WETLAND WILDLIFE POPULATIONS

Wetland Wildlife Populations and Research
102 23rd Street
Bemidji, MN 56601
(218) 308-2282

2017 WATERFOWL BREEDING POPULATION SURVEY MINNESOTA

Steve Cordts, Minnesota DNR, Waterfowl Staff Specialist

ABSTRACT:

The number of breeding waterfowl in a portion of Minnesota has been estimated each year since 1968 as a part of the overall inventory of North American breeding waterfowl. The survey consists of aerial observations in addition to more intensive ground counts on selected routes to determine the proportion of birds counted by the aerial crew. Procedures used are similar to those used elsewhere across the waterfowl breeding grounds. The 2017 aerial survey portion was flown from May 2-11. Spring ice-out dates in the southern 2/3 of the state were near record early and ~3 weeks earlier than median dates. In the northern 1/3 of the state, ice out dates were about 1 week earlier than median dates. Temperatures were well above normal in February, near normal in March, above normal in April, and below normal in May. Precipitation was above normal in April and May. Overall, wetland numbers (Types II-V) were 20% higher than 2016 and near the 10-year (-6%) and long-term (5%) averages.

The 2017 estimated mallard breeding population was 214,000, which was 15% below last year's estimate of 250,000 mallards, but statistically unchanged (P=0.50). Mallard numbers were 16% below the 10-year average and 6% below the long-term average of 228,000 breeding mallards. The estimated blue-winged teal population was 159,000, which was 51% below last year's estimate of 324,000 blue-winged teal, but statistically unchanged (P=0.13). Blue-winged teal numbers were 1% below the 10-year average and 25% below the long-term average of 214,000 blue-winged teal. The combined population index of other ducks, excluding scaup, was 263,000 ducks, which was 23% higher than last year's estimate and 48% above the 10-year average and 48% above the long-term average of 178,000 other ducks.

The estimate of total duck abundance (636,000), which excludes scaup, was 19% below last year's estimate and 7% above the 10-year average and 3% above the long-term average of 620,000 ducks. The estimated number of Canada geese was 152,000 and 30% higher than last year and 1% above the 10-year average.

METHODS:

The aerial survey is based on a sampling design that includes three survey strata (Table 1, Fig. 1). The strata cover 39% of the state area and are defined by density of lake basins (>10 acres) exclusive of the infertile northeastern lake region. The strata include the following:

Stratum I: high density, 21 or more lake basins per township.

Stratum II: moderate density, 11 to 20 lake basins per township.

Stratum III: low density, 2 to 10 lake basins per township.

Areas with less than two basins per township are not surveyed. Strata boundaries were based upon "An Inventory of Minnesota Lakes" (Minnesota Conserv. Dept. 1968:12). Standard procedures for the survey follow those outlined in "Standard Operating Procedures for Aerial Waterfowl Breeding Ground Populations and Habitat Surveys in North America" (USFWS/CWS

1987). Changes in survey methodology were described in the 1989 Minnesota Waterfowl Breeding Population Survey report. Pond and waterfowl data for 1968-74 were calculated from Jessen (1969-72) and Maxson and Pace (1989).

All aerial transects in Strata I-III (Table 1) were flown using an American Champion Scout. Wetlands were counted on only the observer's side of the plane (0.125 mile wide transect); a correction factor obtained in 1989 (123,000/203,000 = 0.606) was used to adjust previous estimates (1968-88) of wetland abundance (Type II-V; Table 2) that were obtained when the observer counted wetlands on both sides of the plane (0.25 mile wide transect). All wetland and waterfowl data were recorded on digital voice recorders and transcribed by the observer from the digital files.

Visibility correction factors (VCFs) were derived from intensive ground surveys on 14 selected routes flown by the aerial crew. Many of these routes use a county road as the mid-point of the transect boundary which aids in navigation and helps ensure the aerial and ground crews survey the same area. Ground routes each originally included about 100 wetland areas; however, drainage has reduced the number of wetlands on most of the routes. All observations from both ground crews and aerial crews were used to calculate the VCFs.

The SAS computer program was modified in 1992 to obtain standard errors for mallard and blue-winged teal breeding population estimates. These calculations were based upon SAS computer code written by Graham Smith, USFWS-Office of Migratory Bird Management. Estimates for 2016 and 2017 were compared using two-tailed Z-tests.

SURVEY CHRONOLOGY:

The 2017 aerial survey began on 2 May in southern Minnesota and concluded in northern Minnesota on 11 May. Transects were flown on 9 days (no flight May 8) and completed in 53 flight hours. Flights began near 7 AM and were completed by 12:00 PM each day. The median date for survey completion was May 6, which was 1 day earlier than last year.

WEATHER AND HABITAT CONDITIONS*:*

For the southern part of the state, ice out was extremely early with many lakes at or near their earliest dates on record and in general, about 3-4 weeks earlier than median ice out dates. In northern Minnesota, ice out dates were later but still about 1-2 weeks earlier than median dates. Temperatures in February averaged 9°F above normal statewide. Temperatures in March averaged 0.1°F above normal and precipitation was 0.4 inches below normal statewide. Temperatures in April averaged 1.4°F above normal and precipitation was 0.37 inches above normal statewide. Temperatures in May averaged 1.7°F below normal statewide and precipitation was 0.9 inches above normal statewide (http://climate.umn.edu). Precipitation during the period of time just prior to and during the survey showed above average precipitation in eastern MN and near average precipitation across the rest of the state (Appendix A).

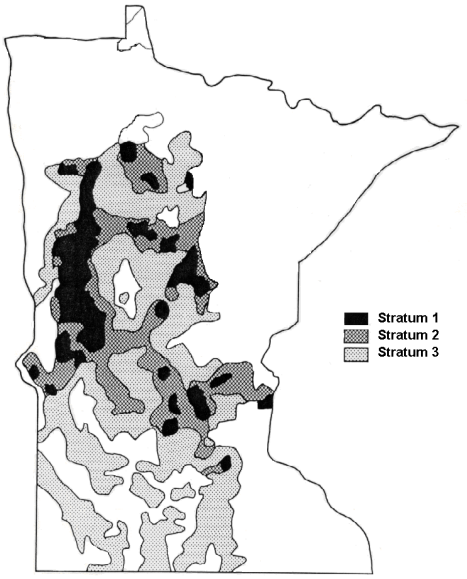

Figure 1. Location of waterfowl breeding population survey strata

Overall wetland conditions in spring 2017 were improved some from last year. In early May 2017, the U.S. drought monitor indicated 0% of the state was under any dryness designation compared to 9% of the state classed as abnormally dry last year. By late May, 95% of the state was under no drought designation and 5% of NW MN was classified as abnormally

dry. On May 1, 2017 statewide topsoil moisture indices were rated as 0% very short, 1% short, 70% adequate and 29% surplus moisture. By May 30, statewide topsoil moisture indices were rated as 0% very short, 1% short, 76% adequate and 23% surplus moisture (http://droughtmonitor.unl.edu).

Wetland numbers (Types II-V) in 2017 were 265,000 ponds which was 20% above last year's estimate of 221,000 ponds. Wetland numbers were 6% below the 10-year average and 5% above the long-term average (Table 2; Fig. 2). The number of temporary (Type 1) sheet water wetlands was 55% higher than last year and 11% below the long-term average.

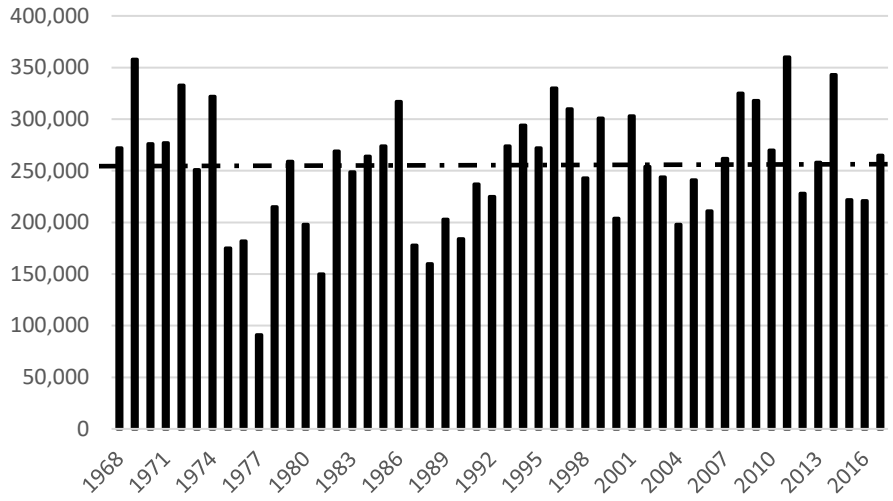

Figure 2. Number of May ponds (Type II-V) and long-term average (dashed line) in Minnesota, 1968-2017.

Planting dates for row crops were late in 2017. By May 1, about 12% of the corn acres had been planted which was 13 days behind last year and 9 days behind average. By May30th, about 14% of alfalfa hay had been cut, 9 days behind last year and 3 days behind average (Minnesota Agricultural Statistics Service Weekly Crop Weather Reports, (http://www.nass.usda.gov/mn/).

WATERFOWL POPULATIONS:

The number of ducks, Canada geese, coots, and swans, by stratum, are shown in Tables 3-5; total numbers are presented in Table 6. These estimates are expanded for area but not corrected for visibility bias. Table 7 and Table 8 provide the unadjusted population index (Unad. PI), which is multiplied by the visibility correction factor (VCF) to obtain the population index (PI) for ducks and Canada geese. The standard error (SE) of the estimate is also provided for mallard and blue-winged teal estimates.

The 2017 breeding population estimate of mallards was 213,644 (SE = 32,704), which was 15% lower than the 2016 estimate of 250,204 mallards, but statistically unchanged (Z = 0.68, P = 0.50) (Table 7, Fig. 3). Mallard numbers were 16% below the 10-year average and 6% below the long-term average of 228,000 mallards. In 2017, the mallard population was comprised of 73% lone or flocked males, 16% pairs, and 11% flocked mallards. The 5-year average is 71% lone or flocked males, 21% pairs, and 9% flocked mallards.

The estimated blue-winged teal population was 159,483 (SE = 55,100), which was 51% lower than the 2016 estimate of 323,916 blue-winged teal, but statistically unchanged (Z = 1.50, P = 0.13). Blue-winged teal numbers were 1% below the 10-year average and 25% below the long-term average (Table 7, Fig. 4). The blue-winged teal population was comprised of 7% lone males, 37% pairs, and 55% flocks. The long-term average is 10% lone males, 43% pairs, and 48% flocks.

The combined population estimate of other ducks (excluding scaup) was 262,867 which was 23% above last year's estimate of 212,967 other ducks and 48% above the 10-year average and 48% above the long-term average (Table 7, Fig. 5). Ring-necked ducks and wood ducks were the most abundant species of other ducks (Table 6). Scaup numbers (77,000) were 39% above last year's estimate and 27% above the long-term average.

The total duck population index, excluding scaup, was 636,000 ducks and was 19% below last year's index of 787,000 ducks and 7% above the 10-year average and 3% above the long-term average (Table 8, Fig. 6).

The population index for total ducks was 713,000 ducks, which was 15% above the 10-year average and 5% above the long-term average.

Visibility Correction Factors (VCFs) were lower for mallards, blue-winged teal, and other ducks in 2017 compared to 2016 (Table 7, Table 8). The mallard VCF (2.04) was 23% below the 10-year average. The blue-winged teal VCF (2.51) was 36% below the 10-year average. The VCF for other ducks (2.20) was 23% below the 10-year average. The VCF for Canada geese (2.16) was 9% above the 10-year average.

The population estimate of Canada geese (adjusted for visibility) was 152,000, which was 30% above last year's estimate and 1% above the 10-year average (Table 8, Fig. 7). A total of 43 Canada goose broods were observed, compared to 56 in 2016.

The estimated coot population, uncorrected for visibility, was 31,000 compared to 16,000 in 2016.

The estimated number of swans (likely trumpeters) was 17,230 swans compared to last year's estimate of 13,400 (Table 6; Fig. 8). Lone swans are not doubled and the estimate is expanded for area but not visibility, although visibility of swans is extremely high. Trumpeter swans continue to expand their range and dramatically increase in number.

ACKNOWLEDGMENTS:

Thanks to the ground crews and the pilot for all of their efforts. This project was funded in part by the Wildlife Restoration (Pittman-Robertson) Program.

Data supplied by: Minnesota Department of Natural Resources (MNDNR) and U.S. Fish and Wildlife Service (USFWS)

Air Crew:

Pilot/Observer: Bob Geving, Conservation Officer Pilot, MNDNR, Division of Enforcement

Observer: Steve Cordts, Waterfowl Staff Specialist, MNDNR, Division of Wildlife

Ground Crew Leaders: Sean Kelly, Deputy Chief, Migratory Birds, USFWS, Region III, Twin Cities; Wayne Brininger, USFWS, Tamarac National Wildlife Refuge; Dan Hertel and Natalee Yates, USFWS, HAPET, Fergus Falls; Tom Cooper, Andy Forbes, and Jim Kelley, USFWS, Twin Cities; Jeff Lawrence, Minnesota DNR; Greg Dehmer, USFWS, Sherburne National Wildlife Refuge

Ground Crew Assistants: Jason Strege, Minnesota DNR; Gina Kemper and Ken Mattson, USFWS, Tamarac National Wildlife Refuge; Adam Weishair and Joseph Schmit, USFWS, HAPET, Fergus Falls; Kelly Van Beek and Beth Rigby, USFWS, Twin Cities; Kris Spaeth, USFWS, Sherburne National Wildlife Refuge

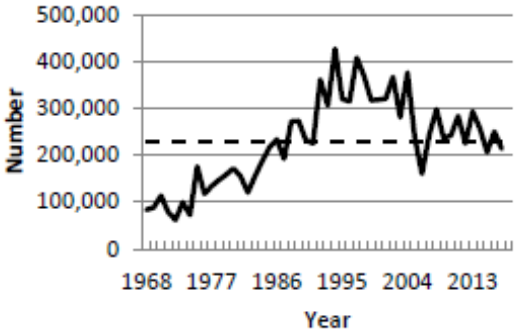

Figure 3. Mallard population estimates (adjusted for visibility bias) and long-term average (dashed line) in Minnesota, 1968-2017.

