding grounds, coupled with its long-term population declines, have led to the classification as a Yellow Watch species by PIF to prevent further declines (Rosenberg et al. 2016). In Minnesota, the species was designated a SGCN due to the long-term declines in population (MNDNR 2015) and is also on the regional forester’s Sensitive Species List for both the Chippewa and Superior National Forests (USDA Forest Service 2012). Olive-sided Flycatchers have shown a significant decline of  $-5.76\%$  in Chippewa NF,  $-2.80\%$  in Superior NF, and  $-4.96\%$

regionally, and BBS trends show a  $-4.77\%$  decline in BCR 12 and a  $-3.10\%$  decline at the national scale (Sauer et al. 2017; Fig. 3; Table 10). This species is most common in northern bogs and coniferous forests with natural or anthropogenic forest openings and edges (Pfanmuller et al. 2017). Although habitat loss and degradation have been cited as potential stressors, because of its low numbers and remote breeding habitat, few studies have identified best management practices critical for maintaining populations. Recommendations generally focus on protecting existing sites that provide suitable habitat, retaining snags and tall trees in harvested stands, and insuring the availability of forest openings in appropriate habitats at the landscape scale (Kreitinger and Paulios 2013).

Winter Wren has shown a consistent decline since 2006 in Chippewa NF and since 2011 in Superior NF (Fig. 3). Habitat loss is generally identified as the cause of the decline and led to its designation as a SGCN (MNDR 2015). Significant decreasing population trends were detected in Chippewa NF ( $-2.66\%$ ), Superior NF ( $-0.83\%$ ), and regionally ( $-1.43\%$ ) in 2019. However, BBS population trends are relatively stable in BCR 12 (0.30) and nationally (0.23; Sauer et al. 2017; Fig. 3; Table 10). Winter Wren uses a variety of forest cover types, including a strong preference for mixed swamp conifer stands, lowland hardwood, black spruce-tamarack, and upland aspen-spruce-fir stands. Common features of occupied habitats include the presence of water and a dense understory littered with coarse woody debris including dead logs, slash piles, and upturned roots at the base of fallen trees (Pfanmuller et al. 2017). These structures provide foraging opportunities, nest sites, and singing perches for Winter Wrens. Forest management plans that aim to conserve mature forest stands across the landscape and promote management practices that ensure the retention of snags and downed and decaying wood help provide additional suitable habitat for Winter Wren.

As stated above, we caution the reliability of the trends for Common Loon and note that BBS trends indicate Common Loon populations are increasing ( $1.17\%$ ) in BCR 12 (Sauer et al. 2017; Fig. 3; Table 10). We suggest referring to the results of the [Minnesota Loon Monitoring Program](#), a 20-year, volunteer-based monitoring program designed to monitor loon populations in the state for more detailed information specific to this species.

### **Guild Analyses**

At both the NF and regional scale, nearly all migratory, nesting, and habitat association guilds showed significant increases from 1995 to 2019 (Table 9). However, species associated with shrub/sub-canopy nesting species showed significantly decreasing trends that were consistent in both NFs and regionally. A continued noteworthy pattern is the trends among the migratory guilds. Short-distance migrants showed significant declines in Chippewa NF ( $-0.61\%$ ) and regionally ( $-0.44\%$ ). Long-distance migrants showed significant declines ( $-0.17\%$ ) in Superior NF but also displayed a significant positive trend in Chippewa NF ( $0.31\%$ ; Fig. 4, Table 9). Permanent residents continue to show the greatest overall percentage increase over the past 25 years with an increase of  $0.85\%$  per year regionally (Table 9).

**Early-successional Habitat Guild.** Trend estimates for early-successional species were highest from 2000 to 2010 in Chippewa NF and Superior NF but have been steadily decreasing since that time (Fig. 4). Several species associated with open areas and early-successional habitats showed statistically significant declines in 2019 including Chipping Sparrow, Mourning Warbler, Chestnut-sided Warbler, and Song Sparrow. Regional decreasing trends were significant for four species that are highly associated with early-successional forests: Chestnut-sided Warbler, Mourning Warbler, Olive-sided Flycatcher, and Song Sparrow. Trends for these species are consistent with national BBS trends (Sauer et al. 2017; Table 10). These results are likely due to the reduction in logging that has occurred in these two NFs over the past 18 years as documented in Niemi et al. (2016, p. 48–52).

