American Woodcock

Population Status, 2021

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U.S. Fish and Wildlife Service
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AMERICAN WOODCOCK POPULATION STATUS, 2021

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Abstract: The American Woodcock (*Scolopax minor*) Singing-ground Survey data for 2021 indicate that the index for singing males was similar to that of 2020 in the Eastern and Central Management Regions. Both regions had a significant negative trend over the most recent 10-years (2011–2021): Eastern = -1.13%/year; Central = -2.06%/year. Both regions had a significant, long-term (1968-21) negative trend; Eastern = -1.00%/year; Central -0.92%/year. The 2020 recruitment index in the U.S. portion of the Eastern Region (1.60 immatures per adult female) was 6.0% greater than the 2019 index, and 1.2% less than the long-term regional average, while the recruitment index in the Central Region (1.09 immatures per adult female) was 22.1% less than the 2019 index, and 26.8% less than the long-term regional average. Estimates from the Harvest Information Program indicated that U.S. woodcock hunters in the Eastern Region spent 142,800 days afield and harvested 51,100 woodcock during the 2020–21 season, while in the Central Region hunters spent 260,600 days afield and harvested 123,700 woodcock.

INTRODUCTION

The American woodcock is a popular game bird throughout eastern North America. The management objective of the U.S. Fish and Wildlife Service (FWS) is to stabilize woodcock populations, while ultimately returning the population to a level that occurred in the early 1970s (Kelley et al. 2008). Reliable annual population estimates, harvest estimates, and information on recruitment and distribution are essential for comprehensive woodcock management. Unfortunately, this information is difficult and often impractical to obtain. Woodcock are difficult to find and count because of their cryptic coloration, small size, and preference for areas with dense vegetation. The Singing-ground Survey (SGS) was developed to provide indices to changes in abundance. The Parts-collection Survey (PCS) provides annual indices of woodcock recruitment. The Harvest Information Program (HIP) utilizes a sampling frame of woodcock hunters to estimate harvest and hunter days spent afield.

This report summarizes the results of these surveys and presents an assessment of the population status of woodcock as of early June 2021. The report is intended to assist managers in regulating the sport harvest of woodcock and to draw attention to areas where management actions are needed. Historical woodcock hunting regulations are summarized in Appendix A.

The primary purpose of this report is to facilitate the prompt distribution of timely information. Results are preliminary and may change with the inclusion of additional data.

METHODS
Woodcock Management Regions

Woodcock are managed on the basis of two regions or populations, Eastern and Central (Fig. 1), as recommended by Owen et al. (1977). Coon et al. (1977) reviewed the concept of management regions for woodcock and recommended the current configuration over several alternatives. This configuration was biologically justified because analysis of band recovery data indicated that there was little crossover between the regions (Krohn et al. 1974, Martin et al. 1969). Furthermore, the boundary between the two regions conforms to the boundary between the Atlantic and Mississippi Flyways. The results of the Parts-collection and Singing-ground Survey, as well as the Harvest Information Program, are reported by state or province, and management region. Although state and province level results are included in this report, analyses are designed to support management decisions made at the management region scale.

Singing-ground Survey

The Singing-ground Survey was developed to exploit the conspicuous courtship display of the male woodcock. Early studies demonstrated that counts of singing males provide indices to woodcock populations and could be used to monitor annual changes (Mendall and Aldous 1943, Goudy 1960, Duke 1966, and Whitcomb 1974). Before 1968, counts were conducted on non-randomly-located routes. Beginning in 1968, routes were relocated along lightly-traveled secondary roads in the center of randomly-chosen 10-minute degree blocks within each state and province in the
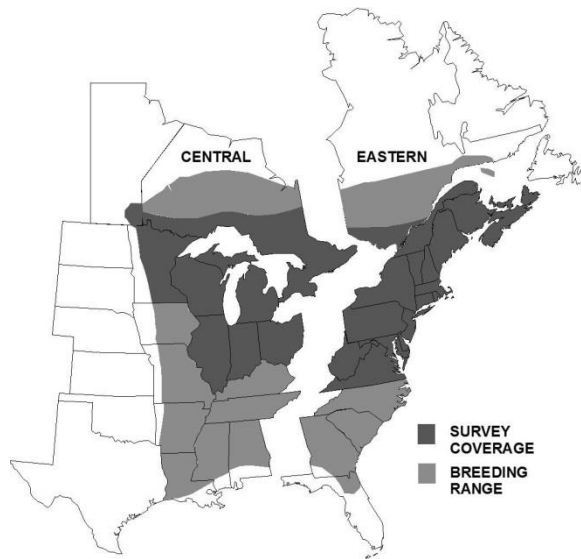
Fig. 1. Woodcock management regions, breeding range, and Singing-ground Survey coverage.

central and northern portions of the woodcock's breeding range (Fig. 1). Data collected prior to 1968 are not included in this report.

Each route was 3.6 miles (5.4 km) long and consisted of 10 listening points. The routes were surveyed shortly after sunset by an observer who drove to each of the 10 stops and recorded the number of woodcock heard peenting (the vocalization by displaying male woodcock on the ground). Acceptable dates for conducting the survey were assigned by latitude to coincide with peaks in courtship behavior of local woodcock. In most states and provinces, the peak of courtship activity (including local woodcock and woodcock still migrating) occurred earlier in the spring and local reproduction may have already been underway when the survey was conducted. However, it was necessary to conduct the survey during the designated survey dates in order to minimize the counting of migrating woodcock. Because adverse weather conditions may affect courtship behavior and/or the ability of observers to hear woodcock, surveys were only conducted when wind, precipitation, and temperature conditions were within prescribed limits.

The survey consists of about 1,500 routes. To avoid expending unnecessary resources and funds, approximately two-thirds of these routes were selected for survey each year. The remaining routes were carried as "constant zero" routes. Routes for which no woodcock were heard for 2 consecutive years enter this constant zero status and were not surveyed for the next 5 years. If woodcock were heard on a constant zero route during its next survey, the route reverted to normal status and was surveyed again each year. Data from constant zero routes were included in the analysis only

for the years they were actually surveyed. Sauer and Bortner (1991) reviewed the implementation and analysis of the Singing-ground Survey in more detail.

Trends in the number of male woodcock heard were estimated using a hierarchical model. Sauer et al. (2008) describe a hierarchical log-linear model for estimation of population change from SGS data. In practice, the hierarchical modeling approach provides trend and annual index values that are generally comparable to the estimates provided by the previously used route regression approach (see Link and Sauer 1994 for more information on the route regression approach). The hierarchical model, however, has a more rigorous and realistic theoretical basis than the weightings used in the route regression approach.

With the hierarchical model, the log of the expected value of the counts was modeled as a linear combination of strata-specific intercepts and year effects, a random effect for each unique combination of route and observer, a start-up effect on the route for first year counts by new observers, and overdispersion. In the hierarchical model, the parameters of interest were treated as random and were assumed to follow distributions that were governed by additional parameters. The hierarchical model is fit using Bayesian methods. Markov-chain Monte Carlo methods were used to iteratively produce sequences of parameter estimates which were used to describe the distribution of the parameters of interest. After an initial "burn-in" period, means, medians, and credible (or Bayesian confidence) intervals (CI) for the parameters were estimated from the replicates. Annual indices were defined as exponentiated strata, underlying trend, and year effects, which were then weighted by the proportion of routes where at least 1 woodcock was observed between 1968 and the present. Trends were defined as ratios of the indices at the start and end of the interval of interest, taken to the appropriate power to estimate a yearly change (Sauer et al. 2008). Trend estimates were expressed as percent change per year, while indices were expressed as the number of singing males per route. Annual indices were calculated for the 2 regions and each state and province, while short-term (2020–21), 10-year (2011–21) and long-term (1968–2021) trends were evaluated for each region as well as for each state and province.

