MIGRATORY BIRD POPULATIONS

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2008 WATERFOWL BREEDING POPULATION SURVEY MINNESOTA

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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 supplemented by 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 2008 aerial survey portion was flown from 5-12 May. Spring wetland habitat conditions were generally good and much improved from recent years. Wetland numbers increased 24% compared to 2007 and were 32% above both the 10-year and long-term averages. The estimated numbers of temporary (Type 1) wetlands increased 115% from 2007 but were similar to the long-term average. The mallard breeding population index (298,000) increased 23% from the 2007 estimate (242,000) but was statistically unchanged (P = 0.18). Mallard numbers were identical to the 10-year average but 34% above the long-term average of 222,000 breeding mallards. The blue-winged teal breeding population index (152,000) was 23% above the 2007 estimate (124,000) but remained below both the 10-year (-28%) and long-term (-32%) averages. Populations of other ducks (290,000), excluding scaup, increased 151% and were above the 10-year average (28%) and the long-term average (65%). Much of this increase was due to the record high numbers of ring-necked ducks observed. Ring-necked duck numbers increased by over 100,000 birds from last year and accounted for 43% of the other duck total. Many of these were likely migrant birds still present in the state due to the late spring weather conditions. However, totals for other typical late nesting species (i.e. blue-winged teal, scaup) that are often inflated during late springs showed different results and remained below average in 2008. Wood duck numbers more than doubled from last year but estimates remain lower than levels recorded in the late 1990s. The estimate of total ducks (740,000), which excludes scaup, increased 51% compared to 2007 and was identical to the 10-year average and 19% above the long-term average (623,000). Canada goose numbers (uncorrected for visibility) decreased 28% compared to 2007, were 20% below the 10-year average but 65% above the long-term average. Spring phenology (ice out, leaf-out, temperatures) was 1-2 weeks later than average this year. Based on the social status of mallards observed (number of pairs, lone males, and flocked birds), the survey timing was adequate and similar to recent years. For other species (i.e. ring-necked ducks), the late spring contributed to a large number of migrant birds still present in the state.

METHODS:

The aerial survey is based on a sampling design that includes three survey strata (Table 1, Figure 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.

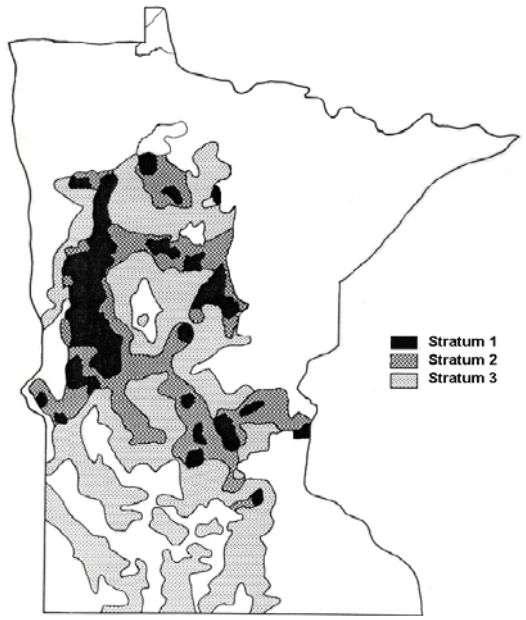

Figure 1. Location of waterfowl breeding population survey strata in Minnesota.

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 a Cessna 185 (N105NR). Wetlands were counted on the observer's side of the plane (0.125 mile wide transect) only; a correction factor obtained in 1989 was used to adjust previous data (1968-88) that was obtained when the observer counted wetlands on both sides of the plane (0.25 mile wide transect). Data were recorded on digital voice recorders for both the pilot and observer and stored as WAV 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 approximately 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. We compared estimates for 2007 and 2008 using two-tailed Z-tests.

SURVEY CHRONOLOGY:

The 2008 aerial survey began on 5 May in southern Minnesota and concluded in northern Minnesota on 12 May. The survey was completed in 8 days of flight time, which was the shortest span since the survey was initiated in 1968. Transects were flown each day and flights began no earlier than 7 AM and were completed by 12 PM each day.

