U.S. Fish & Wildlife Service

American Woodcock

Population Status, 2017

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U.S. Fish and Wildlife Service
Division of Migratory Bird Management
Population and Habitat Assessment Branch
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AMERICAN WOODCOCK POPULATION STATUS, 2017

MARK E. SEAMANS, U.S. Fish and Wildlife Service, Division of Migratory Bird Management, 755 Parfet St, Suite 235, Lakewood, CO 80215 (mark_seamans@fws.gov).

REBECCA D. RAU, U.S. Fish and Wildlife Service, Division of Migratory Bird Management, Patuxent Wildlife Research Center, 11510 American Holly Dr., Laurel, MD 20708-4002 (rebecca_rau@fws.gov).

Abstract: The American Woodcock (*Scolopax minor*) Singing-ground Survey data for 2017 indicate that the index for singing males was significantly less than in 2016 in the Eastern Management Region, and not significantly different from 2016 in the Central Management Region. The Eastern Management Region had a significant, declining 10-year (2007-2017) trend of -0.89%/year. The 10-year trend in the Central Management Region was not significant. Both regions have a significant, long-term (1968-17) negative trend (-1.05%/year for the Eastern Management Region and -0.56%/year for the Central Management Region). The 2016 recruitment index for the U.S. portion of the Eastern Region (1.42 immatures per adult female) was 2.9% more than the 2015 index and 12.3% less than the long-term regional average, while the recruitment index for the U.S. portion of the Central Region (1.32 immatures per adult female) was 10.9% more than the 2015 index and was 14.3% less than the long-term regional average. Estimates from the Harvest Information Program indicated that U.S. woodcock hunters in the Eastern Region spent 96,100 days afield and harvested 44,400 woodcock during the 2016-17 season, while in the Central Region hunters spent 300,200 days afield and harvested 158,000 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 increase populations of woodcock to levels consistent with the demands of consumptive and non-consumptive users (U.S. Fish and Wildlife Service 1990). 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 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 2017. 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 surveys, 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

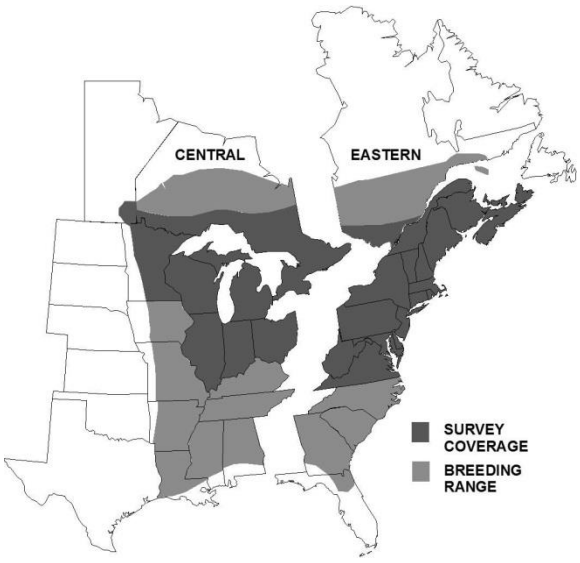

Fig. 1. Woodcock management regions, breeding range, and Singing-ground Survey coverage.

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 are selected for survey each year. The remaining routes are carried as "constant zero" routes. Routes for which no woodcock are heard for 2 consecutive years enter this constant zero status and are not run for the next 5 years. If woodcock are heard on a constant zero route during its next survey, the route reverts to normal status and is surveyed again each year. Data from constant zero routes are 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 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 is 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 are treated as random and are assumed to follow distributions that are governed by additional parameters. The hierarchical model is fit using Bayesian methods. Markov-chain Monte Carlo methods are used to iteratively produce sequences of parameter estimates which can be 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 be estimated from the replicates. Annual indices are defined as exponentiated strata, underlying trend, and year effects, which are then weighted by the proportion of routes where at least 1 woodcock was observed between 1968 and the present. Trends are 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 are expressed as percent change per year, while indices are 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 (2016-17), 10-year (2007-17) and long-term (1968-2017) trends were evaluated for each region as well as for each state or province.
Credible Intervals are used to describe uncertainty around the estimates when fitting hierarchical models. If the CI does not overlap 0 for a trend estimate, the trend is considered significant. We present the median and 95% CIs of 10,000 estimates (i.e., we simulated 10,000 replicates and thinned by 2), which were calculated after an initial 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, which includes any route on which woodcock were ever encountered. Each route was to be surveyed during the peak time of daily singing activity. For editing purposes, "acceptable" times were between 22 and 58 minutes after sunset (or, between 15 and 51 minutes after sunset on overcast evenings). Due to observer error, 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. Therefore, only route observations with at least 9 acceptable stops were included in the analysis. Routes for which data were received after 30 June 2017 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 2016 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 bagged. 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 2016 recruitment index for each state with $\geq$ 125 submitted wings was calculated as the number of immatures per adult female. The regional indices for 2016 were weighted by the relative contribution of each state to the cumulative number of adult female and immature wings received during 1963-2015.

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). In the past, the annual FWS migratory bird harvest survey (Mail Questionnaire Survey) was based on a sampling frame that consisted solely of hunters who purchased a federal duck stamp. However, people that hunt only non-waterfowl species such as woodcock and doves were not required to purchase a duck stamp, and therefore were not included in that sampling frame. The HIP sampling frame consists of all migratory game bird hunters, thus providing more reliable estimates of woodcock hunter numbers and harvest than we have had in the past. 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 for woodcock since 1999. Although estimates from 1999-2002 have been finalized, the estimates from 2003-16 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 2016).

RESULTS AND DISCUSSION

Singing-ground Survey

Data for 814 routes were submitted by 30 June 2017 (Table 1). Short-term analysis indicated that the number of woodcock heard singing during the 2017 Singing-ground Survey declined from last year for the Eastern Management Region, and remained stationary for the 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 (2007-2017) showed a significant decline for the Eastern Management Region, while there was no significant trend for the Central Management Region. (Table 1, Fig. 2).