Due to SARS-CoV-2 (i.e., coronavirus) related restrictions in Canada and the U.S. only a portion of Singing-ground Survey (n=329 routes) were conducted in 2020. Indices for states and provinces with little or no data for 2020 were estimated with the hierarchical model using strata-specific intercepts and year effects that were calculated from the limited 2020 data and the long-term dataset.

Credible Intervals were used to describe uncertainty around the estimates when fitting hierarchical models.

If the CI did not overlap 0 for a trend estimate, the trend was considered significant. We present the median and 95% CIs of 10,000 estimates (i.e., we simulated 20,000 replicates and thinned by 2), which were calculated after an initial burn-in of 20,000 iterations to allow the series to converge. Refer to Sauer et al. (2008) and Link and Sauer (2002) for a detailed description of the statistical model and fitting process.

The reported sample sizes are the number of routes on which trend estimates are based. Each route was to be surveyed during the peak time of daily singing activity. For editing purposes, "acceptable" stops were surveyed between 22 and 58 minutes after sunset (or between 15 and 51 minutes after sunset on overcast evenings). Due to observer error or road conditions, some stops on some routes were surveyed before or after the peak times of singing activity. Earlier analysis revealed that routes with 8 or fewer acceptable stops tended to be biased low. Beginning with data from 1988, only route observations with at least 9 acceptable stops were included in the analysis. Route observations prior to 1988 are used regardless of the number of acceptable stops. Routes for which data were received after 20 July 2021 were not included in this analysis but will be included in future trend estimates.

Parts-collection Survey

The primary objective of the Parts-collection Survey is to provide data on the reproductive success of woodcock. The survey is administered as a cooperative effort between woodcock hunters, the FWS, and state wildlife agencies. Participants in the 2020 survey included hunters who either: (1) participated in past surveys; (2) were a subset of hunters that indicated on the Harvest Information Program Survey that they hunted woodcock; or (3) contacted the FWS to volunteer for the survey.

Parts-collection Survey participants were provided with prepaid mailing envelopes and asked to submit one wing from each woodcock they harvested. Hunters were asked to record the date of the hunt as well as the state and county where the bird was shot. Hunters were not asked to submit envelopes for unsuccessful hunts. The age and gender of birds were determined by examining plumage characteristics (Martin 1964, Sepik 1994). An in-person wingbee could not be held in 2021 due to SARS-CoV-2 (i.e., coronavirus) restrictions. Wings were mailed to a subset of state and federal biologists that have annually attended the wingbee prior to 2021.

The ratio of immature birds per adult female in the harvest provides an index to recruitment of young into the population. The 2020 recruitment index for each state with ≥ 125 submitted wings was calculated as the number of immatures per adult female. The regional indices for 2020 were weighted by the relative contribution of each state to the cumulative number of adult female and immature wings received during 1963–2019.

Harvest Information Program

The Harvest Information Program (HIP) was cooperatively developed by the FWS and state wildlife agencies to provide reliable annual estimates of hunter activity and harvest for all migratory game birds (Elden et al. 2002). The HIP sampling frame consists of all migratory game bird hunters. Under this program, state wildlife agencies collect the name, address, and additional information from each migratory bird hunter in their state, and send that information to the FWS. The FWS then selects stratified random samples of those hunters and asks them to voluntarily provide detailed information about their hunting activity. For example, hunters selected for the woodcock harvest survey are asked to complete a daily diary about their woodcock hunting and harvest during the current year's hunting season. Their responses are then used to develop nationwide woodcock harvest estimates. HIP survey estimates of woodcock harvest have been available since 1999. Although estimates from 1999–2002 have been finalized, the estimates from 2003–20 should be considered preliminary as refinements are still being made in the sampling frame and estimation techniques. Canadian hunter and harvest estimates, which were obtained through the Canadian National Harvest Survey Program, are presented in Appendix B (Gendron and Smith 2019).

RESULTS AND DISCUSSION
Singing-ground Survey

Data for 880 routes were submitted by 20 July 2021 (Table 1). Analysis of the most recent 2 years of data indicated that the number of woodcock heard singing during the 2021 Singing-ground Survey remained unchanged from last year for the Eastern and Central Management Regions (Table 1). Trends for individual states and provinces are reported in Table 1. Consistency in route coverage over time is a critical component of precision in estimation of population change. Low precision of 2-year change estimates reflect the low numbers of routes surveyed by the same observer in both years. Ensuring that observers participate for several years on the same route would greatly enhance the quality of the results.

The 10-year trend (2011–2021) showed a significant decline in both the Eastern and Central Management Regions (Table 1, Fig. 2). Many states and provinces in both management regions have experienced significant long-term (1968–2021) declines as measured by the Singing-ground Survey (Table 1, Fig. 3). The long-term trend estimate was −1.00%/year

Fig. 2. Ten-year trends in the number of American woodcock heard on the Singing-ground Survey, 2011–2021, as determined by the hierarchical modeling method. A significant trend (S) does not include zero in the 95% credible interval, while a non-significant (NS) trend does include zero.

