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American Woodcock

Population Status, 2002

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AMERICAN WOODCOCK POPULATION STATUS, 2002

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Abstract: Singing-ground and Wing-collection surveys were conducted to assess the population status of the American woodcock (*Scolopax minor*). Singing-ground Survey data indicated that the number of displaying woodcock in the Eastern Region was 1.3% lower than in 2001, but this decrease was non-significant (P>0.1). In the Central Region, there was a 7.9% decrease in the number of woodcock heard displaying compared to 2001 levels, but this decrease also was non-significant (P>0.1). Trends from the Singing-ground Survey during 1992-02 were –2.1 and –1.5% per year for the Eastern and Central regions, respectively (P<0.01). There were long-term (1968-02) declines (P<0.01) of 2.3% per year in the Eastern Region and 1.6% per year in the Central Region. The 2001 recruitment index for the Eastern Region (1.4 immatures per adult female) was the same as the 2000 index, but was 18% below the long-term regional average. The 2001 recruitment index for the Central Region (1.3 immatures per adult female) was slightly higher than the 2000 index (1.2 immatures per adult female), but was 23% below the long-term regional average of 1.7. The index of daily hunting success in the Eastern Region was 2.0 woodcock per successful hunt in both 2000 and 2001, and seasonal hunting success was 8.7 woodcock per successful hunter in both years. In the Central Region, the daily success index increased slightly from 2.0 woodcock per successful hunt in 2000 to 2.1 in 2001; but seasonal hunting success decreased from 10.7 to 10.5 woodcock per successful hunter.

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. Up until the recent advent of the Harvest Information Program, a sampling frame for woodcock hunters had been lacking. Because of these difficulties, the Wing-collection Survey and the Singing-ground Survey were developed to provide indices of recruitment, hunting success and changes in abundance.

This report summarizes the results of these surveys and presents an assessment of the population status of woodcock as of June 2002. 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.

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.

The cover picture of a woodcock hen and chicks is used with permission of Joel M. Vance, Missouri Department of Conservation (retired).

METHODS

Woodcock Management Units

Woodcock are managed on the basis of 2 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 regional boundaries conform to the boundary between the Atlantic and Mississippi flyways. The results of the Wing-collection and Singing-ground surveys are reported by state or province, and region.

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 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.

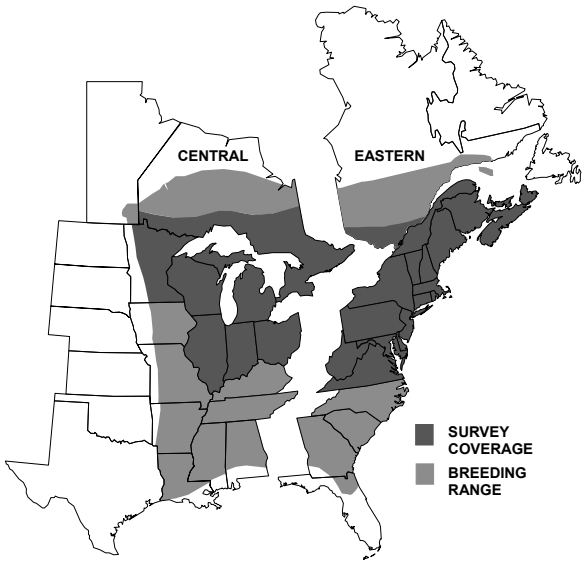

Fig. 1. Woodcock management regions, breeding range, and Singing-ground Survey coverage.

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, 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 avoid counting 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 acceptable.

The survey consists of about 1,500 routes. In order to avoid expending unnecessary manpower and funds, approximately one half of these routes are surveyed each year. The remaining routes are carried as "constant zeros." 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 when it is next run, the route reverts to normal status and is run 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.

Trend Estimation.—Trends were estimated for each route by solving a set of estimating equations (Link and Sauer 1994). Observer data were used as covariables to adjust for differences in observers' ability to hear woodcock. To estimate state and regional trends, a weighted average from individual routes was calculated for each area of interest as described by Geissler (1984). Regional estimates were weighted by state and provincial land areas. Variances associated with the state, provincial, and regional slope estimates were estimated using a bootstrap procedure (Efron 1982). Trend estimates were expressed as percent change per year and trend significance was assessed using normal-based confidence intervals. Short-term (2001-02), intermediate-term (1992-02) and long-term (1968-02) trends were evaluated.

The reported sample sizes are the number of routes on which trend estimates are based. These numbers may be less than the actual number of routes surveyed for several reasons. The estimating equations approach requires at least 2 non-zero counts by the same observer for a route to be used. With the exception of the 2001-02 analysis, routes that did not meet this requirement during the interval of interest were not included in the sample size. For the 2001-02 analysis, a constant of 0.1 was added to counts of low-abundance routes to allow their use in the analysis. Each route should be surveyed during the peak time of 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 31 May 2002 were not included in this analysis but will be included in future trend estimates. Data for 2002 were not received from Ontario and Prince Edward Island. Therefore, short-term trends could not be estimated for those provinces; however, intermediate and long-term trends were estimated for 1992-2001 and 1968-2001, respectively.

Annual indices.—Annual indices were calculated for the 2 regions and each state and province by finding the deviation between the observed count on each route and that predicted by the 1968-2002 regional or state/provincial trend estimate. These residuals were averaged by year and added to the fitted trend to produce annual indices of abundance for each region, state and province. Yearly variation in woodcock abundance was superimposed on the long-term fitted trends (see Sauer and Geissler 1990). Thus, the indices calculated with this method portray year-to-year variation around the predicted trend line, which can be useful for exploratory data analysis (e.g., observing periods of departure from the long-term trend). However, the indices should be viewed in a descriptive context. They are not used to

assess statistical significance and a change in the indices over a subset of years does not necessarily represent a significant change. Observed patterns must be verified using trend estimation methods to examine the period of interest (Sauer and Geissler 1990, Link and Sauer 1994).

Wing-collection Survey

The Wing-collection Survey was incorporated into a national webless migratory game bird wing-collection survey in 1997. Only data on woodcock will be presented in this report. As with the old survey, the primary objective of the Wing-collection Survey is to provide data on the reproductive success of woodcock. The survey also produces information on the chronology and distribution of the harvest and data on hunting success. The survey is administered as a cooperative effort between woodcock hunters, the FWS and state wildlife agencies. Participants in the 2001 survey included hunters who either: (1) participated in the 2000 survey; or (2) indicated on the 2000-01 Annual Questionnaire Survey of U. S. Waterfowl Hunters or Harvest Information Program Survey that they hunted woodcock. 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, and the state and county where the bird was shot. Hunters were not asked to submit envelopes for unsuccessful hunts. The age and sex of the birds were determined by examining plumage characteristics (Martin 1964, Sepik 1994) during the annual Woodcock Wingbee, a cooperative work session. Wings from the 2001-02 hunting season were accepted through 26 April 2002.