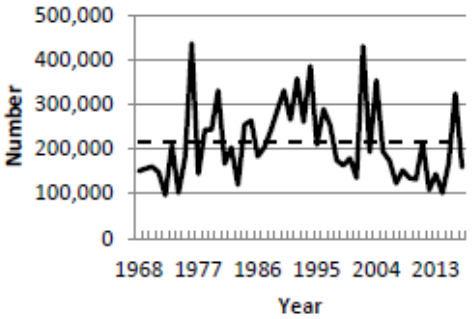

Figure 4. Blue-winged teal population estimates (adjusted for visibility bias) and long-term average (dashed line) in Minnesota, 1968-2017.

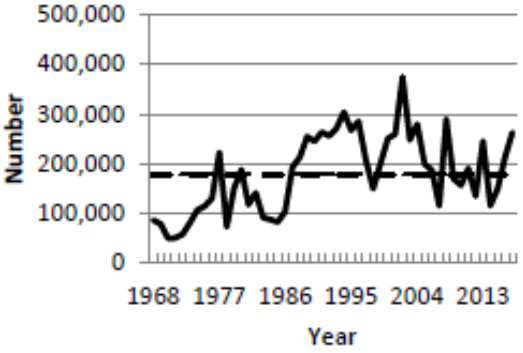

Figure 5. Other duck (excluding scaup) population estimates (adjusted for visibility bias) and long-term average (dashed line) in Minnesota, 1968-2017.

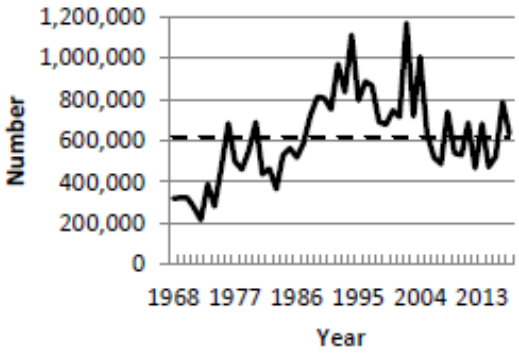

Figure 6. Total duck (excluding scaup) population estimates (adjusted for visibility bias) and long-term average (dashed line) in Minnesota, 1968-2017.

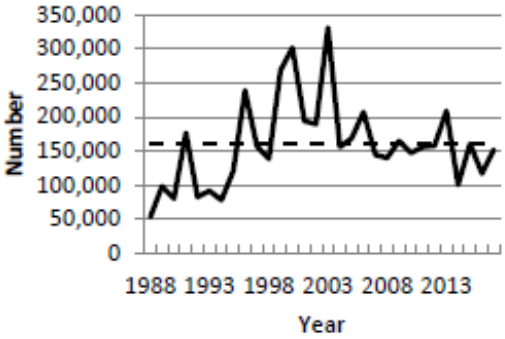

Figure 7. Canada goose population (adjusted for visibility bias) and long term average (dashed line) in Minnesota, 1988-2017.

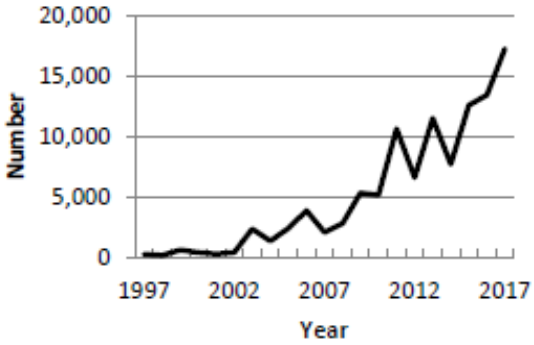

Figure 8. Trumpeter swan population in Minnesota, 1997-2017.

LITERATURE CITED:

Jessen, R. J. 1969. Waterfowl breeding ground survey, 1968. Minn. Game Research Proj. Q. Prog. Rep. 29(32):173-180.

Jessen, R. J. 1971. Waterfowl breeding ground survey, 1969. Minn. Game Research Proj. Q. Prog. Rep. 31(2):100-106.

Jessen, R. J. 1971. Waterfowl breeding ground survey, 1970. Minn. Game Research Proj. Q. Prog. Rep. 31(2):107-113.

Jessen, R. J. 1971. Waterfowl breeding ground survey, 1971. Minn. Game Research Proj. Q. Prog. Rep. 31(2):114-120.

Jessen, R. J. 1972. Waterfowl breeding ground survey, 1972. Minn. Game Research Proj. Q. Prog. Rep. 32(2):89-95.

Minnesota Conservation Department. 1968. An inventory of Minnesota Lakes. Waters Section, Division of Waters, Soils, and Minerals, Bull. No. 25. 498pp.

Maxson, S. J., and R. M. Pace. 1989. Summary and evaluation of Minnesota's waterfowl breeding population survey, 1972-1986. Minnesota Wildl. Rep. 7. 92pp.

USFWS/CWS. 1987. Standard operating procedures for aerial waterfowl breeding ground population and habitat surveys in North America. U.S. Fish and Wildlife Service and Canadian Wildlife Service.

Table 1. Survey design for Minnesota, May 2017.[1]

	Stratum			
	1	2	3	Total
Survey design				
Square miles in stratum	5,075	7,970	17,671	30,716
Square miles in sample - waterfowl	182.75	136.375	203.125	522.25
Square miles in sample - ponds	91.375	68.1875	101.5625	261.125
Linear miles in sample	731.0	545.5	812.5	2,089.0
Number of transects in sample	39	36	40	115
Minimum transect length (miles)	5	6	7	5
Maximum transect length (miles)	36	35	39	39
Expansion Factor - waterfowl	27.770	58.442	86.996	
Expansion Factor - ponds	55.540	116.884	173.991	
Current year coverage				
Square miles in sample - waterfowl	182.75	136.375	203.125	522.25
Square miles in sample - ponds	91.375	68.1875	101.5625	261.125
Linear miles in sample	731.0	545.5	812.5	2,089.0
Number of transects in sample	39	36	40	115
Minimum transect length (miles)	5	6	7	5
Maximum transect length (miles)	36	35	39	39
Expansion Factor - waterfowl	27.770	58.442	86.996	
Expansion Factor - ponds	55.540	116.884	173.991	

[1] Also, 8 additional air-ground transects (total linear miles = 202.5, range - 10-60 miles) were flown to use in calculating the VCF.

Table 2. Estimated May ponds (Type 1 and Types II-V), 1968-2017.

Year	Number of Ponds[1]	Year	Type 1 wetlands	Number of Ponds[1]
1968	272,000	1991	82,862	237,000
1969	358,000	1992	10,019	225,000
1970	276,000	1993	199,870	274,000
1971	277,000	1994	123,958	294,000
1972	333,000	1995	140,432	272,000
1973	251,000	1996	147,859	330,000
1974	322,000	1997	30,751	310,000
1975	175,000	1998	20,560	243,000
1976	182,000	1999	152,747	301,000
1977	91,000	2000	5,090	204,000
1978	215,000	2001	66,444	303,000
1979	259,000	2002	30,602	254,000
1980	198,000	2003	34,005	244,000
1981	150,000	2004	9,494	198,000
1982	269,000	2005	30,764	241,000
1983	249,000	2006	56,798	211,000
1984	264,000	2007	32,415	262,000
1985	274,000	2008	69,734	325,000
1986	317,000	2009	39,078	318,000
1987	178,000	2010	26,880	270,000
1988	160,000	2011	89,218	360,000
1989	203,000	2012	30,910	228,000
1990	184,000	2013	9,813	258,000
		2014	54,300	343,000
		2015	22,056	222,000
		2016	34,487	221,000
		2017	53,576	265,000
	Averages:	10-year	41,000	281,000
		Long-term	60,000	253,000
	% change from:	2016	55%	20%
		10-year	31%	-6%
		Long-term	-11%	5%

[1] Type II-V, correction factor from 1989 (123,000/203,000=0.606) used to adjust 1968-88 pond numbers.

Table 3. Minnesota waterfowl breeding populations by species for Stratum I (high wetland density), expanded for area but not visibility, 2000-2017.

	Year																	
Species	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Dabblers:																		
Mallard	26,604	28,742	29,297	25,937	29,381	19,050	16,829	16,357	25,104	19,467	18,439	19,856	18,911	21,161	19,522	19,633	26,020	21,688
Black Duck	0	0	0	0	0	56	0	0	0	0	0	0	0	333	167	222	0	56
Gadwall	833	1,333	944	1,250	2,111	1,166	1,444	889	1,166	1,055	1,000	167	1,389	722	555	1,083	1,000	2,138
American Wigeon	56	111	0	56	555	167	0	56	111	56	56	111	222	222	167	111	111	167
Green-winged Teal	278	56	278	222	444	56	56	167	278	167	56	56	56	0	0	56	111	278
Blue-winged Teal	11,247	7,387	14,218	9,664	23,771	9,303	5,665	5,332	9,942	5,998	7,304	4,665	5,110	4,193	3,388	4,360	6,998	8,609
Northern Shoveler	1,055	305	1,277	278	1,166	333	167	56	1,000	666	1,027	111	56	333	722	111	666	916
Northern Pintail	167	389	56	111	56	0	56	0	56	56	0	111	0	111	167	222	0	111
Wood Duck	10,219	6,720	2,888	4,499	8,081	5,498	3,555	2,666	6,665	4,277	3,999	3,416	4,138	3,249	2,527	2,222	5,610	4,971
Dabbler Subtotal	50,459	45,043	48,958	42,017	65,565	35,629	27,772	25,523	44,322	31,742	31,881	28,493	29,882	30,324	27,215	28,020	40,516	38,934
Divers:																		
Redhead	583	1,444	750	333	805	666	666	916	1,389	472	944	805	750	861	1,333	583	2,166	1,000
Canvasback	1,222	2,027	1,833	1,333	666	972	833	1,000	2,277	1,333	1,222	833	722	1,555	1,777	1,027	1,944	2,666
Scaup	7,415	5,832	2,444	2,055	5,971	4,110	111	555	6,276	8,553	2,777	2,222	1,055	1,000	1,250	5,526	10,969	7,359
Ring-necked Duck	4,776	2,444	2,777	1,361	5,165	1,722	2,055	1,555	21,494	6,859	3,138	4,804	2,666	3,582	4,554	3,110	8,220	12,608
Goldeneye	56	333	111	0	222	222	56	222	278	278	222	56	56	333	444	278	278	1,000
Bufflehead	56	111	222	111	389	167	222	56	1,611	833	389	278	56	611	56	278	500	2,444
Ruddy Duck	0	83	1,305	417	305	1,222	305	0	1,027	861	28	56	0	305	111	694	1,500	222
Hooded Merganser	500	722	555	333	278	333	555	111	666	944	555	500	555	333	666	1,000	1,222	1,222
Large Merganser	0	111	0	972	0	111	0	278	333	333	333	111	56	222	139	167	56	167
Diver Subtotal	14,608	13,107	9,997	6,915	13,801	9,525	4,803	4,693	35,351	20,466	9,608	9,665	5,916	8,802	10,330	12,663	26,855	28,688
Total Ducks	65,067	58,150	58,955	48,932	79,366	45,154	32,575	30,216	79,673	52,208	41,489	38,158	35,798	39,126	37,545	40,683	67,371	67,622
Other:																		
Coot	3,999	1,722	2,888	2,666	21,411	2,444	639	139	16,829	2,166	139	2,194	444	10,386	2,360	1,972	10,608	13,191
Canada Goose	22,160	24,882	24,104	22,160	23,160	22,938	21,633	29,797	18,717	16,523	16,440	13,691	26,437	23,771	18,578	23,077	17,995	18,273
Swan	0	0	111	1,000	305	417	861	389	694	500	694	1,611	1,277	2,944	1,944	2,472	3,693	4,054

Table 4. Minnesota waterfowl breeding populations by species for Stratum II (medium wetland density), expanded for area but not visibility, 2000-2017.

	Year																	
Species	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Dabblers:																		
Mallard	49,559	44,650	43,773	34,715	44,474	26,883	25,130	24,779	27,935	23,494	21,507	30,974	29,689	27,409	28,987	24,078	32,085	26,299
Black Duck	0	117	0	0	0	0	0	0	0	0	0	0	0	0	0	117	0	0
Gadwall	3,039	1,636	701	584	3,565	584	1,052	234	3,039	1,169	1,286	935	1,987	701	234	818	1,286	4,442
American Wigeon	468	0	0	0	2,513	117	0	0	351	0	351	0	117	234	0	234	234	1,052
Green-winged Teal	117	117	468	234	234	0	117	0	0	234	117	0	0	117	351	584	0	0
Blue-winged Teal	19,637	9,701	21,390	15,955	30,624	11,513	9,000	8,416	12,740	11,104	8,474	12,390	9,000	4,383	7,364	5,026	10,753	15,487
Northern Shoveler	4,675	1,052	2,221	1,403	1,753	234	584	351	468	701	2,513	1,052	0	351	935	877	935	3,857
Northern Pintail	117	117	0	117	0	0	0	234	0	0	0	234	0	0	117	0	0	0
Wood Duck	13,792	7,831	5,143	4,558	8,766	3,273	1,753	2,221	6,546	5,260	6,312	6,955	5,143	4,792	1,636	1,753	4,149	4,851
Dabbler subtotal	91,404	65,221	73,696	57,566	91,929	42,604	37,636	36,235	51,079	41,962	40,560	52,540	45,936	37,987	39,624	33,487	49,442	55,988
Divers:																		
Redhead	2,805	2,455	234	584	1,110	292	175	935	935	584	760	1,578	468	468	526	468	1,110	818
Canvasback	935	0	468	1,052	234	0	0	1,169	468	234	117	584	117	935	1,286	1,169	1,403	2,338
Scaup	6,779	3,039	5,961	2,279	7,188	2,981	468	643	3,097	2,104	0	1,929	935	2,045	2,396	4,909	5,318	5,260
Ring-necked Duck	5,610	3,799	6,370	2,455	5,377	1,929	3,331	1,578	13,149	9,117	2,396	11,455	1,695	6,253	5,143	4,325	4,792	9,292
Goldeneye	584	468	234	234	351	117	117	0	351	584	468	468	584	935	1,519	935	1,169	818
Bufflehead	0	0	1,169	117	468	351	117	117	1,403	818	643	1,403	468	0	818	0	234	2,279
Ruddy Duck	0	0	1,870	2,688	0	351	58	0	0	175	409	58	234	117	0	351	643	468
Hooded Merganser	935	1,403	701	701	234	234	351	234	584	701	117	2,221	1,636	701	234	1,169	2,455	3,448
Large Merganser	117	117	0	0	234	351	0	0	351	0	0	234	0	234	117	234	117	0
Diver subtotal	17,765	11,281	17,007	10,110	15,196	6,606	4,617	4,676	20,338	14,317	4,910	19,930	6,137	11,688	12,039	13,560	17,241	24,721
Total Ducks	109,169	76,502	90,703	67,676	107,125	49,210	42,253	40,911	71,417	56,279	45,470	72,470	52,073	49,675	51,663	47,047	66,683	80,709
Other:																		
Coot	1,110	468	4,909	1,519	8,007	584	292	409	23,961	0	117	292	292	2,571	877	0	0	6,370
Canada Goose	25,831	24,604	20,688	22,091	28,461	20,688	26,825	25,890	19,753	22,675	18,935	14,201	23,260	22,442	20,572	24,312	17,533	21,799
Swan	58	117	292	994	701	1,461	994	468	1,519	2,922	2,279	7,188	3,507	6,604	3,740	5,318	4,325	5,084

Table 5. Minnesota waterfowl breeding populations by species for Stratum III (low wetland density), expanded for area but not visibility, 2000-2017.

