



U.S. Fish & Wildlife Service

American Woodcock

Population Status, 2018



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U.S. Fish and Wildlife Service
Division of Migratory Bird Management
Branch of Assessment and Decision Support
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AMERICAN WOODCOCK POPULATION STATUS, 2018

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Abstract: The American Woodcock (*Scolopax minor*) Singing-ground Survey data for 2018 indicate that the index for singing males was significantly less than in 2017 in the Central Management Region, and not significantly different from 2017 in the Eastern Management Region. Both regions had significant, declining 10-year (2008–2018) trends: Eastern = -1.41%/year; Central = -0.96%/year. Both regions had a significant, long-term (1968-18) negative trend; Eastern = -1.18%/year; Central = -0.96%/year. The 2017 recruitment index for the U.S. portion of the Eastern Region (1.34 immatures per adult female) was 5.6% less than the 2016 index, and 17.3% below the long-term regional average, while the recruitment index for the U.S. portion of the Central Region (1.14 immatures per adult female) was 13.6% less than the 2016 index and was 25.5% below the long-term regional average. Estimates from the Harvest Information Program indicated that U.S. woodcock hunters in the Eastern Region spent 115,400 days afield and harvested 62,700 woodcock during the 2017–18 season, while in the Central Region hunters spent 272,400 days afield and harvested 140,900 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 Wing-collection Survey (WCS) 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 2018. 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, as recommended by Owen et al. (1977; Fig. 1). Coon et al. (1977) reviewed the concept of management units 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 Wing-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

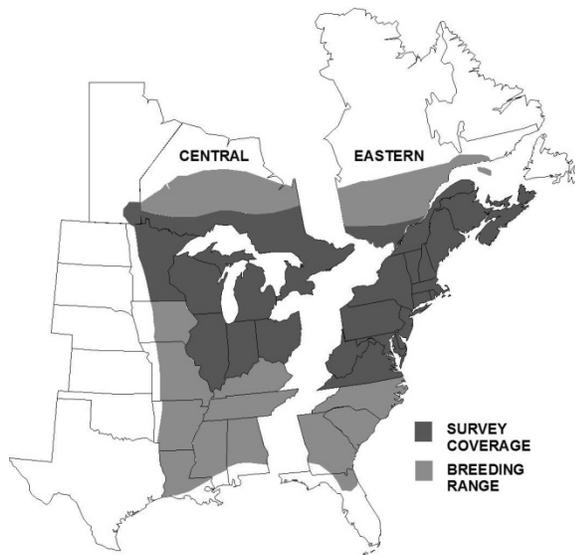


Fig. 1. Woodcock management regions, breeding range, and Singing-ground Survey coverage.

degree blocks within each state and province in the 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 can 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 (2017–18), 10-year (2008–18) and long-term (1968–2018) trends were evaluated for each region as well as for each state or province.

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 24 July 2018 were not included in this analysis but will be included in future trend estimates.

Wing-collection Survey

The primary objective of the Wing-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 2017 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.

Wing-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) during the annual woodcock wingbee conducted by state, federal and private biologists.

The ratio of immature birds per adult female in the harvest provides an index to recruitment of young into the population. The 2017 recruitment index for each state with ≥ 125 submitted wings was calculated as the number of immatures per adult female. The regional indices for 2017 were weighted by the relative contribution of each state to the cumulative number of adult female and immature wings received during 1963–2016.

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 2003–17 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 2017).

RESULTS AND DISCUSSION

Singing-ground Survey

Data for 836 routes were submitted by 24 July 2018 (Table 1). Analysis of the most recent 2 years of data indicated that the number of woodcock heard singing during the 2018 Singing-ground Survey declined from last year for the Central Management Region, and remained stationary for the Eastern Management Region (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 (2008–2018) showed a significant decline for the Eastern and Central Management Regions (Table 1, Fig. 2). Many states and provinces in both management regions have experienced significant long-term (1968–2018) declines as measured by the Singing-ground Survey (Table 1, Fig. 3). The long-term trend estimate was $-1.18\%/year$ for the Eastern Management Region, while it was $-0.96\%/year$ for the Central Management Region (Table 1).

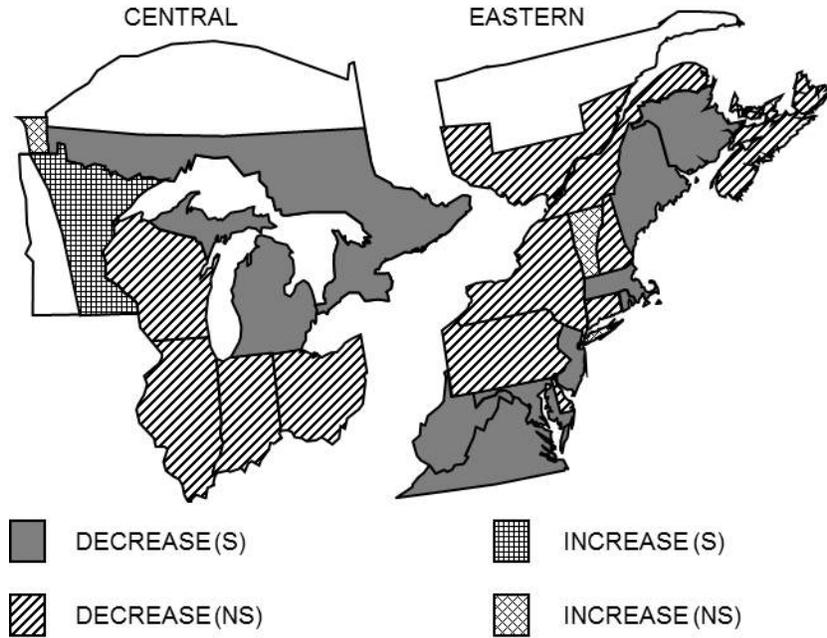


Fig. 2. Ten-year trends in the number of American woodcock heard on the Singing-ground Survey, 2008–2018, as determined by the hierarchical modeling method. A significant trend (S) does not include zero in the 95% credible interval, while a non-significant (NS) trend does include zero. Note, Minnesota is the only state or province that had a significant increase.