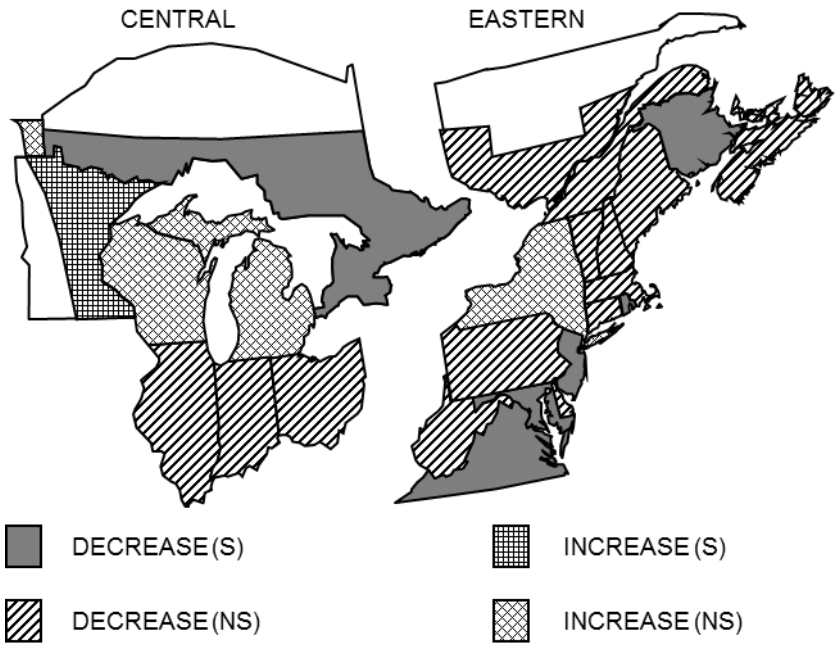

Fig. 2. Ten-year trends in the number of American woodcock heard on the Singing-ground Survey, 2007-2017, as determined by the hierarchical modeling method. A significant trend (S) does not include zero in the 95% credible interval, while a non-significant (NS) trend does include zero. Note, Minnesota is the only state or province that had a significant increase.

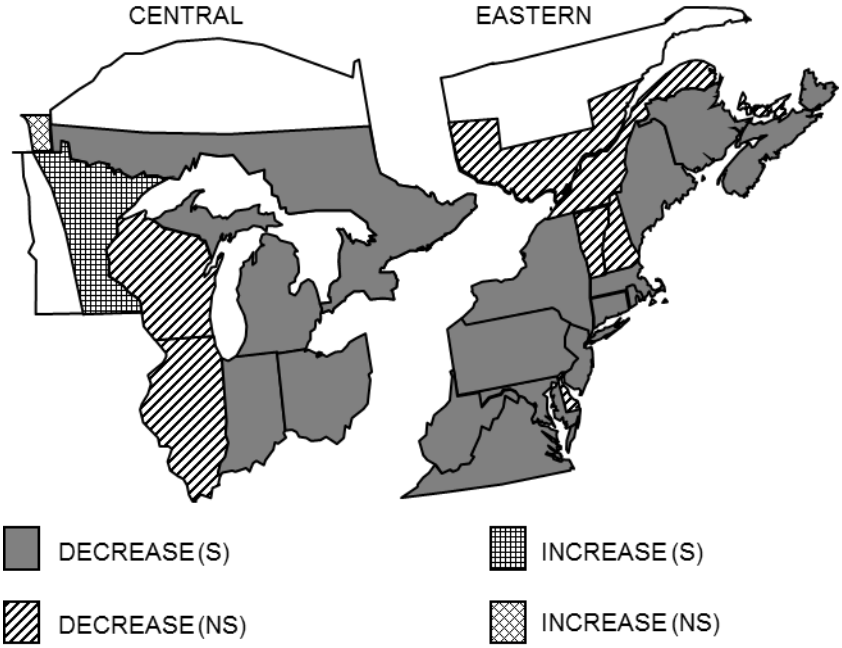

Fig. 3. Long-term trends in the number of American woodcock heard on the Singing-ground Survey, 1968-2017, as determined by the hierarchical modeling method. A significant trend (S) does not include zero in the 95% credible interval, while a non-significant (NS) trend does include zero. Note, Minnesota is the only state or province that had a significant long-term increase.

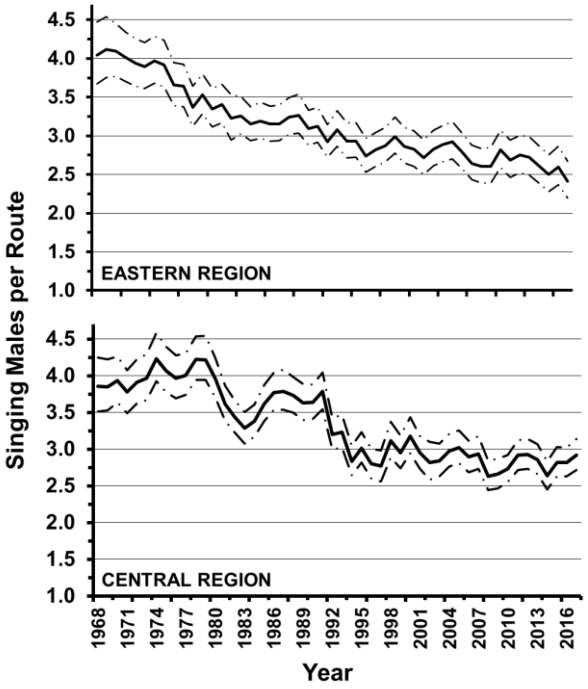

Fig. 4. Annual indices of the number of woodcock heard during the Singing-ground Survey, 1968-2017 as estimated using hierarchical modeling. The dashed lines represent the 95% credible interval of the estimate.

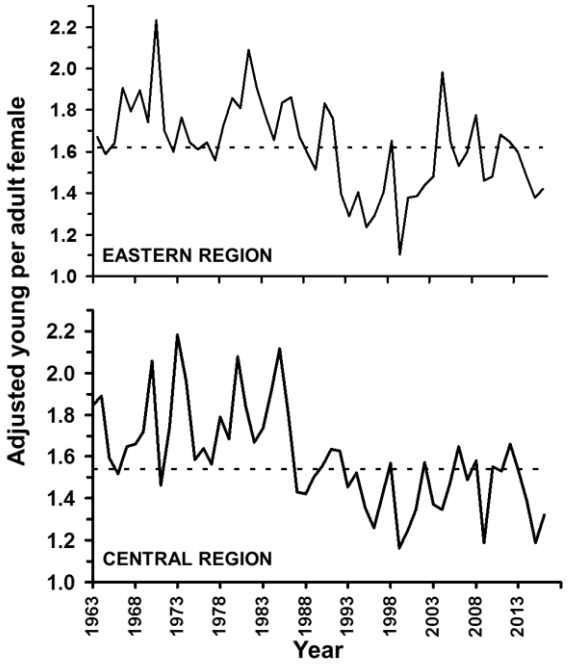

Fig. 5. Weighted annual indices of recruitment (U.S.), 1963-2016. The dashed line is the 1963-2015 average.