Golden-winged Warbler is a species of high conservation concern in Minnesota and has received considerable attention from federal, regional, and local agencies. This species is designated a Red Watch List species by PIF and a SGCN by the MNDNR (MNDNR 2015, Rosenberg et al. 2016). Golden-winged Warbler uses shrub wetlands and young successional habitats with dense ground cover. The most important habitat features are a combination of ground vegetation, shrubs, and scattered trees. These features are often characteristic of young aspen forests, brushy clearcuts, shrubby lowlands, and overgrown farmlands. In Minnesota, most birds of this species have been observed in alder-willow wetlands and young aspen forests (Niemi et al. 2016).

Range-wide Golden-winged Warbler populations have declined an average of 2.28% per year from 1966 through 2015 (Sauer et al. 2017; Table 10). This decline is most notable in the eastern populations such as New York (5.1% decline per year), Pennsylvania (6.7% decline per year), and the Appalachian Mountains (8.4% decline per year). Loss of young forest habitat is considered a major threat in this eastern region. Guidelines for managing breeding habitat were developed by the Golden-winged Warbler Working Group (2013) and identified north-central Minnesota as a focal area for habitat management. The guidelines emphasize the importance of establishing patches of habitat that have interspersed clumps of shrubs and/or saplings, an open canopy, and adjacency to mature forest stands.

Currently, over 50% of Golden-winged Warblers breed in Minnesota, and habitat management of Minnesota forests is critical for the long-term survival of the species. Golden-winged Warbler populations in Minnesota's NFs have remained fairly stable over time, and trend estimates showed a non-significant positive trend in both Chippewa (0.60) and Superior (0.59) NFs (Appendix B; Table 10). Importantly, trend estimates have been increasing in Chippewa NF since 2014. This is likely a result of active habitat management that has occurred in the forest during this time period (Fig. 3). Continued conservation actions should focus on maintaining suitable young forest habitat and ensuring the protection of wet lowland shrub habitat.

**Aerial Insectivores.** Three of the five forest-associated flycatchers (Olive-sided Flycatcher, Yellow-bellied Flycatcher, and Least Flycatcher) have been declining either regionally or in at least one NF. The Eastern Wood-Pewee had a significant decline in the Chippewa NF and regionally in 2018 but moved to a non-significant decline in both forests and regionally in 2019. The fifth forest-associated flycatcher (Great Crested Flycatcher) has a non-significant decline ( $P = 0.51$ ) in the Chippewa NF, the only NF of the two where it is found in suitable abundance for trend analysis. Olive-sided Flycatcher, Least Flycatcher, and Eastern Wood-Pewee are experiencing widespread, significant declines in eastern North America (Pfanmuller et al. 2017; Sauer et al. 2017; Table 10). Yellow-bellied Flycatcher is declining in the northeastern U.S., in Superior NF, and regionally when both NFs are combined. In contrast, Great Crested Flycatcher has maintained a relatively stable population over the past 40 plus years, although there are many areas where their populations are declining. Great Crested Flycatcher is a species that readily uses fragmented forests as long as suitable nest cavities remain (Pfanmuller et al. 2017). The decline in flycatchers may be related to similar issues and declines in aerial insectivores such as swallows and swifts reported by Nebel et al. (2010). Recent research in Europe suggests that the flying insect populations have declined by more than 75% over the duration of a 27-year study. If loss of insect diversity and abundance is also occurring in North America, cascading effects on food webs are likely (Hallman et al. 2017). However, these issues are complex because each bird species has a unique life history and we are unsure how resources or the timing in the availability of resources are changing due to climate and other forest disturbances, but these issues deserve further study.