The ratio of immature birds per adult female in the harvest provided an index to recruitment of young into the population. The 2001 recruitment indices were compared to long-term (1963-2000) averages. Annual indices were calculated as the average number of immatures per adult female in each state, weighted by the relative contribution of each state to the total number of wings received during 1963-2000 (to maintain comparability between years).

Daily and seasonal bags of hunters who participated in the Wing-collection Survey in both 2000 and 2001 were used as indices of hunter success. These indices were weighted to compensate for changes in the proportion of the estimated woodcock harvest attributed to each state and adjusted to a base-year value (1969) for comparison with previous years (Clark 1970, 1972, 1973). Only data on successful hunts from prior years were used so that they would be comparable to data from the new survey. A successful hunt was defined as any envelope returned with complete information in which $\geq$1 woodcock wing was received.

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. In the past, the annual FWS migratory bird harvest 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 are 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 it will provide 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 some additional information from each migratory bird hunter in their state, and send that information to the FWS. The FWS then selects 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. These estimates should be considered preliminary as refinements are still being made in the sampling frame and estimation techniques.

RESULTS AND DISCUSSION

Singing-ground Survey

Trend Estimation.— The number of woodcock displaying during the 2002 Singing-ground Survey in the Eastern Region was not significantly different (P>0.1) from the 2001 level, although the point estimate of the trend was negative (Table 1, Fig. 2). The number of woodcock displaying in the Central Region decreased 7.9% from 2001 levels, however this trend also was not statistically significant (P>0.1). Trends for all states and provinces are reported in Table 1, but results based on fewer than 10 routes should be considered unreliable.

Trends for the 1992-02 period were computed for 340 routes in the Eastern Region and 409 routes in the Central Region. Eastern and Central region breeding populations declined (P<0.01) 2.1 and 1.5% per year, respectively, during this period (Table 1).

Long-term (1968-02) trends were estimated for 606 routes in the Eastern Region and 610 routes in the Central Region. There were long-term declines (P<0.10) in the breeding population throughout most

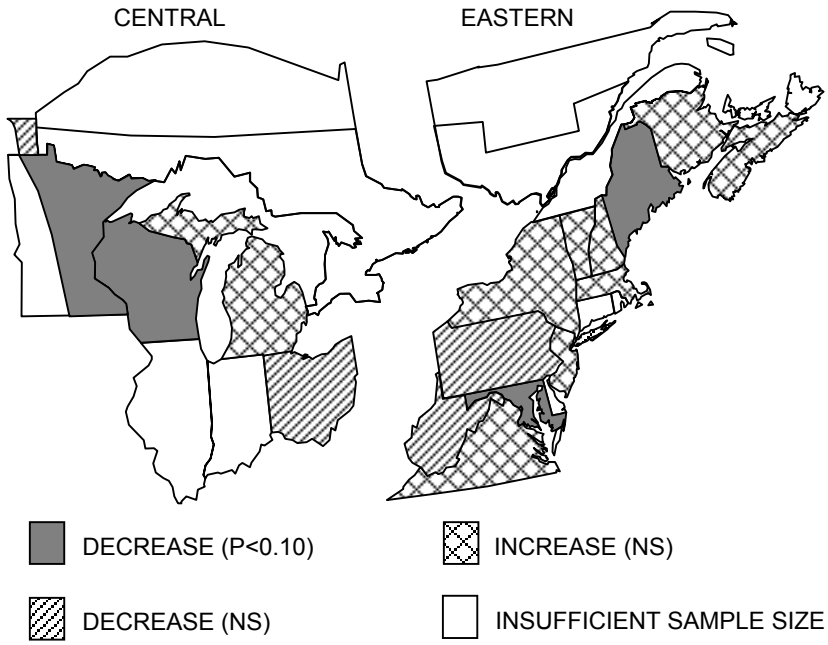

Fig. 2. Short-term trends in the number of American woodcock heard on the Singing-ground Survey, 2001-2002.

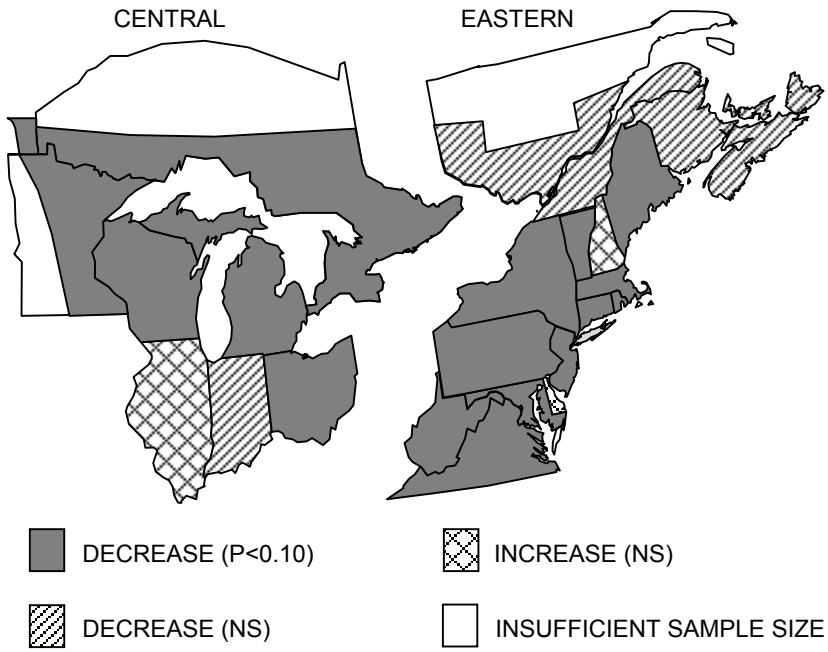

Fig. 3. Long-term trends in the number of American woodcock heard on the Singing-ground Survey, 1968-2002. Due to lack of data for Ontario and Prince Edward Island in 2002, trends for those provinces relate to the period 1968-01.

states and provinces in the Eastern and Central Regions (Table 1, Fig. 3). The long-term trend estimates were –2.3 and –1.6% per year (P<0.01) for the Eastern and Central regions, respectively.

Annual Breeding Population Indices.—In the Eastern Region, the 2002 breeding population index of 1.67 singing-males per route was similar to the predicted value of 1.68 (Table 2, Fig. 4). The Central Region population index of 1.99 males per route was lower than the predicted value of 2.21.

