U.S. Fish & Wildlife Service

American Woodcock

Population Status, 2019

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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, 2019

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Abstract: The American Woodcock (*Scolopax minor*) Singing-ground Survey data for 2019 indicate that the index for singing males was similar to that of 2018 in the Eastern and Central Management Regions. The Eastern Region had a significant negative trend over the most recent 10-years (2009–2019; -0.90%/year) while the Central was negative (-0.78%/year) but not significant. Both regions had a significant, long-term (1968-19) negative trend; Eastern = -1.08%/year; Central -0.89%/year. The 2018 recruitment index for the U.S. portion of the Eastern Region (1.71 immatures per adult female) was 27.6% greater than the 2017 index, and 5.6% greater than the long-term regional average, while the recruitment index for the U.S. portion of the Central Region (1.40 immatures per adult female) was 22.8% more than the 2017 index but was 7.9% less than the long-term regional average. Estimates from the Harvest Information Program indicated that U.S. woodcock hunters in the Eastern Region spent 99,200 days afield and harvested 49,600 woodcock during the 2018–19 season, while in the Central Region hunters spent 246,000 days afield and harvested 130,600 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 2019. 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 degree blocks within each state and province in the

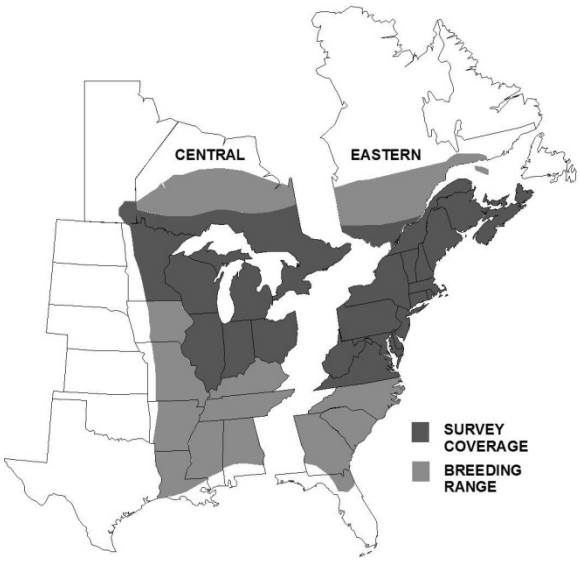

Fig. 1. Woodcock management regions, breeding range, and Singing-ground Survey coverage.

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 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 (2018–19), 10-year (2009–19) and long-term (1968–2019) 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 10 July 2019 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 2018 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 2018 recruitment index for each state with ≥ 125 submitted wings was calculated as the number of immatures per adult female. The regional indices for 2018 were weighted by the relative contribution of each state to the cumulative number of adult female and immature wings received during 1963–2017.

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 2003–18 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 860 routes were submitted by 10 July 2019 (Table 1). Analysis of the most recent 2 years of data indicated that the number of woodcock heard singing during the 2019 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 (2009–2019) showed a significant decline for the Eastern Management Region but not the Central Management Region (Table 1, Fig. 2). Many states and provinces in both management regions have experienced significant long-term (1968–2019) declines as measured by the Singing-ground Survey (Table 1, Fig. 3). The long-term trend estimate was −1.08%/year for the Eastern Management Region, while it was -0.89%/year for the Central Management Region (Table 1).

In the Eastern Region, the 2019 index was 2.36 singing males per route, while it was 2.47 in the Central Management Region (Figure 4, Table 2). Annual indices (1968–2019) by state, province, and region are available in Table 2.

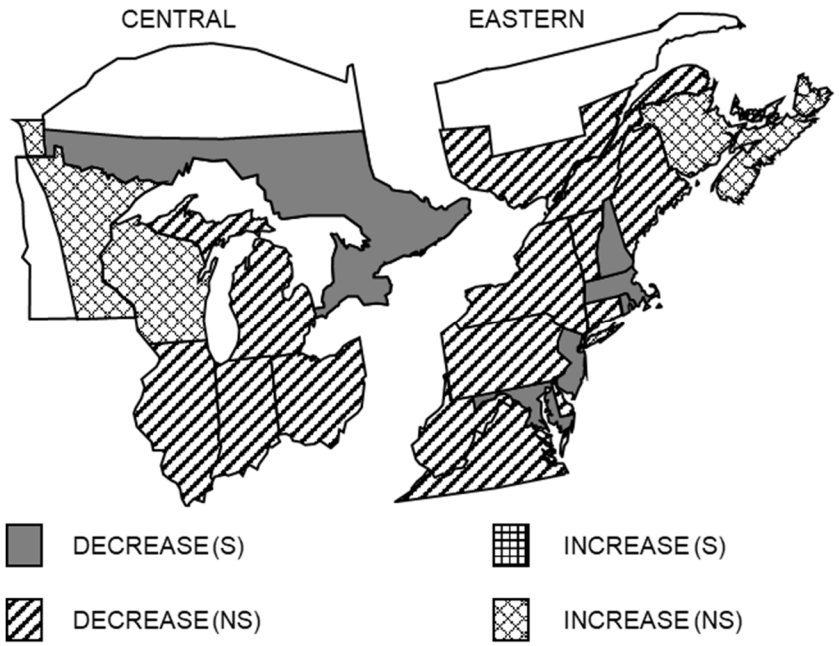

Fig. 2. Ten-year trends in the number of American woodcock heard on the Singing-ground Survey, 2009–2019, as determined by the hierarchical modeling method. A significant trend (S) does not include zero in the 95% credible interval, while a non-significant (NS) trend does include zero.