## CONCLUSIONS

There are several possible hypotheses as to why so many species seem to be stable or increasing in relative abundance over the past 24 years. First, and most apparent, logging activity has steadily decreased in both the Chippewa and Superior NFs over the past ten years, primarily due to factors that have contributed to reduced demand for lumber, paper, and other forest products. This has led to several potentially important changes to the age structure of forests. Over the period 1977–2012, northeastern Minnesota saw an increase in the proportion of forest that is greater than 60 years old and a concurrent decrease in mid-successional forests of 41–60 years old (MFRC 2013). Aspen forests provide an excellent example of how this structural diversity develops; stands >60 years old have 2–3 times higher natural mortality than those that are 41–60 years old (MFRC 2013), thus providing a variety of habitat elements from snags that increase nest-cavities to tree-fall gaps that create shrubby growth utilized by many species.

Silvicultural practices have also changed over the last two decades. Although about 70% of harvesting is completed through clear-cutting, this has steadily decreased from 1991 to 2008 with selection harvesting, thinning, and patch clear-cuts being utilized more often (D’Amato et al. 2009). Over the same period, there has been a nearly two-fold increase in the number of clear-cuts that incorporate leave trees (44% in 1991 to 80% in 2008) (D’Amato et al. 2009). With logging providing the most significant disturbance in these NFs, changes in practice have a variety of effects on both local and regional populations of birds. This is especially true if modifications (e.g., leaving standing timber and snags in clear-cuts) mimic disturbance features that these species evolved to utilize. Changing age-class structure and silvicultural practices might better represent the natural fire disturbance regime that once dominated these forests (Heinselman 1973; Niemi et al. 1998, 2016) and to which most of these bird species certainly respond.

Despite increasing mature forest cover, several species that are decreasing breed primarily in mid-to-late-successional forests including the Connecticut Warbler, Hermit Thrush, Swainson’s Thrush, and Yellow-bellied Flycatcher. For each, there are potential reasons for these trends. First, these species have primarily boreal distributions and are at or near the southern edge of their breeding range in these NFs. This is where we might expect initial declines to be most evident, especially if changing climatological factors are influencing these species’ populations. For example, Langham et al. (2015) predict large-scale shifts northward due to climate changes by the year 2080. Additionally, these species are all associated with coniferous and, especially, lowland coniferous forests, which have different logging and management pressures than upland deciduous forests. These species also share similar food types and foraging-space in dense, shrubby growth near the ground (Jones and Donovan 1996; Pitocchelli et al. 1997; Evans Mack and Yong 2000; Gross and Lowther 2001).

The overall message in this report is positive regarding breeding forest birds in the Chippewa and Superior NFs. Although there is evidence of positive trends in forest-cover across the region (5.5% in last 35 years; MFRC 2013), from a historical perspective, most of these forest-associated breeding species likely have much lower populations today than in the past due to habitat loss. For example, Minnesota has lost almost half of its forest area, from 31 million acres in the mid-1800s to less than 17 million acres today. These rates of forest loss are conservative relative to other U.S. states and in over-wintering habitats of Mexico and in Central and South America. Maintaining adequate forested habitat across these species’ ranges and identifying the factors influencing their populations will be a major challenge for many generations to come.

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**TABLES**

**Table 1.** Trends for two National Forests (NF) and pooled NFs based on linear regression of loess-smoothed annual index of abundance (See Methods) (1995-2019). I = significantly increasing, D = significantly decreasing. \*  $P < 0.05$ , \*\*  $P < 0.01$ . See Appendix A for species graphs and Appendix B for test statistics and sample sizes.