The major causes of these declines are thought to be degradation and loss of suitable habitat on both the breeding and wintering grounds, resulting from forest succession and various human uses (Dwyer et al. 1983, Owen et al. 1977, Straw et al. 1994). If current trends in land use practices persist, continued long-term population declines are likely.

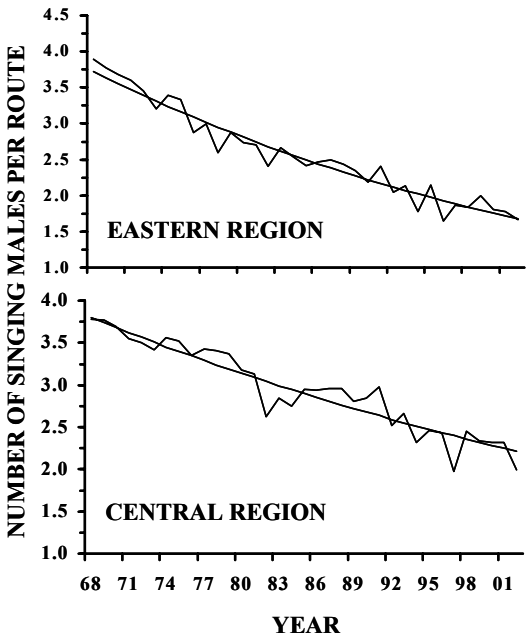

Fig. 4. Long-term trends (smooth line) and annual indices of the number of woodcock heard on the Singing-ground Survey, 1968-2002.

Wing-collection Survey

A total of 6,063 potential woodcock hunters in states with woodcock seasons were contacted and asked to participate in the 2001 Wing-collection Survey. Eighteen percent (Table 3) cooperated by sending in 9,646 woodcock wings (Table 4).

Recruitment.—The 2001 recruitment index in the Eastern Region (1.4 immatures per adult female) was the same as the 2000 index, but was 18% below the long term (1963-00) regional average of 1.7 immatures per adult female (Table 4, Fig 5). In the Central Region the 2001 recruitment index (1.3 immatures per adult female) was slightly higher than the 2000 index (1.2), but was 23% below the long-term regional average of 1.7.

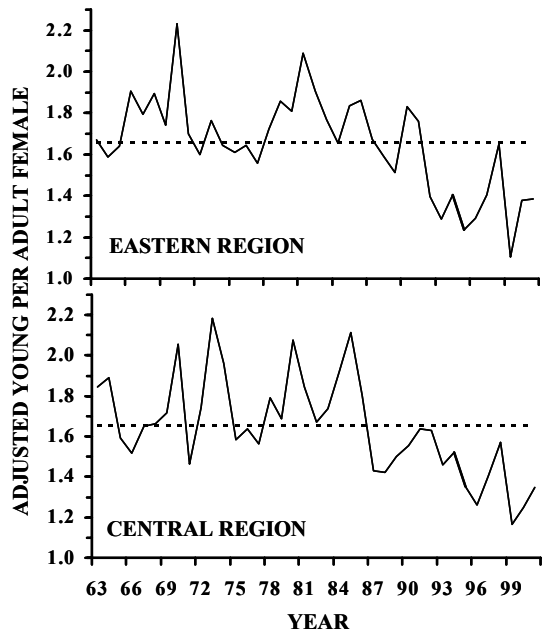

Fig. 5. Adjusted annual indices of recruitment, 1963-2001. The dashed line is the 1963-2000 average.

Hunting Success.— There were no changes in Federal frameworks for woodcock hunting seasons during 2001-02 (Appendix 1). The 2001 index of daily hunting success in the Eastern Region (2.0 woodcock per successful hunt) was the same as in the 2000 season (Table 5). The index of seasonal hunting success in the Eastern Region was 8.7 woodcock per successful hunter in both 2000 and 2001. In the Central Region, the 2001 daily success index (2.1 woodcock per successful hunt) was slightly higher than the 2000 index (2.0 woodcock per successful hunt). Central Region hunters experienced a small decrease in the seasonal success index from 10.7 woodcock per successful hunter in 2000 to 10.5 woodcock per hunter in 2001. Base-year adjusted indices of daily and seasonal hunting success were below long-term averages in both regions (Figs. 6 and 7).

Indices to seasonal hunting success indicate that the annual woodcock harvest has been declining among participants in the survey for over a decade. This is consistent with the results of the Annual Questionnaire

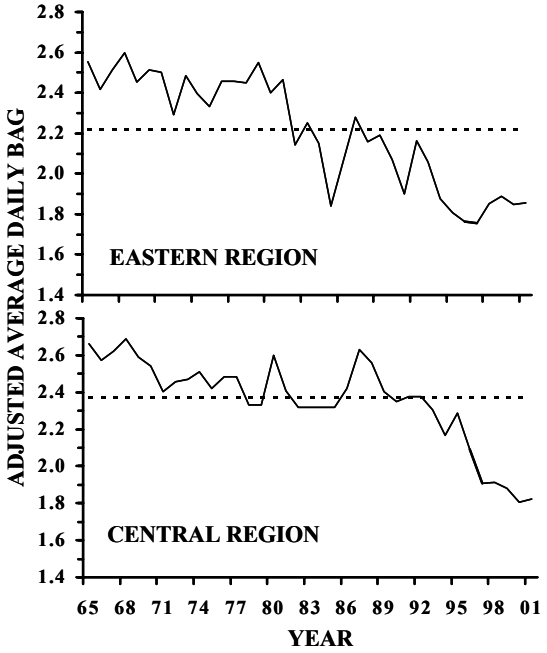

Fig. 6. Base-year adjusted indices of daily hunting success, 1965-2001. The base year is 1969; the dashed line is the 1965-2000 average.

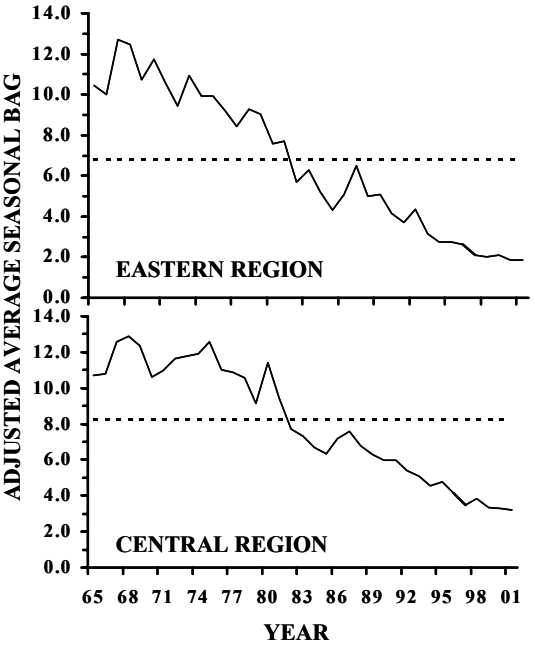

Fig. 7. Base-year adjusted indices of seasonal hunting success, 1965-2001. The base year is 1969; the dashed line is the 1965-2000 average.