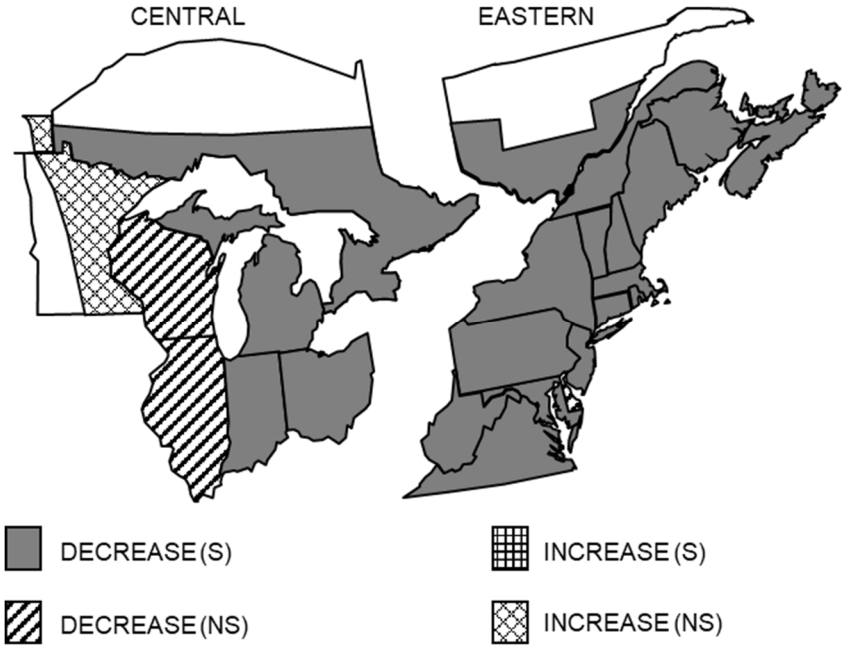

Fig. 3. Long-term trends in the number of American woodcock heard on the Singing-ground Survey, 1968–2019, as determined by the hierarchical modeling method. A significant trend (S) does not include zero in the 95% credible interval, while a non-significant (NS) trend does include zero.

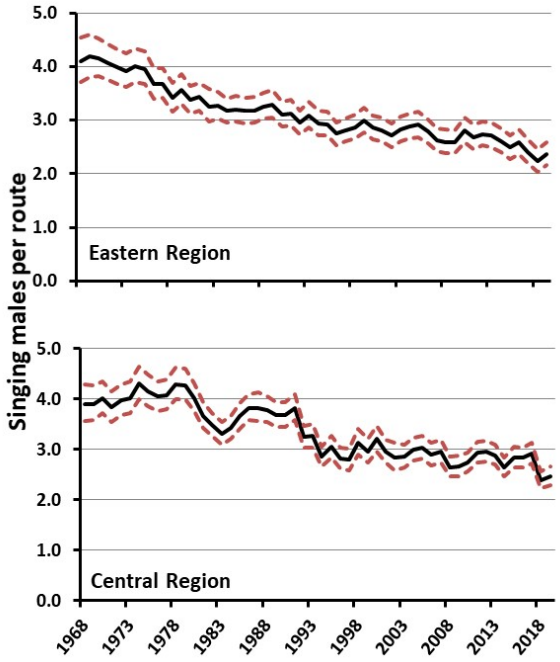

Fig. 4. Annual indices of the number of woodcock heard during the Singing-ground Survey, 1968–2019 as estimated using hierarchical modeling. The red dashed lines represent the 95% credible interval for the estimate.

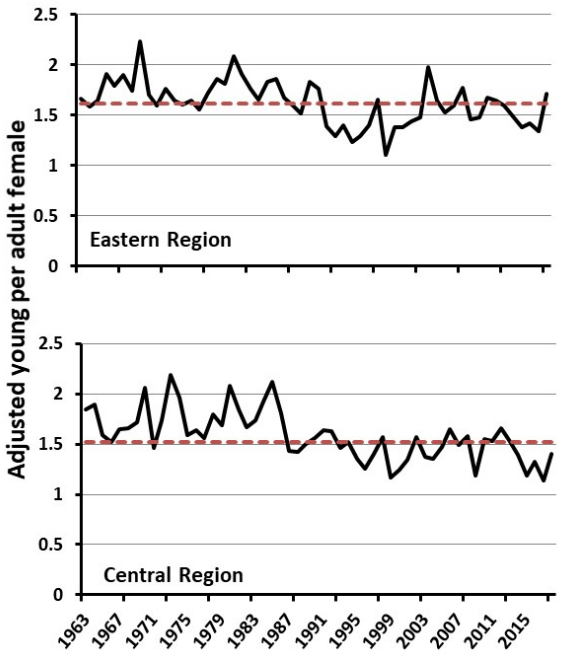

Fig. 5. Weighted annual indices of recruitment (U.S.), 1963–2018. The red dashed line is the 1963–2017 average.

Wing-collection Survey

A total of 986 woodcock hunters (Table 3) from states with a woodcock season sent in a total of 8,590 usable woodcock wings for the 2018 Wing-collection Survey (Table 4).

The 2018 recruitment index in the U.S. portion of the Eastern Region (1.71 immatures per adult female) was 27.6% more than the 2017 index of 1.34, and 5.6% more than the long-term (1963–17) regional average of 1.62 (Table 4, Fig 5). In the Central Region, the 2018 recruitment index (1.40 immatures per adult female) was 22.8% more than the 2017 index of 1.14 but was 7.9% less than the long-term regional average of 1.52 (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 2018–19 HIP survey are provided in Table 5. In the Eastern Management Region, woodcock hunters spent an estimated 99,200 days afield (Figure 6) and harvested 49,600 birds (Figure 7) during the 2018–19 hunting season. In the Eastern Region, harvest in 2018–19 was 37.3% less than the long-term (1999–2017) average (79,042 birds/year) and 20.9% less than last year (62,700 birds). Woodcock hunters in the Central Region spent an estimated 246,000 days afield (Figure 6) and harvested 130,600 birds (Figure 7) during the 2018–19 hunting season. In the Central Region, harvest in 2018–19 was 36.8% less than the long-term (1999–2017) average (206,700 birds/year) and 7.3% less than last year (140,900 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 3,286 successful hunters harvested 19,296 woodcock during the 2018 season in Canada (Gendron and Smith 2017; Appendix B).