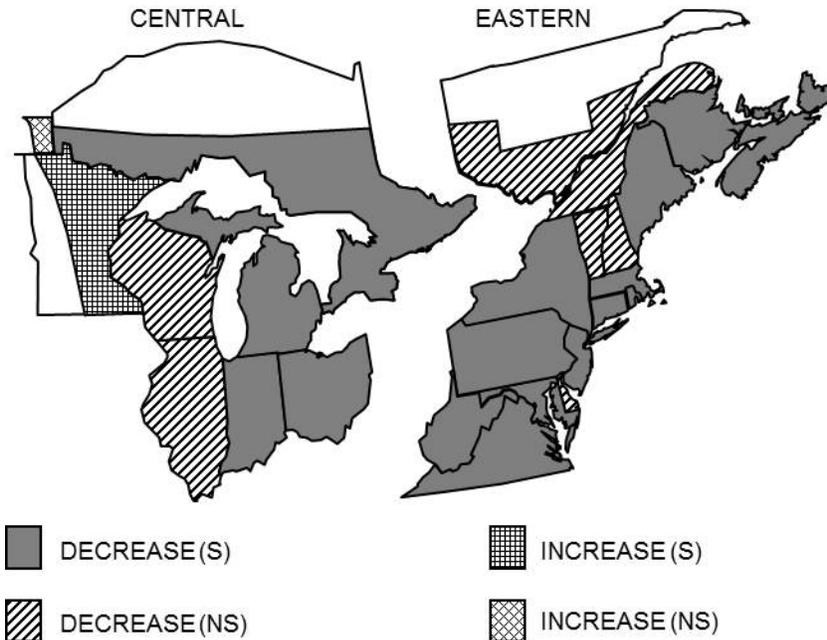


Fig. 3. Long-term trends in the number of American woodcock heard on the Singing-ground Survey, 1968–2018, as determined by the hierarchical modeling method. A significant trend (S) does not include zero in the 95% credible interval, while a non-significant (NS) trend does include zero. Note, Minnesota is the only state or province that had a significant long-term increase.

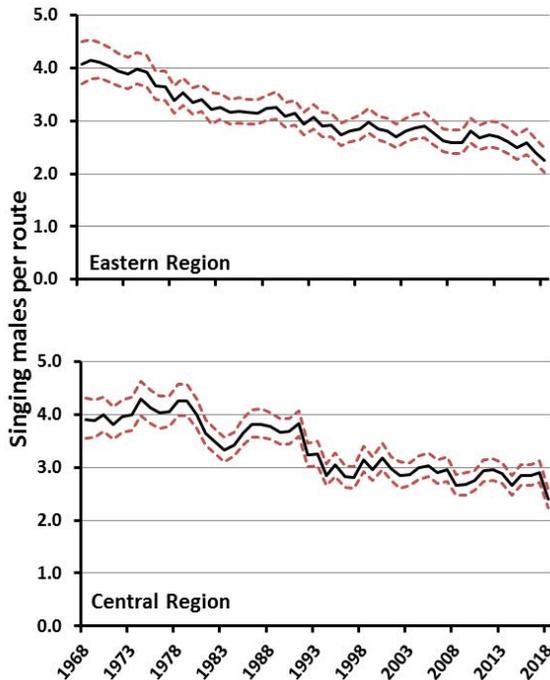


Fig. 4. Annual indices of the number of woodcock heard during the Singing-ground Survey, 1968–2018 as estimated using hierarchical modeling. The red dashed lines represent the 95% credible interval for the estimate.

In the Eastern Region, the 2018 index was 2.24 singing males per route, while it was 2.41 in the Central Management Region (Figure 4, Table 2). Annual indices (1968–2018) by state, province, and region are available in Table 2.

Wing-collection Survey

A total of 1,042 woodcock hunters (Table 3) from states with a woodcock season sent in a total of 9,420 usable woodcock wings for the 2017 Wing-collection Survey (Table 4).

The 2017 recruitment index in the U.S. portion of the Eastern Region (1.34 immatures per adult female) was 5.6% less than the 2016 index of 1.42, and 17.3% less than the long-term (1963–16) regional average of 1.62 (Table 4, Fig 5). In the Central Region, the 2017 recruitment index (1.14 immatures per adult female) was 13.6% less than the 2016 index of 1.32 and was 25.5% less than the long-term regional average of 1.53 (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 2017–18 HIP survey are provided in Table 5. In

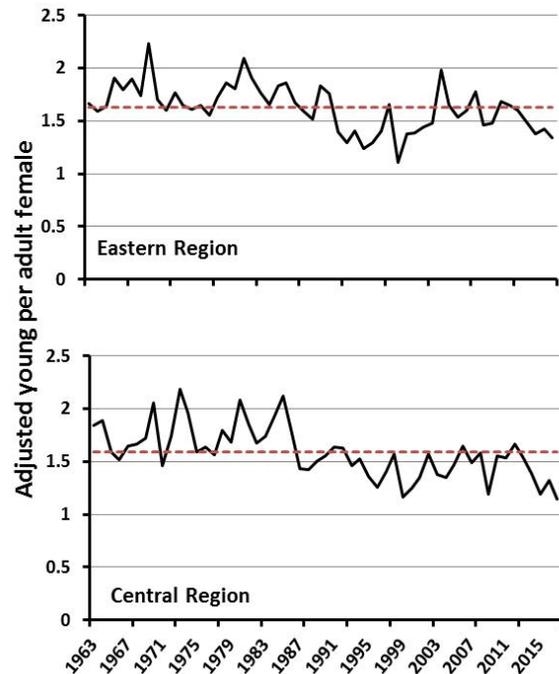


Fig. 5. Weighted annual indices of recruitment (U.S.), 1963–2017. The red dashed line is the 1963–2016 average.