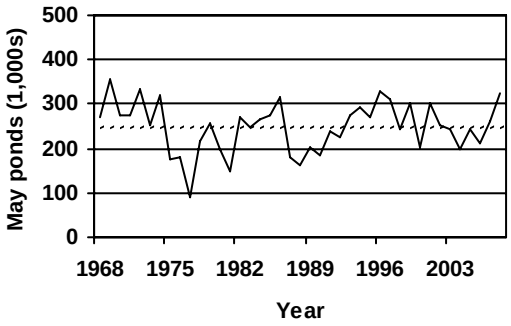

Fig. 2. Number of May ponds (Types II-V) and long-term average (dashed line) in Minnesota, 1968-2008.

WEATHER AND HABITAT CONDITIONS:

Wetland conditions in spring 2008 were improved from 2007. Ice out on most lakes across the state was 1 to 2 weeks later than average, particularly in the northern regions of the state. Some ice was still present on portions of large lakes (Leech, Bemidji) on the final day of the survey but no ice was present on any of the aerial transects. April temperatures averaged 2.7°F below normal statewide; regional temperatures ranged from 1.4°F below average in northeast Minnesota to 3.6°F below average in west central Minnesota (http://climate.umn.edu/cawap/monsum/0804.txt). April precipitation was 1.6 inches above normal statewide and ranged from 0.3 inches above normal in southwest Minnesota to 3.1 inches above normal in southeast

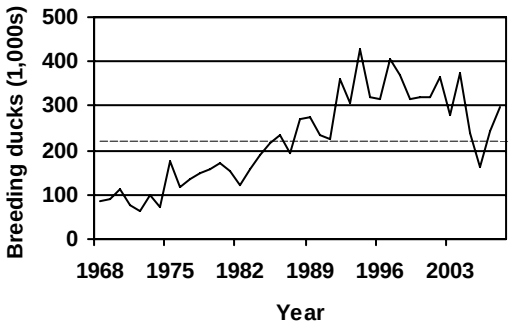

Figure 3. Mallard population estimates (adjusted for visibility bias) and long-term average (dashed line) in Minnesota, 1968-2008.

Minnesota. May temperatures averaged 3.8°F below normal statewide. May precipitation was 0.2 inches below normal statewide and ranged from 1.0 inch below normal in northwest Minnesota to 0.5 inches above normal in southwest Minnesota (http://climate.umn.edu/cawap/monsum/0805.txt).

From 20 April through 18 May, which normally would coincide with peak spring migration time for most duck species, average temperatures were near normal in mid-April (1°F above) but well below (2°F to 7°F) normal for the next 4 weeks throughout the state. Precipitation across the state averaged almost 2 inches above normal during this time period. Additional temperature and precipitation data are provided in Appendix A.

In early May 2008, statewide topsoil moisture indices were rated as 1 % short, 67 % adequate, and 32% surplus moisture. In late May, statewide indices were rated as 9% short, 81% adequate and 10% surplus moisture. (Minnesota Agricultural Statistics Service Weekly Crop Weather Reports, http://www.nass.usda.gov/mn/). For comparison, in early May 2007 statewide topsoil moisture indices were rated as 8% very short or short, 79% adequate, and 13% surplus moisture.

Planting dates for row crops were later in 2008 than recent years. By 4 May, 8% of the corn acres had been planted statewide compared to 58% in 2007 and 65% for the previous 5-year average. By 1 June, 7% of alfalfa hay had been cut compared to 29% in 2007 and a 5-year average of 20% (Minnesota Agricultural Statistics Service Weekly Crop Weather Reports, http://www.nass.usda.gov/mn/).

Wetland numbers (Type II-V) increased 24% from 2007 and were 32% above both the 10-year and long-term averages (Table 2; Figure 2). The numbers of temporary (Type 1) wetlands increased 115% from 2007 but were similar to the long-term average.

Leaf-out dates were considerably later than average, which greatly improved visibility from the air, particularly compared to recent years. The emergence of wetland vegetation was also much later than average, which also improved visibility from the air.