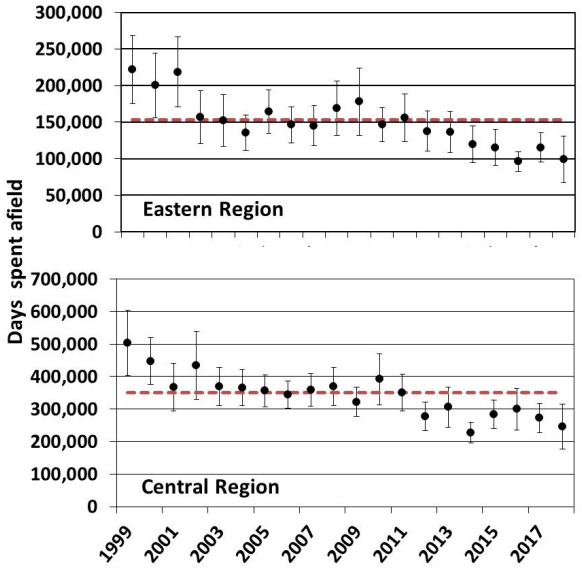

Fig. 6. Harvest Information Program Survey estimates of days spent afield by U.S. woodcock hunters, 1999–2018. The dashed line represents the 1999–2017 average and error bars represent the 95% confidence interval of the point estimate.

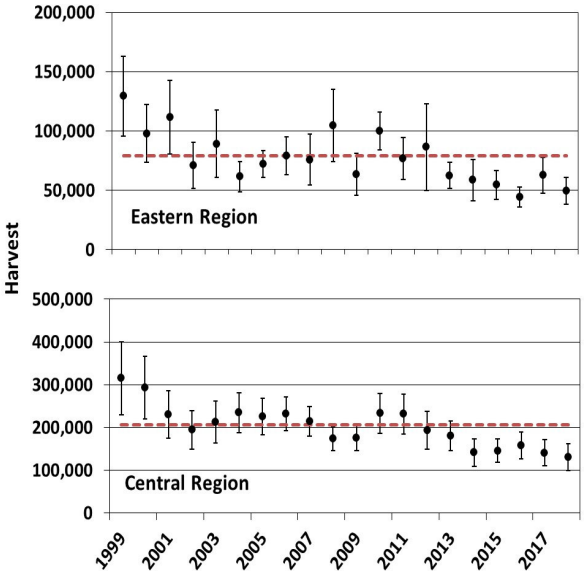

Fig. 7. Harvest Information Program Survey estimates of U.S. woodcock harvest, 1999–2018. The dashed line represents the 1999–2017 average and the error bars represent the 95% confidence interval of the point estimate.

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We especially thank all the woodcock hunters who sent in wings for the survey.

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Table 1. Short-term (2018–19), 10-year (2009–2019), and long-term (1968–2019) 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]		2018-2019			2009-2019			1968-2019		
				95% CI[d]			95% CI[d]			95% CI[d]	
		n[c]	% change	lower	upper	% change	lower	upper	% change	lower	upper
CT	6	11	-5.93	-44.18	36.08	-2.52	-6.50	2.20	-2.69	-4.57	-1.00
DE	1	3	-3.45	-87.77	618.10	-4.36	-23.13	16.32	-4.20	-9.53	0.65
ME	50	74	13.37	-5.81	38.47	-0.87	-2.77	1.15	-1.22	-1.71	-0.75
MD	4	26	-3.65	-27.00	27.47	-3.96	-7.07	-1.14	-3.91	-5.27	-2.53
MA	11	22	-1.60	-21.78	30.10	-2.89	-5.78	-0.68	-2.58	-3.57	-1.67
NB	50	73	27.57	3.60	57.80	0.17	-1.99	2.46	-0.99	-1.72	-0.27
NH	13	18	-4.61	-31.71	32.03	-3.08	-6.89	-0.09	-1.19	-2.18	-0.25
NJ	4	19	-12.32	-54.48	56.12	-8.49	-14.83	-3.74	-6.37	-7.87	-4.85
NY	79	117	4.41	-10.05	22.27	-0.83	-2.43	0.81	-0.78	-1.19	-0.35
NS	40	63	5.14	-14.21	31.20	0.23	-1.85	2.72	-0.75	-1.44	-0.13
PA	30	83	-1.79	-23.92	26.27	-1.64	-4.50	0.72	-1.01	-1.70	-0.30
PEI	8	13	-3.01	-34.56	38.62	-1.56	-5.31	2.04	-1.40	-2.61	-0.19
QUE	28	114	-1.91	-17.85	13.26	-1.07	-3.05	0.47	-0.85	-1.55	-0.18
RI	1	3	-12.54	-70.68	144.67	-12.31	-22.87	-2.26	-12.19	-17.83	-6.90
VT	17	24	-15.24	-40.98	16.03	-1.94	-5.65	1.51	-0.99	-1.85	-0.10
VA	13	75	1.25	-33.19	77.02	-4.04	-7.66	2.16	-5.26	-6.31	-4.17
WV	24	57	-0.36	-18.69	28.24	-2.19	-4.51	0.22	-2.19	-2.96	-1.41
Eastern	**379**	**795**	**5.69**	**-1.73**	**13.49**	**-0.90**	**-1.69**	**-0.15**	**-1.08**	**-1.34**	**-0.82**
IL	27	47	-1.65	-67.59	203.75	-1.51	-11.05	9.26	-1.09	-3.69	1.66
IN	15	62	-13.99	-52.05	36.86	-3.96	-9.08	1.16	-4.10	-5.34	-3.02
MB[e]	19	30	5.33	-21.14	43.99	0.65	-2.56	4.18	0.18	-1.35	1.65
MI	114	158	12.23	-1.26	27.79	-0.67	-2.03	0.69	-1.01	-1.36	-0.67
MN	87	124	-6.43	-20.03	9.72	0.43	-1.22	2.15	0.49	-0.06	1.07
OH	35	73	6.44	-14.14	39.11	-1.65	-4.21	0.84	-1.45	-2.16	-0.74
ON	87	166	-3.32	-17.62	12.65	-2.24	-4.17	-0.37	-1.32	-1.77	-0.88
WI	97	128	11.76	-5.08	31.76	0.21	-1.61	2.08	-0.26	-0.72	0.20
Central	**481**	**758**	**3.43**	**-3.70**	**11.14**	**-0.78**	**-1.62**	**0.02**	**-0.89**	**-1.12**	**-0.68**
Continent	**860**	**1,553**	**4.52**	**-0.76**	**10.07**	**-0.85**	**-1.43**	**-0.29**	**-0.99**	**-1.16**	**-0.82**