	Year																	
Species	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Dabblers:																		
Mallard	81,690	72,642	72,121	55,156	84,561	36,539	30,884	35,843	50,371	35,408	40,976	51,415	47,848	62,638	62,899	51,154	59,593	56,983
Black Duck	0	0	0	0	174	0	0	174	174	0	0	0	174	174	0	0	0	0
Gadwall	2,610	10,701	3,306	1,566	6,960	2,001	5,568	4,176	870	1,392	1,392	4,089	1,566	5,220	1,914	2,088	9,570	5,046
American Wigeon	522	174	1,218	174	1,566	1,044	174	348	348	174	348	1,044	174	348	174	1,566	870	174
Green-winged Teal	1,218	1,392	522	174	0	174	522	0	0	0	0	174	348	696	0	348	0	348
Blue-winged Teal	29,405	20,618	56,374	21,140	39,758	27,578	23,663	15,659	18,095	20,183	16,964	44,716	35,669	18,617	21,227	24,098	53,155	39,323
Northern Shoveler	20,444	10,701	6,264	870	3,828	348	522	870	4,002	2,088	6,873	2,088	8,265	6,786	522	1,914	4,959	3,219
Northern Pintail	696	522	0	174	348	174	174	348	174	0	174	0	174	174	0	174	522	174
Wood Duck	25,055	17,225	13,572	12,702	20,705	7,482	7,308	5,394	14,442	10,266	12,354	13,659	10,962	12,180	9,657	8,265	8,700	16,094
Dabbler subtotal	161,640	133,975	153,377	91,956	157,900	75,340	68,815	62,812	88,476	69,511	79,081	117,185	105,180	106,833	96,393	89,607	137,369	121,361
Divers:																		
Redhead	2,523	3,654	1,305	174	1,740	1,479	0	522	783	870	174	4,350	3,306	1,827	1,566	1,305	1,044	3,480
Canvasback	3,915	522	696	1,131	2,784	0	0	348	1,566	1,218	348	1,044	1,044	696	522	696	348	1,914
Scaup	18,182	6,873	4,611	783	17,747	5,307	1,392	696	5,481	1,914	522	5,133	696	8,874	2,871	435	3,915	22,271
Ring-necked Duck	8,178	8,526	7,395	1,479	5,133	10,179	6,699	1,392	8,526	6,525	3,045	6,264	9,135	6,960	5,568	3,480	4,089	18,095
Goldeneye	1,044	1,566	3,132	1,305	696	1,044	1,044	870	348	522	174	870	0	348	174	1,218	870	1,566
Bufflehead	0	0	1,218	783	2,088	0	174	696	1,218	870	174	2,871	174	3,915	4,698	522	2,523	1,740
Ruddy Duck	0	696	18,878	87	2,262	870	696	261	87	348	0	3,828	522	522	174	0	87	1,305
Hooded Merganser	957	174	2,175	174	1,740	1,218	870	174	696	348	1,218	1,044	1,044	348	348	522	1,392	1,653
Large Merganser	0	0	522	0	0	261	957	348	348	348	348	174	174	0	0	0	870	957
Diver subtotal	34,799	22,011	39,932	5,916	34,190	20,358	11,832	5,307	19,053	12,963	6,003	25,578	16,095	23,490	15,921	8,178	15,138	52,981
Total Ducks	196,439	155,986	193,309	97,872	192,090	95,698	80,647	68,119	107,529	82,474	85,084	142,763	121,275	130,323	112,314	97,785	152,507	174,342
Other:																		
Coot	67,684	3,132	14,007	7,134	77,427	8,613	14,702	5,742	15,137	7,047	435	1,479	25,664	27,578	15,746	7,917	5,829	10,962
Canada Goose	57,940	39,932	33,407	43,412	46,717	39,758	27,230	42,629	31,841	28,274	30,710	32,711	37,496	48,022	24,707	43,498	31,145	30,101
Swan	348	174	0	348	348	522	2,001	1,218	609	1,914	2,175	1,827	1,827	2,088	2,001	4,785	5,394	8,091

Table 6. Minnesota waterfowl breeding populations by species for Stratum I-III combined, expanded for area coverage but not for visibility, 2000-2017.

	Year																	
Species	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Dabblers:																		
Mallard	157,853	146,034	145,191	115,974	158,416	82,472	72,843	76,979	103,411	78,368	80,922	102,245	96,448	111,208	111,408	94,866	117,698	104,970
Black Duck	0	117	0	0	174	56	0	174	174	0	0	0	174	507	167	339	0	56
Gadwall	6,482	13,670	4,951	3,400	12,635	3,752	8,064	5,298	5,075	3,616	3,677	5,191	4,941	6,643	2,703	3,989	11,855	11,626
American Wigeon	1,045	285	1,218	230	4,634	1,327	174	404	810	230	754	1,155	513	804	341	1,911	1,215	1,393
Green-winged Teal	1,613	1,564	1,267	630	678	230	694	167	278	400	172	230	404	813	351	988	111	626
Blue-winged Teal	60,288	37,706	91,982	46,759	94,152	48,394	38,328	29,407	40,777	37,286	32,742	61,772	49,779	27,194	31,979	33,484	70,907	63,418
Northern Shoveler	26,175	12,058	9,762	2,550	6,747	915	1,273	1,276	5,469	3,456	10,413	3,251	8,320	7,470	2,179	2,902	6,560	7,992
Northern Pintail	979	1,028	56	402	404	174	230	582	230	56	174	345	174	285	284	396	522	285
Wood Duck	49,067	31,777	21,603	21,759	37,553	16,253	12,616	10,281	27,652	19,802	22,664	24,029	20,242	20,221	13,820	12,240	18,459	25,916
Dabbler subtotal	303,502	244,239	276,030	191,704	315,393	153,573	134,222	124,568	183,876	143,214	151,518	198,218	180,995	175,145	163,232	151,115	227,327	216,282
Divers:																		
Redhead	5,911	7,552	2,289	1,092	3,656	2,438	842	2,373	3,107	1,926	1,878	6,733	4,523	3,155	3,425	2,356	4,320	5,298
Canvasback	6,072	2,549	2,996	3,516	3,684	972	833	2,517	4,311	2,785	1,687	2,461	1,883	3,186	3,585	2,892	3,694	6,918
Scaup	32,376	15,743	13,016	5,117	30,906	12,397	1,971	1,894	14,854	12,571	3,299	9,283	2,686	11,919	6,517	10,870	20,202	34,890
Ring-necked Duck	18,565	14,768	16,542	5,294	15,675	13,829	12,085	4,525	43,169	22,501	8,579	22,523	13,495	16,795	15,265	10,915	17,101	39,995
Goldeneye	1,684	2,367	3,477	1,539	1,269	1,383	1,216	1,092	976	1,384	864	1,393	640	1,616	2,138	2,431	2,317	3,384
Bufflehead	56	111	2,609	1,011	2,944	517	513	868	4,231	2,521	1,206	4,551	697	4,526	5,572	800	3,257	6,463
Ruddy Duck	0	779	22,054	3,192	2,567	2,443	1,060	261	1,114	1,384	437	3,942	756	944	285	1,045	2,229	1,995
Hooded Merganser	2,392	2,299	3,432	1,209	2,251	1,785	1,776	519	1,947	1,993	1,890	3,765	3,236	1,383	1,248	2,691	5,068	6,323
Large Merganser	117	228	522	972	234	723	957	626	1,032	681	681	519	230	456	256	400	1,042	1,124
Diver subtotal	67,173	46,396	66,937	22,942	63,186	36,487	21,253	14,675	74,741	47,746	20,521	55,170	28,146	43,980	38,291	34,400	59,230	106,390
Total Ducks	370,675	290,635	342,967	214,646	378,579	190,060	155,475	139,243	258,617	190,960	172,039	253,388	209,141	219,125	201,523	185,515	286,557	322,672
Other:																		
Coot	72,793	5,321	21,804	11,319	106,845	11,641	15,633	6,290	55,927	9,213	691	3,965	26,401	40,535	18,984	9,888	16,437	30,523
Canada Goose	105,932	89,418	78,200	87,663	98,339	83,384	75,688	98,316	70,311	67,473	66,085	60,603	87,193	94,235	63,857	90,887	66,672	70,172
Swan	406	291	403	2,341	1,355	2,400	3,855	2,074	2,823	5,336	5,148	10,626	6,611	11,500	7,700	12,575	13,412	17,230

Table 7. Mallard, blue-winged teal, and other duck (excluding scaup) populations in Minnesota, 1968-2017.

	Mallard				Blue-winged teal				Other ducks (exc. scaup)		
Year	Unad. PI	VCF	PI	SE	Unad. PI	VCF	PI	SE	Unad. PI	VCF	PI
1968	41,030	2.04	83,701		61,493	2.44	151,141		41,419	2.08	86,152
1969	53,167	1.67	88,789		45,180	3.45	155,871		34,605	2.27	78,553
1970	67,463	1.69	113,945		31,682	5.06	160,343		30,822	1.62	49,932
1971	47,702	1.65	78,470		42,445	3.49	148,218		29,520	1.71	50,450
1972	49,137	1.27	62,158		49,386	1.96	96,895		34,405	1.69	58,127
1973	56,607	1.76	99,832		53,095	3.92	208,292		33,155	2.45	81,362
1974	44,866	1.62	72,826		39,402	2.59	102,169		38,266	2.79	106,609
1975	55,093	3.19	175,774		45,948	3.95	181,375		34,585	3.31	114,459
1976	69,844	1.69	117,806		89,370	4.87	435,607		39,022	3.35	130,669
1977	60,617	2.21	134,164		37,391	3.86	144,187		18,633	11.95	222,748
1978	56,152	2.61	146,781		28,491	8.53	242,923		22,034	3.30	72,798
1979	61,743	2.57	158,704	28,668	46,708	5.21	243,167	62,226	39,749	3.79	150,545
1980	83,775	2.05	171,957	22,312	50,966	6.49	330,616	40,571	47,322	3.97	188,020
1981	79,562	1.95	154,844	16,402	64,546	2.59	167,258	23,835	30,947	3.80	117,667
1982	51,655	2.33	120,527	17,078	42,772	4.75	203,167	34,503	32,726	4.32	141,501
1983	73,424	2.12	155,762	15,419	42,728	2.81	119,980	20,809	32,240	2.84	91,400
1984	94,514	1.99	188,149	24,065	89,896	2.82	253,821	33,286	40,326	2.18	87,709
1985	96,045	2.26	216,908	32,935	90,453	2.91	263,607	33,369	35,018	2.35	82,383
1986	108,328	2.16	233,598	30,384	68,235	2.69	183,338	28,204	38,900	2.67	103,851
1987	165,881	1.16	192,289	23,500	102,480	1.99	203,718	32,289	76,746	2.51	192,947
1988	155,543	1.75	271,718	38,675	101,183	2.38	240,532	39,512	81,514	2.61	212,988
1989	124,362	2.19	272,968	26,508	90,300	3.16	285,760	39,834	88,109	2.89	254,887
1990	140,879	1.65	232,059	26,316	107,177	3.09	330,659	44,455	124,531	1.97	245,152
1991	128,315	1.75	224,953	28,832	91,496	2.90	265,138	42,057	93,784	2.81	263,619
1992	144,126	2.50	360,870	43,621	93,107	3.83	356,679	53,619	109,779	2.33	255,774
1993	123,771	2.47	305,838	31,103	64,670	4.02	260,070	36,307	82,612	3.28	271,263
1994	138,482	3.08	426,455	66,240	70,324	5.48	385,256	82,580	85,671	3.55	303,847
1995	142,557	2.24	319,433	48,124	47,737	4.40	210,043	40,531	66,096	4.05	267,668

	Mallard				Blue-winged teal				Other ducks (exc. scaup)		
Year	Unad. PI	VCF	PI	SE	Unad. PI	VCF	PI	SE	Unad. PI	VCF	PI
1996	153,473	2.05	314,816	53,461	57,196	5.05	288,913	64,064	107,950	2.64	285,328
1997	160,629	2.54	407,413	65,771	45,496	5.57	253,408	67,526	76,095	2.72	207,316
1998	188,972	1.95	368,450	61,513	47,788	3.66	174,848	33,855	91,478	1.64	149,786
1999	169,213	1.87	316,394	51,651	36,106	4.53	163,499	36,124	80,459	2.49	200,570
2000	157,853	2.02	318,134	36,857	60,288	2.97	179,055	32,189	120,158	2.09	250,590
2001	146,034	2.20	320,560	39,541	37,706	3.60	135,742	19,631	91,152	2.85	260,051
2002	145,191	2.53	366,625	46,264	91,982	4.67	429,934	87,312	92,778	4.04	374,978
2003	115,974	2.42	280,517	34,556	46,759	4.13	193,269	36,176	46,796	5.30	248,019
2004	158,416	2.37	375,313	57,591	94,152	3.75	353,209	56,539	95,105	2.94	279,802
2005	82,472	2.89	238,500	28,595	48,394	4.01	194,125	37,358	46,797	4.26	199,355
2006	72,843	2.21	160,715	24,230	38,328	4.53	173,674	60,353	42,333	4.41	186,719
2007	76,979	3.15	242,481	30,020	29,407	4.20	123,588	20,055	30,963	3.73	115,390
2008	103,411	2.88	297,565	27,787	40,777	3.74	152,359	24,157	99,575	2.91	289,629
2009	78,368	3.02	236,436	36,539	37,286	3.63	135,262	32,155	62,725	2.70	169,568
2010	80,922	2.99	241,884	33,940	32,742	4.04	132,261	27,430	55,076	2.84	156,599
2011	102,245	2.77	283,329	49,845	61,772	3.46	213,584	88,720	79,743	2.39	190,586
2012	96,448	2.33	224,965	45,057	49,779	2.18	108,607	31,971	60,228	2.24	135,017
2013	111,208	2.64	293,239	58,463	27,194	5.29	143,927	46,635	68,804	3.57	245,729
2014	111,408	2.31	256,996	55,366	31,979	3.18	101,640	24,089	51,619	2.24	115,751
2015	94,866	2.17	206,229	37,498	33,484	5.04	168,615	56,787	46,295	3.23	149,330
2016	117,698	2.13	250,204	42,850	70,907	4.57	323,916	94,952	77,750	2.74	212,967
2017	104,970	2.04	213,644	32,704	63,418	2.51	159,483	55,100	119,394	2.20	262,867
Averages: 10-year	97,355	2.64	253,333	41,737	41,533	3.93	160,376	44,695	63,278	2.86	178,057
Long-term	102,842	2.23	228,205	37,831	57,310	3.91	213,740	43,844	60,947	3.11	177,677
% change from 2016	-11%	-4%	-15%	-24%	-11%	-45%	-51%	-42%	54%	-20%	23%
10-year average	8%	-23%	-16%	-22%	53%	-36%	-1%	23%	89%	-23%	48%
Long-term average	2%	-8%	-6%	-14%	11%	-36%	-25%	26%	96%	-29%	48%

Table 8. Scaup, total ducks (excluding scaup), total ducks, and Canada goose populations in Minnesota, 1968-2017.