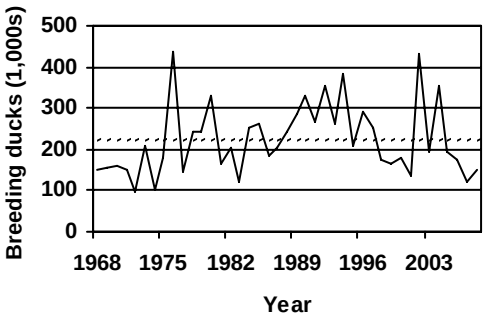

Figure 4. Blue-winged teal population estimates (adjusted for visibility bias) and long-term average (dashed line) in Minnesota, 1968-2008.

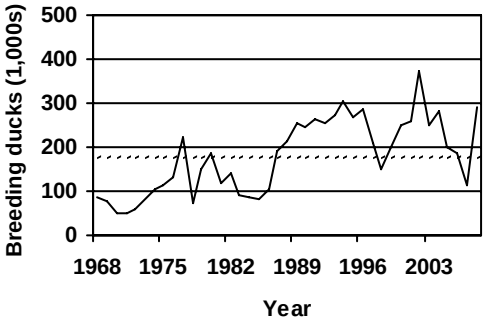

Figure 5. Other duck (excluding scaup) populations (adjusted for visibility bias) and long-term average (dashed line) in Minnesota, 1968-2008.

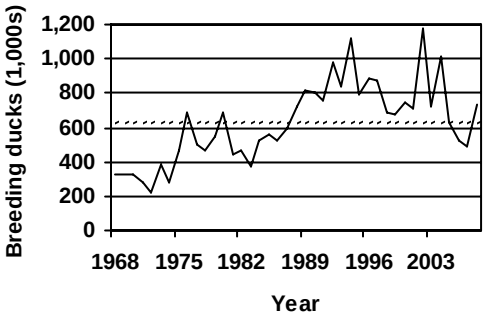

Figure 6. Total duck (excluding scaup) population estimate and long-term average (dashed line) in Minnesota, 1968-2008.

WATERFOWL POPULATIONS:

The number of ducks, Canada geese, and coots, 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.

The 2008 waterfowl breeding population estimate of mallards was 297,565 (SE = 27,787), which was 23% higher but statistically unchanged from 2007 (Z = 1.37, P = 0.18) (Table 7, Figure 3). Mallard numbers were similar to the 10-year average and 34% above the long-term average of 222,000. In 2008, 2% of the total mallards were in flocks compared to 6% in 2007 and 7% in 2006. Pairs comprised 13% of the mallards observed, compared to 9% and 12% in 2006 and 2007, respectively. This suggests that survey timing was similar to recent years based on their social status.

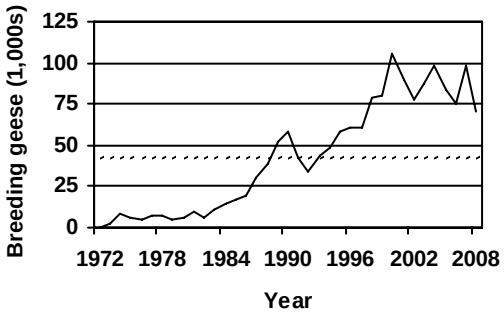

Figure 7. Canada goose population estimates (not adjusted for visibility bias) and long-term average in Minnesota, 1972-2008.

The estimated blue-winged teal population was 152,359 (SE = 24,157), which was higher than 2007 (123,000) but statistically unchanged from last year (Z = 0.92, P = 0.36). Blue-winged teal numbers remained 28% below the 10-year average and 32% below the long-term average (Table 7, Figure 4). In 2008, 11% of the blue-winged teal were observed in flocks compared to no teal in flocks in 2007. Pairs comprised 74% of the blue-winged teal observed, compared to 64% in 2007 and an average of 55% counted as pairs since 2000. This index of social status suggests that migrant blue-winged teal were still present in the state (flocked birds) and few had begun nesting (low numbers of lone males). Typically, this can result in higher than average population estimates but blue-winged teal estimates were below average this year.

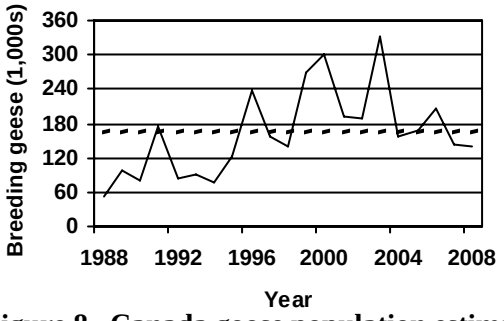

Figure 8. Canada goose population estimates (adjusted for visibility bias) and long-term average in Minnesota, 1988-2008.