Species	Chippewa NF	Superior NF	Regional
Alder Flycatcher	D**	ns	ns
American Bittern	-	ns	-
American Crow	ns	D**	D*
American Goldfinch	ns	ns	ns
American Redstart	ns	I*	I*
American Robin	D**	ns	ns
Black-and-white Warbler	I**	ns	I**
Black-billed Cuckoo	-	D*	-
Black-capped Chickadee	ns	D**	D**
Black-throated Blue Warbler	-	ns	-
Black-throated Green Warbler	I**	I**	I**
Blackburnian Warbler	ns	ns	ns
Blue-headed Vireo	D**	ns	D*
Blue Jay	I**	I**	I**
Broad-winged Hawk	-	D**	-
Brown-headed Cowbird	D*	-	-
Brown Creeper	ns	ns	ns
Canada Jay	ns	ns	ns
Canada Warbler	I*	ns	ns
Cape May Warbler	-	I**	-
Cedar Waxwing	ns	ns	I*

Species	Chippewa NF	Superior NF	Regional
Chestnut-sided Warbler	ns	D**	D**
Chipping Sparrow	D**	D**	D**
Common Loon	ns	D**	D**
Common Raven	ns	ns	ns
Common Yellowthroat	D*	D**	D**
Connecticut Warbler	D**	D**	D**
Dark-eyed Junco (Slate-colored)	ns	-	-
Downy Woodpecker	D*	D**	D**
Eastern Towhee	ns	-	-
Eastern Wood-Pewee	ns	ns	ns
Evening Grosbeak	-	ns	-
Golden-crowned Kinglet	D**	ns	ns
Golden-winged Warbler	ns	ns	ns
Gray Catbird	ns	-	-
Great Crested Flycatcher	ns	-	-
Hairy Woodpecker	ns	ns	I*
Hermit Thrush	ns	D**	D**
Indigo Bunting	ns	-	-
Least Flycatcher	D**	ns	ns
Lincoln's Sparrow	I**	D*	ns
Magnolia Warbler	ns	D**	D**
Mourning Dove	ns	-	-
Mourning Warbler	ns	D**	D**
Nashville Warbler	I**	I**	I**
Northern Flicker (Yellow-shafted)	ns	ns	ns

Species	Chippewa NF	Superior NF	Regional
Northern Parula	ns	I**	I**
Northern Waterthrush	ns	I**	I**
Olive-sided Flycatcher	D**	D*	D**
Ovenbird	I**	ns	I**
Palm Warbler (Western)	ns	-	-
Pileated Woodpecker	I**	ns	I*
Pine Warbler	I**	I**	I**
Purple Finch	ns	I*	I*
Red-breasted Nuthatch	I**	I**	I**
Red-eyed Vireo	D**	D**	D**
Red-winged Blackbird	ns	ns	ns
Rose-breasted Grosbeak	ns	D*	ns
Ruby-crowned Kinglet	-	I**	-
Ruby-throated Hummingbird	I*	-	-
Ruffed Grouse	-	I**	-
Scarlet Tanager	D*	ns	D**
Song Sparrow	D**	D**	D**
Swainson's Thrush	-	D**	-
Swamp Sparrow	ns	ns	D*
Tennessee Warbler	-	I**	-
Veery	I**	ns	ns
White-breasted Nuthatch	ns	-	-
White-throated Sparrow	ns	ns	ns
Wilson's Snipe	ns	ns	ns
Winter Wren	D**	D**	D**

Species	Chippewa NF	Superior NF	Regional
Wood Thrush	ns	ns	ns
Yellow-bellied Flycatcher	ns	D**	D*
Yellow-bellied Sapsucker	I**	ns	I**
Yellow-rumped Warbler (Myrtle)	ns	ns	ns
Yellow-throated Vireo	ns	-	-
Yellow Warbler	ns	-	-

**Table 2.** Species with significantly increasing trends ( $P \leq 0.05$ ) for two national forests and region-wide (1995–2019), based on regression of loess-smoothed annual index of abundance. \*\*  $P \leq 0.01$ . Species graphs can be found in Appendix A.