	Scaup			Total Ducks (exc. Scaup)		Total Ducks		Canada geese		
Year	Unad. PI	VCF	PI	Unad. PI	PI	Unad. PI	PI	Unad. PI	VCF	PI
1968	22,834	2.08	47,495	144,392	320,994	167,226	368,488			
1969	9,719	2.27	22,062	132,952	323,213	142,671	345,275			
1970	12,105	1.62	19,610	129,967	324,219	142,072	343,829			
1971	5,713	1.71	9,764	119,667	277,137	125,380	286,901			
1972	12,062	1.69	20,379	132,928	217,181	144,990	237,560	366		
1973	10,633	2.45	26,093	142,857	389,486	153,490	415,580	1,965		
1974	18,378	2.79	51,201	122,534	281,605	140,912	332,806	8,835		
1975	9,563	3.31	31,649	135,626	471,608	145,189	503,257	5,997		
1976	22,494	3.35	75,323	198,236	684,082	220,730	759,405	5,409		
1977	2,971	11.95	35,517	116,641	501,099	119,612	536,616	7,279		
1978	14,774	3.35	48,812	106,677	462,502	121,451	511,314	7,865		
1979	92,134	3.79	348,948	148,200	552,416	240,334	901,364	4,843		
1980	12,602	3.97	50,070	182,063	690,593	194,665	740,663	6,307		
1981	19,844	3.88	75,451	175,055	439,769	194,899	515,220	10,156		
1982	21,556	4.32	93,204	127,153	465,195	148,709	558,399	6,600		
1983	9,551	2.84	27,077	148,392	367,142	157,943	394,219	11,081		
1984	15,683	2.18	34,111	224,736	529,679	240,419	563,790	14,051		
1985	7,409	2.35	17,430	221,516	562,898	228,925	580,328	16,658		
1986	6,247	2.67	16,678	215,463	520,787	221,710	537,465	19,599		
1987	10,306	2.51	25,910	345,107	588,954	355,413	614,864	29,960		
1988	10,545	2.61	27,553	338,240	725,238	348,785	752,791	39,057	1.36	53,004
1989	71,898	2.89	207,991	302,771	813,615	374,669	1,021,606	51,946	1.88	97,898
1990	40,075	1.97	78,892	372,587	807,870	412,662	886,761	58,425	1.37	80,147
1991	40,727	2.81	114,480	313,595	753,710	354,322	868,191	42,231	4.18	176,465
1992	66,071	2.33	153,939	347,012	973,323	413,083	1,127,262	33,965	2.43	82,486
1993	11,801	3.28	38,750	271,053	837,172	282,854	875,921	43,858	2.08	91,369
1994	57,670	3.55	204,536	294,477	1,115,558	352,147	1,320,095	48,595	1.68	77,878
1995	28,421	4.05	115,096	256,390	797,144	284,811	912,241	58,065	2.08	120,775
1996	65,585	2.64	173,351	318,619	889,057	384,204	1,062,408	60,870	3.92	238,708
1997	31,138	2.72	84,834	282,220	868,137	313,358	952,971	60,449	2.59	156,817

	Scaup			Total Ducks (exc. Scaup)		Total Ducks		Canada geese		
Year	Unad. PI	VCF	PI	Unad. PI	PI	Unad. PI	PI	Unad. PI	VCF	PI
1998	28,416	1.64	46,528	328,238	693,084	356,654	739,612	79,147	1.75	138,507
1999	14,041	2.49	35,002	285,778	680,463	299,819	715,465	80,012	3.35	268,168
2000	32,376	2.09	67,520	338,299	747,779	370,675	815,299	105,932	2.84	301,298
2001	15,743	2.85	44,914	274,892	716,353	290,653	761,267	89,418	2.17	193,887
2002	13,016	4.04	52,606	327,951	1,171,537	340,967	1,224,143	78,200	2.42	189,353
2003	5,117	5.30	27,120	209,529	721,805	214,646	748,925	87,663	3.78	331,094
2004	30,906	2.94	90,926	347,673	1,008,324	378,579	1,099,250	98,339	1.58	155,859
2005	12,397	4.26	52,811	177,663	631,980	190,060	684,791	83,384	2.02	168,469
2006	1,971	4.41	8,692	153,504	521,109	155,475	529,801	75,688	2.73	206,757
2007	1,894	3.73	7,058	137,349	488,517	139,243	495,575	98,316	1.47	144,289
2008	14,854	2.91	43,205	243,763	739,553	258,617	782,758	70,311	1.99	139,708
2009	12,571	2.70	33,979	178,379	541,266	190,950	575,245	67,473	2.44	164,405
2010	3,299	2.84	9,380	168,740	530,744	172,039	540,124	66,085	2.22	146,960
2011	9,283	2.39	22,186	244,105	687,499	253,043	709,685	60,603	2.57	155,750
2012	2,686	2.24	6,021	206,455	468,589	209,141	474,610	87,193	1.81	157,706
2013	11,919	3.57	42,568	207,206	682,895	219,125	725,463	94,235	2.22	208,825
2014	6,517	2.24	14,614	195,006	474,387	201,523	489,001	63,857	1.57	100,255
2015	10,870	3.23	35,062	174,645	524,174	185,515	559,236	90,887	1.77	160,427
2016	20,202	2.74	55,336	266,355	787,087	286,557	842,423	66,672	1.75	117,096
2017	34,890	2.20	76,817	287,782	635,994	322,672	712,811	70,172	2.16	151,740
Averages:										
10-year	9,410	2.86	26,941	202,200	592,471	211,575	619,412	76,563	1.98	149,542
Long-term	20,583	3.11	60,648	221,075	619,766	241,651	680,414	48,841	2.28	159,461
% change from										
2016	73%	-20%	39%	8%	-19%	13%	-15%	5%	23%	30%
10-year average	271%	-23%	185%	42%	7%	53%	15%	-8%	9%	1%
Long-term average	70%	-29%	27%	30%	3%	34%	5%	44%	-5%	-5%

Appendix A. Precipitation in selected regions of Minnesota, 11 April - 11 May 2017 (Source: Minnesota DNR; link to state climate data).

Region	Precipitation	Departure from normal
Northwest	1.39	-0.52
North Central	2.35	0.18
Northeast	3.50	0.92
West Central	2.24	-0.32
Central	4.13	1.07
East Central	4.13	1.01
Southwest	3.11	-0.09
South Central	3.54	-0.30
Southeast	4.45	0.70
Statewide	3.45	0.37

Waterfowl information is taken from the U.S. Fish and Wildlife Service report Waterfowl Population Status, 2017 by Joshua Dooley, Walt Rhodes, and Nathan Zimpfer. The entire report is available on the Division of Migratory Bird Management website (http://www.fws.gov/birds/surveys-and-data/reports-and-publications.php).

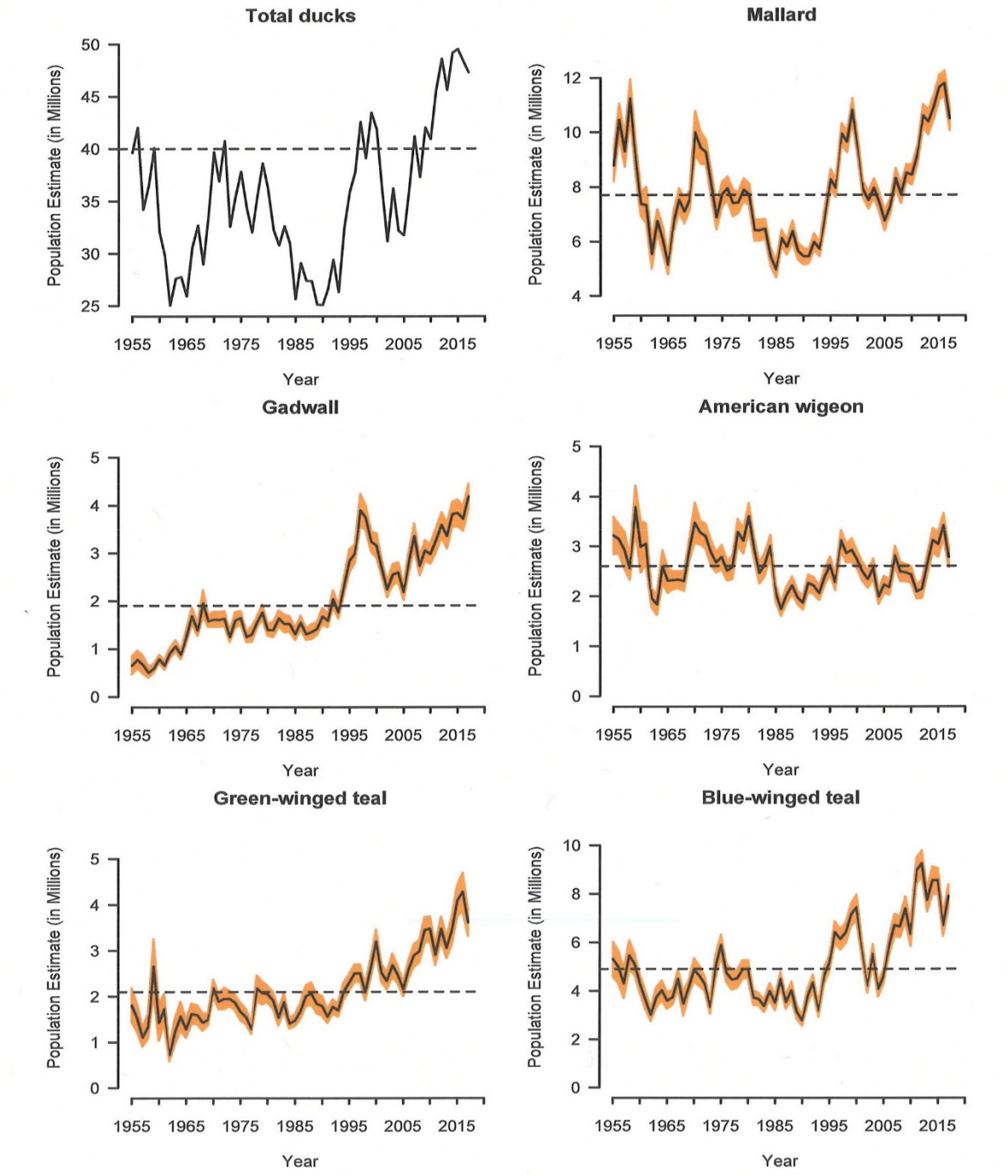

Figure 1 Estimates of North American breeding populations, 90% confidence intervals, and North American Waterfowl Management Plan population goal (dashed line) for selected species and number of water areas in May in Prairie Canada and Northcentral U.S (from: U.S. Fish and Wildlife Service 2016).

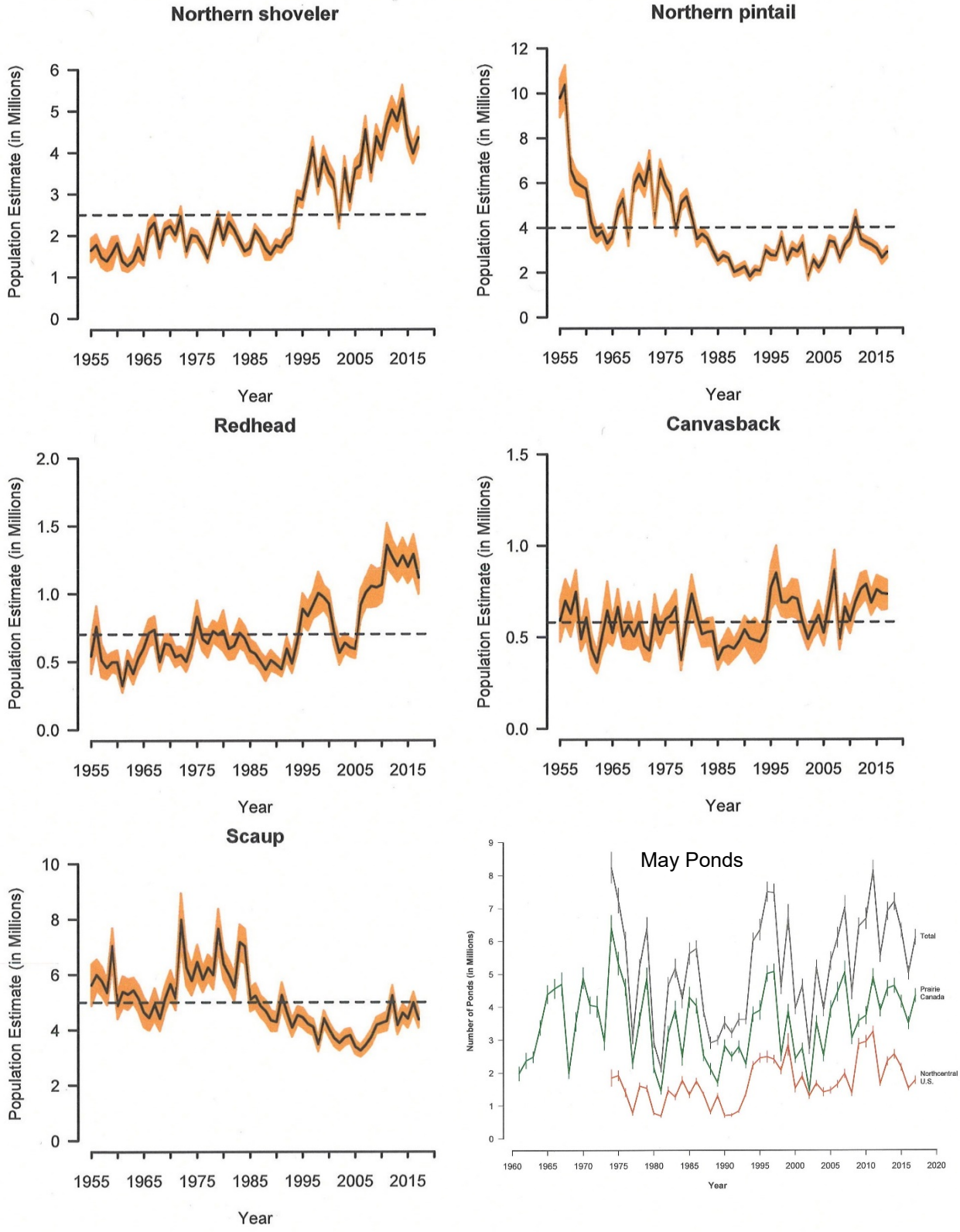

Figure 1 (continued).