Many states and/or provinces in both management regions have experienced significant long-term (1968-2017) declines as measured by the Singing-ground Survey (Table 1, Fig. 3). The long-term trend estimate, rounded to the nearest hundredth of a percent, was -1.05%/year for the Eastern Management Region, while it was -0.56%/year for the Central Management Region (Table 1).

In the Eastern Region, the 2017 index was 2.41 singing males per route, while it was 2.92 in the Central Management Region (Figure 4, Table 2). Annual indices (1968-2017) by state, province, or region are available in Table 2.

Wing-collection Survey

A total of 1,110 woodcock hunters (Table 3) from states with a woodcock season sent in a total of 11,330 usable woodcock wings for the 2016 Wing-collection Survey (Table 4).

The 2016 recruitment index in the U.S. portion of the Eastern Region (1.42 immatures per adult female) was 2.9% more than the 2015 index of 1.38, and 12.3% less than the long-term (1963-15) regional average of 1.62 (Table 4, Fig 5). In the Central Region, the 2016 recruitment index (1.32 immatures per adult female) was 10.9% greater than the 2015 index of 1.19 and was 14.3% less than the long-term regional average of 1.54 (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 2016-17 HIP survey are provided in Table 5. In the Eastern Management Region, woodcock hunters spent an estimated 96,100 days afield (Figure 6) and harvested 44,400 birds (Figure 7) during the 2016-17 hunting season. Harvest in 2016-17 was 45.9% less than the long-term (1999-2015) average (82,047 birds/year) and 18.5% less than last year (54,500 birds) in the Eastern Region. Woodcock hunters in the Central Region spent an estimated 300,200 days afield (Figure 6) and harvested 158,000 birds (Figure 7) during the 2016-17 hunting season. Harvest in 2016-17 was 26.0% less than the long-term (1999-2015) average (213,400 birds/year) and 8.4% more than last year (145,700 birds) in the Central Region.

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

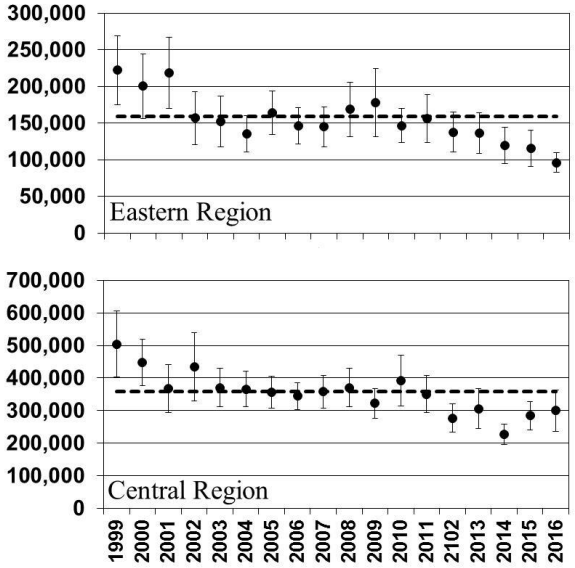

Fig. 6. Harvest Information Program Survey estimates of days spent afield by U.S. woodcock hunters, 1999-2016. The dashed line represents the 1999-2015 average and error bars represent the 95% confidence interval of the point estimate.

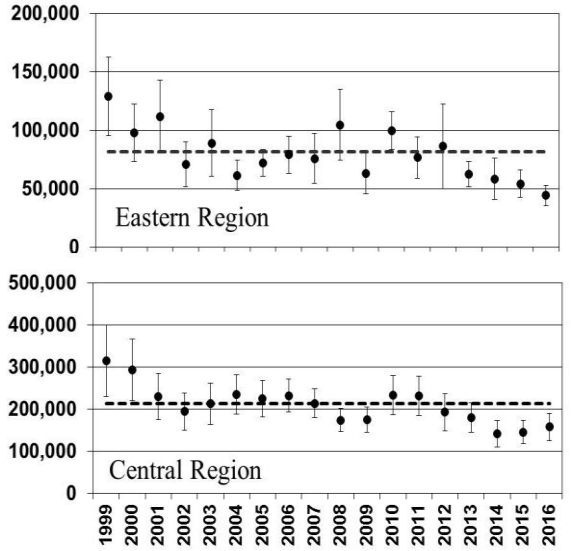

Fig. 7. Harvest Information Program Survey estimates of U.S. woodcock harvest, 1999-2016. The dashed line represents the 1999-2015 average and the error bars represent the 95% confidence interval of the point estimate.

basis. All estimates have been rounded to the nearest hundred.

Data from Canada show a long-term decline in both the number of successful woodcock hunters and harvest (Appendix B). The most recent data available indicate that an estimated 3,862 successful hunters harvested 25,173 woodcock during the 2016 season in Canada (Gendron and Smith 2017; Appendix B).

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computer programs for calculating trends and indices from Singing-ground Survey data and conducted this year's analyses for the survey. G. Zimmerman, P. Devers, reviewed a draft of parts or all of this report and provided helpful comments.

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Table 1. Short-term (2016-17), 10-year (2007-2017), and long-term (1968-2017) trends (% change per year[a]) in the number of American woodcock heard during the Singing-ground Survey as determined by using the hierarchical log-linear modeling technique (Sauer et al. 2008).