the Eastern Management Region, woodcock hunters spent an estimated 115,400 days afield (Figure 6) and harvested 62,700 birds (Figure 7) during the 2017–18 hunting season. In the Eastern Region, harvest in 2017–18 was 21.6% less than the long-term (1999–2016) average (79,953 birds/year) and 41.3% more than last year (44,400 birds). Woodcock hunters in the Central Region spent an estimated 272,400 days afield (Figure 6) and harvested 140,900 birds (Figure 7) during the 2017–18 hunting season. In the Central Region, harvest in 2017–18 was 33.0% less than the long-term (1999–2016) average (210,400 birds/year) and 10.8% less than last year (158,000 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 3,261 successful hunters harvested 24,728 woodcock during the 2017 season in Canada (Gendron and Smith 2017; Appendix B).

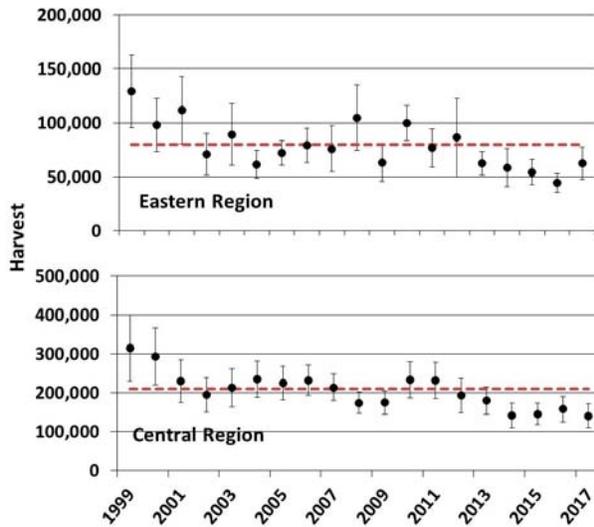


Fig. 6. Harvest Information Program Survey estimates of days spent afield by U.S. woodcock hunters, 1999–2017. The dashed line represents the 1999–2016 average and error bars represent the 95% confidence interval of the point estimate.

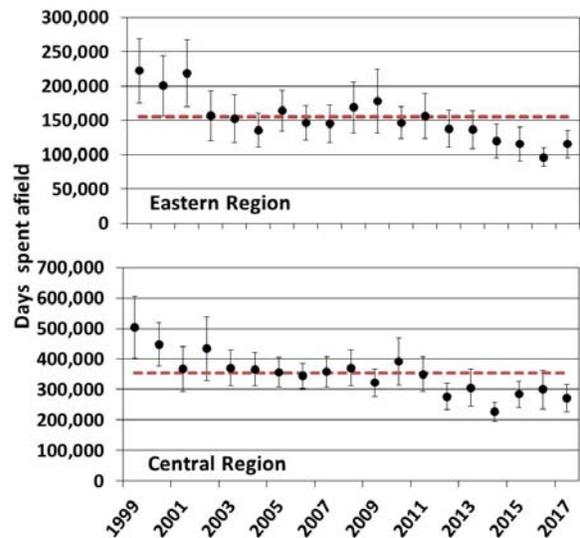


Fig. 7. Harvest Information Program Survey estimates of U.S. woodcock harvest, 1999–2017. The dashed line represents the 1999–2016 average and the error bars represent the 95% confidence interval of the point estimate.

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Table 1. Short-term (2017–18), 10-year (2008–2018), and long-term (1968–2018) 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	Number of routes ^b	n ^c	2017-2018			2008-2018			1968-2018		
			% change	95% CI ^d		% change	95% CI ^d		% change	95% CI ^d	
				lower	upper		lower	upper		lower	upper
CT	4	11	-1.95	-35.38	50.07	-2.16	-5.84	3.23	-2.57	-4.33	-0.73
DE	1	3	-3.83	-88.25	634.61	-3.98	-22.31	18.19	-4.10	-9.53	0.89
ME	51	73	-8.48	-25.07	11.09	-2.60	-4.66	-0.64	-1.55	-2.05	-1.05
MD	6	26	-5.54	-31.22	18.08	-4.00	-6.86	-1.36	-3.89	-5.21	-2.51
MA	12	22	-2.88	-27.01	26.44	-3.11	-6.68	-0.80	-2.61	-3.58	-1.61
NB	48	72	-8.65	-27.31	13.40	-2.84	-5.11	-0.59	-1.40	-2.13	-0.70
NH	11	18	-0.76	-27.98	34.41	-0.65	-3.79	2.44	-0.88	-1.89	0.13
NJ	4	19	-9.42	-50.93	59.75	-6.12	-11.43	-0.11	-6.11	-7.59	-4.52
NY	81	115	-15.55	-28.24	-2.05	-0.45	-2.03	1.29	-0.91	-1.35	-0.48
NS	43	63	-2.21	-20.25	19.21	-0.31	-2.34	1.89	-0.95	-1.65	-0.31
PA	32	82	-4.16	-27.69	22.73	-1.79	-4.76	0.58	-1.03	-1.76	-0.37
PEI	9	13	-7.28	-36.60	24.80	-0.64	-3.99	3.72	-1.21	-2.40	-0.02
QUE	15	111	-2.37	-18.69	12.41	-0.68	-2.31	1.03	-0.70	-1.42	0.00
RI ^e	3	3	-----	-----	-----	-12.21	-23.71	-0.92	-11.88	-18.59	-6.68
VT	19	24	5.35	-22.81	46.29	0.16	-3.08	3.99	-0.69	-1.61	0.28
VA	12	75	-6.56	-43.00	48.74	-6.13	-10.94	-2.05	-5.56	-6.66	-4.46
WV	25	57	-5.22	-28.87	13.83	-2.42	-4.98	-0.30	-2.28	-3.11	-1.55
Eastern	376	787	-6.79	-13.86	0.30	-1.41	-2.18	-0.63	-1.18	-1.46	-0.90
IL	19	47	-10.79	-69.87	162.00	-2.62	-12.09	7.20	-0.98	-3.55	1.88
IN	16	62	6.52	-34.06	86.84	-2.52	-7.20	3.47	-3.79	-4.95	-2.70
MB ^f	13	30	-18.53	-42.55	10.14	1.10	-2.49	5.04	0.14	-1.49	1.69
MI	112	156	-25.13	-34.50	-14.43	-1.96	-3.36	-0.57	-1.31	-1.67	-0.95
MN	83	123	-12.96	-25.49	1.53	2.17	0.47	3.97	0.66	0.10	1.23
OH	38	73	2.79	-18.48	33.91	-0.89	-3.35	2.09	-1.59	-2.33	-0.90
ON	89	165	-13.88	-26.18	0.06	-2.33	-4.12	-0.63	-1.23	-1.69	-0.79
WI	90	124	-18.35	-31.20	-3.80	-0.43	-2.17	1.48	-0.44	-0.90	0.05
Central	460	750	-17.20	-22.88	-10.91	-0.96	-1.76	-0.15	-0.96	-1.20	-0.73
Continent	836	1,537	-12.46	-16.92	-7.80	-1.18	-1.73	-0.62	-1.07	-1.25	-0.89