Survey of U.S. Waterfowl Hunters (Martin 1979, and FWS unpublished data, Division of Migratory Bird Management, Laurel, Maryland), which indicates that the woodcock harvest and the number of woodcock hunters have generally declined since the early 1980s (Fig. 8).

These results should be interpreted cautiously because of the limitations of both of these surveys. A comprehensive critique of these limitations is beyond the scope of this report; interested readers should see Owen et al. (1977), Martin (1979), and Straw et al. (1994). Briefly, historic indices based on the Wing-collection Survey are potentially biased because of the non-random sampling procedure by which survey participants were selected. Because the Annual Questionnaire Survey of U. S. Waterfowl Hunters does not provide information on the woodcock harvest by non-waterfowl hunters, it does not provide an estimate of total harvest or the total number of hunters. Nevertheless, results from this survey should at least approximate trends in harvest and hunter participation.

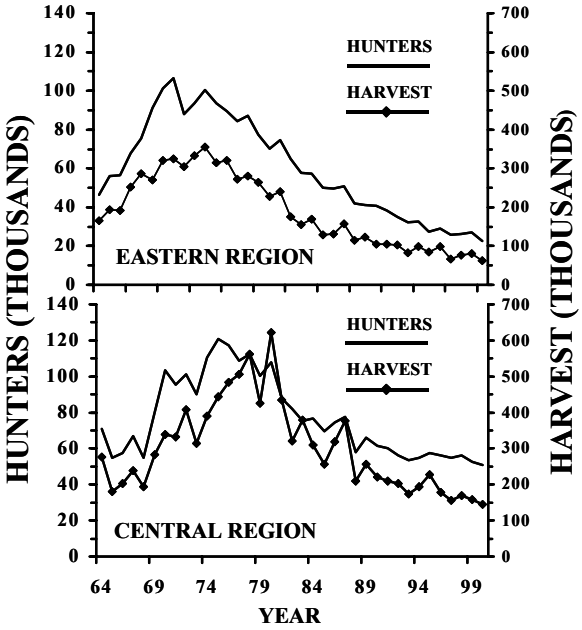

Fig. 8. U. S. harvest of American woodcock by duck stamp purchasers, and hunter numbers, 1964-2000 (Martin 1979, and FWS unpublished data, Division of Migratory Bird Management, Laurel, Maryland).

Harvest Information Program

Estimates of active woodcock hunters, days afield, and woodcock harvest from the 1999-00 and 2000-01 HIP surveys are provided in Table 6. In the Eastern Region woodcock hunters spent approximately 204,000 days afield and harvested nearly 106,000 birds during 2000-01. Woodcock hunters in the Central Region spent approximately 553,000 days afield and harvested 329,500 birds during the 2000-01 season. Although HIP provides statewide estimates of woodcock hunter numbers (Table 6), it is not possible to develop regional estimates, due to the occurrence of some hunters visiting more than one state to hunt. Preliminary estimates of woodcock harvest in Canada indicate that approximately 6,021 hunters harvested 45,950 birds during the 2001-02 season (CWS, unpublished data).

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Rebecca Holmes (FWS) mailed and processed Singing-ground Survey forms, corresponded with cooperators, keypunched portions of data, and continued development of the new Internet web site that allowed cooperators to submit survey data electronically. T. Nguyen (FWS) played a vital role in web site and database development. Personnel from the FWS, Biological Resources Division (BRD) of the U. S. Geological Survey, Canadian Wildlife Service (CWS), and many state and provincial agencies, and other individuals assisted in collecting the Singing-ground Survey data and processing wings at the Woodcock Wingbee. Special thanks to M. Bateman (CWS), G. Haas (FWS) and S. Kelly (FWS) for help in coordinating the Singing-ground Survey. Special appreciation is extended to F. Kimmel and the Louisiana Department of Wildlife and Fisheries for hosting the 2002 wingbee. Individuals that participated in the wingbee were: D. Dessecker (Ruffed Grouse Society); L. Fendrick (Ohio Division of Wildlife); F. Kimmel and M. Olinde (Louisiana Department of Wildlife and Fisheries); D. Krementz and D. McAuley (BRD); W. Palmer (Pennsylvania Game Commission); A. Stewart (Michigan DNR); R. Stonebraker (Indiana DNR); and M. Gautreaux, R. Holmes, J. Kelley, P. Stinson, R. Speer, Laura Shiver, and L. Wolff (FWS). Thanks to the 1,088 woodcock hunters who sent in wings. The Harvest Surveys Section of the Division of Migratory Bird Management (FWS) mailed Wing-collection Survey materials, organized wing submissions, assisted with data management, and provided Harvest Information Program estimates of woodcock harvest (special thanks to P. Padding, M. Moore, E. Martin, and J. Bezek-Balcombe). B. H. Powell (BRD) developed the computer programs for administering the Wing-collection Survey. M. Bateman (CWS) provided estimates of woodcock hunters and harvest for Canada. J. Sauer (BRD) developed computer programs for calculating trends and indices from Singing-ground Survey data. W. Kendall (BRD) performed the analyses and assisted with interpretation. R. Holmes, W. Kendall, P. Padding, J. Sauer, and G. Smith reviewed a draft of parts or all of this report and provided helpful comments. Portions of this report were copied in whole or in part from previous status reports.

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Table 1. Trends (% change per year[a]) in the number of American woodcock heard in the Singing-ground Survey as determined by the estimating equations technique (Link and Sauer 1994), 1968-2002.