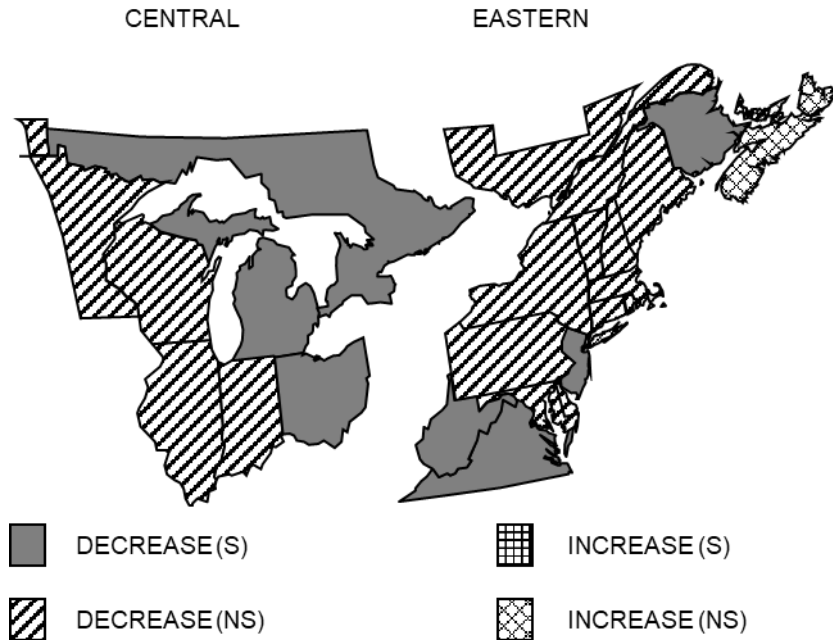**Fig. 3.** Long-term trends in the number of American woodcock heard on the Singing-ground Survey, 1968–2021, as determined by the hierarchical modeling method. A significant trend (S) does not include zero in the 95% credible interval, while a non-significant (NS) trend does include zero.
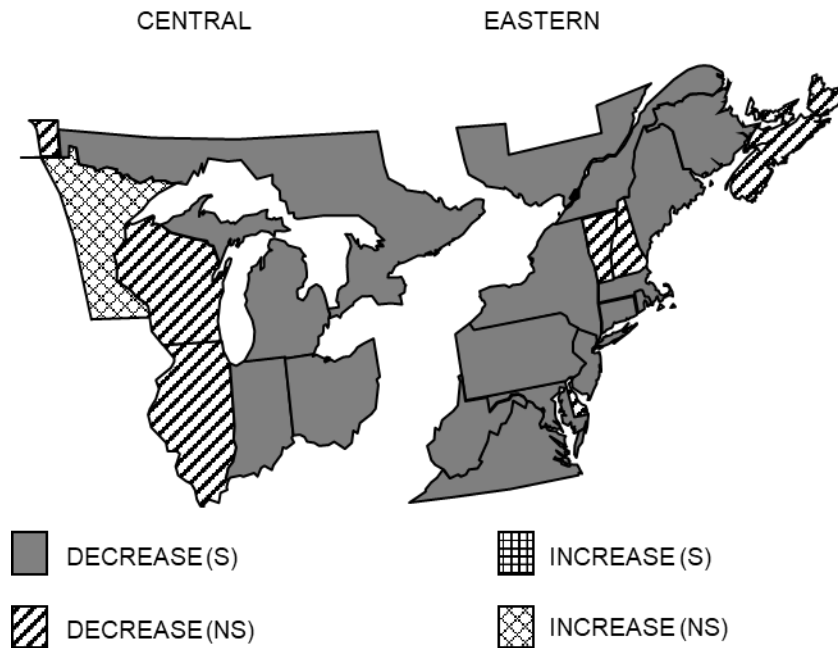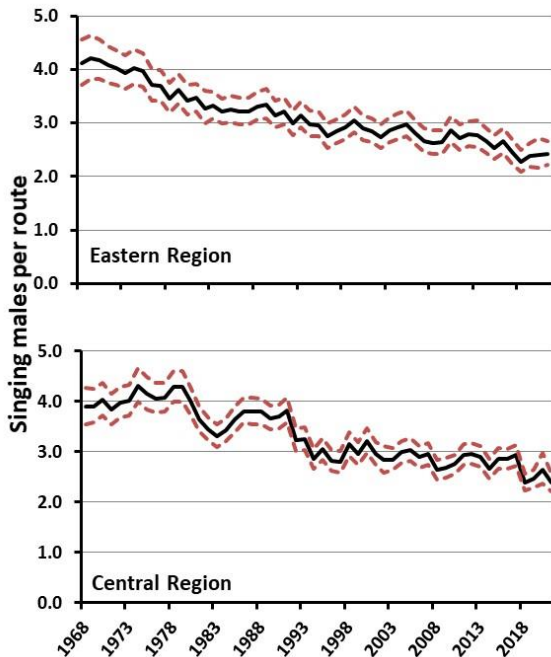
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Fig. 4. Annual indices of the number of woodcock heard during the Singing-ground Survey, 1968–2021 as estimated using hierarchical modeling. The red dashed lines represent the 95% credible interval for the estimate.

Fig. 5. Annual indices of recruitment (U.S.), 1963–2020. The red dashed line is the 1963–2019 average.

for the Eastern Management Region, while it was -0.92%/year for the Central Management Region (Table 1).

In the Eastern Region, the 2021 index was 2.43 singing males per route, while it was 2.39 in the Central Management Region (Figure 4, Table 2). Annual indices (1968–2021) by state, province, and region are available in Table 2.

Parts-collection Survey

A total of 884 woodcock hunters (Table 3) from states with a woodcock season sent in a total of 8,713 usable woodcock wings for the 2020 Parts-collection Survey (Table 4).

The 2020 recruitment index in the U.S. portion of the Eastern Region (1.60 immatures per adult female) was 6.0% greater than the 2019 index of 1.51, and 1.2% less than the long-term (1963–19) regional average of 1.62 (Table 4, Fig 5). In the Central Region, the 2020 recruitment index (1.09 immatures per adult female) was 22.1% less than the 2019 index of 1.40 and was 26.8% less than the long-term regional average of 1.49 (Table 4, Fig 5). Percent change for all comparisons was calculated using unrounded recruitment indices.

Harvest Information Program

Estimates of woodcock harvest, number of active hunters, days afield, and seasonal hunting success from the 2020–21 HIP survey are provided in Table 5. In the Eastern Management Region, woodcock hunters spent an estimated 142,800 days afield (Figure 6) and harvested 51,100 birds (Figure 7) during the 2020–21 hunting season. In the Eastern Region, harvest in 2020–21 was 32.4% less than the long-term (1999–2019) average (75,600 birds/year) and 44.9% greater than last year (35,300 birds). Woodcock hunters in the Central Region spent an estimated 260,600 days afield (Figure 6) and harvested 123,700 birds (Figure 7) during the 2020–21 hunting season. In the Central Region, harvest in 2020–21 was 38.1% less than the long-term (1999–2019) average (199,700 birds/year) and 9.0% less than last year (136,000 birds).

Although HIP provides statewide estimates of woodcock hunter numbers, it is not possible to develop regional estimates due to the occurrence of some hunters being registered for HIP in more than one state. Therefore, regional estimates of seasonal hunting success rates cannot be determined on a per hunter basis. All estimates have been rounded to the nearest hundred.

Data from Canada indicate that the annual number of successful hunters and annual harvest have been similar since 2009 (Appendix B). The most recent data available indicate that an estimated 3,237 successful

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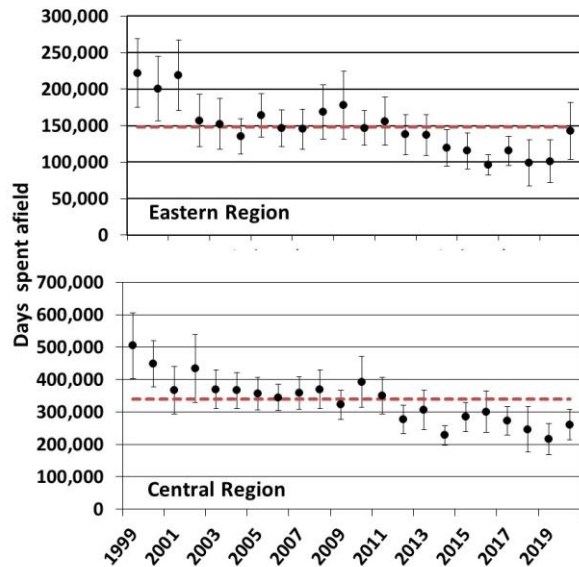
Fig. 6. Harvest Information Program Survey estimates of days spent afield by U.S. woodcock hunters, 1999–2020. The dashed line represents the 1999–2019 average and error bars represent the 95% confidence interval of the point estimate.
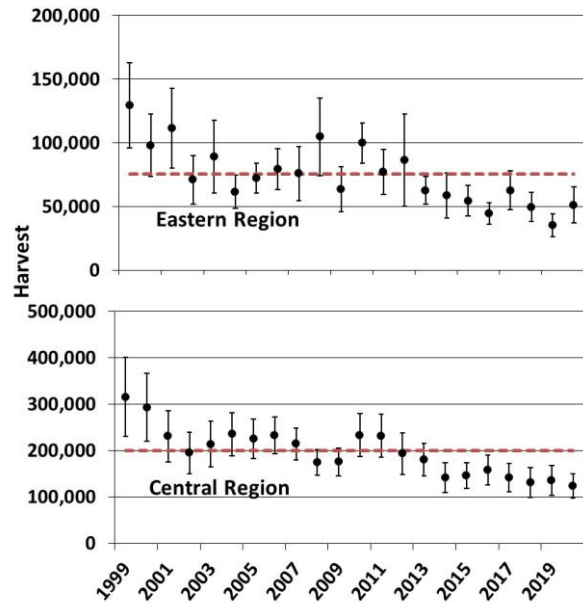
Fig. 7. Harvest Information Program Survey estimates of U.S. woodcock harvest, 1999–2020. The dashed line represents the 1999–2019 average and the error bars represent the 95% confidence interval of the point estimate.

hunters harvested 20,554 woodcock during the 2019 season in Canada (Gendron and Smith 2019; Appendix B).