State, Province, or Region	Number of routes[b]	2016-2017				2007-2017			1968-2017		
				95% CI[d]			95% CI[d]			95% CI[d]	
		n[c]	% change	lower	upper	% change	lower	upper	% change	lower	upper
CT	3	11	-2.47	-38.61	55.51	-1.68	-5.57	4.51	-2.49	-4.29	-0.61
DE	1	3	-5.97	-89.40	567.29	-3.20	-20.47	19.73	-3.65	-9.09	1.42
ME	50	73	-16.03	-31.09	1.05	-1.58	-3.54	0.35	-1.36	-1.86	-0.86
MD	7	26	-2.78	-24.68	33.85	-3.73	-6.37	-0.45	-3.78	-5.15	-2.31
MA	9	22	-5.01	-29.84	18.54	-2.45	-5.06	0.35	-2.52	-3.50	-1.53
NB	55	72	-21.97	-36.54	-3.80	-2.83	-4.95	-0.71	-1.35	-2.13	-0.58
NH	12	18	-10.34	-36.71	17.90	-0.35	-3.37	2.86	-0.77	-1.79	0.21
NJ	9	19	-7.24	-48.84	64.38	-6.48	-12.05	-0.91	-6.02	-7.52	-4.52
NY	81	115	3.34	-11.30	20.76	0.89	-0.78	2.80	-0.55	-0.98	-0.10
NS	43	63	-5.09	-23.03	14.95	-0.39	-2.51	1.86	-0.90	-1.62	-0.25
PA	27	82	-2.08	-23.42	24.78	-0.58	-2.91	2.29	-1.03	-1.74	-0.32
PEI	9	13	12.33	-14.27	76.51	-1.05	-4.44	2.57	-1.08	-2.24	0.20
QUE	10	111	-0.92	-16.07	16.41	-0.48	-2.10	1.34	-0.59	-1.34	0.15
RI[e]	0	3	-----	-----	-----	-12.02	-21.77	-1.11	-11.78	-17.70	-6.01
VT	16	24	-10.93	-37.34	21.03	-1.04	-4.41	2.54	-0.83	-1.76	0.15
VA	20	75	0.65	-34.37	66.74	-5.53	-9.90	-1.16	-5.51	-6.58	-4.45
WV	25	57	-0.15	-18.71	29.87	-2.01	-4.13	0.71	-2.18	-2.98	-1.36
Eastern	**377**	**787**	**-7.09**	**-13.80**	**-0.11**	**-0.89**	**-1.67**	**-0.08**	**-1.05**	**-1.32**	**-0.76**
IL	14	47	21.11	-58.21	247.13	-1.63	-12.38	10.33	-0.89	-3.51	2.07
IN	11	62	-3.57	-43.05	62.19	-3.05	-7.82	2.76	-4.06	-5.30	-2.88
MB[f]	17	30	22.85	-7.70	71.45	2.56	-0.95	6.87	0.48	-1.13	2.21
MI	119	155	1.30	-10.50	14.37	0.30	-1.02	1.72	-0.70	-1.06	-0.34
MN	74	122	1.76	-12.40	19.30	2.56	0.82	4.35	0.94	0.37	1.56
OH	33	73	-9.84	-32.61	13.74	-0.54	-2.96	2.75	-1.65	-2.42	-0.93
ON	92	163	1.60	-11.85	17.90	-2.12	-3.88	-0.42	-0.85	-1.29	-0.39
WI	77	122	15.70	-1.60	36.56	0.37	-1.47	2.26	-0.01	-0.49	0.50
Central	**437**	**744**	**3.64**	**-3.50**	**11.37**	**-0.05**	**-0.88**	**0.79**	**-0.56**	**-0.79**	**-0.33**
Continent	**814**	**1,531**	**-1.53**	**-6.46**	**3.64**	**-0.44**	**-1.01**	**0.14**	**-0.80**	**-0.98**	**-0.61**

[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 2017 for which data were received by 30 June, 2017.
[c] Number of routes with at least one year of non-zero data between 1968 and 2017.
[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, 1968-2017. These indices are based on 1968-2017 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	-----	2.49	2.61	2.34	2.49	2.31	2.31	2.36	1.88	1.91	1.62	1.65	1.71	1.71	1.91	1.73
DE	1.04	0.85	1.03	0.72	0.88	1.03	0.92	1.77	0.48	0.66	0.48	0.53	0.66	0.63	0.61	1.00
ME	6.23	6.22	6.88	6.25	6.17	6.50	6.65	6.93	6.44	5.44	5.28	5.75	4.99	5.78	4.46	4.96
MD	1.83	1.82	1.70	1.66	1.58	1.53	1.47	1.42	1.30	1.28	1.25	1.20	1.20	1.14	1.08	1.01
MA	-----	3.35	3.38	3.36	3.06	3.26	3.10	2.75	2.70	2.69	2.61	2.67	2.42	2.52	2.32	2.17
NB	-----	8.97	8.73	7.96	7.92	7.44	7.89	8.45	6.56	7.87	5.92	6.45	5.33	6.15	6.79	5.73
NH	-----	3.88	4.14	3.67	4.18	3.49	4.01	3.76	3.74	3.78	3.60	3.55	3.91	3.78	3.23	3.35
NJ	4.62	4.42	4.65	5.94	4.28	5.25	4.82	3.96	2.84	2.85	2.36	2.86	2.13	1.99	1.84	1.95
NY	4.26	4.43	3.89	4.28	4.10	4.21	4.27	3.79	3.87	3.87	3.42	3.87	4.20	3.97	3.62	3.92
NS	4.25	3.77	3.26	3.84	3.60	3.80	3.97	3.73	3.65	3.62	3.85	3.44	3.42	3.21	3.06	3.30
PA	1.96	1.86	2.04	1.97	1.92	1.94	1.72	1.73	1.76	1.73	1.67	1.74	1.58	1.58	1.53	1.55
PEI	-----	5.25	5.30	5.80	4.90	4.87	5.08	5.94	5.17	4.98	4.78	4.89	4.20	4.02	4.10	4.54
QUE	-----	-----	-----	5.92	6.00	5.82	5.86	5.79	5.72	5.60	5.81	5.85	5.79	5.61	5.56	5.61
RI	-----	1.99	1.72	2.11	1.63	1.47	1.19	1.02	0.89	0.80	0.64	0.60	0.54	0.44	0.46	0.39
VT	-----	3.35	3.99	3.61	4.10	3.56	3.94	4.23	4.33	4.47	3.40	3.56	3.39	3.04	2.31	3.02
VA	-----	1.40	1.39	1.20	1.11	0.93	1.16	1.02	0.96	0.92	0.80	0.78	0.67	0.73	0.72	0.65
WV	1.49	1.51	1.40	1.35	1.42	1.34	1.29	1.30	1.25	1.18	1.07	1.16	1.10	1.17	1.10	1.06
Region	**4.04**	**4.12**	**4.10**	**4.01**	**3.94**	**3.89**	**3.97**	**3.92**	**3.66**	**3.65**	**3.37**	**3.53**	**3.35**	**3.41**	**3.23**	**3.26**
Central Region																
IL	-----	-----	0.24	0.47	0.42	0.30	0.43	0.34	0.21	0.30	0.46	0.31	0.23	0.43	0.27	0.82
IN	1.48	1.08	1.03	0.84	1.19	1.07	0.96	0.80	0.82	0.76	0.78	0.94	0.74	0.84	0.60	0.62
MB	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
MI	7.34	7.22	7.23	6.85	6.91	7.21	8.03	8.04	7.63	7.16	7.76	7.70	7.26	6.46	6.73	5.76
MN	-----	2.81	2.76	3.12	2.96	3.38	4.01	3.58	3.67	3.75	3.98	3.66	4.23	3.80	3.74	3.29
OH	-----	-----	1.58	1.48	1.52	1.39	1.48	1.31	1.49	1.42	1.29	1.23	1.25	1.34	1.17	1.20
ON	7.92	8.81	9.32	8.51	9.29	8.99	9.09	8.66	8.78	9.01	9.32	9.59	8.93	8.15	6.93	6.92
WI	3.45	3.50	4.05	3.86	3.81	4.04	4.10	4.19	3.78	4.24	4.41	4.58	3.70	3.14	3.35	3.22
Region	**3.85**	**3.83**	**3.94**	**3.78**	**3.91**	**3.96**	**4.23**	**4.07**	**3.97**	**4.00**	**4.22**	**4.22**	**3.96**	**3.62**	**3.44**	**3.28**
Continent	**3.95**	**3.98**	**4.02**	**3.90**	**3.93**	**3.93**	**4.10**	**4.00**	**3.82**	**3.83**	**3.80**	**3.88**	**3.65**	**3.51**	**3.33**	**3.27**