State, Province or Region	No. of routes[b]	2001-2002				1992-2002				1968-2002			
		n[c]	% change	90%	CI	n	% change	90%	CI	n	% change	90%	CI
CT	6					3	11.2 ***[d]	8.3	14.1	9	-9.9 **	-16.4	-3.4
DE	2					2	9.2 *	0.4	17.9	2	4.0	-10.4	18.3
ME	40	23	-18.9 **	-33.7	-4.2	52	-0.9	-2.7	1.0	63	-2.4 ***	-3.3	-1.5
MD	8	2	-59.4 ***	-69.0	-49.9	6	-2.5	-35.9	30.8	21	-10.6 ***	-16.9	-4.2
MA	12	4	69.6	-7.9	147.0	11	5.2 **	1.6	8.9	20	-4.4 **	-7.8	-1.0
NB	43	18	12.5	-23.1	48.0	51	0.3	-2.2	2.9	62	-0.8	-2.1	0.4
NH	13	8	11.6	-38.3	61.4	13	2.7	-2.2	7.6	18	0.2	-2.7	3.1
NJ	7	3	28.7	-12.3	69.8	6	-10.0	-20.3	0.3	17	-10.6 ***	-13.9	-7.4
NY	64	24	2.1	-16.2	20.5	69	-4.4 ***	-7.0	-1.9	104	-2.8 ***	-3.7	-1.8
NS	37	13	9.3	-16.6	35.2	34	1.6	-1.5	4.6	55	-0.3	-1.5	0.9
PA	34	9	-3.9	-27.6	19.8	26	-3.9	-9.4	1.6	56	-5.5 ***	-8.0	-3.0
PEI	0					7	1.3[f]	-4.9	7.5	12	-0.8[g]	-2.4	0.8
QUE	16					13	-3.1 **	-5.2	-1.0	54	0.0	-1.4	1.4
RI	1									2	-15.0 ***	-22.9	-7.1
VT	14	6	3.0	-21.1	27.1	18	3.3	0.0	6.6	21	-1.8 *	-3.6	-0.1
VA	25	2	86.6	-119.1	292.3	12	-6.2	-19.5	7.1	47	-10.2 ***	-14.0	-6.3
WV	13	5	-11.5	-52.6	29.6	17	-4.9	-9.9	0.0	43	-2.4 **	-4.5	-0.4
Eastern	335	117	-1.3	-11.2	8.6	340	-2.1 ***	-3.2	-0.9	606	-2.3 ***	-2.8	-1.8
IL	7					4	4.4	-6.3	15.2	23	24.4	-16.8	65.6
IN	18					8	0.9	-11.9	13.7	38	-5.8	-11.8	0.1
MB[e]	18	7	-1.9	-36.6	32.8	20	-4.8***	-7.6	-2.1	20	-4.9 ***	-7.4	-2.5
MI	90	47	13.7	-10.8	38.1	110	-1.2	-2.8	0.2	142	-1.5 ***	-2.2	-0.8
MN	79	38	-17.4 **	-29.0	-5.7	75	-0.6	-2.3	1.0	98	-1.0 *	-2.0	-0.1
OH	19	6	-7.3	-64.6	50.0	27	-7.1	-15.2	1.0	54	-6.5 ***	-10.2	-2.9
ON	0					94	-2.5 [f]	-5.5	0.5	135	-1.3 ***[g]	-2.1	-0.6
WI	69	36	-21.4	-35.8	-7.1	71	-1.5	-3.1	0.0	100	-1.9 ***	-2.7	-1.0
Central	300	136	-7.9	-17.6	1.9	409	-1.5 ***	-2.3	-0.6	610	-1.6 ***	-2.0	-1.2
Continent	635	253	-6.0	-13.3	1.3	749	-1.6 ***	-2.4	-0.9	1216	-1.8	-2.2	-1.5

[a] Mean of weighted route trends within each state, province or region. 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 2002 for which data were received by 31 May.

[c] Number of comparable routes with at least 2 non-zero counts.

[d] Indicates slope is significantly different from zero: * P<0.10, ** P<0.05. *** P <0.01; significance levels are approximate for states where n<10.

[e] Manitoba began participating in the Singing-ground Survey in 1990.

[f] Data were not received from PEI and ON for the 2002 survey. Trend estimate is for the period 1992-2001.

[g] Data were not received from PEI and ON for the 2002 survey. Trend estimate is for the period 1968-2001.

Table 2. Breeding population indices for American woodcock from the Sing-ground Survey, 1968-2001. These indices are based on the 1968-2001 trend and should be used for exploratory data analysis only; observed patterns should be verified using trend estimation methods (Sauer and Geissler 1990).