[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 2019 for which data were received by 10 July, 2019.
[c] Number of routes with at least one year of non-zero data between 1968 and 2019.
[d] 95% credible interval, if the interval overlaps zero, the trend is considered non-significant.
[e] 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, 1968–2019. These indices are based on 1968–2019 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	-----	2.51	2.58	2.35	2.47	2.30	2.28	2.33	1.91	1.93	1.69	1.77	1.74	1.72	1.86	1.67
DE	1.05	0.82	1.04	0.72	0.87	1.03	0.92	1.71	0.46	0.64	0.43	0.50	0.62	0.60	0.57	0.94
MA	-----	3.31	3.31	3.30	3.04	3.20	3.05	2.72	2.66	2.64	2.56	2.62	2.39	2.47	2.27	2.13
MD	1.81	1.81	1.69	1.65	1.57	1.52	1.45	1.41	1.28	1.26	1.24	1.18	1.18	1.13	1.07	0.99
ME	6.40	6.32	6.98	6.34	6.26	6.50	6.76	7.02	6.55	5.52	5.35	5.89	5.08	5.88	4.53	5.06
NB	-----	9.12	8.85	8.05	7.98	7.44	7.93	8.50	6.52	7.86	5.97	6.49	5.32	6.17	6.82	5.69
NH	-----	4.14	4.42	3.86	4.47	3.64	4.26	3.96	3.90	3.93	3.77	3.64	4.06	3.91	3.25	3.35
NJ	4.68	4.49	4.69	5.96	4.32	5.25	4.84	4.00	2.86	2.88	2.38	2.88	2.15	1.99	1.85	1.95
NS	4.29	3.85	3.34	3.92	3.67	3.88	4.03	3.83	3.70	3.70	3.95	3.53	3.50	3.30	3.17	3.40
NY	4.31	4.48	3.94	4.32	4.15	4.24	4.31	3.82	3.92	3.92	3.54	3.87	4.23	4.02	3.69	3.96
PA	1.97	1.86	2.06	1.98	1.94	1.95	1.72	1.76	1.77	1.74	1.68	1.77	1.58	1.57	1.54	1.56
PEI	-----	5.37	5.36	5.98	4.93	4.92	5.15	6.12	5.30	5.05	4.84	4.97	4.16	3.97	4.05	4.57
QUE	-----	-----	6.17	6.04	6.11	5.93	5.95	5.88	5.74	5.70	5.86	5.89	5.82	5.63	5.57	5.61
RI	-----	1.88	1.64	2.05	1.56	1.40	1.14	0.95	0.84	0.74	0.59	0.56	0.49	0.41	0.42	0.35
VA	-----	1.40	1.40	1.20	1.11	0.95	1.17	1.02	0.97	0.94	0.81	0.79	0.68	0.74	0.73	0.62
VT	-----	3.38	4.07	3.67	4.14	3.63	4.01	4.29	4.37	4.54	3.47	3.64	3.47	3.10	2.35	3.07
WV	1.51	1.51	1.41	1.36	1.43	1.35	1.30	1.31	1.25	1.19	1.08	1.17	1.11	1.17	1.11	1.07
Region	**4.11**	**4.19**	**4.16**	**4.06**	**3.99**	**3.93**	**4.01**	**3.96**	**3.68**	**3.69**	**3.42**	**3.57**	**3.38**	**3.44**	**3.25**	**3.27**
Central Region																
IL	-----	-----	0.25	0.47	0.42	0.31	0.44	0.35	0.22	0.30	0.46	0.31	0.24	0.43	0.27	0.79
IN	1.48	1.05	1.03	0.82	1.19	1.07	0.95	0.79	0.81	0.76	0.78	0.96	0.74	0.86	0.59	0.62
MB	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
MI	7.40	7.31	7.36	6.89	6.96	7.24	8.17	8.20	7.79	7.24	7.86	7.73	7.35	6.52	6.94	5.77
MN	-----	2.86	2.82	3.21	3.02	3.46	4.08	3.65	3.74	3.81	4.03	3.71	4.33	3.84	3.78	3.38
OH	-----	-----	1.61	1.47	1.50	1.38	1.49	1.34	1.48	1.41	1.30	1.25	1.26	1.34	1.19	1.23
ON	8.08	9.05	9.58	8.75	9.55	9.24	9.31	8.86	8.99	9.25	9.61	9.76	9.11	8.29	6.95	6.93
WI	3.52	3.57	4.09	3.89	3.87	4.08	4.16	4.25	3.85	4.29	4.44	4.64	3.77	3.22	3.39	3.31
Region	**3.90**	**3.90**	**4.02**	**3.84**	**3.97**	**4.02**	**4.31**	**4.15**	**4.05**	**4.07**	**4.30**	**4.27**	**4.02**	**3.67**	**3.49**	**3.32**
Continent	**4.01**	**4.05**	**4.09**	**3.95**	**3.98**	**3.97**	**4.16**	**4.06**	**3.86**	**3.88**	**3.85**	**3.92**	**3.70**	**3.55**	**3.37**	**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	1.59	1.59	1.63	1.47	1.62	1.35	1.37	1.37	1.28	1.18	1.22	1.27	1.27	1.15	1.12	1.17
DE	0.44	0.46	0.49	0.47	0.44	0.44	0.55	0.28	0.28	0.37	0.35	0.34	0.36	0.35	0.52	0.26
MA	2.23	2.18	2.09	2.07	2.01	1.91	1.86	1.84	1.74	1.69	1.67	1.64	1.59	1.59	1.53	1.63
MD	0.97	0.92	0.87	0.84	0.81	0.79	0.76	0.72	0.67	0.67	0.64	0.61	0.60	0.57	0.53	0.51
ME	5.05	5.22	5.57	5.89	5.45	5.59	4.46	5.04	4.38	4.70	4.34	4.45	3.78	4.07	4.03	4.41
NB	5.32	5.55	4.69	5.13	5.95	7.12	6.06	5.62	5.49	6.54	6.68	6.15	5.40	6.04	6.04	6.89
NH	3.28	3.41	4.46	3.68	3.56	3.46	3.19	3.46	3.11	3.11	3.14	3.55	3.43	3.40	3.32	3.58
NJ	2.01	1.85	1.65	1.89	1.43	1.37	1.30	1.13	1.06	0.93	0.80	0.93	0.88	0.69	0.75	0.79
NS	3.23	3.39	3.49	3.11	3.36	3.33	3.11	3.35	3.37	3.41	3.10	3.25	3.30	3.09	3.17	3.49
NY	3.51	3.94	3.64	3.54	3.82	3.40	3.82	3.83	3.59	3.52	3.14	3.29	3.12	3.20	3.24	3.31
PA	1.62	1.54	1.61	1.54	1.50	1.47	1.58	1.74	1.47	1.56	1.34	1.49	1.46	1.41	1.56	1.45
PEI	4.57	4.50	4.75	4.03	4.52	4.70	4.17	3.97	4.02	3.84	3.63	3.83	4.16	3.99	3.80	3.54
QUE	5.50	5.44	5.41	5.44	5.52	5.56	5.33	5.22	5.21	5.30	5.21	5.02	4.84	4.88	5.07	4.98
RI	0.31	0.25	0.22	0.20	0.17	0.15	0.13	0.12	0.10	0.09	0.08	0.07	0.06	0.05	0.05	0.04
VA	0.83	0.51	0.55	0.53	0.47	0.43	0.45	0.41	0.43	0.39	0.36	0.31	0.30	0.32	0.27	0.28
VT	3.02	2.79	2.99	3.42	3.67	3.55	3.32	3.42	2.52	2.86	2.74	2.70	2.62	2.67	2.98	3.43
WV	1.04	1.00	0.99	0.97	0.94	0.92	0.93	0.87	0.87	0.84	0.83	0.85	0.79	0.79	0.75	0.75
Region	**3.17**	**3.21**	**3.17**	**3.18**	**3.26**	**3.28**	**3.10**	**3.13**	**2.95**	**3.08**	**2.93**	**2.93**	**2.75**	**2.82**	**2.87**	**3.00**
Central Region																
IL	0.39	0.74	0.60	1.07	0.33	0.52	0.27	0.55	0.34	0.47	0.29	0.22	0.27	0.22	0.27	0.35
IN	0.60	0.56	0.66	0.62	0.56	0.49	0.63	0.59	0.56	0.46	0.44	0.41	0.38	0.37	0.45	0.40
MB	-----	-----	-----	-----	-----	-----	-----	-----	5.57	5.60	5.85	6.14	5.36	3.88	4.71	4.63
MI	6.53	6.68	6.97	6.52	6.94	6.75	6.76	7.42	5.79	5.91	5.20	5.82	5.52	5.34	6.33	5.32
MN	3.28	3.67	3.83	3.88	4.28	3.55	4.25	4.09	3.50	3.58	3.24	3.37	3.26	2.95	3.43	3.54
OH	1.25	1.16	1.15	1.13	1.19	1.04	1.26	1.15	1.14	1.08	1.07	1.03	1.05	0.93	1.04	0.92
ON	7.01	7.82	8.02	7.87	7.97	8.00	7.57	7.69	7.17	6.91	5.92	6.48	5.30	5.99	6.25	5.74
WI	3.62	3.57	4.07	4.14	3.85	3.93	3.74	3.78	3.07	3.23	2.84	2.95	2.89	2.78	2.96	3.35
Region	**3.43**	**3.66**	**3.82**	**3.82**	**3.79**	**3.68**	**3.68**	**3.82**	**3.24**	**3.26**	**2.86**	**3.06**	**2.82**	**2.80**	**3.14**	**2.96**
Continent	**3.30**	**3.43**	**3.50**	**3.50**	**3.52**	**3.48**	**3.39**	**3.48**	**3.10**	**3.17**	**2.90**	**2.99**	**2.78**	**2.81**	**3.01**	**2.98**