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	1.57	1.60	1.68	1.48	1.69	1.35	1.37	1.40	1.29	1.17	1.24	1.30	1.31	1.16	1.14	1.21
DE	0.48	0.50	0.53	0.51	0.49	0.48	0.62	0.32	0.33	0.41	0.40	0.39	0.41	0.40	0.62	0.30
ME	5.00	5.20	5.48	5.78	5.37	5.49	4.39	4.96	4.20	4.61	4.27	4.40	3.73	4.02	3.97	4.33
MD	0.99	0.94	0.89	0.86	0.83	0.81	0.78	0.74	0.69	0.69	0.66	0.63	0.62	0.59	0.54	0.53
MA	2.28	2.23	2.15	2.12	2.07	1.95	1.92	1.89	1.79	1.73	1.72	1.69	1.64	1.64	1.58	1.70
NB	5.28	5.51	4.69	5.11	5.92	7.05	6.00	5.50	5.34	6.46	6.60	6.16	5.36	5.98	5.96	6.78
NH	3.19	3.40	4.29	3.64	3.56	3.48	3.26	3.51	3.24	3.23	3.25	3.63	3.51	3.49	3.44	3.68
NJ	2.04	1.86	1.66	1.91	1.45	1.38	1.30	1.23	1.07	0.96	0.82	0.95	0.91	0.71	0.78	0.81
NY	3.45	3.90	3.60	3.46	3.79	3.36	3.80	3.85	3.54	3.49	3.10	3.26	3.08	3.15	3.21	3.27
NS	3.13	3.28	3.42	2.98	3.26	3.25	3.02	3.26	3.20	3.31	2.98	3.15	3.18	3.01	3.06	3.39
PA	1.61	1.54	1.59	1.53	1.49	1.45	1.55	1.69	1.46	1.53	1.35	1.46	1.43	1.39	1.52	1.42
PEI	4.53	4.47	4.69	4.06	4.50	4.66	4.18	4.10	4.06	3.90	3.70	3.84	4.18	4.03	3.85	3.62
QUE	5.52	5.47	5.44	5.50	5.60	5.62	5.40	5.32	5.32	5.41	5.33	5.14	4.96	5.02	5.22	5.15
RI	0.34	0.28	0.25	0.23	0.20	0.17	0.16	0.13	0.12	0.11	0.09	0.08	0.07	0.06	0.06	0.05
VT	2.95	2.73	2.93	3.33	3.58	3.46	3.24	3.35	2.49	2.79	2.67	2.65	2.56	2.68	2.92	3.30
VA	0.83	0.50	0.54	0.52	0.46	0.41	0.43	0.40	0.41	0.38	0.35	0.30	0.29	0.32	0.26	0.27
WV	1.02	0.99	0.98	0.96	0.93	0.91	0.92	0.86	0.86	0.83	0.82	0.84	0.78	0.78	0.74	0.74
Region	**3.15**	**3.19**	**3.15**	**3.15**	**3.25**	**3.27**	**3.09**	**3.13**	**2.92**	**3.08**	**2.93**	**2.93**	**2.74**	**2.82**	**2.87**	**2.99**
Central Region																
IL	0.38	0.74	0.61	1.11	0.34	0.53	0.27	0.56	0.34	0.48	0.29	0.22	0.28	0.22	0.27	0.35
IN	0.61	0.57	0.66	0.62	0.54	0.49	0.61	0.59	0.55	0.45	0.44	0.40	0.37	0.37	0.44	0.39
MB	-----	-----	-----	-----	-----	-----	-----	-----	5.62	5.74	5.94	6.15	5.43	3.76	4.65	4.60
MI	6.43	6.65	6.93	6.48	6.88	6.69	6.71	7.33	5.76	5.90	5.21	5.77	5.54	5.35	6.31	5.35
MN	3.23	3.56	3.76	3.81	4.19	3.46	4.17	4.07	3.41	3.48	3.16	3.26	3.16	2.85	3.33	3.44
OH	1.23	1.14	1.11	1.11	1.17	1.01	1.25	1.14	1.13	1.06	1.07	1.02	1.03	0.91	1.03	0.89
ON	6.95	7.77	7.94	7.87	7.88	7.97	7.54	7.64	7.16	6.92	5.99	6.51	5.39	5.99	6.35	5.87
WI	3.55	3.48	3.94	4.03	3.76	3.84	3.64	3.68	2.97	3.15	2.73	2.83	2.77	2.66	2.85	3.23
Region	**3.38**	**3.62**	**3.77**	**3.79**	**3.73**	**3.63**	**3.64**	**3.78**	**3.20**	**3.23**	**2.84**	**3.02**	**2.80**	**2.77**	**3.12**	**2.95**