Other duck numbers (excluding scaup) increased 151% to 289,629 and were 28% above the 10-year average and 65% above the long-term average (Table 7, Figure 5). Much of this increase was due to record numbers of ring-necked ducks counted. Ring-necked ducks accounted for 43% of the total number of other ducks and estimated numbers increased by over 100,000 from last year, reflecting large numbers of migrants present during the survey. Scaup numbers, however, were identical to the 10-year average (43,000) and 36% below the long-term average. Although scaup are only rare nesters in the state, spring migration patterns are generally assumed to be similar to ring-necked ducks. Based on the record high number of ring-necked ducks present this year, scaup numbers were considerably lower than expected. The total duck population, excluding scaup, was 740,000, which was 51% higher than 2007, identical to the 10-year average and 19% above the long-term average (Table 7, Figure 6).

Visibility Correction Factors (VCFs) were lower in 2008 for mallards (9%), blue-winged teal (11%) and other ducks (22%) compared to 2007 (Table 7). Mallard VCFs (2.88) were lower than last year (3.15) but 34% above the long-term average. The blue-winged teal VCF (3.74) was lower than last year (4.20) and near the long-term average. The VCF for other ducks (2.91) was also lower than last year (3.73) and near the long-term average. The late leaf-out conditions and/or ideal flying conditions (light winds, overcast skies, no precipitation) may have contributed to better visibility from the air and lower VCFs this year.

Canada goose numbers (uncorrected for visibility) decreased 28% compared to 2007 and were 65% above the long-term average (Table 7, Figure 7). The VCF for Canada geese was 1.99, 35% higher than 2007 but 15% below the long-term average. The population estimate of Canada geese, adjusted for visibility, was similar (-3%) to last year (Table 7, Figure 8). There were no Canada goose broods observed during the aerial survey compared to 30-50 broods each of the past 3 years. This may be related to the late spring chronology and a delayed nesting effort by Canada geese, or simply the timing to complete this year's survey (8 days vs. >20 days the past 3 years).

The estimated coot population, uncorrected for visibility, was 56,000 in 2008 compared to 6,000 in 2007.

SUMMARY:

Overall wetland conditions were improved from 2007 and above the long-term average. Mallard abundance in 2008 (298,000) was higher than 2007 (242,000) but statistically unchanged (P=0.18). Mallard numbers were 34% above the long-term average (222,000) and at the 10-year average (299,000). Blue-winged teal abundance (152,000) was higher than 2007 (124,000) but not significantly different (P=0.36) and remained 28% below the 10-year average (212,000) and 32% below the long-term average (225,000). Duck abundance for all other species increased relative to 2007. Total duck abundance (740,000), excluding scaup, increased 51% from 2007, was identical to the 10-year average and 19% above the long-term average. Much of this increase was attributed to large numbers of migrant ring-necked ducks present in the state, likely as a result of the late spring phenology. Canada goose numbers, unadjusted for visibility bias, decreased 28% from 2007 and were 65% above the long-term average.

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Table 1. Survey design for Minnesota, May 2008.[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 number of May ponds (Type 1 and Types II-V) during Minnesota waterfowl breeding population survey, 1968-2008.

Year	Type I	Number of ponds [1]
1968		272,000
1969		358,000
1970		276,000
1971		277,000
1972		333,000
1973		251,000
1974		322,000
1975		175,000
1976		182,000
1977		91,000
1978		215,000
1979		259,000
1980		198,000
1981		150,000
1982		269,000
1983		249,000
1984		264,000
1985		274,000
1986		317,000
1987		178,000
1988		160,000
1989		203,000
1990		184,000
1991	82,862	237,000
1992	10,019	225,000
1993	199,870	274,000
1994	123,958	294,000
1995	140,432	272,000
1996	147,859	330,000
1997	30,751	310,000
1998	20,560	243,000
1999	152,747	301,000
2000	5,090	204,000
2001	66,444	303,000
2002	30,602	254,000
2003	34,005	244,000
2004	9,494	198,000
2005	30,764	241,000
2006	56,798	211,000
2007	32,415	262,000
2008	69,734	325,000
10-year average (1998-2007)	43,892	246,100
Long-term average (1968-2007)	69,098	246,500
Change from:		
2007	115%	24%
10-year average	59%	32%
Long-term average	1%	32%

[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, 1990-2008.