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	0.94	0.95	0.92	0.89	0.84	0.85	0.85	0.82	0.80	0.86	0.85	0.77	0.78	0.72
DE	0.37	0.24	0.26	0.24	0.24	0.24	0.19	0.18	0.19	0.19	0.18	0.17	0.17	0.15	0.14	0.15
MA	1.51	1.43	1.42	1.37	1.41	1.29	1.28	1.21	1.25	1.21	1.15	1.11	1.06	1.04	1.02	1.04
MD	0.51	0.51	0.46	0.45	0.43	0.41	0.41	0.38	0.37	0.35	0.34	0.32	0.32	0.30	0.29	0.28
ME	4.58	4.06	3.77	4.09	4.20	4.28	4.17	3.80	3.86	3.73	4.04	4.11	4.10	4.03	3.84	3.45
NB	6.47	6.74	6.45	7.05	7.01	7.72	6.94	6.33	6.08	5.46	7.18	6.70	7.32	6.82	6.40	5.68
NH	3.01	3.12	3.07	3.40	3.41	3.36	3.09	2.53	2.59	3.12	3.11	2.70	3.06	2.96	3.08	2.64
NJ	0.69	0.64	0.54	0.58	0.45	0.41	0.41	0.42	0.36	0.41	0.26	0.32	0.35	0.31	0.28	0.21
NS	3.45	3.27	3.04	3.02	3.26	3.11	2.97	2.96	2.85	2.85	3.23	2.87	3.23	3.48	3.23	2.76
NY	3.15	3.08	3.02	3.16	3.38	3.13	3.22	3.01	2.90	3.14	3.37	3.11	3.22	3.22	3.04	3.27
PA	1.20	1.40	1.38	1.37	1.40	1.43	1.31	1.28	1.41	1.40	1.49	1.30	1.18	1.12	1.26	1.24
PEI	3.80	3.57	3.07	3.17	3.18	3.30	3.51	3.39	2.93	3.11	2.92	3.09	3.40	3.02	3.45	2.97
QUE	4.81	4.81	4.73	4.76	4.74	4.82	4.61	4.57	4.50	4.56	4.51	4.46	4.37	4.53	4.35	4.31
RI	0.04	0.03	0.03	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	----	----	----
VA	0.26	0.22	0.21	0.22	0.21	0.19	0.18	0.17	0.17	0.14	0.14	0.15	0.13	0.14	0.12	0.10
VT	3.48	2.79	2.54	2.74	2.79	2.96	2.94	2.56	2.37	2.51	2.61	2.47	2.66	2.46	2.21	2.21
WV	0.74	0.70	0.68	0.69	0.65	0.63	0.63	0.62	0.62	0.60	0.58	0.59	0.58	0.54	0.54	0.51
Region	**2.87**	**2.82**	**2.72**	**2.83**	**2.88**	**2.91**	**2.79**	**2.63**	**2.59**	**2.59**	**2.81**	**2.68**	**2.74**	**2.71**	**2.61**	**2.49**
Central Region																
IL	0.27	0.33	0.25	0.58	0.62	0.18	0.39	0.19	0.19	0.17	0.20	0.17	0.11	0.11	0.13	0.24
IN	0.35	0.39	0.30	0.29	0.34	0.34	0.28	0.27	0.26	0.26	0.28	0.23	0.24	0.22	0.22	0.20
MB	5.00	5.06	4.22	4.99	4.63	5.48	4.76	4.99	4.76	5.02	5.07	5.86	5.54	4.84	4.82	5.41
MI	5.67	5.28	5.42	5.58	5.63	5.50	5.10	5.03	4.72	4.72	4.86	5.29	5.40	5.63	5.38	5.46
MN	4.03	3.67	3.10	3.17	3.28	3.63	3.50	3.55	3.20	3.50	4.09	4.06	3.94	3.47	2.99	3.89
OH	0.94	0.93	0.90	0.87	1.06	0.97	0.95	0.78	0.82	0.93	0.90	0.90	0.87	0.87	0.81	0.86
ON	6.88	6.02	6.18	5.50	5.93	6.25	6.00	6.29	5.38	5.15	4.86	5.41	5.51	5.22	5.11	4.97
WI	3.15	3.07	2.63	2.83	2.89	3.23	3.00	3.45	2.97	3.01	3.07	3.36	3.47	3.49	2.77	3.16
Region	**3.21**	**2.97**	**2.84**	**2.86**	**2.99**	**3.03**	**2.90**	**2.95**	**2.65**	**2.67**	**2.75**	**2.93**	**2.95**	**2.89**	**2.64**	**2.84**
Continent	**3.04**	**2.89**	**2.78**	**2.85**	**2.94**	**2.98**	**2.84**	**2.79**	**2.62**	**2.63**	**2.78**	**2.80**	**2.85**	**2.80**	**2.63**	**2.67**