Chippewa NF	Superior NF	Regional
Black-and-white Warbler**	American Redstart*	American Redstart*
Black-throated Green Warbler**	Black-throated Green Warbler**	Black-and-white Warbler**
Blue Jay**	Blue Jay**	Black-throated Green Warbler**
Canada Warbler*	Cape May Warbler**	Blue Jay**
Lincoln's Sparrow**	Nashville Warbler**	Cedar Waxwing*
Nashville Warbler**	Northern Parula**	Hairy Woodpecker*
Ovenbird**	Northern Waterthrush**	Nashville Warbler**
Pileated Woodpecker**	Pine Warbler**	Northern Parula**
Pine Warbler**	Purple Finch*	Northern Waterthrush**
Red-breasted Nuthatch**	Red-breasted Nuthatch**	Ovenbird**
Ruby-throated Hummingbird*	Ruby-crowned Kinglet**	Pileated Woodpecker*
Veery**	Ruffed Grouse**	Pine Warbler**
Yellow-bellied Sapsucker**	Tennessee Warbler**	Purple Finch*
		Red-breasted Nuthatch**
		Yellow-bellied Sapsucker**

**Table 3.** Summary of species with increasing trends ( $P \leq 0.05$ ) on two national forests (1995–2019). Individual species graphs can be found in Appendix A.

Increased in one NF	Increased in both NFs
American Redstart	Black-throated Green Warbler
Black-and-white Warbler	Blue Jay
Canada Warbler	Nashville Warbler
Cape May Warbler	Pine Warbler
Lincoln's Sparrow	Red-breasted Nuthatch
Northern Parula	
Northern Waterthrush	
Ovenbird	
Pileated Woodpecker	
Purple Finch	
Ruby-crowned Kinglet	
Ruby-throated Hummingbird	
Ruffed Grouse	
Tennessee Warbler	
Veery	
Yellow-bellied Sapsucker	

**Table 4.** Species with significantly decreasing trends ( $p < 0.05$ ) for two national forests (1995–2019), based on regression of loess-smoothed annual index of abundance. \*\*  $p < 0.01$ . Species graphs can be found in Appendix A.

Chippewa NF	Superior NF	Regional
Alder Flycatcher**	American Crow**	American Crow*
American Robin**	Black-billed Cuckoo*	Black-capped Chickadee**
Blue-headed Vireo**	Black-capped Chickadee**	Blue-headed Vireo*
Brown-headed Cowbird*	Broad-winged Hawk**	Chestnut-sided Warbler**
Chipping Sparrow**	Chestnut-sided Warbler**	Chipping Sparrow**
Common Yellowthroat*	Chipping Sparrow**	Common Loon**
Connecticut Warbler**	Common Loon**	Common Yellowthroat**
Downy Woodpecker*	Common Yellowthroat**	Connecticut Warbler**
Golden-crowned Kinglet**	Connecticut Warbler**	Downy Woodpecker**
Least Flycatcher**	Downy Woodpecker**	Hermit Thrush**
Olive-sided Flycatcher**	Hermit Thrush**	Magnolia Warbler**
Red-eyed Vireo**	Lincoln's Sparrow*	Mourning Warbler**
Scarlet Tanager*	Magnolia Warbler**	Olive-sided Flycatcher**
Song Sparrow**	Mourning Warbler**	Red-eyed Vireo**
Winter Wren**	Olive-sided Flycatcher*	Scarlet Tanager**
	Red-eyed Vireo**	Song Sparrow**
	Rose-breasted Grosbeak*	Swamp Sparrow*
	Song Sparrow**	Winter Wren**
	Swainson's Thrush**	Yellow-bellied Flycatcher*
	Winter Wren**	
	Yellow-bellied Flycatcher**	

**Table 5.** Species with marginally significant trends ( $0.05 < P \leq 0.10$ ) for two national forests and region-wide (1995–2019), based on regression of loess-smoothed annual index of abundance. Direction of trend indicated by either positive (+) or negative-sign (-). Species graphs can be found in Appendix A.