2017 MINNESOTA SPRING CANADA GOOSE SURVEY

Jeffrey S. Lawrence, Wetland Wildlife Populations and Research Group,
John H. Giudice, Wildlife Biometrics Unit, and
Patrick Hagen, Wildlife Health Program

INTRODUCTION

This report presents results from the seventeenth year of a spring helicopter survey of locally nesting Canada geese (*Branta canadensis*) in Minnesota. Minnesota Department of Natural Resources (MNDNR) personnel developed the survey per a request from the Mississippi Flyway Council to produce a statewide population estimate having 95% confidence intervals (CI) that are within ± 25% of the estimate for this bird species.

METHODS

MNDNR Wetland Group staff initiated surveys for resident Canada geese in 2001 (Maxson 2002). The state was divided into 3 ecoregions (Prairie, Transition, Forest) using boundaries of the Prairie Parkland, Eastern Broadleaf Forest, Tallgrass Aspen Parklands, and Laurentian Mixed Forest ecoprovinces (Aaseng et al. 2005). The Transition ecoregion comprises the Eastern Broadleaf Forest and Tallgrass Aspen Parklands, the Prairie ecoregion is equivalent to the Prairie Parkland ecozone, and the Forest ecoregion is equivalent to the Laurentian Mixed Forest ecoprovince. The 7-county Metro area was excluded from the Transition ecoregion, and Lake County, Cook County, and the Boundary Waters Canoe Wilderness Area were excluded from the Forest ecoregion. The remaining survey area was divided into quadrats (hereafter, plots) using PLS quarter-sections as the primary sampling unit.

From 2002-2007, double sampling was used to construct a stratified sample (Maxson 2002). Nine hundred plots were randomly selected from each ecoregion (Prairie, Transition, and Forest), and then various GIS datalayers (NWI, Circular 39, MNDNR 1:24000 lakes, airphotos) were used to quantify the potential nesting habitat on these plots based on 1) total acres of type 3, 4, and 5 wetlands; 2) total acres of type 3 wetlands; 3) total acres of 1:24,000 lakes, and; 4) total acres of riverine habitat. This information was used to form 3 habitat classes that reflected expected number of pairs of resident Canada geese: 1) no nesting habitat (on average, no geese were expected on such plots), 2) limited nesting habitat (habitat capable of supporting 1 or 2 pairs of geese), and 3) prime nesting habitat (habitat capable of supporting 3 or more pairs). The 3 ecoregions and 3 habitat classes were used to form 9 strata (P0, P12, P3+, T0, T12, T3+, F0, F12, F3+).

Strata with expected counts equal to zero (P0, T0, F0) were excluded from further consideration, and the F3+ stratum did not contain any plots. Thus, the final stratification scheme consisted of 5 strata: P12, P3+, T12, T3+, F12. Thirty 30 plots were randomly selected from each stratum each year, for an annual sample size of 150 plots.

In 2008, the entire sampling frame was stratified using GIS data and the same stratification criteria. Thus, double sampling was eliminated (Rave 2008). The sampling frame was also

modified by removing Lake of the Woods and the Northwest Angle from the Forest ecoregion. Again, 30 plots were randomly selected from each of the 5 strata each year. In 2011, a proposed Intensive Harvest Zone (IHZ) was incorporated into the sampling frame, which permitted a domain analysis of total geese in the proposed IHZ (Rave 2011). Thirty plots were randomly selected from the IHZ and 130 plots from outside the zone, and plots were proportionally allocated to strata. The actual IHZ used from 2013-2015 to delineate boundaries for an August Canada goose conservation action and during the September Canada goose season was larger than the proposed zone (see Minnesota Waterfowl Hunting Regulations Booklet, 2013, 2014, 2015). However, we continued to use the proposed IHZ to monitor changes in goose numbers in a portion of the intensive harvest area. In 2017, we dropped the IHZ from the sampling frame, and we used a spatially balanced sampling design (Stevens and Olsen 2004) to draw 30 random plots from each of the 5 original strata.

Surveys were flown in a military surplus OH-58 or an Enstrom 480B. Plots were surveyed from an altitude that maximized visibility of Canada geese (approximately 20 - 80 meters AGL). Each plot was surveyed completely and typically wetland areas were circled 2-3 times to be confident that we did not miss any geese.

Canada geese observed within plot boundaries were recorded on paper datasheets (2001-2016) or digitally using DNRSurvey and a Toughbook computer (2017). From 2001-2011, goose observations were classified as singles with nest, singles (without nest), pairs with nest, pairs (without nest), and groups (>=3 birds).

From 2012-2016, goose observations were classified as singles, pairs, and groups, and nests were recorded separately as total nests/plot. In 2017, we reverted to the original observation classes. Our primary response metrics were indicated pairs (IP=singles + pairs), total geese (IPx2 + groups), and productive geese (2x[singles + pairs with nest]). By doubling single-goose observations we implicitly assumed the mate was present on the survey plot but was missed. As noted above, we did not survey the Twin Cities (7-county Metro area) where there is a significant number of nesting Canada geese; instead, we relied on estimates from Cooper (2004) to approximate the average contribution of the Metro area to the statewide population estimate.

RESULTS AND DISCUSSION

The 2017 survey was completed in 6 flight days from 17-29 April (Figure 2) by observer Patrick Hagen and DNR pilot John Heineman. The survey took 48.3 hours of helicopter time and 8.7 hours was spent on the 150 plots. Survey time per plot was 3.5 minutes in 2017 compared to 2.5 minutes in 2016.

The aerial crew counted 63 singles, 9 singles with nests, 84 pairs, 123 pairs with nests, and 42 Canada geese in groups. The 2017 population estimate (321,582$\pm$87,478) was the largest estimate since 2012 and 59% > 2016 (Table 2). This difference was non-significant. The point estimate was 9% > the long-term (2001-2016) average. Increased estimates were indicated in all 3 ecoregions (Table 2). The stratification worked well with occupancy being greater in the strata with predicted higher densities (Figure 3). There were few significant differences among years, but the tendency had been downward from 2012-2016. The 2017 estimate changed this trend. There have been shorter periods of increase or declines, but generally the population has been stable over the 17-year period (Figure 4).

We do not survey the Twin Cities Metro area, but use a constant estimate (17,500) from an earlier survey (Cooper 2004). The statewide estimate including the metro area is 339,082 (Table 2), above the state Canada goose population goal of 250,000. Last year (2016) was the only year population numbers have been below goal.

There was a low proportion of single geese and a high proportion of pairs observed during the 2017 survey (Table 3). This was a good production year and 132 nests were observed, including 9 singles and 123 pairs observed with nests. The previous high nest year was 2011, when there were 75 nests, but other years had 3-44 nests (Table 3). In most years, productive geese closely track the number of singles since they are believed to be indicated breeding pairs. However, in 2017, singles declined and the high productivity was indicated by large numbers of pairs observed with nests (Figure 5). Often when both members of a pair are observed together, they are not actively nesting. For example, in 2013 when a large proportion of pairs were observed, productivity was low (Figure 5) and few nests were observed (Table 3). It is possible some of this difference may be due to a new observer on the survey, but the pilot remained the same in most years. We do believe that this was a good production year as reflected in the number of productive geese, but future analyses should examine the value of this metric.

The average temperature was near to slightly above average in March and April 2017, although ice out dates were 2-3 weeks earlier than normal. Geese nested early in many areas and incubation was well underway during the survey. Precipitation was above normal in April and May, especially in areas in southern Minnesota.

Last year's Goose survey was expected to be the last (Weegman 2016); however, we decided to conduct the 2017 goose survey when we did not implement an expanded May Waterfowl Survey (Cordts 2016). Part of the reason for continuing the goose survey was the downward trend we had seen in point estimates the previous 4 years. This year's results changed that pattern. We will need to consider the importance of this survey in future years.

ACKNOWLEDGMENTS

John Heineman once again ably piloted the helicopter and served as the second observer. Chris Scharenbroich assisted in providing GPS coordinates of plots to the pilot and developing area maps. This project was funded in part by the Wildlife Restoration (Pittman-Robertson) Program.

LITERATURE CITED

Aaseng, N., J. Almendinger, R. Dana, T. Klein, M. Lee, and D. Wovcha. 2005. Field Guide to the Native Plant Communities of Minnesota. State of Minnesota, Department of Natural Resources.

Cooper, J. 2004. Canada goose program report 2004. Unpublished report. Division of Fish and Wildlife, Minnesota Department of Natural Resources, St. Paul, Minnesota.

Cordts, S. 2016. 2016 Minnesota May Waterfowl Survey. Division of Fish and Wildlife, Minnesota Department of Natural Resources, St. Paul, Minnesota.

Maxson, S. J. 2002. 2002 Minnesota Spring Canada goose Survey. Unpublished report. Division of Fish and Wildlife, Minnesota Department of Natural Resources, St. Paul, Minnesota.

Rave, D. P. 2008. 2008 Minnesota Spring Canada goose survey. Pages 115-118 in Dexter, M. H., editor. 2008. Status of Wildlife Populations, fall 2008. Unpublished Report, Division of Fish and Wildlife, Minnesota Department of Natural Resources, St. Paul, Minnesota. 300 pages.

Rave, D. P. 2011 Minnesota Spring Canada goose survey. Pages 140-144 in Dexter, M. H., editor. 2011. Status of Wildlife Populations, fall 2011. Unpublished Report, Division of Fish and Wildlife, Minnesota Department of Natural Resources, St. Paul, Minnesota. 327 pages.

Stevens, D. L., Jr. and A. R. Olsen. 2004. Spatially balanced sampling of natural resources. Journal of American Statistical Association 99:262–278.

Weegman, M. M. 2017. 2016 Minnesota Spring Canada goose survey. Pages 125-138 in Dexter, M. H., editor. 2017. Status of Wildlife Populations, fall 2016. Unpublished Report, Division of Fish and Wildlife, Minnesota Department of Natural Resources, St. Paul, Minnesota. 326 pages.

Table 1. Sampling frames used to conduct spring Canada goose surveys in Minnesota from 2001 – 2007 (*n*=2,700 plots) and 2008 – 2017 (*n* = 304,929 plots). Ecoregion is the combination of provinces across the state. Strata are determined by type and acres (ac) of wetlands and rivers per quarter section plot.

			N plots in sample frame by period	
Ecoregion	Strata	National Wetland Inventory Data	2001 – 2007[a]	2008 – 2017[b,c]
Prairie	0 pairs[d]	Type 3, 4, and 5 wetlands <0.5 ac and rivers <10.0 ac all water	476	61,597
	1-2 pairs	Type 4 and 5 wetlands >0.5 ac but type 3 <15.0 ac or type 3, 4, and 5 <0.5 ac and rivers >10.0 ac all water	344	30,751
	≥ 3 pairs	Type 3 >15.0 ac but plot not all water	80	9,533
Transition	0 pairs[d]	Type 3, 4, and 5 wetlands <1.0 ac and rivers <8.0 ac or plot all water	377	39,484
	1-2 pairs	Type 3, 4, and 5 wetlands 1.0–25.0 ac or >25.0 ac, but type 3 <15.0 ac or type 3, 4, and 5 <1.0 ac and rivers >8.0 ac	428	29,048
	≥ 3 pairs	Type 3, 4, and 5 wetlands >25.0 ac, but type 3 >15.0 ac and plot not all water	95	8,015
Forest	0 pairs[d]	Type 3, 4, and 5 wetlands <2.0 ac and rivers <2.0 ac or plot all water	510	75,835
	1-2 pairs	Type 3, 4, and 5 wetlands >2.0 ac but plot not all water or type 3, 4, and 5 <2.0 ac and rivers >2.0 ac	390	50,666
	≥ 3 pairs	None	0	0
Total			2,700	304,929

[a] From 2001-2007, double-sampling was used to estimate stratum weights and the survey plots were randomly drawn from a sample of 900 plots in each Ecoregion.

[b] The entire sampling frame was re-stratified in 2008 and Lake of the Woods and the NW Angle were removed from the sampling frame. The sampling frame was adjusted slightly in 2009 because of some processing errors in 2008. The population estimates for 2008–2016 are based on the updated sampling frame.

[c] From 2011-16, a portion of the potential survey plots were in the original proposed intensive harvest goose hunting zone (Fig. 1). These included 9,674 of the 1-2 pair plots and 3,400 of the >3 pair plots in the Prairie Ecoregion and 5,777 of the 1-2 pair plots and 1,479 of the > 3 pair plots in the Transition Ecoregion.

[d] The 0-pair strata were excluded from the random selection process.

Table 2. Population estimates of resident Canada geese for prairie transition, and forest ecoregions, ecoregions combined ±95% confidence interval (CI), the seven-county Twin cities metro area (see Figure 1), and state of Minnesota, 2001-2017 (*n*=150 plots 2001-2007 and 2017, *n*=160 plots 2008-2015, *n*=161 plots 2016).