	Year																		
Species	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Dabblers:																			
Mallard	29,686	25,854	28,770	23,327	22,160	20,494	25,104	26,992	33,157	26,576	26,604	28,742	29,297	25,937	29,381	19,050	16,829	16,357	25,104
Black Duck	0	56	0	0	56	0	0	0	0	0	0	0	0	0	0	56	0	0	0
Gadwall	2,694	2,721	2,777	778	444	1,055	1,083	611	1,111	1,777	833	1,333	944	1,250	2,111	1,166	1,444	889	1,166
American Wigeon	222	0	56	0	0	194	0	0	56	56	56	111	0	56	555	167	0	56	111
Green-winged Teal	0	56	0	111	278	0	278	56	333	0	278	56	278	222	444	56	56	167	278
Blue-winged Teal	23,771	15,940	15,274	10,358	9,164	7,609	6,720	6,387	8,220	6,998	11,247	7,387	14,218	9,664	23,771	9,303	5,665	5,332	9,942
Northern Shoveler	778	1,777	1,000	111	278	111	1,277	1,500	500	555	1,055	305	1,277	278	1,166	333	167	56	1,000
Northern Pintail	444	389	222	611	167	167	167	111	111	167	167	389	56	111	56	0	56	0	56
Wood Duck	14,468	10,775	10,941	11,636	7,359	6,831	6,498	9,497	12,302	5,582	10,219	6,720	2,888	4,499	8,081	5,498	3,555	2,666	6,665
Dabbler Subtotal	72,063	57,568	59,040	46,932	39,906	36,461	41,127	45,154	55,790	41,711	50,459	45,043	48,958	42,017	65,565	35,629	27,772	25,523	44,322
Divers:																			
Redhead	3,305	2,555	3,499	1,416	1,972	639	722	778	944	500	583	1,444	750	333	805	666	666	916	1,389
Canvasback	1,972	2,305	2,111	2,777	3,166	3,860	1,166	1,333	1,777	2,971	1,222	2,027	1,833	1,333	666	972	833	1,000	2,277
Scaup	8,970	9,858	23,854	6,748	19,661	7,192	13,829	3,416	9,247	1,750	7,415	5,832	2,444	2,055	5,971	4,110	111	555	6,276
Ring-necked Duck	1,638	1,777	4,721	2,222	3,582	1,583	3,166	2,694	2,749	2,360	4,776	2,444	2,777	1,361	5,165	1,722	2,055	1,555	21,494
Goldeneye	56	0	222	111	222	111	167	0	111	56	56	333	111	0	222	222	56	222	278
Bufflehead	0	333	722	0	444	56	278	0	56	111	56	111	222	111	389	167	222	56	1,611
Ruddy Duck	1,500	361	500	1,250	639	167	139	528	11,052	972	0	83	1,305	417	305	1,222	305	0	1,027
Hooded Merganser	139	0	444	222	111	278	611	555	389	722	500	722	555	333	278	333	555	111	666
Large Merganser	0	56	111	0	56	0	0	56	0	0	0	111	0	972	0	111	0	278	333
Diver Subtotal	17,580	17,245	36,184	14,746	29,853	13,886	20,078	9,360	26,325	9,442	14,608	13,107	9,997	6,915	13,801	9,525	4,803	4,693	35,351
Total Ducks	89,643	74,813	95,224	61,678	69,759	50,347	61,205	54,514	82,115	51,153	65,067	58,150	58,955	48,932	79,366	45,154	32,575	30,216	79,673
Other:																			
Coot	27,326	11,108	11,386	1,166	528	611	3,055	5,054	555	83	3,999	1,722	2,888	2,666	21,411	2,444	639	139	16,829
Canada Goose	16,523	9,803	10,914	13,135	12,802	14,413	12,774	10,330	16,967	19,495	22,160	24,882	24,104	22,160	23,160	22,938	21,633	29,797	18,717

Table 4. Minnesota waterfowl breeding populations by species for Stratum II (medium wetland density), expanded for area but not visibility, 1990-2008.