<b>Chippewa NF</b>	<b>Superior NF</b>	<b>Regional</b>
Eastern Wood-Pewee (-)	Black-and-white Warbler (+)	Brown Creeper (-)
Indigo Bunting (-)	Brown Creeper (-)	Common Raven (-)
Wood Thrush (+)	Common Raven (-)	Eastern Wood-Pewee (-)
	Golden-crowned Kinglet (+)	Least Flycatcher (-)
	Hairy Woodpecker (+)	
	Yellow-rumped Warbler (Myrtle) (+)	

**Table 6.** Species with changes in trend significance from 2018 to 2019. Changes were either in a positive direction, from decreasing (2018) to non-significant (2019) or non-significant to increasing, or in a negative direction, from increasing to non-significant or non-significant to decreasing. The specific National Forest where the change occurred is indicated. Species graphs can be found in Appendix A.

<b>Decreasing to non-significant</b>	<b>Non-significant to increasing</b>	<b>Increasing to non-significant</b>	<b>Non-significant to decreasing</b>
Common Raven, Superior	American Redstart, Superior	Black-and-white Warbler, Superior	Black-billed Cuckoo, Superior
Eastern Wood-Pewee, Chippewa	Hairy Woodpecker, Regional	Golden-crowned Kinglet, Superior	Black-capped Chickadee, Regional
Eastern Wood-Pewee, Regional	Purple Finch, Regional	Mourning Dove, Chippewa	Black-capped Chickadee, Superior
Veery, Superior		Wood Thrush, Chippewa	Golden-crowned Kinglet, Chippewa
White-throated Sparrow, Regional		Yellow-rumped Warbler (Myrtle), Regional	Lincoln's Sparrow, Superior
		Yellow-rumped Warbler (Myrtle), Superior	Magnolia Warbler, Regional
			Olive-sided Flycatcher, Superior
			Swamp Sparrow, Regional

**Table 7.** Summary of the 20 most common species in 2019 from 25 stands (75 points) first added to the Chippewa National Forest in 2016. Included in the summary are total individuals observed, mean abundance (observations/point, stand), and percent occupied (points, stands). Points sampled are intended to target Golden-winged Warblers or non-forested habitats. Sites chosen represent a broad range of environmental conditions from open, wet shrubby habitats to dryer, forested upland habitats.

Species	Total Individuals	Point		Stand	
		Mean Abundance	% Occupied	Mean Abundance	% Occupied
Alder Flycatcher	35	0.5	33	1.4	60
American Crow	19	0.3	21	0.8	48
American Redstart	16	0.2	16	0.6	28
American Robin	37	0.5	35	1.5	56
Black-and-white Warbler	39	0.5	45	1.6	84
Black-capped Chickadee	16	0.2	16	0.6	40
Blue Jay	50	0.7	40	2	72
Cedar Waxwing	38	0.5	20	1.5	40
Chestnut-sided Warbler	78	1	60	3.1	88
Common Yellowthroat	116	1.5	61	4.6	92
Golden-winged Warbler	52	0.7	49	2.1	88
Hermit Thrush	16	0.2	12	0.6	20
Nashville Warbler	144	1.9	69	5.8	96
Ovenbird	114	1.5	67	4.6	84
Red-eyed Vireo	134	1.8	83	5.4	100
Red-winged Blackbird	25	0.3	8	1	12
Sedge Wren	36	0.5	20	1.4	36
Swamp Sparrow	72	1	52	2.9	84
Veery	143	1.9	73	5.7	88
White-throated Sparrow	111	1.5	61	4.4	80

**Table 8.** Population trend estimates (% annual change) and associated test statistics for lowland-conifer forests in the Superior National Forest (2008-2019). Only species in "conifer" and "lowland-conifer" habitat guilds were analyzed. Included for each species are its trend within the Superior NF, the significance of the trend ( $P$ ), the explained variation of the trend ( $r^2$ ), and the number of stands ( $n$ ) in which the species was detected sufficiently to include in the trend calculation.