State, Province or Region	Year																	
	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Eastern Region																		
CT[a]	--[b]	7.06	7.05	5.48	6.73	4.96	4.84	5.15	2.82	3.30	2.00	2.00	1.75	2.37	2.98	2.29	1.54	1.33
DE[a]	0.77	0.60	0.70	0.51	0.61	1.01	0.94	1.64	0.52	0.70	0.67	0.57	--	--	--	2.27	0.88	0.90
ME	5.21	5.38	5.65	5.12	4.82	5.13	5.09	5.44	4.82	4.35	4.00	4.36	3.84	4.20	2.89	3.71	3.71	3.76
MD	8.18	7.23	6.42	5.98	5.01	5.56	3.95	4.19	2.84	2.71	2.88	2.27	2.81	2.40	2.37	1.58	1.25	1.26
MA	--	3.76	4.41	5.16	3.78	5.08	4.10	2.38	3.14	2.41	2.81	3.07	2.21	2.24	1.92	1.42	2.50	1.96
NB	--	5.20	5.50	5.38	5.60	4.97	5.50	6.23	4.58	5.69	4.07	4.51	4.04	4.08	4.25	4.45	3.60	3.71
NH	--	2.91	3.36	2.72	3.41	2.65	3.62	3.06	3.78	3.08	3.12	3.19	3.87	4.03	2.37	2.76	2.46	2.61
NJ	7.80	6.71	8.36	10.38	6.12	8.60	8.50	6.31	3.72	4.10	2.38	4.08	2.53	1.93	1.93	2.26	2.64	1.88
NY	5.09	5.62	4.31	4.86	4.55	4.59	4.83	4.04	3.99	4.11	3.25	3.67	4.23	3.85	3.12	3.59	2.90	3.66
NS	3.60	2.61	2.22	2.75	2.63	2.55	3.19	2.73	2.42	2.42	2.80	2.28	2.17	2.00	1.79	2.23	2.15	2.15
PA	3.97	3.62	3.97	3.44	3.03	3.24	2.33	2.61	2.52	2.49	1.97	2.22	2.03	1.99	1.58	1.78	1.88	1.45
PEI[a]	--	3.41	2.62	4.88	2.90	2.33	3.12	4.74	4.04	3.56	2.85	3.52	2.62	1.99	2.14	3.39	3.86	2.84
QUE[a]	--	--	--	3.80	3.50	2.70	3.32	3.36	2.34	2.61	3.22	3.30	3.64	2.86	2.81	3.51	2.86	3.54
RI[a]	--	2.30	2.27	4.32	3.36	3.36	2.51	1.94	1.94	--	0.65	1.12	1.12	0.65	2.65	1.76	1.59	0.53
VT	--	2.65	4.49	3.41	3.84	3.39	3.31	3.83	3.47	4.14	3.16	3.03	2.69	2.39	1.79	2.62	2.64	2.08
VA	--	4.66	4.83	3.86	3.37	2.43	3.55	3.03	2.53	2.44	1.84	2.03	1.72	1.70	1.61	1.25	1.80	0.93
WV	1.57	1.77	1.26	1.23	1.50	1.20	1.16	1.33	1.17	1.18	0.81	1.20	0.98	1.36	1.20	1.25	1.04	0.98
Region	3.89	3.77	3.68	3.60	3.45	3.20	3.39	3.33	2.87	2.99	2.60	2.87	2.74	2.71	2.41	2.67	2.54	2.42
Central Region																		
IL	--	--	0.02	0.03	0.03	0.04	0.04	0.07	0.06	0.08	0.08	0.10	0.11	0.17	0.14	0.21	0.24	0.43
IN	2.12	1.85	1.77	1.37	1.66	1.71	1.27	1.23	1.23	1.20	1.08	1.35	1.00	1.04	0.76	0.81	0.79	0.65
MB	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MI	5.93	5.81	5.54	5.35	5.08	5.22	6.07	6.12	5.64	5.17	5.48	5.40	5.33	4.46	4.71	4.11	4.53	4.75
MN	--	4.56	3.91	4.19	3.57	4.06	4.72	4.12	4.14	4.11	4.12	4.07	4.52	4.15	3.75	3.41	3.04	3.63
OH	--	--	3.65	3.70	3.10	2.56	3.29	2.47	2.67	3.05	2.42	1.88	1.85	2.11	1.51	1.92	1.76	1.52
ON	6.07	6.67	6.34	6.04	6.71	6.00	6.45	5.68	5.47	5.97	6.47	6.24	6.40	5.95	4.52	4.68	4.93	5.04
WI	4.29	4.23	4.57	4.05	3.86	3.93	4.02	3.90	3.74	4.06	4.27	4.17	3.55	3.03	2.95	2.98	3.25	3.00
Region	3.78	3.77	3.69	3.55	3.50	3.42	3.56	3.52	3.35	3.43	3.41	3.37	3.18	3.13	2.62	2.84	2.75	2.95
Continent	3.79	3.74	3.65	3.54	3.45	3.29	3.45	3.41	3.08	3.19	2.96	3.10	2.94	2.91	2.51	2.76	2.65	2.68

[a] Annual indices are unreliable due to small sample size.

[b] Insufficient data.

Table 2. Continued.

State, Province or Region	Year																
	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Eastern Region																	
CT[a]	1.92	0.90	2.25	0.95	0.84	0.89	0.61	0.50	0.63	0.81	0.73	0.65	0.61	1.31	0.88	0.34	0.32
DE[a]	--	--	--	--	1.24	0.65	0.41	--	--	--	1.23	1.23	2.44	0.71	1.60	1.21	1.24
ME	3.89	4.25	4.00	4.10	2.82	3.53	2.94	3.17	2.80	2.97	2.27	2.52	2.38	3.00	2.95	2.54	2.40
MD	1.10	0.87	0.92	1.04	0.83	0.72	0.29	0.56	0.50	0.31	0.42	0.49	0.25	0.33	0.31	0.60	0.28
MA	1.99	2.07	2.06	1.62	1.48	1.77	1.46	1.22	1.37	0.99	1.30	1.40	1.29	1.94	1.30	1.29	1.26
NB	3.28	3.89	4.17	5.40	4.27	4.08	3.89	5.22	5.03	4.25	3.84	4.67	3.88	4.87	4.40	4.79	3.76
NH	4.42	3.14	3.11	3.20	2.76	3.74	2.16	2.67	2.23	4.48	3.54	3.88	3.57	4.52	3.10	3.16	3.48
NJ	1.82	2.12	1.59	1.49	1.02	0.95	0.77	0.73	0.32	0.73	0.91	0.18	0.61	0.70	0.50	0.48	0.33
NY	3.11	2.86	3.32	2.56	3.10	3.34	2.84	2.33	2.32	2.41	2.24	2.23	2.29	2.23	2.02	2.05	1.83
NS	2.53	2.27	2.47	2.69	1.85	2.26	2.51	2.73	2.06	2.54	2.60	1.98	2.30	2.30	2.74	2.67	2.09
PA	1.65	1.56	1.55	1.11	1.45	1.60	1.15	1.26	0.61	1.13	0.91	0.97	1.05	0.84	0.55	0.67	0.71
PEI[a]	3.74	2.61	4.16	4.00	3.27	2.42	2.39	2.28	2.33	2.73	3.11	2.66	2.89	2.45	2.86	2.97	--
QUE[a]	3.41	3.58	3.11	3.90	3.08	4.07	3.30	3.92	3.06	3.69	1.35	2.61	2.70	3.43	2.82	2.69	3.15
RI[a]	0.53	--	0.79	0.79	--	0.20	--	--	--	--	--	0.08	--	--	--	--	0.04
VT	2.63	2.83	3.35	3.10	2.95	2.89	1.88	1.98	2.00	2.25	1.70	2.22	2.46	2.39	3.27	1.88	1.85
VA	0.95	0.99	0.70	0.61	0.61	0.60	0.48	0.53	0.42	0.32	0.28	0.39	0.28	0.29	0.25	0.21	0.20
WV	0.94	1.08	0.86	0.89	0.94	0.87	0.87	0.76	0.67	1.16	0.74	0.83	0.69	0.73	0.83	0.68	0.63
Region	2.47	2.50	2.44	2.35	2.19	2.41	2.05	2.14	1.78	2.15	1.65	1.87	1.84	2.00	1.81	1.78	1.67
Central Region																	
IL	0.35	0.53	0.53	0.64	0.54	0.84	1.10	1.32	1.36	1.27	4.01	1.80	--	2.77	3.73	3.77	5.51
IN	0.87	0.63	0.61	0.61	0.69	0.72	0.57	0.59	0.52	0.54	0.45	0.37	0.74	0.48	0.41	0.47	0.28
MB	--	--	--	--	--	--	2.35	3.44	2.17	2.44	2.21	1.28	1.57	1.57	1.64	1.73	1.25
MI	4.83	4.48	4.89	4.68	4.58	5.40	3.85	3.87	3.51	3.79	3.63	3.55	4.22	3.38	3.63	3.31	3.36
MN	3.83	3.67	4.10	3.55	4.09	3.82	3.24	3.46	3.02	3.28	3.00	2.60	3.22	3.18	3.46	3.48	2.90
OH	1.18	1.28	1.53	1.05	1.43	1.09	0.97	0.98	0.82	0.83	0.87	0.68	0.73	0.57	0.64	0.54	0.44
ON	5.02	5.24	5.21	5.51	5.19	5.16	4.96	4.49	3.90	4.88	3.59	4.12	4.11	4.14	4.86	4.72	--
WI	3.52	3.50	3.50	3.24	3.16	3.20	2.55	2.51	2.35	2.38	2.49	2.33	2.28	2.73	2.53	2.31	2.13
Region	2.94	2.96	2.96	2.81	2.84	2.98	2.52	2.66	2.32	2.46	2.43	1.97	2.45	2.34	2.32	2.32	1.99
Continent	2.71	2.73	2.70	2.58	2.51	2.70	2.30	2.41	2.05	2.32	2.04	1.93	2.15	2.19	2.08	2.06	1.85