Continent	**3.27**	**3.41**	**3.46**	**3.47**	**3.49**	**3.45**	**3.37**	**3.46**	**3.06**	**3.16**	**2.89**	**2.98**	**2.77**	**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	1.09	1.03	0.95	0.96	0.93	0.90	0.85	0.86	0.87	0.84	0.82	0.91	0.89	0.80	0.81	0.74
DE	0.44	0.29	0.31	0.28	0.29	0.28	0.23	0.23	0.23	0.23	0.23	0.22	-----	0.19	0.18	-----
ME	4.49	3.99	3.71	4.03	4.13	4.22	4.10	3.73	3.79	3.68	3.98	4.04	4.02	3.93	3.74	3.37
MD	0.53	0.52	0.48	0.46	0.45	0.42	0.42	0.40	0.39	0.37	0.36	0.33	0.33	0.31	0.30	0.29
MA	1.57	1.48	1.47	1.43	1.47	1.35	1.34	1.26	1.30	1.26	1.21	1.16	1.10	1.08	1.07	1.09
NB	6.34	6.65	6.37	6.94	6.92	7.63	6.84	6.23	5.99	5.38	7.04	6.54	7.15	6.64	6.25	5.54
NH	3.19	3.26	3.23	3.54	3.55	3.50	3.26	2.77	2.84	3.32	3.32	2.94	3.28	3.19	3.29	2.90
NJ	0.71	0.67	0.55	0.60	0.47	0.42	0.43	0.43	0.37	0.42	0.27	0.33	0.37	0.32	0.29	0.22
NY	3.11	3.04	2.98	3.12	3.35	3.10	3.18	2.98	2.86	3.11	3.35	3.07	3.18	3.19	3.00	3.23
NS	3.35	3.17	2.93	2.91	3.17	3.00	2.85	2.83	2.72	2.73	3.12	2.77	3.13	3.39	3.11	2.65
PA	1.19	1.37	1.35	1.34	1.36	1.39	1.27	1.24	1.37	1.36	1.44	1.27	1.16	1.10	1.22	1.19
PEI	3.84	3.65	3.21	3.28	3.29	3.38	3.58	3.48	3.04	3.19	3.05	3.17	3.46	3.13	3.52	3.07
QUE	4.97	4.99	4.90	4.94	4.94	5.04	4.82	4.78	4.73	4.78	4.74	4.72	4.60	4.78	4.59	4.56
RI	0.04	0.04	0.04	0.03	0.03	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	-----	-----	-----
VT	3.39	2.71	2.50	2.66	2.71	2.87	2.87	2.48	2.30	2.45	2.52	2.39	2.58	2.39	2.15	2.14
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	0.10
WV	0.73	0.69	0.67	0.68	0.64	0.63	0.62	0.62	0.61	0.60	0.57	0.58	0.57	0.53	0.54	0.50
Region	**2.87**	**2.83**	**2.72**	**2.83**	**2.89**	**2.92**	**2.79**	**2.64**	**2.60**	**2.60**	**2.82**	**2.69**	**2.75**	**2.72**	**2.62**	**2.50**
Central Region																
IL	0.27	0.33	0.25	0.59	0.62	0.17	0.40	0.19	0.18	0.16	0.19	0.17	0.10	0.10	0.13	0.23
IN	0.35	0.38	0.30	0.29	0.33	0.33	0.27	0.26	0.26	0.25	0.27	0.23	0.23	0.21	0.21	0.20
MB	4.96	5.02	4.09	4.92	4.53	5.46	4.64	4.92	4.67	4.95	4.98	5.84	5.49	4.69	4.76	5.40
MI	5.63	5.30	5.43	5.57	5.64	5.50	5.13	5.05	4.75	4.75	4.88	5.29	5.39	5.58	5.36	5.43
MN	3.90	3.54	2.99	3.06	3.16	3.52	3.38	3.43	3.08	3.37	3.94	3.91	3.81	3.32	2.87	3.74
OH	0.92	0.91	0.88	0.84	1.06	0.96	0.94	0.76	0.79	0.91	0.89	0.87	0.84	0.85	0.80	0.86
ON	7.01	6.16	6.33	5.69	6.10	6.43	6.20	6.45	5.57	5.37	5.07	5.62	5.71	5.44	5.35	5.18
WI	3.04	2.94	2.52	2.69	2.76	3.13	2.87	3.31	2.84	2.88	2.92	3.23	3.31	3.33	2.65	2.98
Region	**3.18**	**2.95**	**2.82**	**2.85**	**2.98**	**3.02**	**2.89**	**2.94**	**2.64**	**2.66**	**2.73**	**2.92**	**2.93**	**2.86**	**2.64**	**2.82**
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**	**2.66**