Species	Superior			
	Trend (%)	$P$	$r^2$	$n$
Blackburnian Warbler	-1.64	0.58	0.18	24
Blue-headed Vireo	-1.68	0.68	0.10	19
Canada Jay	-14.44	0.03	0.94	6
Cape May Warbler	20.12	<0.01	0.92	8
Chipping Sparrow	-3.40	0.41	0.44	7
Common Raven	-7.13	0.05	0.64	9
Dark-eyed Junco (Slate-colored)	13.98	<0.01	0.85	8
Golden-crowned Kinglet	-0.76	0.67	0.26	32
Magnolia Warbler	0.16	0.99	0.00	36
Nashville Warbler	-0.61	0.47	0.23	42
Northern Parula	-2.62	0.42	0.50	18
Northern Waterthrush	4.98	0.14	0.49	12
Red-breasted Nuthatch	-1.16	0.45	0.28	38
Ruby-crowned Kinglet	0.37	0.86	0.01	30
Swainson's Thrush	-2.74	0.09	0.40	32
Tennessee Warbler	22.67	<0.01	0.92	11
Winter Wren	-2.97	0.01	0.44	41
Yellow-bellied Flycatcher	2.45	<0.01	0.44	38
Yellow-rumped Warbler (Myrtle)	0.68	0.58	0.02	35



**Table 10.** Trend direction for 77 bird species with trend estimates in at least one National Forest. Breeding Bird Survey (BBS) trends in Bird Conservation Region 12 (BCR12) and BBS survey-wide (North America) are included for comparison. Color-coding indicates direction if the trend 95% CI did not include zero; red is a negative trend, green is a positive trend. Yellow indicates that the 95% CI included zero. National Forest trends are 1995 through 2019, while BBS trends are 1966 through 2015 (Sauer et al. 2017).

Common Name	Chippewa	Superior	Regional	BCR12	N America
Alder Flycatcher	-2.84	0.61	-0.4	0.15	-0.89
American Bittern	NA	-2.25	NA	-0.45	-0.52
American Crow	-0.41	-3.52	-1.19	0.64	0.07
American Goldfinch	1.23	0.82	1.08	-0.33	-0.17
American Redstart	1.03	1.63	1.25	-0.18	-0.28
American Robin	-1.72	0.37	-0.42	-0.23	0.12
Black-and-white Warbler	3.46	0.62	1.75	-0.6	-0.86
Black-billed Cuckoo	NA	-4.46	NA	-0.85	-1.62
Black-capped Chickadee	-0.78	-1.12	-0.93	1.79	0.61
Black-throated Blue Warbler	NA	1.27	NA	1.34	1.95
Black-throated Green Warbler	1.63	1.78	1.7	0.62	0.35
Blackburnian Warbler	0.68	-0.57	-0.17	0.56	0.35
Blue-headed Vireo	-2.09	-0.55	-1.33	3.57	2.86
Blue Jay	1.14	1.07	1.1	0.86	-0.66
Broad-winged Hawk	NA	-7.9	NA	0.48	1.02
Brown-headed Cowbird	-3.9	NA	NA	-5.1	-0.66
Brown Creeper	-0.91	-1.36	-1.12	3.37	0.55
Canada Jay	-1.02	-0.84	-0.91	-0.16	-0.32
Canada Warbler	2.99	0.01	0.4	-2.57	-2.05
Cape May Warbler	NA	6.06	NA	-0.15	-2.51
Cedar Waxwing	1.21	1.54	1.37	-0.9	0.07
Chestnut-sided Warbler	-0.28	-1.38	-0.9	-0.09	-1.15
Chipping Sparrow	-3.25	-3.59	-3.36	-0.72	-0.6
Common Loon	-0.8	-4.04	-1.73	1.17	0.66
Common Raven	-0.45	-1.29	-0.88	2.74	2.04
Common Yellowthroat	-1.19	-1.82	-1.37	-0.34	-1.01
Connecticut Warbler	-8.17	-7.43	-8.01	-2.86	-1.93
Dark-eyed Junco (Slate-colored)	NA	4.71	NA	-2.09	-1.38
Downy Woodpecker	-3.01	-8.78	-4.36	0.29	0.03
Eastern Towhee	-0.6	NA	NA	-2.2	-1.34
Eastern Wood-Pewee	-0.88	-0.83	-0.86	-1.45	-1.4
Evening Grosbeak	NA	-5.54	NA	-6.54	-6.36
Golden-crowned Kinglet	-2.4	1.16	0.34	0.51	-1.54
Golden-winged Warbler	0.6	0.59	0.61	-0.83	-2.28
Gray Catbird	-1.27	NA	NA	-1.57	-0.01
Great Crested Flycatcher	-0.59	NA	NA	-1.64	-0.03