[a] Annual indices are unreliable due to small sample size.

[b] Insufficient data.

Table 3. Distribution of hunters contacted and hunters who submitted woodcock wings in the 2001-02 Wing-collection Survey.

State of residence	No. of hunters Contacted	No. of hunters who submitted wings	Percent who submitted wings
AL	28	0	0
AR	28	2	7
CT	172	31	18
DE	19	1	5
FL	95	0	0
GA	76	6	8
IL	136	21	15
IN	110	30	27
IA	65	6	9
KS	15	0	0
KY	30	1	3
LA	188	16	9
ME	365	77	21
MD	75	5	7
MA	358	77	22
MI	712	193	27
MN	497	97	20
MS	19	0	0
MO	122	15	12
NE	27	1	4
NH	187	46	25
NJ	139	20	14
NY	394	77	20
NC	99	6	6
ND	7	0	0
OH	173	30	17
OK	34	1	3
PA	441	68	15
RI	43	8	19
SC	74	18	24
TN	69	5	7
TX	67	1	1
VT	151	40	26
VA	131	16	12
WV	32	8	25
WI	885	165	19
Total	6,063	1,088	18

Table 4. Numbers of woodcock wings received from hunters, and indices of recruitment. Recruitment indices for individual states were calculated as the ratio of immatures per adult female. The regional indices for 2001 were calculated as the average of the state values, adjusted for comparability with the 1963-2000 average. Recruitment indices were not calculated for states where the sample of wings was <125.

State or Region of harvest	Wings received						Recruitment index	
	Total		Adult females		Immatures			
	1963-00	2001	1963-00	2001	1963-00	2001	1963-00	2001
Eastern Region								
CT	13,069	80	2,895	14	8,015	51	2.8	
DE	413	5	54	0	290	4	5.4	
FL	660	0	150	0	410	0	2.7	
GA	2,920	7	898	3	1,266	4	1.4	
ME	72,188	1,108	21,212	355	36,138	529	1.7	1.5
MD	3,817	26	953	5	2,132	18	2.2	
MA	18,949	304	5,720	100	9,416	134	1.6	1.3
NH	26,768	688	8,664	212	12,359	338	1.4	1.6
NJ	24,207	150	5,618	42	14,240	91	2.5	2.2
NY	50,750	578	16,774	201	23,625	265	1.4	1.3
NC	2,939	68	861	29	1,464	25	1.7	
PA	27,173	416	8,545	160	12,637	140	1.5	0.9
RI	2,231	15	417	3	1,510	9	3.6	
SC	2,250	62	685	27	1,081	21	1.6	
VT	19,894	417	6,357	156	9,325	169	1.5	1.1
VA	3,821	127	906	36	2,213	61	2.4	1.7
WV	5,125	31	1,560	12	2,598	13	1.7	
Region	277,174	4,082	82,269	1,355	138,719	1,872	1.7	1.4
Central Region								
AL	910	0	243	0	425	0	1.7	
AR	510	5	163	2	207	0	1.3	
IL	1,255	34	279	9	714	13	2.6	
IN	6,699	120	1,627	36	3,742	60	2.3	
IA	889	33	296	14	395	12	1.3	
KS	44	0	9	0	22	0		
KY	979	31	225	8	509	15	2.3	
LA	28,658	236	6,318	62	18,574	137	2.9	2.2
MI	98,093	2,527	30,805	867	49,144	1,176	1.6	1.4
MN	27,818	786	9,100	298	12,538	302	1.4	1.0
MS	1,716	3	486	2	875	0	1.8	
MO	2,633	70	639	22	1,326	34	2.1	
NE	10	3	4	1	5	1		
OH	13,456	192	4,007	52	6,380	96	1.6	1.8
OK	168	2	38	0	87	2	2.3	
TN	983	25	235	6	503	14	2.1	
TX	945	41	239	22	488	13	2.0	
WI	61,222	1,456	19,438	539	29,826	603	1.5	1.1
Region	246,988	5,564	76,050	1,940	125,760	2,478	1.7	1.3

Table 5. State and regional indices of daily and seasonal woodcock hunting success in 2000 and 2001. State and regional indices were calculated for states represented by ≥10 hunters who participated in the Wing-collection Survey both years. Regional indices were weighted as described by Clark (1970).

State of harvest	No. of successful hunters	No. of successful hunts		Woodcock bagged		Woodcock per successful hunt		Woodcock per season	
		2000	2001	2000	2001	2000	2001	2000	2001
Eastern Region									
CT	14	38	28	66	41	1.7	1.5	4.7	2.9
DE	1	1	2	2	4				
GA	1	1	2	3	2				
ME	82	335	374	700	817	2.1	2.2	8.5	10.0
MD	5	16	11	39	23				
MA	22	85	92	172	158	2.0	1.7	7.8	7.2
NH	47	271	275	582	588	2.1	2.1	12.4	12.5
NJ	15	48	50	94	101	2.0	2.0	6.3	6.7
NY	60	291	240	564	422	1.9	1.8	9.4	7.0
NC	4	26	30	56	68				
PA	40	116	140	227	296	2.0	2.1	5.7	7.4
RI	2	2	4	3	5				
SC	6	31	23	76	51				
VT	40	219	164	466	298	2.1	1.8	11.7	7.5
VA	10	57	46	126	101	2.2	2.2	12.6	10.1
WV	3	17	9	36	15				
Region	352	1,554	1,490	3,212	2,990	2.0	2.0	8.7	8.7
Central Region									
IL	3	3	4	5	4				
IN	12	43	33	101	65	2.3	2.0	8.4	5.4
KY	2	16	15	31	31				
LA	15	122	86	377	226	3.1	2.6	25.1	15.1
MI	198	1,089	1,085	2,145	2,199	2.0	2.0	10.8	11.2
MN	71	341	340	722	700	2.1	2.1	10.2	9.9
MO	7	12	14	17	28				
OH	14	100	87	221	184	2.2	2.1	15.8	13.1
TN	2	11	14	20	25				
WI	127	485	507	955	1,052	2.0	2.1	7.5	8.3
Region	453	2,225	2,189	4,600	4,520	2.0	2.1	10.7	10.5

Table 6. Preliminary state and regional estimates of woodcock hunter numbers, days afield, and harvest from the 1999-2000 and 2000-2001 Harvest Information Program harvest surveys.