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Table 1. Short-term (2020–21), 10-year (2011–2021), and long-term (1968–2021) trends (% change per year[a]) in the number of American woodcock heard during the Singing-ground Survey. Trends were estimated using a hierarchical log-linear modeling technique (Sauer et al. 2008).

State, Province, or Region	Routes 2020[b]	Routes 2021[c]	n[d]	2020-2021 % change[e]	2020-2021 95% CI[f] lower	2020-2021 95% CI[f] upper	2011-2021 % change	2011-2021 95% CI[f] lower	2011-2021 95% CI[f] upper	1968-2021 % change	1968-2021 95% CI[f] lower	1968-2021 95% CI[f] upper
CT	0	5	11	-0.68	-33.32	54.81	-2.81	-6.97	1.00	-2.37	-3.91	-0.86
DE	1	0	3	-2.07	-46.27	84.97	-2.58	-8.65	3.87	-2.51	-5.47	0.14
ME	43	55	76	8.23	-10.90	31.74	-1.38	-3.24	0.51	-1.01	-1.47	-0.53
MD	0	6	26	-2.79	-29.12	35.81	-3.19	-6.14	0.57	-3.49	-4.81	-2.20
MA	11	10	23	1.53	-23.41	39.09	-2.70	-5.72	0.28	-2.58	-3.52	-1.65
NB	0	54	74	-7.09	-36.06	35.93	-2.34	-4.41	-0.29	-1.02	-1.71	-0.39
NH	13	14	19	2.75	-23.27	42.01	-0.22	-3.18	3.22	-0.81	-1.73	0.11
NJ	2	5	19	-12.54	-53.28	49.82	-6.41	-11.53	-1.33	-5.78	-7.21	-4.28
NY	78	80	118	2.33	-12.03	19.54	-0.74	-2.34	0.88	-0.72	-1.14	-0.31
NS	39	40	66	11.40	-8.48	38.05	1.04	-1.05	3.44	-0.46	-1.08	0.13
PA	35	36	86	-0.45	-23.39	29.69	-0.89	-3.48	1.85	-0.95	-1.60	-0.29
PEI	0	11	13	21.27	-17.45	94.53	1.01	-2.35	5.33	-0.62	-1.72	0.55
QUE	0	39	149	-1.60	-21.44	21.91	-0.94	-3.16	1.23	-0.88	-1.58	-0.17
RI	0	1	5	-6.81	-45.17	49.82	-5.20	-10.47	0.62	-5.17	-8.35	-2.17
VT	19	19	24	13.64	-15.82	59.01	-0.81	-3.83	2.45	-0.79	-1.63	0.05
VA	21	26	75	-1.66	-33.81	51.92	-4.80	-8.66	-0.58	-4.80	-5.74	-3.82
WV	22	25	59	-3.70	-26.65	23.57	-2.69	-5.52	-0.28	-2.29	-3.08	-1.54
Eastern	**284**	**426**	**846**	**0.84**	**-9.46**	**11.51**	**-1.13**	**-1.95**	**-0.32**	**-1.00**	**-1.24**	**-0.74**
IL	15	19	49	-62.90	-86.46	-9.41	-2.54	-11.27	7.41	-1.24	-3.52	1.28
IN	13	12	63	-3.62	-40.26	52.88	-3.28	-7.75	1.43	-3.90	-4.97	-2.85
MB[g]	0	10	31	0.11	-32.29	48.66	-1.21	-4.78	1.98	-0.05	-1.42	1.30
MI	0	112	161	-9.08	-27.94	14.25	-2.31	-3.69	-0.94	-1.06	-1.39	-0.72
MN	12	92	126	-12.61	-30.16	8.46	-1.57	-3.18	0.04	0.36	-0.14	0.89
OH	0	35	74	-14.56	-41.47	18.04	-3.80	-7.03	-1.05	-2.03	-2.79	-1.33
ON	0	71	175	-6.70	-27.21	18.82	-2.38	-4.03	-0.74	-1.23	-1.65	-0.80
WI	5	103	131	-2.34	-24.87	26.04	-1.33	-3.09	0.46	-0.32	-0.76	0.13
Central	**45**	**454**	**779**	**-9.94**	**-20.05**	**1.16**	**-2.06**	**-2.83**	**-1.28**	**-0.92**	**-1.13**	**-0.70**
Continent	**329**	**880**	**1625**	**-4.85**	**-12.09**	**2.77**	**-1.60**	**-2.16**	**-1.03**	**-0.96**	**-1.13**	**-0.79**

[a] Median of route trends estimated used hierarchical modeling. To estimate the total percent change over several years, use: (100((% change/100)+1)^y)-100, where y is the number of years. Note: extrapolating the estimated trend statistic (% change per year) over time (e.g., 30 years) may exaggerate the total change over the period.
[b] Total number of routes surveyed in 2020.
[c] Total number of routes surveyed in 2021 for which data were received by 20 July, 2021.
[d] Number of routes with at least one year of non-zero data between 1968 and 2021.
[e] For most states (where there is no 2020 data), the model generally predicts an index from 2020 that is between the 2019 and the 2021 index. but it does use data when it is available.
[f] 95% credible interval, if the interval overlaps zero, the trend is considered non-significant.
[g] Manitoba began participating in the Singing-ground Survey in 1992.

Table 2. Breeding population indices (singing-males per route) for American woodcock from the Singing-ground Survey, 1968–2021. These indices are based on 1968–2021 trends that were estimated using hierarchical modeling techniques. Dashes indicate no data were available for that year.