Table 2. Continued

State, Province, or Region	Year 2016	2017
Eastern Region		
CT	0.77	0.74
DE	0.18	0.17
ME	3.79	3.18
MD	0.28	0.27
MA	1.05	0.98
NB	6.00	4.67
NH	3.02	2.67
NJ	0.24	0.22
NY	3.15	3.26
NS	2.88	2.73
PA	1.21	1.18
PEI	2.71	3.13
QUE	4.61	4.57
RI	0.01	-----
VT	2.52	2.24
VA	0.09	0.09
WV	0.51	0.51
Region	**2.60**	**2.41**
Central Region		
IL	0.13	0.16
IN	0.20	0.19
MB	5.15	6.38
MI	5.15	5.22
MN	4.33	4.42
OH	0.81	0.72
ON	5.13	5.21
WI	2.97	3.44
Region	**2.82**	**2.92**
Continent	**2.71**	**2.67**

Table 3. The number of U.S. hunters by state that submitted woodcock wings for the 2015-16 and 2016-17 Wing-collection Surveys.

State of residence	Number of Hunters who submitted woodcock wings[a]	
	2015-16 Season	2016-17 Season
Alabama	0	1
Arkansas	1	1
Connecticut	17	20
Delaware	1	3
Florida	0	0
Georgia	5	2
Illinois	1	1
Indiana	15	17
Iowa	4	4
Kansas	0	0
Kentucky	1	3
Louisiana	14	14
Maine	102	111
Maryland	14	14
Massachusetts	42	39
Michigan	237	239
Minnesota	95	99
Mississippi	4	3
Missouri	13	15
Nebraska	0	0
New Hampshire	66	62
New Jersey	17	13
New York	98	89
North Carolina	10	9
North Dakota	0	0
Ohio	15	17
Oklahoma	0	0
Pennsylvania	63	59
Rhode Island	2	3
South Carolina	12	11
Tennessee	3	1
Texas	1	1
Vermont	59	51
Virginia	16	17
West Virginia	11	17
Wisconsin	170	174
Total	**1,109**	**1,110**

[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 2016 were weighted by the relative contribution of each state to the cumulative number of adult female and immature wings received during 1963-2015.

State or	Wings received							
Region of	Total		Adult females		Immatures		Recruitment index	
harvest	1963-15	2016	1963-15	2016	1963-15	2016	1963-15	2016
Eastern Region								
CT	15,291	171	3,423	41	9,338	73	2.7	1.8
DE	520	7	79	4	352	8	4.5	----
FL	678	0	153	0	422	0	2.8	----
GA	3,306	51	1,043	12	1,420	5	1.4	----
ME	89,578	936	26,463	311	44,671	497	1.7	1.6
MD	4,885	119	1,199	22	2,787	53	2.3	----
MA	25,179	434	7,924	87	12,254	116	1.5	1.3
NH	37,388	691	12,197	197	17,384	242	1.4	1.2
NJ	27,366	205	6,327	47	16,183	110	2.6	2.3
NY	64,768	623	21,964	185	29,311	198	1.3	1.1
NC	4,343	114	1,387	34	2,068	53	1.5	----
PA	33,767	353	10,688	144	15,565	149	1.5	1.0
RI	2,473	4	476	3	1,633	6	3.4	----
SC	3,794	201	1,200	76	1,724	77	1.4	1.0
VT	29,042	393	9,541	138	13,226	163	1.4	1.2
VA	6,064	213	1,587	67	3,241	138	2.0	2.1
WV	6,510	62	1,959	29	3,260	26	1.7	----
Region	**354,952**	**4,577**	**107,610**	**1,397**	**174,839**	**1,914**	**1.62**	**1.42**
Central Region								
AL	1,014	0	282	0	462	0	1.6	----
AR	559	2	178	3	228	2	1.3	----
IL	1,510	3	353	1	846	4	2.4	----
IN	8,678	68	2,197	37	4,776	65	2.2	----
IA	1,367	19	445	5	618	2	1.4	----
KS	50	0	9	0	26	0	----	----
KY	1,222	1	290	23	608	12	2.1	----
LA	33,674	195	7,538	58	21,796	99	2.9	1.7
MI	142,390	2,781	46,939	835	69,659	1087	1.5	1.3
MN	43,947	1,232	15,562	487	18,789	567	1.2	1.2
MS	1,970	23	551	11	998	7	1.8	----
MO	4,566	53	1,189	59	2,194	46	1.8	----
NE	13	0	5	0	6	0	----	----
ND	4	0	3	0	1	0	----	----
OH	15,325	105	4,702	49	7,216	25	1.5	----
OK	174	0	38	0	92	0	2.4	----
TN	1,361	3	358	6	690	5	1.9	----
TX	1,067	2	296	4	529	2	1.8	----
WI	93,642	2,266	31,722	847	43,795	1075	1.4	1.3
Region	**352,533**	**6,753**	**112,657**	**2,425**	**173,329**	**2,998**	**1.54**	**1.32**

Table 5. Preliminary estimates of woodcock harvest, hunter numbers, days afield, and hunter success from the 2016-17 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	900	100	5,100	1,000	0.91	0.30
DE	400	100	200	100	800	400	2.67	2.01
FL	<100	<100	200	100	400	200	0.25	0.27
GA	500	200	2,000	1,600	4,200	3,200	0.25	0.23
ME	6,700	1,100	3,200	600	10,600	1,400	2.10	0.51
MD	500	100	500	400	800	400	0.83	0.65
MA	2,600	500	1,300	200	7,000	1,200	1.93	0.44
NH	6,600	1,900	2,000	300	10,300	2,000	3.27	1.07
NJ	3,800	1,700	900	200	2,900	700	4.37	2.24
NY	4,800	600	3,200	500	13,900	2,200	1.48	0.30
NC	4,300	2,700	2,600	1,700	5,600	2,800	1.67	1.54
PA	3,900	800	6,300	1,200	18,200	3,200	0.62	0.17
RI	200	100	100	<100	300	100	2.53	1.48
SC	1,200	400	200	<100	1,100	200	5.59	1.86
VT	5,300	1,600	1,800	200	10,500	2,000	2.90	0.95
VA	1,900	300	700	300	2,600	700	2.59	1.32
WV	700	200	400	100	1,600	500	1.93	0.79
Region	**44,400**	**4,300**	**na[a]**	**na[a]**	**96,100**	**6,900**	**na[a]**	**na[a]**
Central Region								
AL	100	100	1,400	1,300	1,400	1,300	0.07	0.09
AR	3,000	1,900	4,100	2,300	13,400	10,800	0.74	0.62
IL	1,600	1,400	1,500	1,000	13,200	11,000	1.07	1.18
IN	900	200	300	200	1,300	500	2.79	1.62
IA	2,900	2,500	500	400	1,800	1,300	5.79	6.92
KS	0	0	400	400	400	400	0.00	0.00
KY	2,400	2,000	1,100	1,000	1,500	1,000	2.27	2.77
LA	1,800	1,100	900	700	4,600	3,100	1.92	1.90
MI	64,900	8,600	24,100	2,300	107,100	11,600	2.70	0.44
MN	25,900	4,700	13,500	2,300	46,000	8,200	1.93	0.48
MS	<100	<100	600	600	1,300	1,300	0.02	0.03
MO	3,400	2,800	2,200	1,200	6,200	3,800	1.52	1.50
NE	600	600	600	600	600	600	1.00	1.41
OH	3,200	1,300	2,600	900	8,200	3,700	1.25	0.67
OK[b]								
TN	0	0	1,400	1,400	9,800	9,700	0.00	0.00
TX	12,100	11,200	11,300	7,900	28,400	20,100	1.07	1.24
WI	35,100	4,400	11,700	1,700	55,100	8,900	3.01	0.58
Region	**158,000**	**16,300**	**na[a]**	**na[a]**	**300,200**	**32,500**	**na[a]**	**na[a]**
Total	**202,300**	**16,900**	**na[a]**	**na[a]**	**396,300**	**33,300**	**na[a]**	**na[a]**

[a] Regional estimates of hunter numbers and hunter success cannot be obtained due to the occurrence of individual hunters being registered in the Harvest Information Program in more than one state.