	Year																		
Species	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Dabblers:																			
Mallard	39,682	39,215	45,585	37,111	42,896	42,896	48,507	54,643	53,942	52,247	49,559	44,650	43,773	34,715	44,474	26,883	25,130	24,779	27,935
Black Duck	0	0	0	0	0	0	0	0	0	0	0	117	0	0	0	0	0	0	0
Gadwall	2,805	1,870	2,045	1,286	1,403	1,052	935	468	584	1,519	3,039	1,636	701	584	3,565	584	1,052	234	3,039
American Wigeon	234	701	351	0	117	0	468	351	818	0	468	0	0	0	2,513	117	0	0	351
Green-winged Teal	0	0	0	351	117	0	935	234	351	117	117	117	468	234	234	0	117	0	0
Blue-winged Teal	31,208	24,663	26,766	18,818	19,227	10,636	13,851	13,792	13,208	10,578	19,637	9,701	21,390	15,955	30,624	11,513	9,000	8,416	12,740
Northern Shoveler	2,104	3,857	1,636	1,286	935	818	1,636	2,571	701	2,104	4,675	1,052	2,221	1,403	1,753	234	584	351	468
Northern Pintail	701	701	234	351	468	234	117	234	468	117	117	117	0	117	0	0	0	234	0
Wood Duck	14,903	8,065	11,221	9,468	9,409	6,662	8,708	11,338	10,520	19,753	13,792	7,831	5,143	4,558	8,766	3,273	1,753	2,221	6,546
Dabbler subtotal	91,637	79,072	87,838	68,671	74,572	62,298	75,157	83,631	80,592	86,435	91,404	65,221	73,696	57,566	91,929	42,604	37,636	36,235	51,079
Divers:																			
Redhead	4,325	1,519	3,097	2,279	3,799	1,403	1,110	1,987	935	1,636	2,805	2,455	234	584	1,110	292	175	935	935
Canvasback	234	117	0	584	1,052	0	234	701	117	117	935	0	468	1,052	234	0	0	1,169	468
Scaup	25,189	13,383	22,208	877	14,085	7,831	21,916	18,935	4,032	3,331	6,779	3,039	5,961	2,279	7,188	2,981	468	643	3,097
Ring-necked Duck	2,513	2,104	2,922	3,156	3,331	1,403	7,714	3,565	2,279	2,221	5,610	3,799	6,370	2,455	5,377	1,929	3,331	1,578	13,149
Goldeneye	351	818	351	584	701	701	1,753	818	234	935	584	468	234	234	351	117	117	0	351
Bufflehead	234	0	526	117	234	0	117	117	0	0	0	0	1,169	117	468	351	117	117	1,403
Ruddy Duck	1,227	4,558	1,227	3,390	409	117	58	117	0	468	0	0	1,870	2,688	0	351	58	0	0
Hooded Merganser	0	0	351	584	468	117	234	468	117	701	935	1,403	701	701	234	234	351	234	584
Large Merganser	0	0	117	0	0	0	0	0	0	0	117	117	0	0	234	351	0	0	351
Diver subtotal	34,073	22,499	30,799	11,571	24,079	11,572	33,136	26,708	7,714	9,409	17,765	11,281	17,007	10,110	15,196	6,606	4,617	4,676	20,338
Total Ducks	125,710	101,571	118,637	80,242	98,651	73,870	108,293	110,339	88,306	95,844	109,169	76,502	90,703	67,676	107,125	49,210	42,253	40,911	71,417
Other:																			
Coot	11,630	5,552	11,162	5,201	1,461	526	7,013	5,026	643	234	1,110	468	4,909	1,519	8,007	584	292	409	23,961
Canada Goose	11,279	8,591	7,305	9,409	12,565	12,682	13,559	16,364	19,812	18,585	25,831	24,604	20,688	22,091	28,461	20,688	26,825	25,890	19,753

Table 5. Minnesota waterfowl breeding populations by species for Stratum III (low wetland density), expanded for area but not visibility, 1990-2008.