^a Median of route trends estimated used hierarchical modeling. To estimate the total percent change over several years, use: $(100((\% \text{ change}/100)+1)^y)-100$, 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 2018 for which data were received by 24 July, 2018.

^c Number of routes with at least one year of non-zero data between 1968 and 2018.

^d 95% credible interval, if the interval overlaps zero, the trend is considered non-significant.

^e Insufficient data to calculate trend.

^f 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, 1968–2018. These indices are based on 1968–2018 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	----	2.52	2.58	2.35	2.46	2.30	2.30	2.31	1.93	1.95	1.71	1.78	1.75	1.73	1.87	1.68
DE	1.07	0.86	1.08	0.71	0.90	1.09	0.94	1.85	0.44	0.64	0.44	0.50	0.64	0.63	0.60	1.02
ME	6.34	6.25	6.94	6.36	6.20	6.43	6.69	6.95	6.48	5.46	5.29	5.85	4.94	5.82	4.45	4.99
MD	1.82	1.82	1.70	1.66	1.57	1.52	1.46	1.42	1.30	1.27	1.25	1.19	1.19	1.13	1.07	1.00
MA	----	3.35	3.38	3.38	3.07	3.30	3.11	2.73	2.68	2.67	2.59	2.66	2.40	2.50	2.29	2.14
NB	----	8.95	8.80	8.04	7.92	7.35	7.88	8.43	6.48	7.81	5.94	6.42	5.44	6.14	6.76	5.81
NH	----	3.93	4.18	3.71	4.23	3.50	4.05	3.79	3.74	3.79	3.66	3.56	3.93	3.88	3.21	3.29
NJ	4.65	4.44	4.64	5.95	4.32	5.25	4.85	4.00	2.84	2.87	2.37	2.88	2.15	1.99	1.87	1.96
NY	4.30	4.46	3.92	4.30	4.11	4.21	4.30	3.81	3.89	3.89	3.50	3.84	4.19	4.00	3.65	3.92
NS	4.25	3.80	3.28	3.86	3.60	3.81	3.96	3.75	3.67	3.63	3.87	3.43	3.43	3.22	3.09	3.31
PA	1.97	1.86	2.07	1.99	1.94	1.96	1.71	1.74	1.76	1.73	1.67	1.77	1.57	1.56	1.52	1.55
PEI	----	5.30	5.33	5.91	4.91	4.91	5.12	6.04	5.29	5.02	4.82	4.95	4.20	4.02	4.10	4.60
QUE	----	----	6.06	5.96	6.02	5.84	5.87	5.80	5.73	5.63	5.82	5.84	5.78	5.59	5.54	5.60
RI	----	1.83	1.60	2.11	1.57	1.41	1.13	0.96	0.84	0.75	0.58	0.56	0.49	0.40	0.44	0.35
VT	----	3.34	4.04	3.62	4.08	3.57	3.95	4.23	4.35	4.46	3.42	3.60	3.42	3.05	2.32	3.06
VA	----	1.40	1.40	1.21	1.11	0.95	1.16	1.02	0.96	0.93	0.80	0.79	0.67	0.73	0.73	0.63
WV	1.52	1.52	1.41	1.37	1.44	1.36	1.31	1.32	1.25	1.19	1.09	1.17	1.12	1.18	1.11	1.08
Region	4.07	4.14	4.12	4.04	3.95	3.89	3.98	3.93	3.66	3.65	3.39	3.54	3.35	3.41	3.22	3.26
Central Region																
IL	----	----	0.24	0.47	0.41	0.30	0.43	0.35	0.22	0.30	0.45	0.31	0.24	0.44	0.26	0.85
IN	1.47	1.05	1.03	0.83	1.18	1.07	0.95	0.80	0.81	0.76	0.78	0.94	0.75	0.86	0.60	0.62
MB	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
MI	7.45	7.30	7.34	6.89	6.97	7.25	8.16	8.19	7.80	7.24	7.83	7.77	7.35	6.51	6.87	5.78
MN	----	2.88	2.82	3.18	3.02	3.45	4.09	3.66	3.73	3.83	4.09	3.71	4.23	3.82	3.76	3.35
OH	----	----	1.60	1.48	1.51	1.37	1.50	1.35	1.49	1.42	1.31	1.24	1.26	1.35	1.18	1.21
ON	8.03	8.96	9.43	8.65	9.40	9.13	9.21	8.76	8.88	9.10	9.37	9.65	9.02	8.20	7.00	6.93
WI	3.51	3.58	4.11	3.89	3.88	4.08	4.17	4.25	3.85	4.28	4.43	4.63	3.77	3.21	3.42	3.32
Region	3.90	3.89	3.99	3.82	3.95	4.00	4.29	4.13	4.03	4.05	4.26	4.26	4.00	3.65	3.48	3.32
Continent	3.98	4.02	4.06	3.93	3.95	3.94	4.13	4.03	3.85	3.85	3.82	3.90	3.67	3.53	3.35	3.29