	Active woodcock hunters		Days afield		Harvest	
	1999	2000	1999	2000	1999	2000
Eastern region						
AL	4,000 ± 42%	5,100 ± 111%	41,200 ± 70%	20,500 ± 127%	27,800 ± 76%	10,300 ± 144%
CT	2,100 ± 98%	1,900 ± 47%	14,500 ± 109%	9,000 ± 57%	300 ± 128%	1,900 ± 50%
DE	50 ± 192%	300 ± 163%	300 ± 193%	700 ± 88%	0	300 ± 116%
GA	2,300 ± 138%	1,000 ± 195%	11,600 ± 138%	1,000 ± 196%	18,600 ± 148%	2,100 ± 196%
ME	10,100 ± 13%	8,100 ± 44%	57,300 ± 18%	41,700 ± 50%	38,300 ± 24%	17,200 ± 51%
MD	3,400 ± 123%	300 ± 44%	5,800 ± 115%	1,100 ± 53%	2,600 ± 118%	600 ± 64%
MA	1,500 ± 93%	1,700 ± 43%	6,900 ± 69%	12,400 ± 76%	3,000 ± 80%	5,300 ± 51%
NH	1,600 ± 9%	3,000 ± 32%	10,700 ± 15%	16,000 ± 42%	7,500 ± 20%	7,300 ± 38%
NJ	1,100 ± 129%	1,700 ± 54%	3,900 ± 112%	7,200 ± 70%	3,600 ± 90%	3,500 ± 58%
NY	4,600 ± 51%	8,000 ± 54%	19,100 ± 41%	35,600 ± 61%	19,000 ± 55%	26,000 ± 73%
NC	8,000 ± 94%	3,800 ± 121%	14,000 ± 93%	8,400 ± 75%	10,200 ± 101%	5,700 ± 82%
PA	14,900 ± 43%	9,800 ± 50%	57,000 ± 51%	36,800 ± 62%	19,200 ± 49%	11,600 ± 53%
RI	100 ± 35%	200 ± 132%	500 ± 45%	600 ± 111%	300 ± 48%	200 ± 83%
SC	3,100 ± 102%	4,400 ± 90%	13,800 ± 126%	15,800 ± 115%	1,400 ± 76%	11,400 ± 117%
VT	1,800 ± 109%	2,000 ± 59%	6,300 ± 67%	14,500 ± 86%	4,400 ± 55%	6,300 ± 59%
VA	300 ± 28%	300 ± 29%	1,500 ± 41%	1,400 ± 33%	1,800 ± 49%	1,600 ± 46%
WV	na	600 ± 90%	na	1,900 ± 107%	na	4,900 ± 125%
Region	na	na	223,300 ± 21%	204,100 ± 23%	130,400 ± 26%	105,800 ± 26%
Central region						
AR	1,400 ± 171%	6,500 ± 76%	19,800 ± 183%	54,200 ± 92%	26,500 ± 182%	30,800 ± 136%
IA	800 ± 87%	200 ± 34%	4,300 ± 116%	500 ± 61%	4,000 ± 124%	600 ± 56%
IL	1,900 ± 125%	3,700 ± 89%	5,300 ± 116%	14,300 ± 91%	3,900 ± 178%	3,000 ± 115%
IN	4,800 ± 77%	1,300 ± 147%	24,300 ± 129%	11,800 ± 164%	6,600 ± 123%	4,100 ± 95%
KS	1,300 ± 138%	50 ± 103%	4,600 ± 139%	200 ± 134%	0	50 ± 188%
KY	100 ± 200%	0	1400 ± 195%	0	100 ± 196%	0
LA	7,200 ± 71%	10,300 ± 51%	42,700 ± 75%	47,800 ± 65%	78,600 ± 85%	43,000 ± 59%
MI	21,600 ± 25%	18,700 ± 26%	113,300 ± 38%	84,600 ± 30%	67,000 ± 35%	83,700 ± 53%
MS	100 ± 58%	50 ± 77%	500 ± 63%	100 ± 112%	700 ± 77%	100 ± 131%
MN	14,600 ± 32%	20,000 ± 28%	77,400 ± 42%	83,500 ± 30%	54,600 ± 57%	51,200 ± 35%
MO	500 ± 31%	2,800 ± 105%	1,600 ± 41%	8,600 ± 119%	800 ± 65%	500 ± 74%
NE	1,500 ± 108%	1,800 ± 84%	9,600 ± 155%	13,500 ± 134%	5,500 ± 185%	16,800 ± 149%
OH	3,000 ± 84%	16,200 ± 56%	8,600 ± 89%	96,000 ± 82%	3,600 ± 106%	33,500 ± 143%
OK	2,500 ± 88%	100 ± 62%	7,300 ± 106%	500 ± 167%	12,700 ± 120%	200 ± 193%
TN	4,500 ± 96%	3,200 ± 185%	14,800 ± 109%	7,700 ± 157%	19,100 ± 23%	1,200 ± 175%
TX	14,400 ± 112%	0	28,800 ± 122%	0	9,600 ± 196%	0
WI	24,800 ± 21%	21,400 ± 32%	103,700 ± 27%	109,200 ± 35%	47,100 ± 144%	50,400 ± 47%
Region	na	na	509,300 ± 19%	553,100 ± 21%	368,200 ± 28%	329,500 ± 28%

Appendix 1. History of framework dates, season lengths, and daily bag limits for hunting American woodcock in the Eastern and Central Regions, 1918-2001.

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	*Sep. 20 - Jan. 31	45	3
1985-96	Oct. 1 - Jan. 31	45	3	1998	*Sep. 19 - Jan. 31	45	3
1997-01	Oct. 6 - Jan. 31	30	3	1999	*Sep. 25 - Jan. 31	45	3
				2000	*Sep. 23 - Jan. 31	45	3
				2001	*Sep. 22 - Jan. 31	45	3

* Saturday nearest September 22.