	Year																		
Species	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Dabblers:																			
Mallard	71,511	63,246	69,771	63,333	73,425	79,166	79,862	78,993	101,873	90,390	81,690	72,642	72,121	55,156	84,561	36,539	30,884	35,843	50,371
Black Duck	174	0	0	0	0	0	0	0	0	0	0	0	0	0	174	0	0	174	174
Gadwall	8,787	2,262	2,436	1,218	2,610	3,306	3,306	2,436	3,045	2,436	2,610	10,701	3,306	1,566	6,960	2,001	5,568	4,176	870
American Wigeon	957	696	522	348	1,218	0	1,044	348	696	0	522	174	1,218	174	1,566	1,044	174	348	348
Green-winged Teal	0	348	0	348	174	0	957	348	174	0	1,218	1,392	522	174	0	174	522	0	0
Blue-winged Teal	52,198	50,893	51,067	35,494	41,932	29,492	36,625	25,316	26,360	18,530	29,405	20,618	56,374	21,140	39,758	27,578	23,663	15,659	18,095
Northern Shoveler	23,663	5,568	11,048	1,914	2,784	5,307	12,701	11,049	4,176	4,002	20,444	10,701	6,264	870	3,828	348	522	870	4,002
Northern Pintail	696	1,914	870	1,218	696	174	870	522	870	870	696	522	0	174	348	174	174	348	174
Wood Duck	25,055	17,747	24,185	25,229	23,228	16,355	27,926	14,268	23,837	20,531	25,055	17,225	13,572	12,702	20,705	7,482	7,308	5,394	14,442
Dabbler subtotal	183,041	142,674	159,899	129,102	146,067	133,800	163,291	133,280	161,031	136,759	161,640	133,975	153,377	91,956	157,900	75,340	68,815	62,812	88,476
Divers:																			
Redhead	3,219	2,610	6,438	1,827	2,958	7,134	1,044	1,044	2,001	3,480	2,523	3,654	1,305	174	1,740	1,479	0	522	783
Canvasback	1,044	696	0	348	696	174	1,392	0	3,306	174	3,915	522	696	1,131	2,784	0	0	348	1,566
Scaup	5,916	17,486	20,009	4,176	23,924	13,397	29,840	8,787	15,137	8,961	18,182	6,873	4,611	783	17,747	5,307	1,392	696	5,481
Ring-necked Duck	2,088	3,480	3,654	2,871	5,568	1,044	12,875	3,654	2,958	1,479	8,178	8,526	7,395	1,479	5,133	10,179	6,699	1,392	8,526
Goldeneye	609	696	1,044	696	783	1,479	1,914	522	696	696	1,044	1,566	3,132	1,305	696	1,044	1,044	870	348
Bufflehead	0	552	696	348	696	0	1,044	174	348	0	0	0	1,218	783	2,088	0	174	696	1,218
Ruddy Duck	1,218	9,396	6,786	1,218	2,175	2,349	1,740	348	0	174	0	696	18,878	87	2,262	870	696	261	87
Hooded Merganser	174	348	348	348	696	1,044	1,566	696	696	1,218	957	174	2,175	174	1,740	1,218	870	174	696
Large Merganser	0	0	348	0	174	174	0	0	0	0	0	0	522	0	0	261	957	348	348
Diver subtotal	14,268	35,264	39,323	11,832	37,670	26,795	51,415	15,225	25,142	16,182	34,799	22,011	39,932	5,916	34,190	20,358	11,832	5,307	19,053
Total Ducks	197,309	177,938	199,222	140,934	183,737	160,595	214,706	148,505	186,173	152,941	196,439	155,986	193,309	97,872	192,090	95,698	80,647	68,119	107,529
Other:																			
Coot	11,918	47,587	62,463	12,179	12,788	3,828	182,953	24,620	5,133	14,702	67,684	3,132	14,007	7,134	77,427	8,613	14,702	5,742	15,137
Canada Goose	30,623	23,837	15,746	21,314	23,228	30,971	34,537	33,755	42,368	41,933	57,940	39,932	33,407	43,412	46,717	39,758	27,230	42,629	31,841

Table 6. Minnesota waterfowl breeding populations by species for Stratum I-III combined, expanded for area coverage but not for visibility, 1990-2008.