State, Province, or Region	Year															
	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Eastern Region																
CT	-----	2.39	2.47	2.25	2.38	2.23	2.23	2.26	1.88	1.89	1.67	1.75	1.72	1.71	1.84	1.67
DE	1.00	0.96	0.97	0.90	0.91	0.91	0.88	0.97	0.75	0.77	0.72	0.72	0.74	0.72	0.70	0.72
MA	-----	3.36	3.42	3.40	3.07	3.38	3.16	2.71	2.66	2.66	2.57	2.68	2.40	2.52	2.27	2.09
MD	1.74	1.78	1.64	1.62	1.54	1.50	1.44	1.41	1.26	1.26	1.24	1.19	1.22	1.16	1.09	1.00
ME	6.39	6.32	7.01	6.37	6.30	6.53	6.79	7.07	6.60	5.57	5.41	5.98	5.13	5.97	4.60	5.12
NB	-----	9.00	8.78	8.10	8.03	7.38	7.99	8.51	6.51	7.86	5.99	6.51	5.28	6.18	6.82	5.80
NH	-----	4.17	4.42	3.92	4.45	3.68	4.24	3.98	3.93	3.95	3.80	3.69	4.08	3.93	3.32	3.45
NJ	4.52	4.31	4.45	5.49	4.13	4.87	4.53	3.77	2.86	2.85	2.41	2.82	2.18	2.03	1.91	1.97
NS	4.43	3.94	3.38	4.02	3.75	4.00	4.17	3.95	3.85	3.84	4.13	3.62	3.63	3.40	3.23	3.57
NY	4.33	4.53	3.96	4.37	4.18	4.28	4.36	3.86	3.96	3.94	3.53	3.91	4.28	4.05	3.72	4.02
PA	1.98	1.87	2.10	2.02	1.97	1.99	1.72	1.76	1.78	1.75	1.68	1.79	1.58	1.57	1.53	1.56
PEI	-----	5.04	5.06	5.77	4.63	4.63	4.91	6.01	5.12	4.87	4.66	4.79	3.98	3.77	3.87	4.45
QUE	-----	-----	6.29	6.08	6.24	5.92	6.00	5.91	5.77	5.63	5.98	6.03	5.95	5.66	5.58	5.69
RI	-----	1.60	1.51	1.69	1.47	1.40	1.27	1.19	1.12	1.07	0.97	0.94	0.90	0.83	0.83	0.78
VA	-----	1.34	1.35	1.16	1.07	0.92	1.14	1.00	0.95	0.92	0.80	0.79	0.68	0.74	0.74	0.66
VT	-----	3.52	4.21	3.82	4.26	3.79	4.10	4.37	4.44	4.61	3.57	3.75	3.60	3.22	2.51	3.21
WV	1.53	1.55	1.41	1.37	1.47	1.37	1.31	1.33	1.26	1.19	1.04	1.17	1.11	1.20	1.12	1.07
Region	**4.12**	**4.21**	**4.17**	**4.09**	**4.02**	**3.93**	**4.04**	**3.98**	**3.71**	**3.70**	**3.46**	**3.62**	**3.42**	**3.47**	**3.27**	**3.33**
Central Region																
IL	-----	-----	0.28	0.46	0.43	0.32	0.44	0.36	0.24	0.31	0.45	0.32	0.26	0.42	0.28	0.76
IN	1.43	1.06	1.04	0.86	1.16	1.06	0.96	0.81	0.83	0.78	0.79	0.95	0.75	0.85	0.62	0.64
MB	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
MI	7.36	7.26	7.32	6.84	6.92	7.20	8.16	8.18	7.77	7.20	7.82	7.75	7.30	6.43	6.70	5.72
MN	-----	2.93	2.86	3.21	3.06	3.47	4.09	3.66	3.75	3.82	4.09	3.74	4.28	3.86	3.78	3.41
OH	-----	-----	1.70	1.52	1.55	1.39	1.55	1.33	1.55	1.45	1.32	1.25	1.26	1.39	1.16	1.21
ON	8.09	9.06	9.55	8.73	9.51	9.20	9.30	8.84	8.94	9.18	9.46	9.72	9.05	8.21	6.99	6.91
WI	3.53	3.56	4.12	3.92	3.90	4.11	4.19	4.29	3.90	4.33	4.48	4.68	3.80	3.25	3.42	3.33
Region	**3.90**	**3.90**	**4.03**	**3.84**	**3.97**	**4.02**	**4.32**	**4.15**	**4.06**	**4.07**	**4.28**	**4.28**	**4.01**	**3.65**	**3.46**	**3.31**
Continent	**4.01**	**4.06**	**4.10**	**3.96**	**4.00**	**3.98**	**4.18**	**4.07**	**3.89**	**3.88**	**3.87**	**3.95**	**3.71**	**3.56**	**3.37**	**3.32**

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Table 2. Continued

State, Province, or Region	Year															
	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Eastern Region																
CT	1.60	1.59	1.64	1.49	1.64	1.38	1.38	1.40	1.31	1.22	1.26	1.30	1.29	1.18	1.18	1.20
DE	0.64	0.64	0.63	0.61	0.59	0.58	0.59	0.52	0.51	0.52	0.51	0.49	0.49	0.47	0.50	0.44
MA	2.23	2.21	2.11	2.09	2.04	1.90	1.86	1.85	1.72	1.68	1.66	1.64	1.59	1.61	1.53	1.73
MD	1.00	0.95	0.89	0.87	0.84	0.82	0.80	0.76	0.70	0.71	0.69	0.65	0.65	0.62	0.56	0.55
ME	5.20	5.32	5.69	6.01	5.55	5.72	4.57	5.17	4.48	4.83	4.47	4.57	3.89	4.19	4.16	4.50
NB	5.35	5.57	4.73	5.13	5.97	7.09	6.04	5.75	5.43	6.49	6.74	6.19	5.39	6.03	5.99	6.84
NH	3.36	3.46	4.43	3.70	3.58	3.52	3.24	3.49	3.19	3.19	3.20	3.59	3.44	3.43	3.36	3.59
NJ	2.02	1.87	1.70	1.88	1.49	1.42	1.35	1.38	1.13	1.01	0.89	1.00	0.95	0.78	0.83	0.85
NS	3.35	3.54	3.72	3.18	3.51	3.46	3.26	3.54	3.53	3.59	3.25	3.46	3.53	3.31	3.38	3.78
NY	3.53	4.01	3.67	3.58	3.86	3.42	3.88	3.94	3.63	3.57	3.14	3.31	3.13	3.22	3.28	3.35
PA	1.63	1.54	1.62	1.55	1.50	1.47	1.60	1.79	1.48	1.58	1.33	1.51	1.47	1.41	1.59	1.47
PEI	4.47	4.42	4.72	3.94	4.59	4.74	4.16	4.08	4.06	3.86	3.64	3.88	4.27	4.11	3.90	3.63
QUE	5.51	5.47	5.41	5.50	5.67	5.77	5.40	5.24	5.28	5.43	5.28	4.96	4.69	4.80	5.14	5.02
RI	0.74	0.69	0.65	0.63	0.59	0.56	0.54	0.50	0.48	0.46	0.43	0.41	0.39	0.36	0.35	0.33
VA	0.85	0.52	0.56	0.54	0.48	0.44	0.47	0.43	0.44	0.41	0.38	0.33	0.32	0.35	0.29	0.30
VT	3.12	2.91	3.09	3.51	3.74	3.64	3.40	3.50	2.69	2.95	2.83	2.81	2.72	2.82	3.05	3.48
WV	1.06	0.99	0.99	0.97	0.94	0.92	0.94	0.86	0.87	0.83	0.82	0.87	0.79	0.79	0.75	0.76
Region	**3.22**	**3.25**	**3.21**	**3.22**	**3.31**	**3.35**	**3.15**	**3.21**	**3.00**	**3.14**	**2.98**	**2.97**	**2.76**	**2.84**	**2.92**	**3.04**
Central Region																
IL	0.38	0.65	0.54	0.95	0.34	0.50	0.28	0.53	0.35	0.45	0.29	0.23	0.29	0.24	0.29	0.35
IN	0.62	0.59	0.66	0.62	0.56	0.50	0.61	0.59	0.55	0.47	0.46	0.42	0.40	0.39	0.45	0.40
MB	-----	-----	-----	-----	-----	-----	-----	-----	5.47	5.46	5.65	6.00	5.35	3.90	4.67	4.61
MI	6.51	6.63	6.97	6.49	6.97	6.72	6.75	7.42	5.77	5.87	5.16	5.70	5.48	5.28	6.31	5.27
MN	3.35	3.71	3.86	3.91	4.31	3.59	4.28	4.13	3.54	3.63	3.30	3.48	3.32	3.00	3.49	3.68
OH	1.26	1.14	1.12	1.10	1.19	1.00	1.29	1.16	1.15	1.06	1.05	1.01	1.04	0.88	1.03	0.87
ON	6.96	7.77	7.93	7.85	7.92	7.97	7.54	7.66	7.11	6.87	5.90	6.44	5.26	5.92	6.20	5.69
WI	3.65	3.59	4.10	4.17	3.89	3.98	3.81	3.79	3.09	3.25	2.86	2.97	2.91	2.78	2.98	3.37
Region	**3.43**	**3.64**	**3.81**	**3.80**	**3.79**	**3.67**	**3.69**	**3.82**	**3.24**	**3.26**	**2.86**	**3.05**	**2.82**	**2.79**	**3.14**	**2.97**
Continent	**3.32**	**3.44**	**3.51**	**3.51**	**3.55**	**3.51**	**3.42**	**3.52**	**3.12**	**3.20**	**2.92**	**3.01**	**2.79**	**2.82**	**3.03**	**3.01**