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	1.48	1.63	1.36	1.38	1.38	1.30	1.20	1.23	1.28	1.27	1.16	1.12	1.17
DE	0.45	0.48	0.50	0.50	0.47	0.45	0.59	0.28	0.29	0.38	0.37	0.36	0.39	0.38	0.59	0.28
ME	5.04	5.17	5.54	5.84	5.34	5.53	4.40	5.00	4.32	4.64	4.27	4.40	3.72	4.01	3.97	4.34
MD	0.98	0.93	0.88	0.85	0.82	0.80	0.77	0.73	0.68	0.68	0.65	0.62	0.61	0.58	0.54	0.52
MA	2.25	2.21	2.13	2.09	2.05	1.92	1.89	1.86	1.75	1.70	1.68	1.66	1.61	1.61	1.54	1.69
NB	5.29	5.50	4.68	5.10	5.93	7.05	6.04	5.67	5.40	6.47	6.61	6.05	5.35	5.99	5.97	6.79
NH	3.23	3.37	4.32	3.62	3.45	3.45	3.22	3.45	3.20	3.19	3.21	3.60	3.48	3.45	3.40	3.66
NJ	2.07	1.87	1.68	1.91	1.45	1.39	1.31	1.24	1.09	0.96	0.83	0.96	0.91	0.71	0.78	0.82
NY	3.47	3.91	3.60	3.48	3.78	3.36	3.79	3.83	3.58	3.45	3.10	3.25	3.07	3.13	3.19	3.26
NS	3.15	3.29	3.46	3.04	3.27	3.24	3.03	3.26	3.25	3.32	2.99	3.15	3.27	2.98	3.03	3.39
PA	1.61	1.53	1.60	1.52	1.49	1.45	1.57	1.75	1.46	1.55	1.32	1.48	1.45	1.40	1.55	1.45
PEI	4.60	4.53	4.77	4.09	4.57	4.75	4.24	4.17	4.11	3.95	3.74	3.93	4.26	4.09	3.90	3.67
QUE	5.49	5.44	5.41	5.45	5.54	5.57	5.36	5.26	5.24	5.34	5.25	5.07	4.90	4.95	5.13	5.05
RI	0.31	0.25	0.22	0.20	0.17	0.15	0.14	0.12	0.11	0.09	0.08	0.07	0.06	0.05	0.05	0.04
VT	2.98	2.75	2.95	3.37	3.60	3.50	3.29	3.41	2.51	2.81	2.70	2.67	2.59	2.70	2.94	3.35
VA	0.83	0.50	0.54	0.52	0.45	0.42	0.44	0.40	0.41	0.38	0.35	0.30	0.29	0.31	0.26	0.26
WV	1.03	1.00	0.99	0.97	0.94	0.92	0.93	0.87	0.86	0.83	0.82	0.85	0.79	0.79	0.75	0.75
Region	3.16	3.18	3.16	3.15	3.23	3.26	3.09	3.14	2.93	3.06	2.91	2.91	2.73	2.80	2.85	2.98
Central Region																
IL	0.37	0.74	0.60	1.11	0.34	0.53	0.27	0.56	0.35	0.47	0.29	0.22	0.28	0.22	0.27	0.36
IN	0.61	0.57	0.67	0.62	0.55	0.50	0.62	0.60	0.56	0.46	0.45	0.42	0.39	0.38	0.45	0.40
MB	-----	-----	-----	-----	-----	-----	-----	-----	5.54	5.58	5.86	6.12	5.29	3.74	4.60	4.55
MI	6.53	6.69	6.98	6.50	6.94	6.75	6.77	7.43	5.80	5.90	5.20	5.75	5.50	5.32	6.33	5.30
MN	3.26	3.66	3.82	3.87	4.26	3.55	4.25	4.10	3.48	3.57	3.26	3.36	3.26	2.96	3.45	3.54
OH	1.24	1.15	1.13	1.11	1.18	1.03	1.26	1.15	1.17	1.07	1.05	1.02	1.04	0.92	1.04	0.90
ON	6.98	7.79	8.02	7.90	7.92	7.98	7.53	7.67	7.10	6.89	5.94	6.50	5.34	6.03	6.28	5.80
WI	3.72	3.56	4.05	4.12	3.84	3.92	3.74	3.77	3.06	3.21	2.82	2.93	2.87	2.75	2.94	3.32
Region	3.43	3.65	3.82	3.82	3.77	3.67	3.68	3.82	3.23	3.25	2.86	3.04	2.82	2.80	3.14	2.96
Continent	3.29	3.42	3.49	3.48	3.50	3.47	3.38	3.48	3.08	3.16	2.88	2.98	2.78	2.80	3.00	2.97