Table 2. Continued

State, Province, or Region	Year			
	2016	2017	2018	2019
Eastern Region				
CT	0.73	0.71	0.70	0.64
DE	0.14	0.13	0.12	0.12
MA	1.00	0.94	0.91	0.90
MD	0.27	0.26	0.25	0.24
ME	3.95	3.25	3.01	3.42
NB	6.17	4.88	4.36	5.55
NH	2.78	2.41	2.38	2.27
NJ	0.23	0.21	0.19	0.16
NS	2.98	2.83	2.77	2.92
NY	3.15	3.27	2.77	2.90
PA	1.26	1.23	1.20	1.18
PEI	2.60	3.02	2.73	2.64
QUE	4.34	4.31	4.17	4.08
RI	0.00	----	0.00	0.00
VA	0.10	0.10	0.09	0.09
VT	2.60	2.30	2.43	2.04
WV	0.51	0.51	0.48	0.48
Region	**2.59**	**2.40**	**2.24**	**2.36**
Central Region				
IL	0.14	0.17	0.15	0.15
IN	0.21	0.19	0.20	0.17
MB	5.23	6.23	5.10	5.38
MI	5.17	5.22	3.94	4.42
MN	4.46	4.55	3.90	3.65
OH	0.80	0.72	0.73	0.79
ON	4.90	4.96	4.24	4.10
WI	3.14	3.51	2.75	3.08
Region	**2.84**	**2.92**	**2.39**	**2.47**
Continent	**2.71**	**2.66**	**2.31**	**2.42**

Table 3. The number of U.S. hunters by state that submitted woodcock wings for the 2017-18 and 2018-19 Wing-collection Surveys.