Table 2. Continued

State, Province, or Region	Year															
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Eastern Region																
CT	1.11	1.06	0.99	1.00	0.97	0.93	0.90	0.90	0.91	0.87	0.85	0.92	0.89	0.82	0.83	0.77
DE	0.45	0.41	0.41	0.40	0.39	0.38	0.37	0.36	0.35	0.35	0.34	0.33	0.32	0.31	0.30	0.30
MA	1.55	1.45	1.45	1.40	1.47	1.31	1.30	1.21	1.29	1.24	1.18	1.13	1.06	1.05	1.04	1.08
MD	0.56	0.57	0.50	0.49	0.48	0.45	0.46	0.43	0.42	0.40	0.39	0.36	0.36	0.34	0.33	0.32
ME	4.71	4.19	3.90	4.23	4.35	4.44	4.33	3.95	4.04	3.89	4.21	4.29	4.29	4.24	4.05	3.63
NB	6.44	6.69	6.42	7.00	6.94	7.67	6.87	6.31	6.06	5.44	7.13	6.68	7.31	6.80	6.40	5.67
NH	3.08	3.18	3.11	3.42	3.43	3.36	3.11	2.61	2.68	3.17	3.16	2.76	3.10	3.01	3.11	2.72
NJ	0.75	0.71	0.61	0.65	0.53	0.49	0.48	0.49	0.43	0.47	0.33	0.38	0.41	0.36	0.33	0.26
NS	3.74	3.53	3.25	3.24	3.54	3.38	3.20	3.18	3.06	3.07	3.54	3.12	3.55	3.85	3.55	2.99
NY	3.19	3.11	3.04	3.20	3.45	3.18	3.29	3.06	2.94	3.22	3.47	3.18	3.30	3.32	3.13	3.39
PA	1.18	1.41	1.40	1.38	1.41	1.46	1.31	1.28	1.44	1.44	1.54	1.31	1.17	1.11	1.27	1.26
PEI	3.92	3.71	3.13	3.24	3.28	3.44	3.70	3.59	3.05	3.27	3.08	3.27	3.64	3.20	3.69	3.17
QUE	4.74	4.78	4.66	4.70	4.73	4.89	4.54	4.50	4.41	4.52	4.45	4.41	4.26	4.55	4.26	4.23
RI	0.31	0.30	0.29	0.27	0.25	0.24	0.23	0.22	0.21	0.19	0.18	0.17	0.17	0.16	0.15	0.14
VA	0.28	0.24	0.24	0.24	0.23	0.21	0.20	0.19	0.19	0.16	0.16	0.17	0.15	0.16	0.15	0.12
VT	3.51	2.88	2.62	2.82	2.87	3.03	3.01	2.64	2.44	2.58	2.66	2.52	2.70	2.52	2.28	2.29
WV	0.74	0.69	0.68	0.69	0.64	0.62	0.62	0.62	0.62	0.60	0.57	0.59	0.59	0.53	0.55	0.50
Region	**2.90**	**2.86**	**2.74**	**2.86**	**2.92**	**2.97**	**2.82**	**2.66**	**2.63**	**2.64**	**2.86**	**2.72**	**2.79**	**2.78**	**2.66**	**2.54**
Central Region																
IL	0.28	0.34	0.26	0.56	0.59	0.20	0.38	0.22	0.21	0.19	0.22	0.19	0.13	0.14	0.16	0.26
IN	0.37	0.39	0.32	0.31	0.34	0.34	0.29	0.28	0.28	0.27	0.28	0.24	0.25	0.23	0.23	0.21
MB	4.93	4.97	4.21	4.89	4.58	5.31	4.67	4.88	4.67	4.91	4.92	5.62	5.32	4.71	4.67	5.16
MI	5.63	5.23	5.38	5.54	5.60	5.47	5.06	4.99	4.67	4.70	4.84	5.29	5.42	5.64	5.37	5.49
MN	4.10	3.74	3.16	3.23	3.34	3.70	3.56	3.61	3.26	3.56	4.16	4.13	3.99	3.54	3.06	3.97
OH	0.90	0.89	0.86	0.82	1.08	0.97	0.94	0.73	0.77	0.91	0.89	0.88	0.85	0.85	0.78	0.84
ON	6.82	5.97	6.10	5.44	5.86	6.19	5.94	6.24	5.33	5.09	4.81	5.35	5.46	5.17	5.10	4.92
WI	3.17	3.10	2.65	2.85	2.91	3.28	3.04	3.49	3.00	3.04	3.10	3.40	3.53	3.56	2.79	3.19
Region	**3.20**	**2.96**	**2.83**	**2.85**	**2.99**	**3.04**	**2.90**	**2.95**	**2.64**	**2.68**	**2.75**	**2.94**	**2.97**	**2.90**	**2.65**	**2.86**
Continent	**3.05**	**2.91**	**2.79**	**2.86**	**2.96**	**3.01**	**2.86**	**2.81**	**2.64**	**2.66**	**2.81**	**2.83**	**2.88**	**2.84**	**2.66**	**2.70**

Table 2. Continued

State, Province, or Region	Year					
	2016	2017	2018	2019	2020	2021
Eastern Region						
CT	0.78	0.76	0.75	0.70	0.68	0.68
DE	0.29	0.28	0.27	0.26	0.26	0.25
MA	1.02	0.95	0.90	0.90	0.84	0.86
MD	0.31	0.31	0.29	0.28	0.27	0.26
ME	4.19	3.44	3.17	3.57	3.45	3.73
NB	6.22	4.86	4.40	5.62	5.68	5.27
NH	2.85	2.50	2.48	2.36	2.63	2.72
NJ	0.28	0.25	0.23	0.21	0.22	0.19
NS	3.26	3.11	3.02	3.24	3.10	3.47
NY	3.27	3.37	2.84	2.92	2.89	2.95
PA	1.28	1.24	1.24	1.19	1.20	1.20
PEI	2.70	3.18	2.92	2.80	2.98	3.65
QUE	4.31	4.26	4.08	3.92	4.08	4.01
RI	0.13	0.13	0.12	0.11	0.11	0.10
VA	0.12	0.12	0.11	0.11	0.11	0.10
VT	2.66	2.36	2.50	2.11	2.04	2.32
WV	0.51	0.52	0.48	0.49	0.47	0.45
Region	**2.66**	**2.45**	**2.28**	**2.39**	**2.41**	**2.43**
Central Region						
IL	0.16	0.19	0.17	0.17	0.40	0.15
IN	0.21	0.20	0.21	0.18	0.18	0.17
MB	4.97	5.86	4.94	5.19	4.95	4.96
MI	5.21	5.25	3.90	4.38	4.60	4.18
MN	4.52	4.63	4.01	3.79	4.04	3.53
OH	0.78	0.68	0.70	0.77	0.70	0.60
ON	4.84	4.91	4.20	4.05	4.51	4.20
WI	3.16	3.51	2.76	3.00	3.05	2.98
Region	**2.85**	**2.93**	**2.39**	**2.47**	**2.65**	**2.39**
Continent	**2.75**	**2.69**	**2.34**	**2.43**	**2.53**	**2.41**

Table 3. The number of U.S. hunters by state that submitted woodcock wings for the 2019-20 and 2020-21 Parts-collection Surveys.