Common Name	Chippewa	Superior	Regional	BCR12	N America
Hairy Woodpecker	1.33	1.87	1.6	1.72	0.81
Hermit Thrush	-0.11	-1.88	-0.94	0.5	0.33
Indigo Bunting	-4.22	NA	NA	0.14	-0.73
Least Flycatcher	-1.75	0.69	-0.93	-2.2	-1.71
Lincoln's Sparrow	6.37	-4.31	3.39	-2.19	-0.36
Magnolia Warbler	-0.12	-1.35	-1.25	1.56	0.87
Mourning Dove	2.28	NA	NA	2.23	-0.29
Mourning Warbler	-0.27	-2.28	-1.66	-1.01	-1.18
Nashville Warbler	1.32	1.23	1.25	-0.02	0.01
Northern Flicker (Yellow-shafted)	0.29	-0.5	-0.28	-0.85	-1.33
Northern Parula	0.68	1.32	1.11	4.63	1.11
Northern Waterthrush	2.08	3.98	3.01	-1.2	1.19
Olive-sided Flycatcher	-5.76	-2.8	-4.96	-4.77	-3.1
Ovenbird	1.54	-0.02	0.66	-0.11	-0.07
Palm Warbler (Western)	3.02	NA	NA	2.69	-1.78
Pileated Woodpecker	3.63	1.1	1.85	4.38	1.41
Pine Warbler	2.03	4.84	2.54	4.74	0.88
Purple Finch	0.85	3.45	2.09	-1.87	-1.23
Red-breasted Nuthatch	3.79	2.85	3.28	2.73	0.72
Red-eyed Vireo	-0.57	-1.03	-0.77	0.83	0.75
Red-winged Blackbird	-1.14	-1.46	-1.19	-0.82	-0.93
Rose-breasted Grosbeak	0.17	-1.18	-0.6	-1.56	-0.86
Ruby-crowned Kinglet	NA	7.52	NA	-2.63	0.47
Ruby-throated Hummingbird	5.24	NA	NA	1.51	1.44
Ruffed Grouse	NA	2.78	NA	-0.17	0.29
Scarlet Tanager	-1.38	-1.68	-1.37	-1.24	-0.22
Song Sparrow	-5.42	-4.08	-4.85	-1.11	-0.76
Swainson's Thrush	NA	-3.97	NA	-0.93	-0.84
Swamp Sparrow	-1.79	-1.37	-1.68	1.13	0.93
Tennessee Warbler	NA	9.73	NA	-3.67	-1.03
Veery	1.02	-0.49	0.31	-1.48	-1.13
White-breasted Nuthatch	0.3	NA	NA	1.85	1.71
White-throated Sparrow	0.06	-0.21	-0.13	-1.01	-0.93
Wilson's Snipe	2.42	-1.66	0.06	-1.53	0.25
Winter Wren	-2.66	-0.83	-1.43	0.3	0.23
Wood Thrush	3.23	-2.99	2.04	-3.39	-1.91
Yellow-bellied Flycatcher	1.22	-2	-1.18	0.52	2.26
Yellow-bellied Sapsucker	1.86	-0.12	0.89	2.3	1.1
Yellow-rumped Warbler (Myrtle)	-0.34	0.74	0.28	0.31	-0.4
Yellow-throated Vireo	-0.47	NA	NA	1.71	0.98
Yellow Warbler	0.32	NA	NA	-1.02	-0.61

## **APPENDICES**

Appendices A through I are attached to this report as separate and individual files.