State of residence	Number of Hunters who submitted woodcock wings[a]	
	2017-18 Season	2018-19 Season
Alabama	1	2
Arkansas	1	2
Connecticut	20	14
Delaware	1	4
Florida	0	0
Georgia	4	4
Illinois	3	0
Indiana	12	12
Iowa	3	4
Kansas	0	0
Kentucky	5	6
Louisiana	10	11
Maine	93	101
Maryland	12	9
Massachusetts	35	22
Michigan	233	210
Minnesota	110	100
Mississippi	1	1
Missouri	14	7
Nebraska	0	0
New Hampshire	54	49
New Jersey	13	13
New York	82	73
North Carolina	8	8
North Dakota	0	0
Ohio	10	10
Oklahoma	0	0
Pennsylvania	51	48
Rhode Island	2	6
South Carolina	9	8
Tennessee	3	4
Texas	3	2
Vermont	46	43
Virginia	20	18
West Virginia	18	14
Wisconsin	165	181
Total	**1,042**	**986**

[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 2018 were weighted by the relative contribution of each state to the cumulative number of adult female and immature wings received during 1963–2017.

State or Region of harvest	Wings received						Recruitment index	
	Total		Adult females		Immatures			
	1963-17	2018	1963-17	2018	1963-17	2018	1963-17	2018
Eastern Region								
CT	15,609	144	3,499	34	9,498	90	2.7	2.6
DE	533	10	83	2	365	6	4.4	----
FL	678	0	153	0	422	0	2.8	----
GA	3,394	34	1,068	8	1,439	14	1.3	----
ME	91,282	739	27,025	207	45,529	379	1.7	1.8
MD	5,072	45	1,240	10	2,883	29	2.3	----
MA	25,816	160	8,080	59	12,461	66	1.5	1.1
NH	38,520	318	12,550	86	17,809	145	1.4	1.7
NJ	27,688	170	6,392	43	16,379	103	2.6	2.4
NY	65,857	542	22,325	205	29,693	229	1.3	1.1
NC	4,547	81	1,462	30	2,150	33	1.5	----
PA	34,395	205	10,931	63	15,840	103	1.4	1.6
RI	2,480	8	480	2	1,641	6	3.4	----
SC	4,160	115	1,337	39	1,854	50	1.4	----
VT	29,928	367	9,860	110	13,604	189	1.4	1.7
VA	6,534	174	1,717	34	3,525	122	2.1	3.6
WV	6,648	57	2,011	16	3,319	27	1.7	----
Region	**363,141**	**3,169**	**110,213**	**948**	**178,411**	**1,591**	**1.62**	**1.71**
Central Region								
AL	1,018	10	284	2	463	6	1.6	----
AR	566	11	183	4	232	3	1.3	----
IL	1,518	0	358	0	851	0	2.4	----
IN	8,794	90	2,247	21	4,865	46	2.2	----
IA	1,392	7	451	2	621	4	1.4	----
KS	50	0	9	0	26	0	----	----
KY	1,286	33	336	6	644	17	1.9	----
LA	34,071	182	7,664	54	21,995	103	2.9	1.9
MI	147,350	1,900	48,564	640	71,719	943	1.5	1.5
MN	46,331	1,088	16,557	417	19,721	428	1.2	1.0
MS	1,996	2	564	0	1,006	2	1.8	----
MO	4,712	67	1,286	16	2,267	40	1.8	----
NE	13	0	5	0	6	0	----	----
ND	4	0	3	0	1	0	----	----
OH	15,495	76	4,772	22	7,276	38	1.5	----
OK	174	0	38	0	92	0	2.4	----
TN	1,371	9	367	3	698	3	1.9	----
TX	1,084	26	309	13	535	6	1.7	----
WI	97,869	1,920	33,303	723	45,664	923	1.4	1.3
Region	**365,094**	**5,421**	**117,300**	**1,923**	**178,682**	**2,562**	**1.52**	**1.40**