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	1.07	1.02	0.96	0.96	0.93	0.89	0.85	0.85	0.85	0.82	0.80	0.86	0.84	0.78	0.78	0.72
DE	0.40	0.25	0.28	0.26	0.26	0.25	0.20	0.19	0.20	0.20	0.19	0.19	0.18	0.16	0.15	0.16
ME	4.52	3.99	3.70	4.02	4.13	4.22	4.10	3.74	3.79	3.67	3.99	4.07	4.04	3.97	3.77	3.40
MD	0.52	0.51	0.47	0.46	0.44	0.42	0.41	0.39	0.38	0.36	0.35	0.33	0.32	0.30	0.29	0.28
MA	1.54	1.45	1.44	1.40	1.45	1.32	1.31	1.22	1.28	1.24	1.18	1.13	1.06	1.05	1.03	1.07
NB	6.39	6.65	6.38	6.93	6.94	7.63	6.86	6.23	5.99	5.40	7.06	6.58	7.20	6.70	6.31	5.58
NH	3.13	3.22	3.18	3.50	3.51	3.46	3.21	2.68	2.75	3.26	3.25	2.87	3.22	3.12	3.21	2.80
NJ	0.72	0.67	0.56	0.61	0.47	0.43	0.43	0.44	0.38	0.43	0.28	0.34	0.37	0.33	0.30	0.22
NY	3.11	3.02	2.97	3.11	3.33	3.09	3.17	2.96	2.85	3.09	3.32	3.05	3.16	3.17	2.99	3.21
NS	3.35	3.18	2.93	2.90	3.16	3.00	2.85	2.83	2.73	2.72	3.10	2.75	3.10	3.35	3.09	2.64
PA	1.18	1.39	1.37	1.37	1.39	1.43	1.30	1.26	1.41	1.40	1.50	1.30	1.17	1.11	1.25	1.22
PEI	3.92	3.70	3.21	3.31	3.30	3.44	3.65	3.53	3.08	3.28	3.09	3.24	3.54	3.18	3.61	3.14
QUE	4.88	4.89	4.82	4.84	4.83	4.92	4.71	4.68	4.63	4.67	4.61	4.60	4.50	4.63	4.48	4.45
RI	0.04	0.03	0.03	0.03	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	-----	-----	-----
VT	3.41	2.74	2.50	2.69	2.74	2.91	2.88	2.51	2.33	2.47	2.54	2.42	2.60	2.39	2.16	2.16
VA	0.25	0.21	0.21	0.21	0.20	0.18	0.17	0.16	0.16	0.13	0.13	0.14	0.12	0.13	0.12	0.09
WV	0.73	0.70	0.68	0.68	0.65	0.63	0.62	0.62	0.61	0.60	0.57	0.58	0.57	0.53	0.54	0.50
Region	2.85	2.81	2.70	2.82	2.87	2.91	2.77	2.62	2.59	2.59	2.80	2.67	2.73	2.70	2.60	2.48
Central Region																
IL	0.26	0.34	0.25	0.59	0.62	0.18	0.40	0.19	0.19	0.17	0.20	0.17	0.11	0.11	0.13	0.25
IN	0.36	0.39	0.31	0.30	0.34	0.34	0.29	0.27	0.27	0.27	0.28	0.24	0.25	0.22	0.22	0.21
MB	4.91	4.98	4.09	4.89	4.50	5.42	4.62	4.88	4.62	4.89	4.96	5.78	5.44	4.66	4.74	5.35
MI	5.60	5.25	5.39	5.58	5.62	5.50	5.10	5.03	4.70	4.73	4.85	5.30	5.38	5.61	5.35	5.44
MN	4.04	3.67	3.10	3.17	3.29	3.64	3.51	3.55	3.20	3.49	4.08	4.05	3.95	3.46	3.00	3.88
OH	0.93	0.92	0.89	0.85	1.07	0.97	0.94	0.77	0.81	0.92	0.90	0.88	0.85	0.85	0.80	0.86
ON	6.89	6.07	6.23	5.60	5.99	6.31	6.07	6.36	5.47	5.25	4.95	5.50	5.57	5.29	5.20	5.05
WI	3.13	3.06	2.62	2.80	2.87	3.21	2.97	3.42	2.94	2.97	3.02	3.32	3.43	3.45	2.76	3.11
Region	3.19	2.97	2.84	2.87	2.99	3.04	2.91	2.96	2.65	2.68	2.75	2.94	2.95	2.88	2.65	2.85
Continent	3.02	2.89	2.77	2.84	2.93	2.97	2.84	2.79	2.62	2.63	2.78	2.80	2.84	2.79	2.63	2.67

Table 2. Continued

State, Province, or Region	Year		
	2016	2017	2018
Eastern Region			
CT	0.73	0.71	0.70
DE	0.15	0.14	0.13
ME	3.86	3.18	2.91
MD	0.27	0.27	0.25
MA	1.02	0.95	0.92
NB	6.09	4.91	4.49
NH	2.94	2.59	2.56
NJ	0.24	0.22	0.20
NY	3.10	3.23	2.72
NS	2.85	2.71	2.64
PA	1.25	1.23	1.17
PEI	2.77	3.17	2.91
QUE	4.48	4.45	4.31
RI	0.00	-----	0.00
VT	2.54	2.25	2.38
VA	0.09	0.09	0.08
WV	0.50	0.51	0.48
Region	2.59	2.41	2.24
Central Region			
IL	0.14	0.17	0.15
IN	0.21	0.20	0.21
MB	5.20	6.36	5.16
MI	5.15	5.16	3.87
MN	4.50	4.56	3.97
OH	0.81	0.72	0.74
ON	4.97	5.01	4.32
WI	3.09	3.45	2.82
Region	2.84	2.91	2.41
Continent	2.72	2.66	2.33

Table 3. The number of U.S. hunters by state that submitted woodcock wings for the 2016-17 and 2017-18 Wing-collection Surveys.