State of residence	Number of Hunters who submitted woodcock wings[a]	
	2019-20 Season	**2020-21 Season**
Alabama	2	2
Arkansas	3	3
Connecticut	22	14
Delaware	2	4
Florida	2	0
Georgia	5	3
Illinois	14	1
Indiana	16	8
Iowa	4	2
Kansas	1	0
Kentucky	4	3
Louisiana	7	8
Maine	59	97
Maryland	5	7
Massachusetts	26	25
Michigan	137	187
Minnesota	109	96
Mississippi	0	1
Missouri	7	6
Nebraska	2	0
New Hampshire	43	51
New Jersey	23	22
New York	57	51
North Carolina	15	0
North Dakota	1	7
Ohio	31	12
Oklahoma	1	1
Pennsylvania	42	35
Rhode Island	8	2
South Carolina	9	12
Tennessee	4	2
Texas	3	2
Vermont	28	37
Virginia	19	18
West Virginia	5	9
Wisconsin	124	156
Total	**840**	**884**

[a] Number of hunters that submitted envelopes in current year. This number may include a small number of hunters that were sent envelopes in prior years and who subsequently submitted wings from birds shot in the current survey year. In addition, some hunters hunted and submitted wings from more than one state.

Table 4. Number of woodcock wings received from hunters, and indices of recruitment in the U.S. Recruitment indices for individual states with ≥125 submitted wings were calculated as the ratio of immatures per adult female. The regional indices for 2020 were weighted by the relative contribution of each state to the cumulative number of adult female and immature wings received during 1963–2019.

State or Region of harvest	Wings received						Recruitment index	
	Total		Adult females		Immatures			
	1963-19	2020	1963-19	2020	1963-19	2020	1963-19	2020
Eastern Region								
CT	15,890	78	3,570	22	9,658	41	2.7	----
DE	552	44	86	8	379	31	4.4	----
FL	678	0	153	0	422	0	2.8	----
GA	3,451	15	1,087	4	1,463	4	1.3	----
ME	92,788	770	27,465	234	46,302	393	1.7	1.7
MD	5,152	34	1,262	4	2,927	22	2.3	
MA	26,137	174	8,200	53	12,608	84	1.5	1.6
NH	39,299	419	12,778	133	18,183	201	1.4	1.5
NJ	28,040	166	6,487	28	16,580	115	2.6	4.1
NY	66,897	403	22,743	157	30,112	135	1.3	0.9
NC	4,722	99	1,527	28	2,210	44	1.4	----
PA	34,803	166	11,051	65	16,058	62	1.5	1.0
RI	2,496	2	485	1	1,650	1	3.4	----
SC	4,438	193	1,435	49	1,976	109	1.4	2.2
VT	30,768	370	10,135	118	13,997	154	1.4	1.3
VA	6,971	267	1,836	74	3,760	145	2.0	2.0
WV	6,743	24	2,041	9	3,358	7	1.6	----
Region	**369,825**	**3,224**	**112,341**	**987**	**181,643**	**1,548**	**1.62**	**1.60**
Central Region								
AL	1,045	20	294	6	475	11	1.6	----
AR	597	10	194	2	242	7	1.2	----
IL	1,518	1	358	0	851	0	2.4	----
IN	8,957	42	2,285	14	4,951	14	2.2	----
IA	1,404	2	453	0	629	0	1.4	----
KS	50	0	9	0	26	0	----	----
KY	1,333	33	345	7	666	21	1.9	----
LA	34,399	114	7,757	37	22,184	62	2.9	----
MI	151,371	1,973	49,952	711	73,657	858	1.5	1.2
MN	48,634	1,149	17,431	445	20,701	446	1.2	1.0
MS	1,999	21	564	2	1,009	13	1.8	----
MO	4,825	64	1,316	13	2,334	35	1.8	----
NE	13	0	5	0	6	0	----	----
ND	4	0	3	0	1	0	----	----
OH	15,648	127	4,814	44	7,353	57	1.5	1.3
OK	175	3	39	0	92	2	2.4	----
TN	1,389	8	374	3	701	2	1.9	----
TX	1,120	19	325	8	545	5	1.7	----
WI	101,886	1,903	34,773	805	47,561	756	1.4	0.9
Region	**376,367**	**5,489**	**121,291**	**2,097**	**181,244**	**2,289**	**1.49**	**1.09**

Table 5. Preliminary estimates of woodcock harvest, hunter numbers, days afield, and hunter success from the 2020–21 Harvest Information Program (note: all estimates rounded to the nearest 100 for harvest, hunters, and days afield).

	Harvest		Active woodcock hunters		Days afield		Season harvest per hunter	
	Total	SE	Total	SE	Total	SE	Total	SE
Eastern Region								
CT	500	200	500	100	1,800	300	1.08	0.38
DE	500	200	400	200	1,100	400	1.26	0.71
FL	0	0	2,400	2,300	2,900	2,400	0	0.00
GA	900	400	300	100	1,800	700	3	1.76
MA	2,500	500	1,600	200	9,000	1,300	1.53	0.38
MD	800	400	900	500	1,400	500	0.85	0.66
ME	9,600	1,200	5,500	800	24,700	4,200	1.74	0.34
NC	13,000	6,500	6,400	2,800	31,400	17,100	2.02	1.33
NH	4,000	1,100	2,400	400	11,400	2,600	1.66	0.53
NJ	2,600	1,400	900	300	5,900	2,500	2.88	1.76
NY	5,600	1,600	3,200	600	16,400	3,300	1.75	0.59
PA	3,500	700	4,200	1,000	20,700	6,300	0.84	0.27
RI	100	0	300	100	1,300	500	0.49	0.22
SC	1,000	300	200	0	700	200	6.17	2.38
VA	3,900	1,300	2,400	800	7,700	3,100	1.62	0.77
VT	2,000	400	1,100	200	4,100	700	1.86	0.52
WV	600	200	200	100	600	100	2.45	1.28
Region	**51,100**	**7,300**	**32,900**[a]	**na**[a]	**142,800**	**19,800**	**na**[b]	**na**[b]
Central Region								
AL	300	200	100	0	200	100	4.00	3.16
AR	0	0	1,400	1,400	8,300	8,300	0.00	0.00
IA	200	100	100	0	400	200	2.50	1.30
IL	100	100	1,800	1,800	5,400	5,300	0.04	0.05
IN	1,000	500	1,100	500	3,200	1,600	0.86	0.54
KS	0	0	0	0	100	0	1.50	1.32
KY	200	100	1,200	1,100	1,500	1,100	0.20	0.21
LA	4,700	2,300	2,900	1,300	7,400	3,000	1.63	1.09
MI	37,400	5,600	18,500	2,100	82,900	10,000	2.03	0.38
MN	25,000	4,700	12,000	2,100	49,700	9,700	2.08	0.54
MO	200	100	800	700	2,600	2,200	0.22	0.21
MS	1,800	1,000	1,600	1,100	2,600	1,400	1.14	0.98
NE[c]								
OH	2,900	1,300	2,000	800	5,200	2,200	1.46	0.88
OK	200	100	1,000	900	2,900	2,800	0.16	0.20
TN	0	0	0	0	100	100	1.00	1.39
TX	400	200	5,300	5,200	5,700	5,200	0.07	0.08
WI	49,300	10,700	17,200	2,500	82,300	14,800	2.86	0.75
Region	**123,700**	**13,300**	**67,100**[a]	**na**[a]	**260,600**	**23,800**	**na**[b]	**na**[b]
Total	**174,800**	**15,200**	**100,000**[a]	**na**[a]	**403,500**	**31,100**	**na**[b]	**na**[b]

[a] Hunter number estimates at the regional and national levels may be biased high because the HIP sample frames are state specific; therefore hunters were counted more than once if they hunted in >1 state. Variance was inestimable.
[b] Regional estimates of hunter success could not be obtained due to the occurrence of individual hunters being registered in the Harvest Information Program in more than one state.
[c] No hunters that registered for HIP in Nebraska said they intended to hunt American woodcock in 2020.