Table 5. Preliminary estimates of woodcock harvest, hunter numbers, days afield, and hunter success from the 2018–19 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	900	300	600	200	2,100	500	1.41	0.54
DE	100	0	100	100	500	300	0.57	0.51
FL	200	200	100	100	300	300	3.00	4.21
GA	4,100	2,500	4,400	2,900	8,000	4,800	0.91	0.82
MA	3,500	1,000	1,400	300	8,100	1,800	2.47	0.82
MD	1,500	1,300	800	700	900	700	1.99	2.45
ME	9,700	1,400	3,800	900	17,200	3,300	2.54	0.71
NC	6,000	3,700	3,400	2,800	13,700	11,200	1.76	1.79
NH	5,400	1,100	2,000	300	8,500	1,200	2.68	0.73
NJ	2,900	1,100	900	300	2,900	900	3.18	1.65
NY	5,100	1,700	3,400	1,000	17,200	9,000	1.50	0.68
PA	4,000	1,600	1,500	400	6,300	2,300	2.67	1.26
RI	200	100	100	100	700	300	1.48	1.00
SC	1,200	500	1,900	1,600	2,800	1,600	0.65	0.61
VA	2,200	700	2,700	1,100	5,300	2,000	0.83	0.43
VT	2,200	500	900	100	4,300	600	2.47	0.60
WV	300	100	100	0	400	100	2.69	0.75
Region	**49,600**	**5,800**	**28,300[a]**	**na[a]**	**99,200**	**16,100**	**na[b]**	**na[b]**
Central Region								
AL	200	200	200	100	500	200	1.29	0.97
AR	10,100	9,400	2,500	2,400	7,700	7,100	4.09	5.47
IA	0	0	100	0	0	0	0.00	0.00
IL	0	0	<100	<100	100	100	0.00	0.00
IN	200	100	100	<100	200	100	1.75	1.40
KS	100	100	100	0	200	0	1.50	1.47
KY	300	100	100	<100	300	100	3.80	2.56
LA	10,600	6,100	5,200	2,200	11,100	5,300	2.03	1.45
MI	59,600	10,400	29,300	3,700	135,800	31,900	2.03	0.44
MN	22,500	3,900	10,400	2,100	41,500	9,700	2.16	0.57
MO	200	100	100	100	200	200	2.00	1.88
MS	400	300	100	0	400	200	4.25	3.30
NE	0	0	<100	0	0	0	0.00	0.00
OH	600	400	500	100	800	300	1.25	0.85
OK	100	100	<100	0	600	600	3.00	4.16
TN	300	200	200	100	600	300	1.67	1.61
TX	0	0	100	0	0	0	0.00	0.00
WI	25,500	4,300	10,800	2,100	45,900	9,300	2.35	0.60
Region	**130,600**	**16,400**	**59,500[a]**	**na[a]**	**246,000**	**35,800**	**na[b]**	**na[b]**
Total	**180,200**	**17,400**	**87,800[a]**	**na[a]**	**345,100**	**39,300**	**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.

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 22nd for the 2018–19 season, and is September 21st for the 2019–20 season.

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

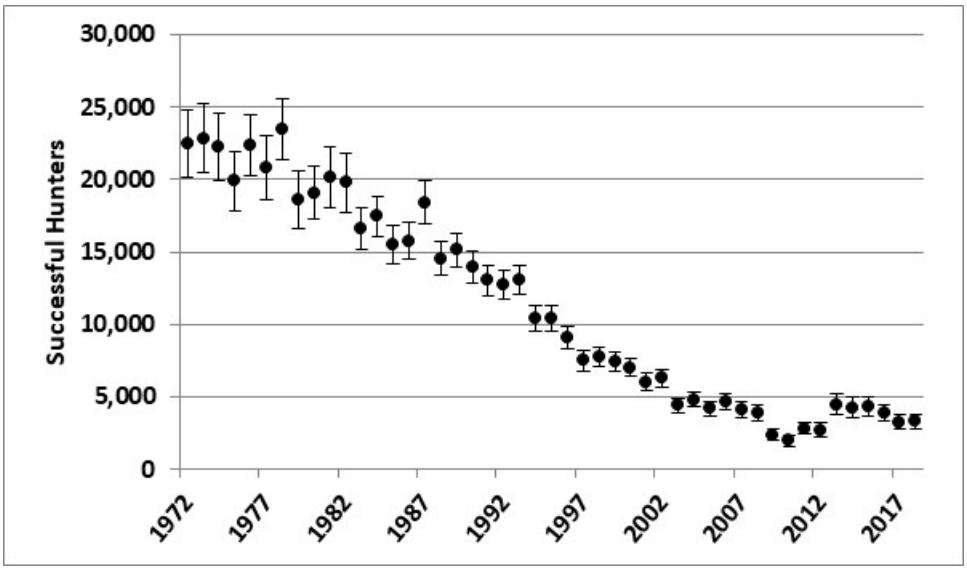

Fig. B1. Estimated number of successful woodcock hunters in Canada and associated 95% confidence intervals, 1972–2018.

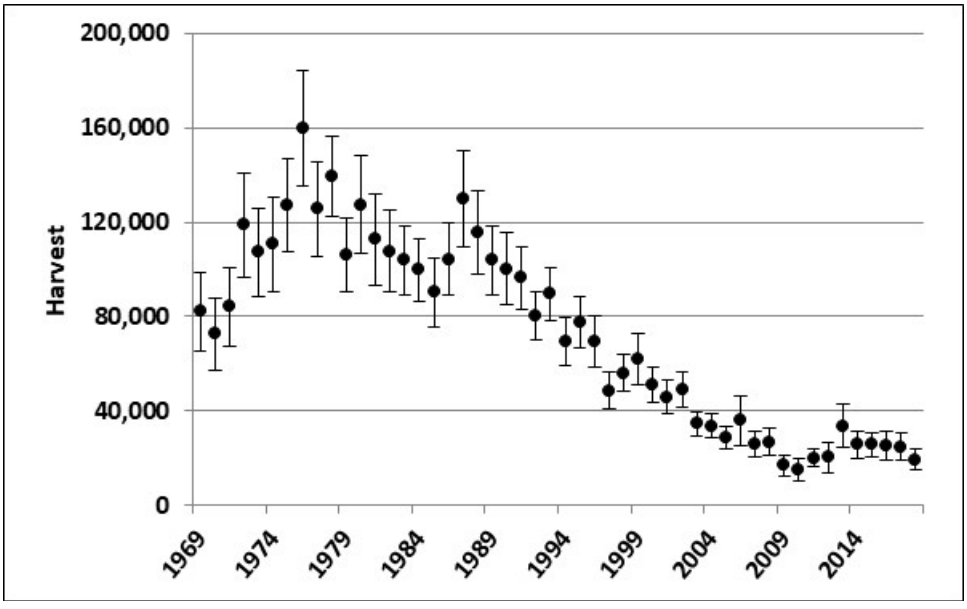

Fig. B2. Estimated woodcock harvest in Canada and associated 95% confidence intervals, 1969–2018.

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