State of residence	Number of Hunters who submitted woodcock wings ^a	
	2016-17 Season	2017-18 Season
Alabama	1	1
Arkansas	1	1
Connecticut	20	20
Delaware	3	1
Florida	0	0
Georgia	2	4
Illinois	1	3
Indiana	17	12
Iowa	4	3
Kansas	0	0
Kentucky	3	5
Louisiana	14	10
Maine	111	93
Maryland	14	12
Massachusetts	39	35
Michigan	239	233
Minnesota	99	110
Mississippi	3	1
Missouri	15	14
Nebraska	0	0
New Hampshire	62	54
New Jersey	13	13
New York	89	82
North Carolina	9	8
North Dakota	0	0
Ohio	17	10
Oklahoma	0	0
Pennsylvania	59	51
Rhode Island	3	2
South Carolina	11	9
Tennessee	1	3
Texas	1	3
Vermont	51	46
Virginia	17	20
West Virginia	17	18
Wisconsin	174	165
Total	1,110	1,042

^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 2017 were weighted by the relative contribution of each state to the cumulative number of adult female and immature wings received during 1963–2016.

State or Region of harvest	Wings received						Recruitment index	
	Total		Adult females		Immatures		1963-16	2017
	1963-16	2017	1963-16	2017	1963-16	2017	1963-16	2017
Eastern Region								
CT	15,462	147	3,464	35	9,411	87	2.7	2.5
DE	527	6	83	0	360	5	4.3	----
FL	678	0	153	0	422	0	2.8	----
GA	3,357	37	1,055	13	1,425	14	1.4	----
ME	90,154	768	26,774	251	45,168	361	1.7	1.4
MD	5,004	68	1,221	19	2,840	43	2.3	----
MA	25,613	203	8,011	69	12,370	91	1.5	1.3
NH	38,079	441	12,394	156	17,626	183	1.4	1.2
NJ	27,571	117	6,374	18	16,293	86	2.6	----
NY	65,391	466	22,149	176	29,509	184	1.3	1.0
NC	4,457	90	1,421	41	2,121	29	1.5	----
PA	34,120	275	10,832	99	15,714	126	1.5	1.3
RI	2,477	3	479	1	1,639	2	3.4	----
SC	3,995	165	1,276	61	1,801	53	1.4	0.9
VT	29,435	493	9,679	181	13,389	215	1.4	1.2
VA	6,277	257	1,654	63	3,379	146	2.0	2.3
WV	6,572	76	1,988	23	3,286	33	1.7	----
Region	359,529	3,612	109,007	1,206	176,753	1,658	1.62	1.34
Central Region								
AL	1,014	4	282	2	462	1	1.6	----
AR	561	5	181	2	230	2	1.3	----
IL	1,513	5	354	4	850	1	2.4	----
IN	8,746	48	2,234	13	4,841	24	2.2	----
IA	1,386	6	450	1	620	1	1.4	----
KS	50	0	9	0	26	0	----	----
KY	1,223	63	313	23	620	24	2.0	----
LA	33,869	202	7,596	68	21,895	100	2.9	1.5
MI	145,171	2,179	47,774	790	70,746	973	1.5	1.2
MN	45,179	1,152	16,049	508	19,356	365	1.2	0.7
MS	1,993	3	562	2	1,005	1	1.8	----
MO	4,619	93	1,248	38	2,240	27	1.8	----
NE	13	0	5	0	6	0	----	----
ND	4	0	3	0	1	0	----	----
OH	15,430	65	4,751	21	7,241	35	1.5	----
OK	174	0	38	0	92	0	2.4	----
TN	1,364	7	364	3	695	3	1.9	----
TX	1,069	15	300	9	531	4	1.8	----
WI	95,908	1,961	32,569	734	44,870	794	1.4	1.1
Region	359,286	5,808	115,082	2,218	176,327	2,355	1.53	1.14

Table 5. Preliminary estimates of woodcock harvest, hunter numbers, days afield, and hunter success from the 2017–18 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	1,600	500	600	100	3,800	800	2.53	0.99
DE	200	200	200	100	700	400	0.97	0.95
FL	200	100	200	100	1,400	1,000	1.00	0.90
GA	1,400	700	3,600	2,300	9,500	6,600	0.39	0.32
ME	17,300	4,700	5,000	800	22,600	3,300	3.44	1.06
MD	400	100	100	<100	500	100	2.92	0.99
MA	1,900	400	1,200	200	5,900	900	1.52	0.41
NH	4,900	1,100	2,400	400	8,600	1,300	2.07	0.57
NJ	1,700	400	800	200	4,700	2,100	2.13	0.78
NY	6,100	1,000	3,300	500	15,100	2,700	1.83	0.41
NC	6,700	3,500	1,200	400	5,800	2,600	5.63	3.44
PA	8,200	2,400	5,200	1,000	20,700	3,600	1.57	0.56
RI	200	100	<100	<100	300	200	4.33	4.26
SC	4,700	3,500	1,400	1,200	4,500	3,500	3.40	3.80
VT	3,400	600	1,300	200	5,800	800	2.71	0.61
VA	3,400	1,800	1,700	700	4,500	2,000	2.00	1.34
WV	500	100	400	100	800	200	1.21	0.49
Region	62,700	7,700	28,700^a	na^a	115,400	10,400	na^b	na^b
Central Region								
AL	600	300	1,800	1,600	2,200	1,700	0.36	0.37
AR	600	600	1,500	1,400	4,700	4,300	0.40	0.54
IL	400	300	100	<100	300	100	3.00	2.46
IN	1,500	1,100	1,100	400	2,900	1,000	1.45	1.17
IA	1,900	1,700	1,000	600	2,400	1,400	1.84	2.01
KS	100	<100	<100	<100	100	<100	4.00	2.88
KY	900	300	100	<100	800	200	7.10	2.71
LA	9,900	9,200	3,500	1,500	14,500	7,100	2.81	2.85
MI	66,100	10,300	24,100	2,300	122,800	15,200	2.74	0.50
MN	26,700	5,000	11,900	2,100	45,700	8,200	2.24	0.58
MS	400	200	1,600	1,100	2,400	1,700	0.23	0.22
MO	200	100	900	700	1,300	800	0.21	0.19
NE	0	0	<100	0	100	<100	0.00	0.00
OH	400	200	1,900	800	5,000	1,800	0.23	0.14
OK ^c								
TN	100	100	1,300	1,200	2,600	2,500	0.07	0.10
TX	0	0	12,100	8,500	12,100	8,500	0.00	0.00
WI	31,100	4,600	11,700	1,800	52,400	7,700	2.66	0.56
Region	140,900	15,500	74,600^a	na^a	272,400	22,800	na^b	na^b
Total	203,500	17,300	103,300^a	na^a	387,700	24,900	na^b	na^b