Year	Prairie	Transition	Forest	Subtotal	95% CI	Metro	Statewide
2001	77,360	95,470	92,390	265,220	69,500	20,000	285,220
2002	135,850	144,900	33,940	314,690	134,286	20,000	334,690
2003	106,520	121,290	56,420	284,230	78,428	20,000	304,230
2004	128,501	130,609	95,636	354,747	107,303	20,000	374,747
2005	113,939	149,286	57,529	320,754	90,541	17,500	338,254
2006	126,042	164,085	67,994	358,071	108,436	17,500	375,571
2007	137,151	99,274	25,509	261,933	80,167	17,500	279,433
2008	113,483	127,490	30,400	271,373	69,055	17,500	288,872
2009	129,116	114,738	23,645	267,497	70,607	17,500	284,996
2010	83,911	151,903	57,422	293,235	70,760	17,500	310,734
2011	143,266	117,711	91,199	352,175	119,814	17,500	369,674
2012	144,762	166,727	104710	416,198	132,344	17,500	433,698
2013	104,907	91,652	54,044	250,602	73,122	17,500	268,102
2014	94,664	122,438	27,022	244,123	77,836	17,500	261,623
2015	97,847	114,986	37,156	249,988	61,291	17,500	267,488
2016	99,499	78,511	23,645	201,654	64,297	17,500	219,154
2017	139,365	145,062	37,155	321,582	87,478	17,500	339,082

*Prior to 2008, double-sampling was used to estimate stratum weights. The entire sampling frame was re-stratified in 2008 and Lake of the Woods and the NW Angle were removed from the sampling frame. The sampling frame was adjusted slightly in 2009 because of some processing errors in 2008. The population estimates for 2008–2016 are based on the updated sampling frame.

Table 3. Percent of Canada geese seen as singles, pairs, groups, nests, and productive geese, the number of nests, and the survey period during the Minnesota Spring Canada Goose Survey, 2001-2017.

Year	Singles[a]	Pairs[a]	Groups	Nests observed	Productive Geese[b]	Survey period
2001	27.0	63.9	9.1	22	36.4	4/14 to 5/02/2001
2002	30.7	52.0	17.2	31	41.5	4/26 to 5/11/2002
2003	27.9	58.2	13.9	11	29.3	4/22 to 5/01/2003
2004	26.5	57.5	16.0	44	35.5	4/22 to 5/04/2004
2005	33.0	50.2	16.8	43	40.7	4/20 to 5/03/2005
2006	43.5	45.9	10.6	30	50.3	4/24 to 5/05/2006
2007	31.0	51.5	17.5	17	36.2	4/23 to 4/28/2007
2008	38.4	55.4	6.2	22	42.6	4/23 to 5/05/2008
2009	41.8	50.7	7.5	31	45.2	4/21 to 5/01/2009
2010	42.5	48.2	9.3	36	46.6	4/15 to 4/20/2010
2011	50.3	47.2	2.6	75	55.7	4/21 to 4/29/2011
2012	30.0	49.6	20.4	41	35.1	4/16 to 4/23/2012
2013	27.1	67.8	5.1	6	29.8	5/06 to 5/14/2013
2014	39.3	55.1	5.6	12	44.0	4/21 to 5/04/2014
2015	38.5	56.4	5.1	8	41.6	4/20 to 4/28/2015
2016	37.1	48.2	14.7	3	37.1[c]	4/18 to 4/29/2016
2017	24.0	69.0	7.0	132	65.0	4/17 to 4/29/2017

[a] Singles and pairs were doubled before calculating proportions
[b] Productive Canada geese = singles + pairs with nests
[c] Productive Canada geese = singles

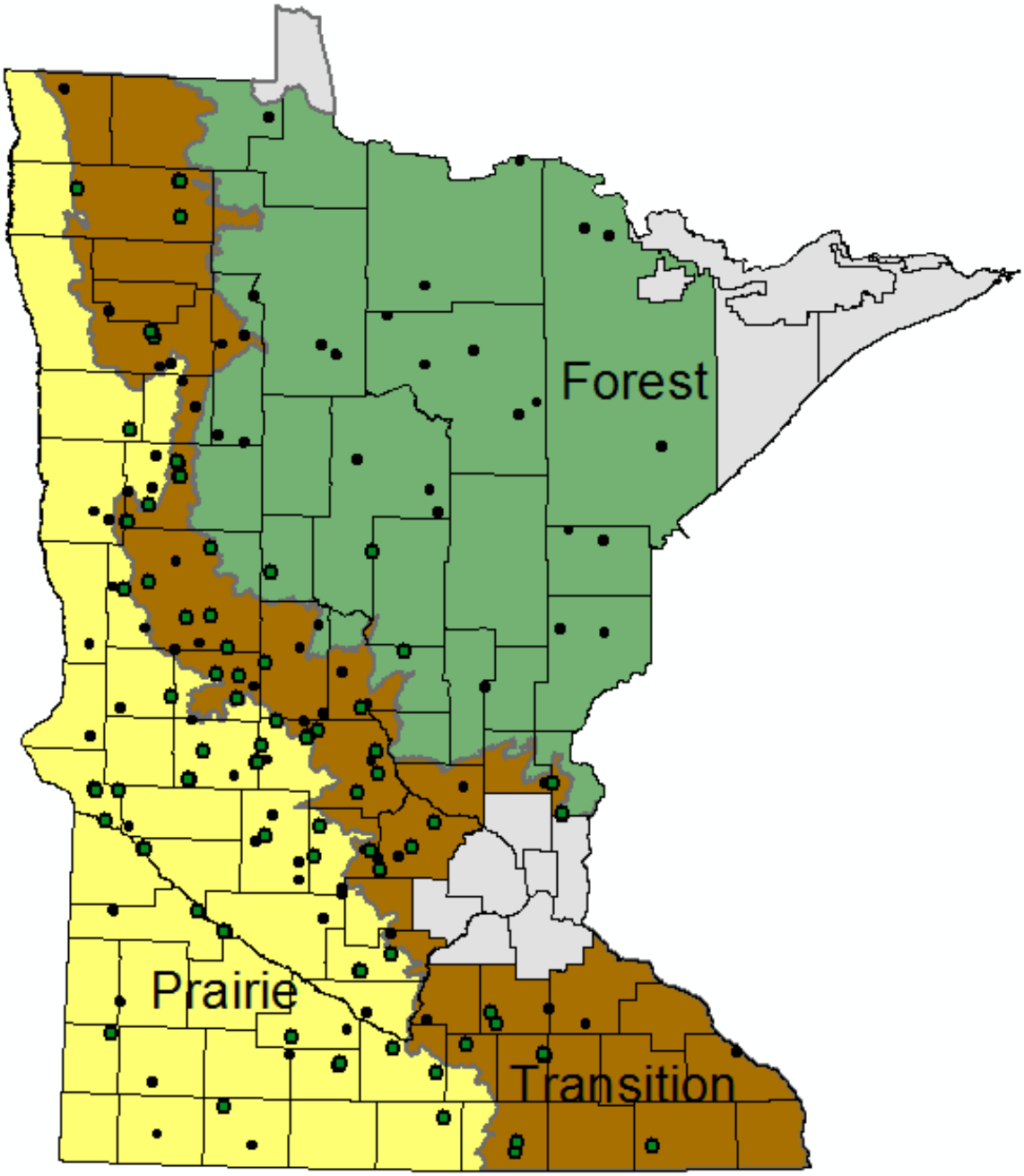

Figure 1. Location of 150 quarter-section plots surveyed during the 2017 spring Canada goose survey. Plots are distributed among the Prairie, Transition, and Forest ecoregions. Plots with geese present are indicated by dots with green centers. Grey areas were not included in the survey.

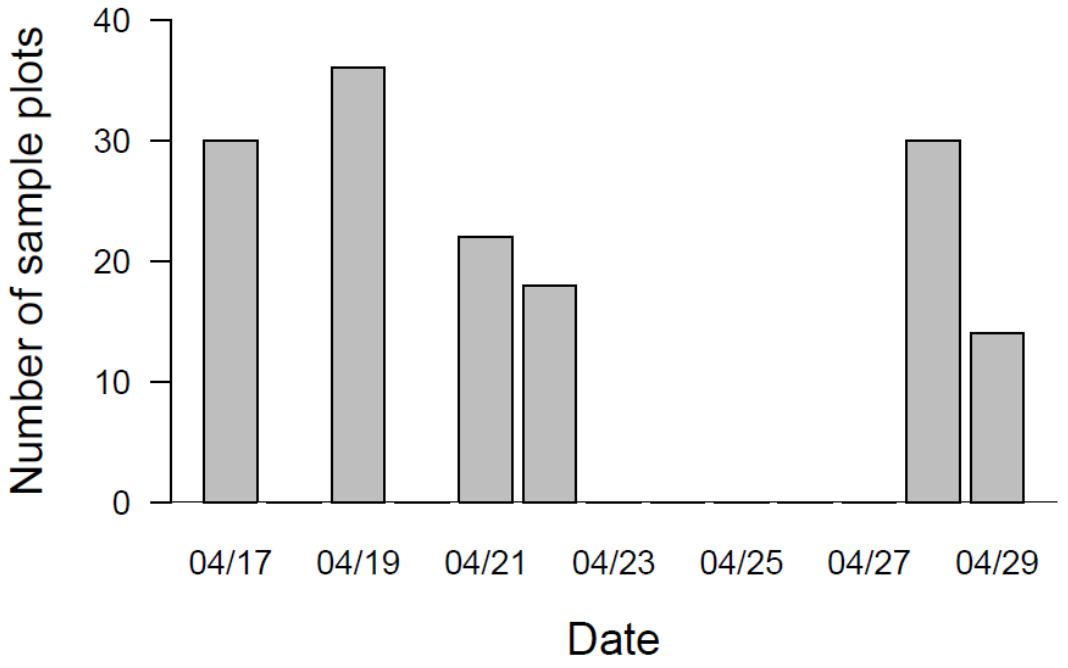

Figure 2. Number of sample plots surveyed by date during the 2017 Minnesota spring Canada goose survey.

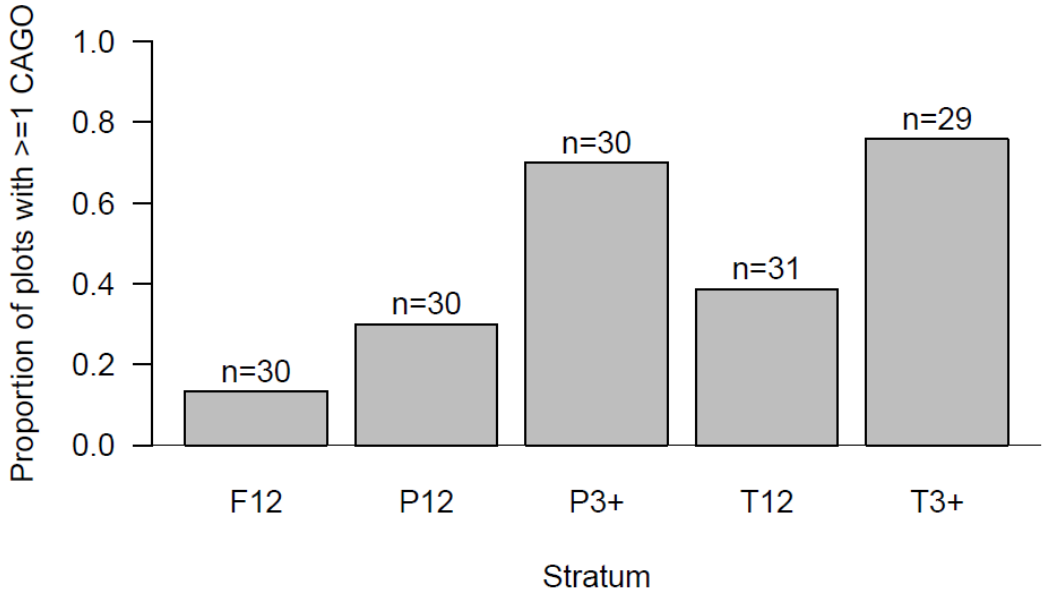

Figure 3. Proportion of plots (*n*/strata) by stratum with ≥ 1 goose observed, 2017 Minnesota spring Canada goose survey.

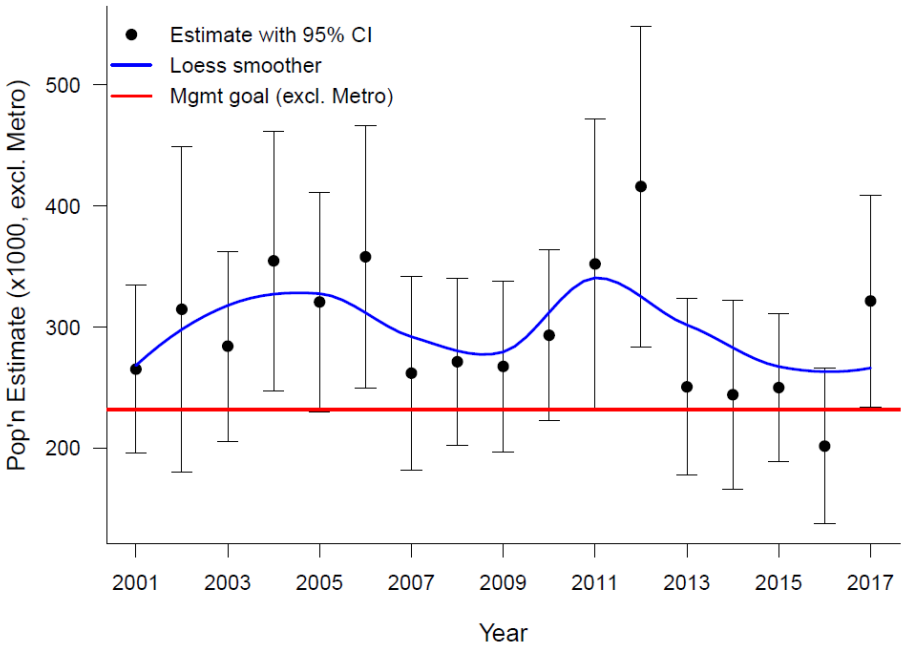

Figure 4. Population estimates and 95% confidence intervals for Canada geese in Minnesota, 2001-2017.