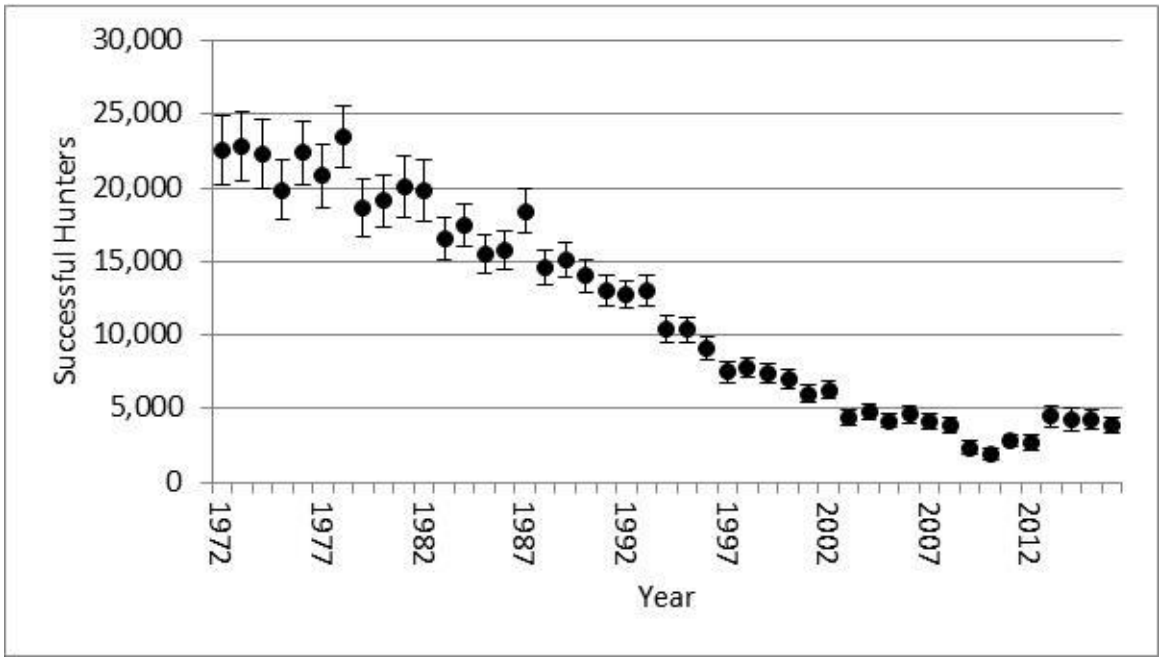
[b] No hunters that registered for HIP in Oklahoma said they intended to hunt woodcock in 2016.

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 - 2017.

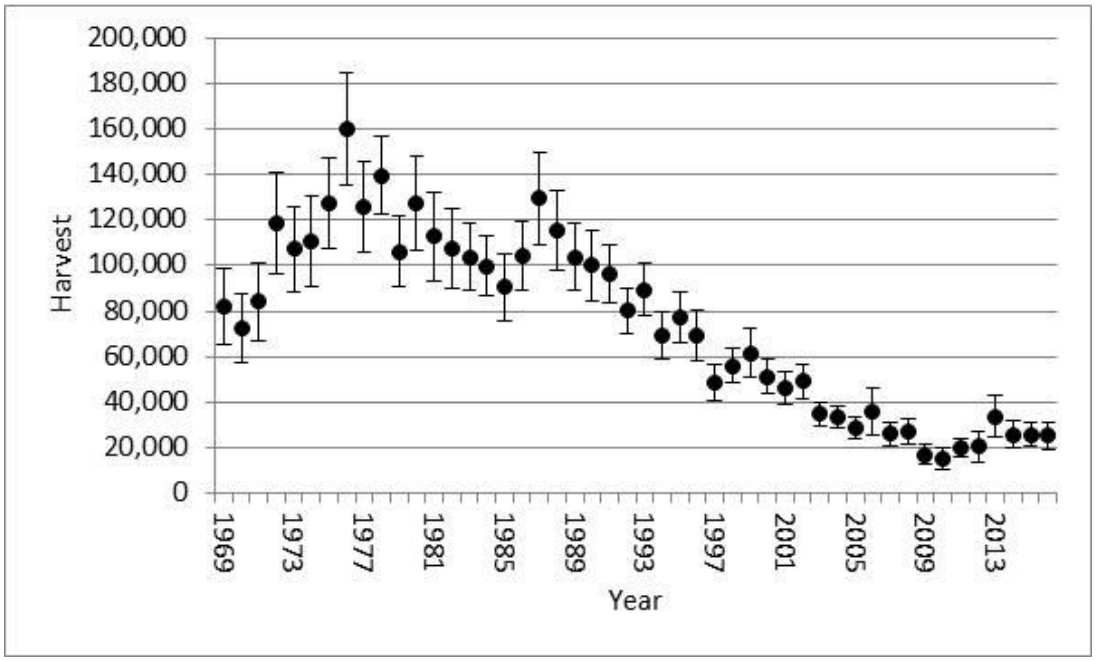
Eastern Region				Central Region			
Year (s)	Outside dates	Season length	Daily bag limit	Year (s)	Outside dates	Season length	Daily bag limit
1918-26	Oct. 1 - Dec. 31	60	6	1918-26	Oct. 1 - Dec. 31	60	6
1927	Oct. 1 - Dec. 31	60	4	1927	Oct. 1 - Dec. 31	60	4
1928-39	Oct. 1 - Dec. 31	30	4	1928-39	Oct. 1 - 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	1997-17	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				
2011-17	Oct. 1 - Jan. 31	45	3				

[a] Saturday nearest September 22nd, which was September 24th for the 2016-17 season.

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



Estimated number of successful woodcock hunters in Canada and associated 95% confidence intervals, 1972-2016.



Estimated woodcock harvest in Canada and associated 95% confidence intervals, 1969-2016.

U.S. Fish and Wildlife Service
Division of Migratory Bird Management
Population and Habitat Assessment Branch
11510 American Holly Drive
Laurel, Maryland 20708-4002

http://www.fws.gov
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