Appendix A. History of federal framework dates, season lengths, and daily bag limits for hunting American woodcock in the U.S. portion of the Eastern and Central Regions, 1918 – 2021.

Eastern Region				Central Region			
Year (s)	Outside dates	Season length	Daily bag limit	Year (s)	Outside dates	Season length	Daily bag limit
1918-26	Oct. 1 - Dec. 31	60	6	1918-26	Oct. 1 - Dec. 31	60	6
1927	Oct. 1 - Dec. 31	60	4	1927	Oct. 1 - Dec. 31	60	4
1928-39	Oct. 1 - Dec. 31	30	4	1928-39	Oct. 1 - Dec. 31	30	4
1940-47	Oct. 1 - Jan. 6	15	4	1940-47	Oct. 1 - Jan. 6	15	4
1948-52	Oct. 1 - Jan. 20	30	4	1948-52	Oct. 1 - Jan. 20	30	4
1953	Oct. 1 - Jan. 20	40	4	1953	Oct. 1 - Jan. 20	40	4
1954	Oct. 1 - Jan. 10	40	4	1954	Oct. 1 - Jan. 10	40	4
1955-57	Oct. 1 - Jan. 20	40	4	1955-57	Oct. 1 - Jan. 20	40	4
1958-60	Oct. 1 - Jan. 15	40	4	1958-60	Oct. 1 - Jan. 15	40	4
1961-62	Sep. 1 - Jan. 15	40	4	1961-62	Sep. 1 - Jan. 15	40	4
1963-64	Sep. 1 - Jan. 15	50	5	1963-64	Sep. 1 - Jan. 15	50	5
1965-66	Sep. 1 - Jan. 30	50	5	1965-66	Sep. 1 - Jan. 30	50	5
1967-69	Sep. 1 - Jan. 31	65	5	1967-69	Sep. 1 - Jan. 31	65	5
1970-71	Sep. 1 - Feb. 15	65	5	1970-71	Sep. 1 - Feb. 15	65	5
1972-81	Sep. 1 - Feb. 28	65	5	1972-90	Sep. 1 - Feb. 28	65	5
1982	Oct. 5 - Feb. 28	65	5	1991-96	Sep. 1 - Jan. 31	65	5
1983-84	Oct. 1 - Feb. 28	65	5	1997-20	Sep. 22[a] - Jan. 31	45	3
1985-96	Oct. 1 - Jan. 31	45	3	2021	Sep. 13 - Jan 31	45	3
1997-01	Oct. 6 - Jan. 31	30	3				
2002-10	Oct. 1 - Jan. 31	30	3				
2011-20	Oct. 1 - Jan. 31	45	3				
2021	Sep. 13 - Jan 31	45	3				

[a] Saturday nearest September 22nd.

Appendix B. Estimates for the number of successful woodcock hunters and woodcock harvest in Canada (Gendron and Smith 2019).
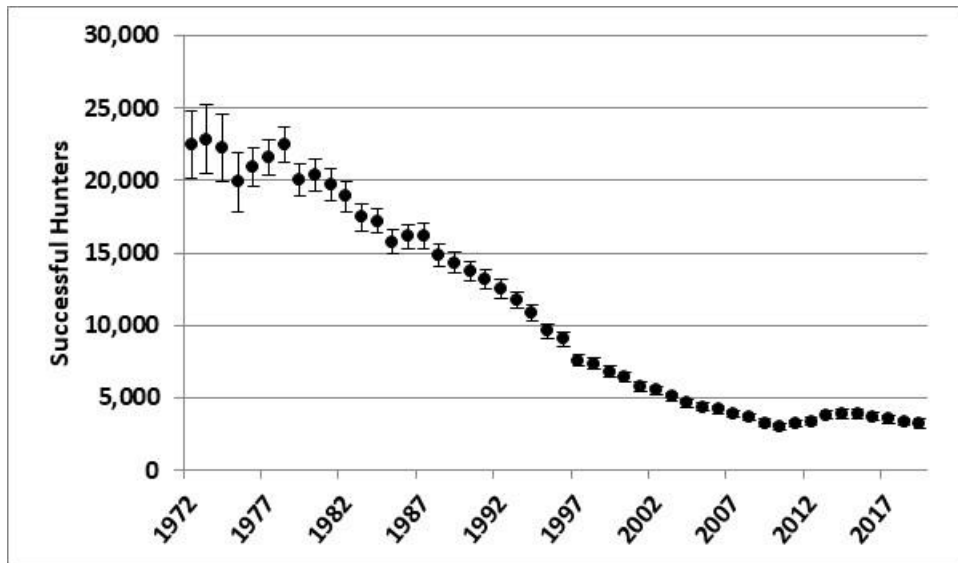

Fig. B1. Estimated number of successful woodcock hunters in Canada and associated 95% confidence intervals, 1972–2019.
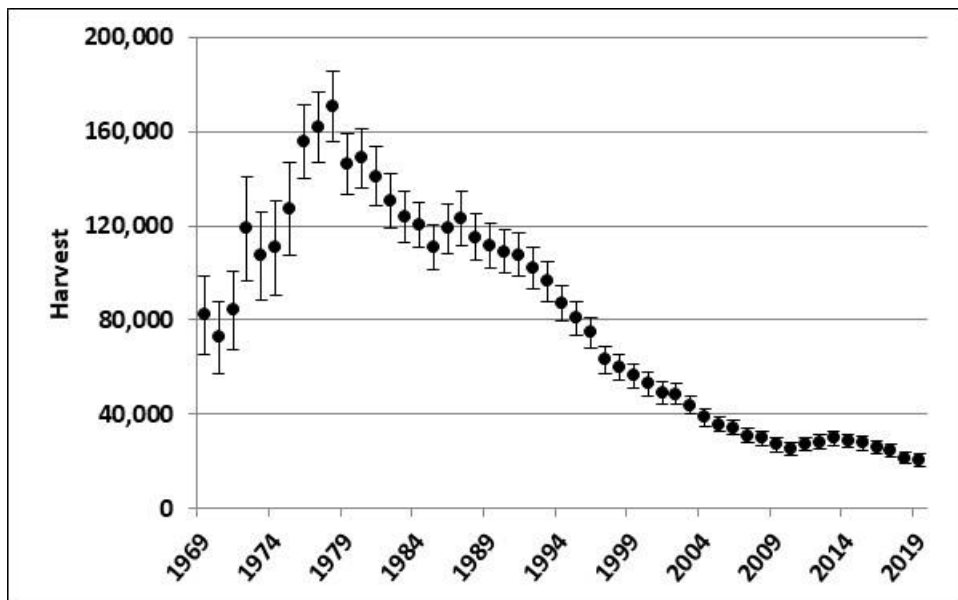

Fig. B2. Estimated woodcock harvest in Canada and associated 95% confidence intervals, 1969–2019.