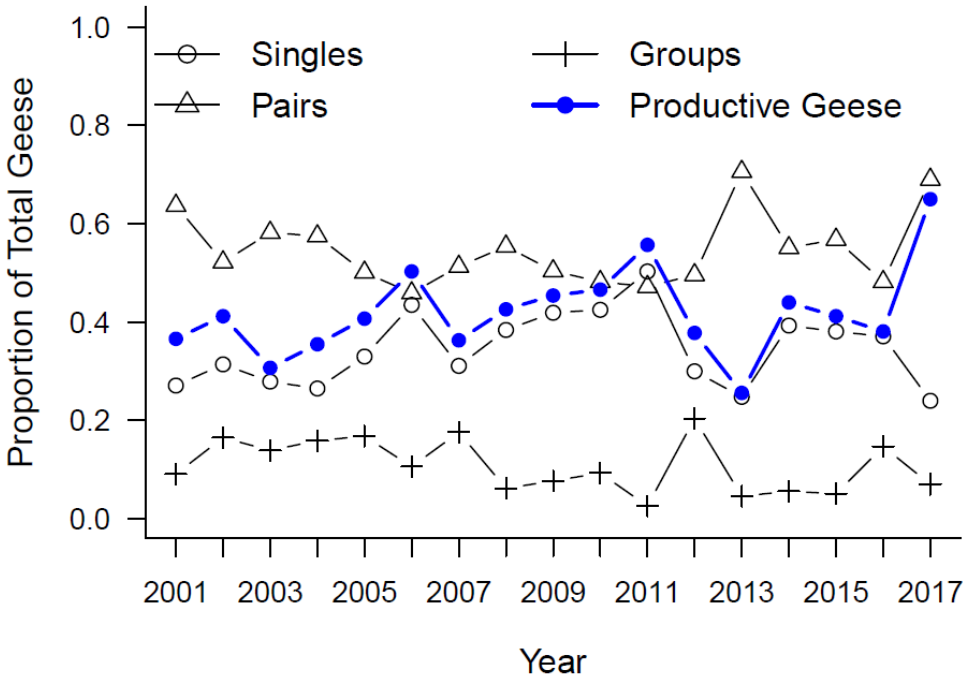

Figure 5. Social status trends from 2001 – 2017 for Canada geese in Minnnesota. Productive Canada geese determined using the proportion of single birds plus pairs with nests, except in 2016 when it is just proportion of single birds.

Mourning dove information is taken from the U.S. Fish and Wildlife Service report by Seamans, M.E. 2017. Mourning dove population status, 2017. U.S. Department of the Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Washington, D.C. 22 pp. The entire report is available on the Division of Migratory Bird Management web site

(http://www.fws.gov/birds/surveys-and-data/reports-and-publications/population-status.php).

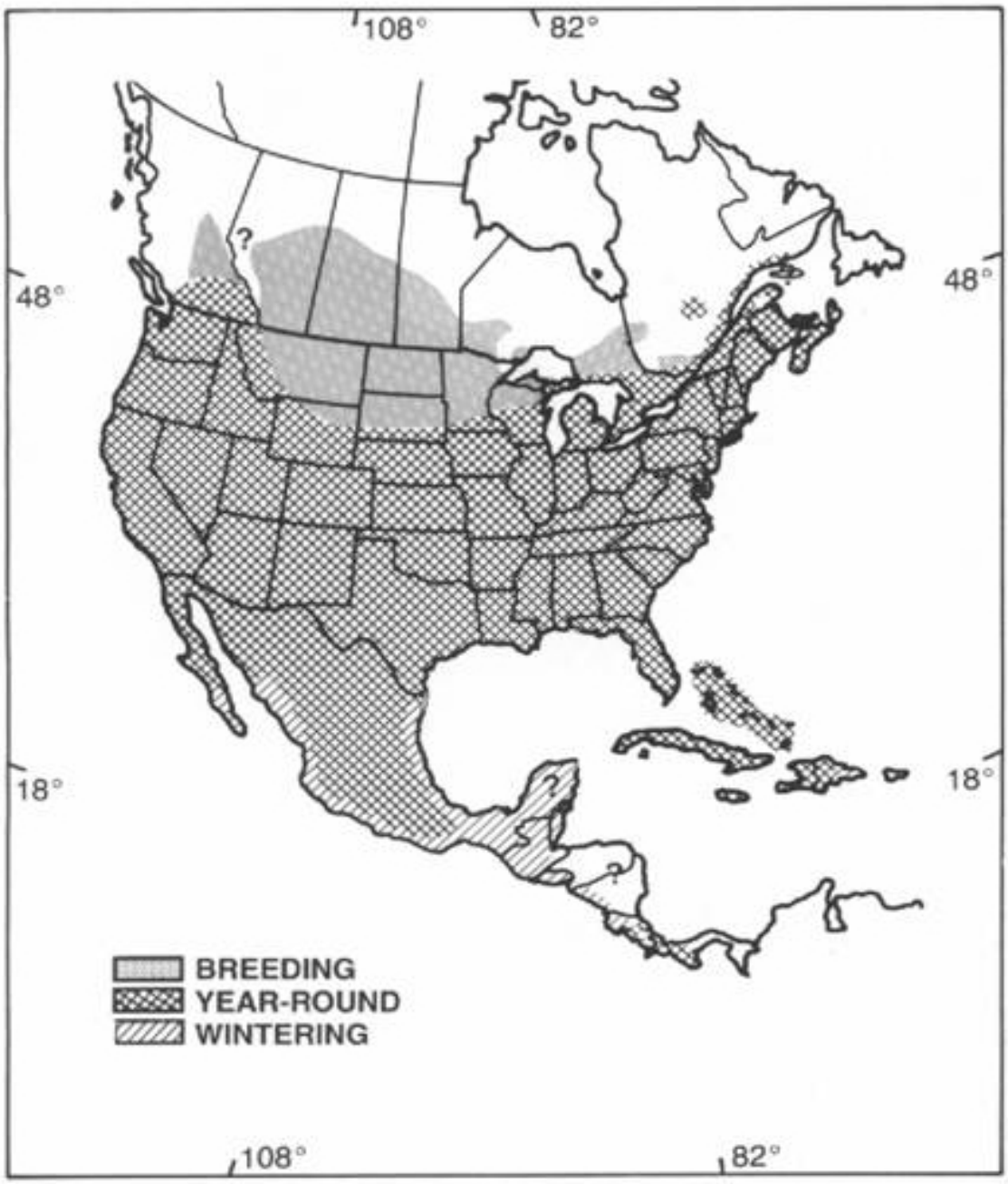

Figure 1. Breeding and wintering ranges of the mourning dove (adapted from Mirarchi and Baskett 1994). (From: Seamans, M.E. 2017. Mourning dove population status, 2017. U.S. Department of the Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Washington, D.C. 22 pp.)

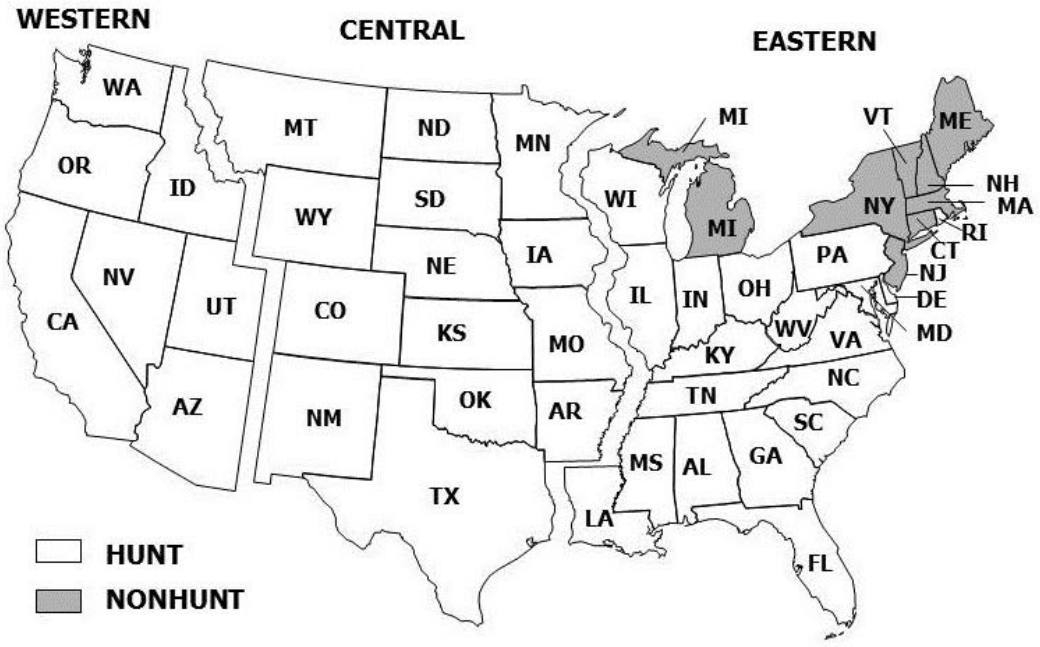

Figure 2. Mourning dove management units with 2016 -17 hunting and non-hunting states. (From: Seamans, M.E. 2017. Mourning dove population status, 2017. U.S. Department of the Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Washington, D.C. 22 pp.)

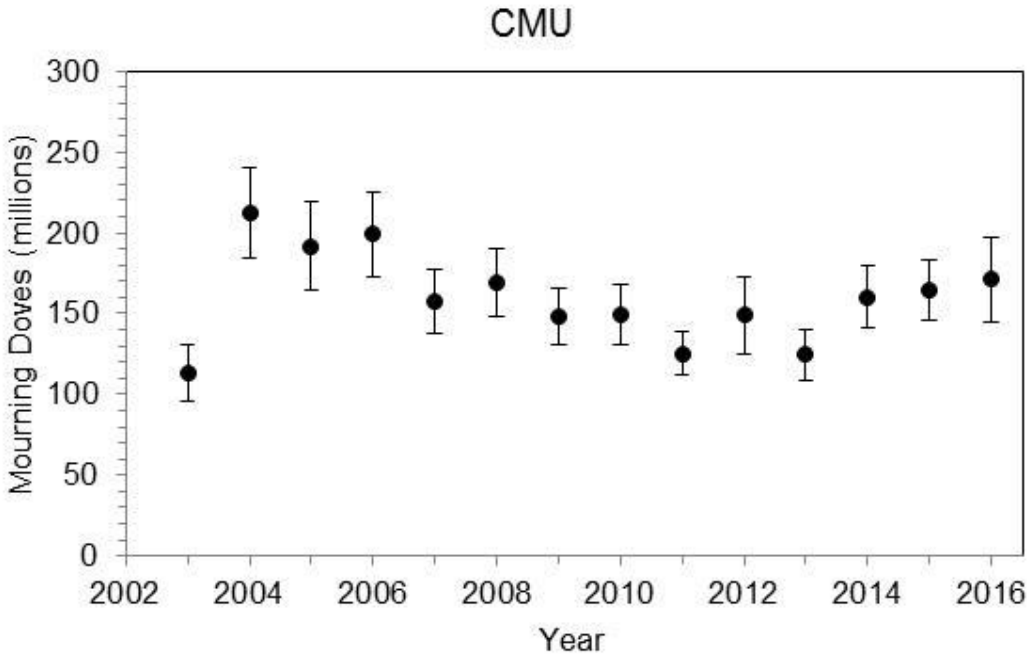

Figure 3. Estimates and 95% confidence intervals of mourning dove absolute abundance by in the Central Management Unit (CMU), 2003-16. Estimates based on band recovery and harvest data. (From: Seamans, M.E. 2017. Mourning dove population status, 2017. U.S. Department of the Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Washington, D.C. 22 pp.)

Table 1. Preliminary estimates and 95% confidence intervals (CI, expressed as the interval half width in percent) of mourning dove harvest and hunter activity for the Central management unit during the 2014, 2015 and 2016 seasons [a]. (From: Seamans, M.E. 2017. Mourning dove population status, 2017. U.S. Department of the Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Washington, D.C. 22 pp.)

Management unit / State	Active Hunters			Hunter Days Afield			Total Harvest		
	2014	2015	2016	2014	2015	2016	2014	2015	2016
CENTRAL	427,100 †	369,800 †	430,400 †	1,333,600 ± 9	1,235,000 ±10	1,344,400 ±13	7,654,700 ±10	7,180,300 ±9	7,334,600 ±14
AR	19,900 ±21	17,88 ±24	16,300 ±28	47,900 ±28	37,600 ±22	36,200 ±27	347,900 ±29	252,400 ±22	258,200 ±29
CO	14,400 ±14	14,200 ±15	13,100 ±18	27,800 ±16	38,900 ±23	29,700 ±19	173,100 ±19	204,500 ±22	141,200 ±20
IA	9,200 ±9	9,200 ±15	9,700 ±15	27,100 ±12	24,600 ±16	25,300 ±17	130,000 ±13	111,500 ±18	128,100 ±19
KS	26,200 ±10	28,600 ±13	28,600 ±12	70,700 ±14	86,400 ±18	77,200 ±17	485,300 ±18	558,200 ±20	427,600 ±18
MN	6,900 ±51	9,700 ±48	6,500 ±58	20,200 ±59	28,200 ±54	18,000 ±55	54,800 ±29	96,700 ±86	96,700 ±79
MO	24,100 ±12	22,500 ±14	25,200 ±14	62,200 ±15	54,300 ±17	65,100 ±21	374,000 ±17	307,400 ±24	321,600 ±20
MT	1,400 ±42	1,600 ±49	1,900 ±44	2,900 ±41	5,100 ±54	3,500 ±43	8,500 ±37	18,000 ±54	16,000 ±53
NE	9,700 ±12	9,000 ±17	9,700 ±19	26,700 ±13	25,500 ±18	24,500 ±18	172,900 ±15	160,600 ±17	132,000 ±22
NM	7,600 ±10	7,000 ±11	4,400 ±18	24,100 ±15	23,100 ±14	12,800 ±33	115,200 ±15	111,900 ±22	47,900 ±26
ND	3,900 ±25	4,200 ±23	5,300 ±24	11,900 ±30	12,800 ±25	15,800 ±35	47,600 ±23	73,500 ±25	76,900 ±30
OK	19,100 ±13	18,200 ±15	23,800 ±14	56,900 ±24	45,300 ±17	58,500 ±21	417,900 ±21	294,000 ±18	400,400 ±28
SD	6,400 ±21	5,300 ±15	5,600 ±22	17,500 ±24	16,000 ±25	17,100 ±33	106,800 ±25	84,500 ±30	112,400 ±46
TX	276,800 ±10	220,700 ±11	278,700 ±13	934,300 ±13	834,000 ±14	956,800 ±18	5,199,400 ±14	4,892,100 ±13	5,155,300 ±19
WY	1,500 ±26	1,700 ±23	1,700 ±27	3,400 ±23	3,300 ±30	3,700 ±36	21,100 ±25	14,900 ±28	20,100 ±40

[a] Hunter number estimates at the Management Unit and national levels may be biased high, because the HIP sample frames are state specific; therefore hunters are counted more than once if they hunt in >1 state. Variance is inestimable.

[b] † No estimate available.

American Woodcock information is taken from the U.S. Fish and Wildlife Service report American Woodcock Population Status, 2017. Seamans, M.E. and R.D. Rau. U.S. Fish and Wildlife Service, Laurel, MD. 20 pp.