^aHunter 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.

^bRegional 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.

^cNo hunters that registered for HIP in Oklahoma said they intended to hunt woodcock in 2017.

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 – 2018.

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	1997-18	Sep. 22 ^a - Jan. 31	45	3
1985-96	Oct. 1 - Jan. 31	45	3				
1997-01	Oct. 6 - Jan. 31	30	3				
2002-10	Oct. 1 - Jan. 31	30	3				
2011-18	Oct. 1 - Jan. 31	45	3				

^a Saturday nearest September 22nd, which was September 23rd for the 2017–18 season, and is September 22nd for the 2018–19 season.

Appendix B. Estimates for the number of successful woodcock hunters and woodcock harvest in Canada (Gendron and Smith 2017).

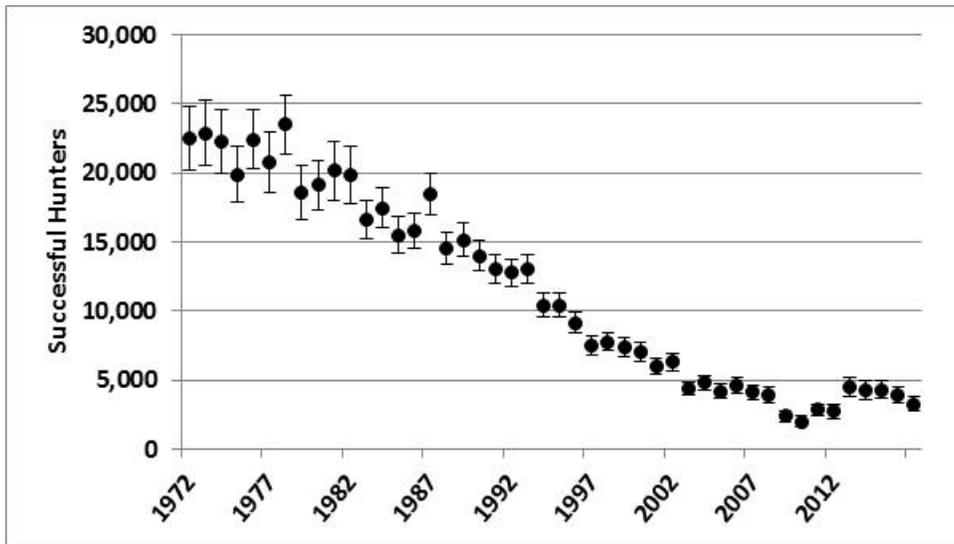


Fig. B1. Estimated number of successful woodcock hunters in Canada and associated 95% confidence intervals, 1972–2017.

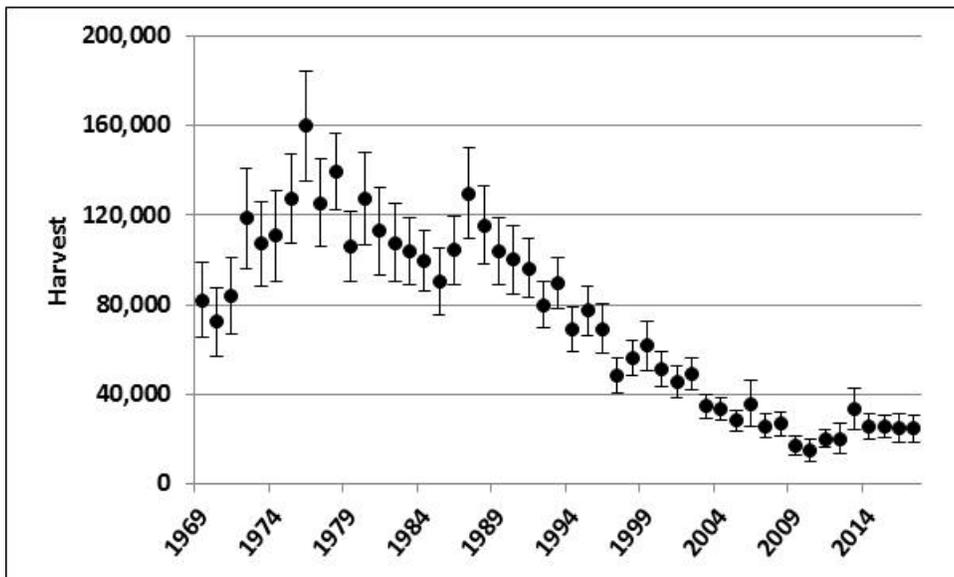


Fig. B2. Estimated woodcock harvest in Canada and associated 95% confidence intervals, 1969–2017.

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