The entire report is available on the Division of Migratory Bird Management home page (https://www.fws.gov/migratorybirds/pdf/surveys-and-data/Population-status/Woodcock/AmericanWoodcockStatusReport17.pdf)

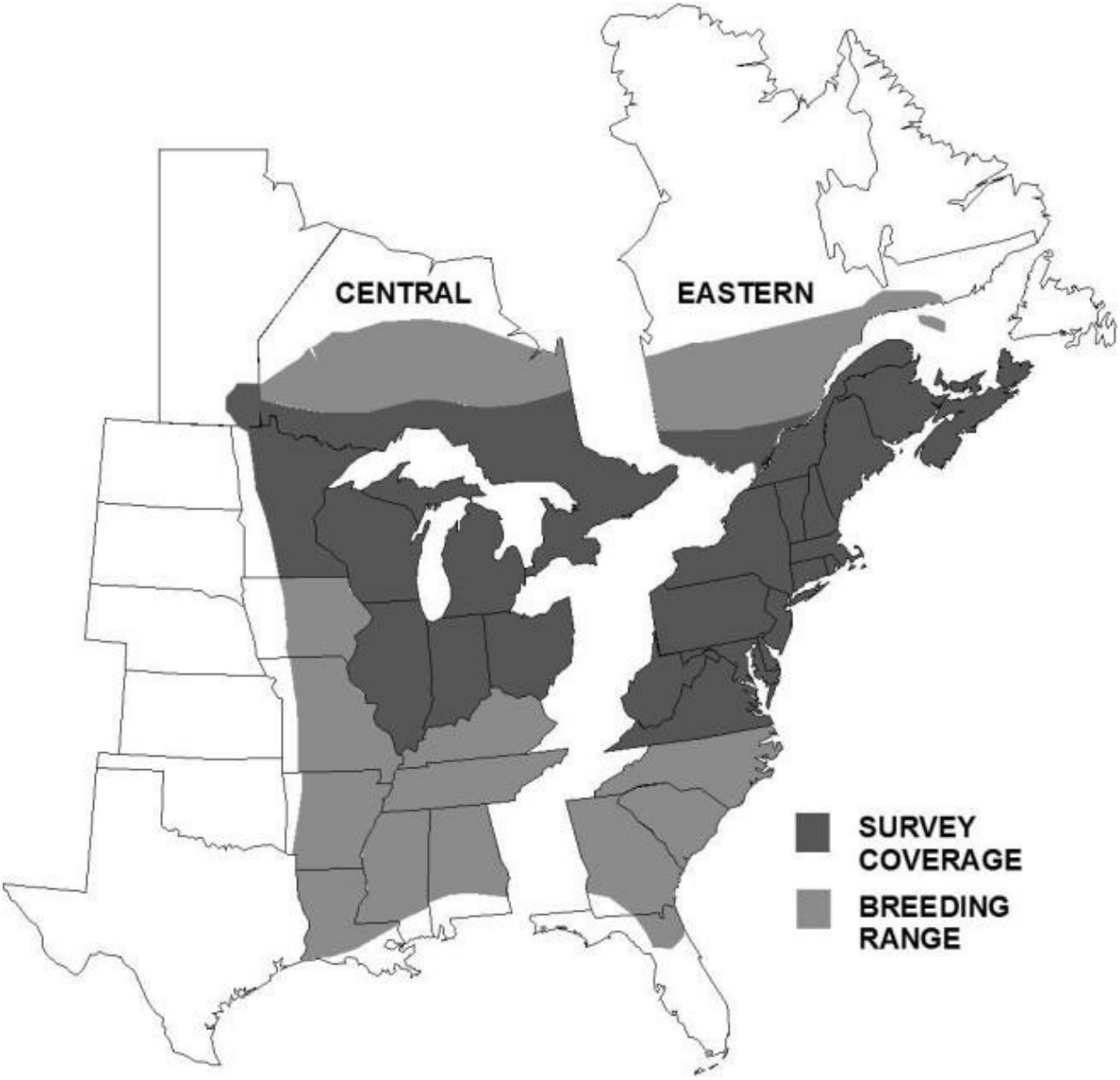

Figure 1. Woodcock management regions, breeding range, singing-ground survey coverage. (from: Seamans, M.E. and R.D. Rau. 2017. American woodcock population status, 2017. U.S. Fish and Wildlife Service, Laurel, MD. 20 pp.).

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) (from: Seamans, M.E. and R.D. Rau. 2017. American woodcock population status, 2017. U.S. Fish and Wildlife Service, Laurel, MD. 20 pp.).

Management Unit/State	Number of Routes[b]	n[c]	2016-17			2007-17			1968-17		
			% Change	95% CI[d] lower	upper	% Change	95% CI[d] lower	upper	% Change	95% CI[d] lower	upper
CENTRAL	437	744	3.64	-3.50	11.37	- 0.44	-0.88	0.79	- 0.56	-0.79	-0.33
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[e]	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

[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] Manitoba began participating in the Singing-ground survey in 1992.

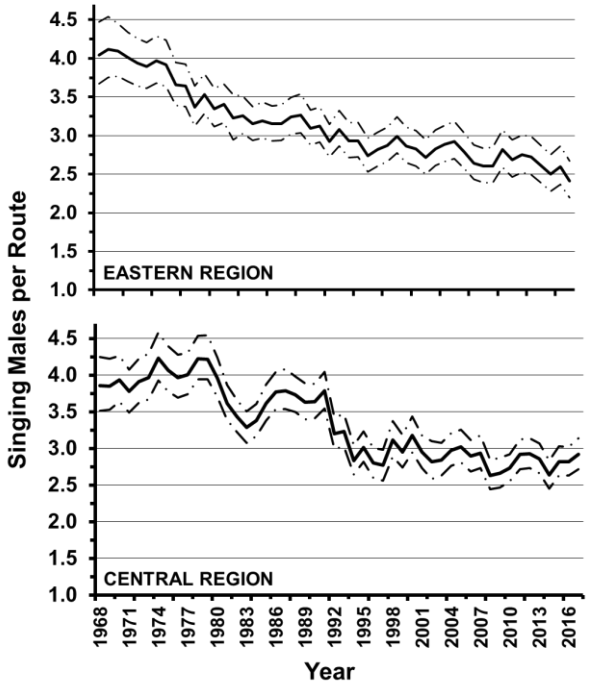

Figure 2. Annual indices of the number of woodcock heard on the Singing-ground Survey, 1968-2017. The dashed lines represent the 95th percentile credible interval. (from: Seamans, M.E. and R.D. Rau. 2017. American woodcock population status, 2017. U.S. Fish and Wildlife Service, Laurel, MD. 20 pp.).

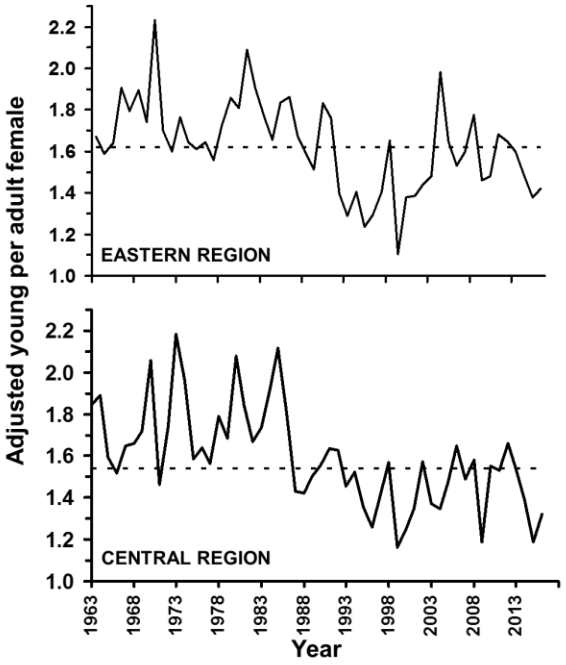

Figure 3. Weighted annual indices of American woodcock recruitment, 1963-2016. Dashed line is the 1963-2015 average. (from: Seamans, M.E. and R.D. Rau. 2017. American woodcock population status, 2017. U.S. Fish and Wildlife Service, Laurel, MD. 20 pp.).

Table 2. Preliminary estimates of woodcock hunter numbers, days afield, and harvest for selected states, from the 2013-14, 2014-15, 2015-16 and 2016-17 Harvest Information Program surveys. (from: Seamans, M.E. and R.D. Rau. 2017. American woodcock population status, 2017. U.S. Fish and Wildlife Service, Laurel, MD. 20 pp.).

Management Unit / State	Active woodcock hunters ([a])				Days afield ([a, c])				Harvest ([a, c])			
	2013-14	2014-15	2015-16	2016-17	2013-14	2014-15	2015-16	2016-17	2013-14	2014-15	2015-16	2016-17
Central Region	n.a. [b]	n.a. [b]	n.a. [b]	n.a. [b]	306,100 ± 20	227,600 ±13.6	284,200 ±16	300,200 ±32,500	180,600 ± 20	141,500 ± 23	145,700 ± 19	158,000 ±16,300
IL	1,600 ± 128	800 ± 169	1,000 ± 170	1,500 ±1,000	3,400 ± 119	2,600 ± 162	1,300 ± 133	13,200 ±11,000	1,000 ± 142	300 ± 132	200 ± 114	1,600 ±1,400
IN	700 ± 77	300 ± 99.7	400 ± 99	300 ±200	1,600 ± 58	900 ± 88.1	1,100 ± 83	1,300 ±500	1,400 ± 84	700 ± 43	600 ± 56	900 ±200
MI	30,000 ± 19	19,400 ± 21.1	26,000 ± 18	24,100 ±2,300	123,700 ± 24	87,500 ± 19.1	124,700 ± 21	107,100 ±11,600	79,300 ± 28	53,500 ± 29	63,200 ± 23	64,900 ±8,600
MN	10,900 ± 37	13,500 ±33.5	13,500 ±34	13,500 ±2,300	74,700 ± 62	47,500 ± 31.8	47,600 ± 40	46,000 ±8,200	18,600 ± 57	23,900 ± 45	25,600 ± 42	25,900 ±4,700
OH	3,000 ± 63	1,600 ± 85.4	1,900 ± 80	2,600 ±900	8,600 ± 64	4,500 ± 94.2	7,500 ± 95	8,200 ±3,700	8,600 ± 85	300 ± 90	2,100 ± 85	3,200 ±1,300
WI	14,500 ± 27	16,200 ± 25	14,700 ± 27	11,700 ±1700	60,000 ± 31	66,400 ± 26.9	66,600 ± 29	55,100 ±8,900	38,400 ± 24	49,300 ± 45	31,000 ± 25	35,100 ±4,400

[a] All 95% Confidence Intervals are expressed as a % of the point estimate.

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

[c]. Days afield and Harvest estimates are for the entire 18 state Central Region.

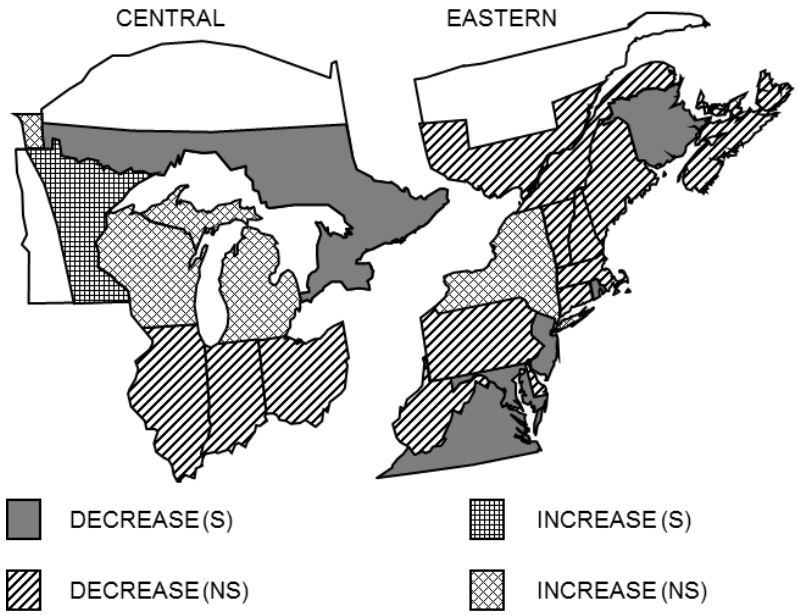

Figure 4. Ten-year trends in number of American woodcock heard on the Singing-ground Survey; 2007-17, as determined by the hierarchical modeling method. A significant trend (S) does not include zero in the 95% credible interval, while a non-significant (NS) trend does include zero. (from: Seamans, M.E. and R.D. Rau. 2017. American woodcock population status, 2017. U.S. Fish and Wildlife Service, Laurel, MD. 20 pp.).

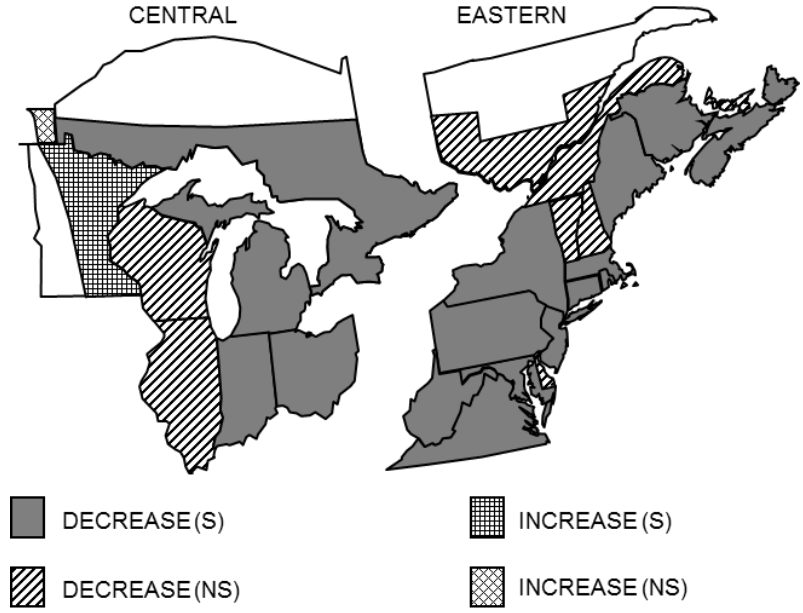

Figure 5. Long-term trends in number of American woodcock heard on the Singing-ground Survey; 1968-2017, as determined by the hierarchical modeling method. A significant trend (S) does not include zero in the 95% credible interval, while a non-significant (NS) trend does include zero. (from: Seamans, M.E. and R.D. Rau. 2017. American woodcock population status, 2017. U.S. Fish and Wildlife Service, Laurel, MD. 20 pp.).