	Year																		
Species	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Dabblers:																			
Mallard	140,879	128,315	144,126	123,771	138,481	142,556	153,473	160,628	188,972	169,213	157,853	146,034	145,191	115,974	158,416	82,472	72,843	76,979	103,411
Black Duck	174	56	0	0	56	0	0	0	0	0	0	117	0	0	174	56	0	174	174
Gadwall	14,286	6,853	7,258	3,282	4,457	5,413	5,324	3,515	4,740	5,733	6,482	13,670	4,951	3,400	12,635	3,752	8,064	5,298	5,075
American Wigeon	1,413	1,397	929	348	1,335	194	1,512	699	1,570	56	1,045	285	1,218	230	4,634	1,327	174	404	810
Green-winged Teal	0	404	0	810	569	0	2,170	638	858	117	1,613	1,564	1,267	630	678	230	694	167	278
Blue-winged Teal	107,177	91,496	93,107	64,670	70,323	47,737	57,196	45,495	47,788	36,106	60,288	37,706	91,982	46,759	94,152	48,394	38,328	29,407	40,777
Northern Shoveler	26,545	11,202	13,684	3,311	3,997	6,236	15,614	15,120	5,377	6,661	26,175	12,058	9,762	2,550	6,747	915	1,273	1,276	5,469
Northern Pintail	1,841	3,004	1,326	2,180	1,331	575	1,154	867	1,449	1,153	979	1,028	56	402	404	174	230	582	230
Wood Duck	54,426	36,587	46,347	46,333	39,996	29,848	43,132	35,103	46,659	45,866	49,067	31,777	21,603	21,759	37,553	16,253	12,616	10,281	27,652
Dabbler subtotal	346,741	279,314	306,777	244,705	260,545	232,559	279,575	262,065	297,413	264,905	303,502	244,239	276,030	191,704	315,393	153,573	134,222	124,568	183,876
Divers:																			
Redhead	10,849	6,684	13,034	5,522	8,729	9,176	2,876	3,809	3,880	5,616	5,911	7,552	2,289	1,092	3,656	2,438	842	2,373	3,107
Canvasback	3,250	3,118	2,111	3,709	4,914	4,034	2,792	2,034	5,200	3,262	6,072	2,549	2,996	3,516	3,684	972	833	2,517	4,311
Scaup	40,075	40,727	66,071	11,801	57,670	28,420	65,585	31,138	28,416	14,041	32,376	15,743	13,016	5,117	30,906	12,397	1,971	1,894	14,854
Ring-necked Duck	6,239	7,361	11,297	8,249	12,481	4,030	23,755	9,913	7,986	6,060	18,565	14,768	16,542	5,294	15,675	13,829	12,085	4,525	43,169
Goldeneye	1,016	1,514	1,617	1,391	1,706	2,291	3,834	1,340	1,041	1,687	1,684	2,367	3,477	1,539	1,269	1,383	1,216	1,092	976
Bufflehead	234	885	1,944	465	1,374	56	1,439	291	404	111	56	111	2,609	1,011	2,944	517	513	868	4,231
Ruddy Duck	3,945	14,315	8,513	5,858	3,223	2,633	1,937	993	11,052	1,613	0	779	22,054	3,192	2,567	2,443	1,060	261	1,114
Hooded Merganser	313	348	1,143	1,154	1,275	1,439	2,411	1,719	1,202	2,641	2,392	2,299	3,432	1,209	2,251	1,785	1,776	519	1,947
Large Merganser	0	56	576	0	230	174	0	56	0	0	117	228	522	972	234	723	957	626	1,032
Diver subtotal	65,921	75,008	106,306	38,149	91,602	52,253	104,629	51,293	59,181	35,031	67,173	46,396	66,937	22,942	63,186	36,487	21,253	14,675	74,741
Total Ducks	412,662	354,322	413,083	282,854	352,147	284,812	384,204	313,358	356,594	299,936	370,675	290,635	342,967	214,646	378,579	190,060	155,475	139,243	258,617
Other:																			
Coot	50,874	64,247	85,011	18,546	14,777	4,965	193,021	34,700	6,331	15,020	72,793	5,321	21,804	11,319	106,845	11,641	15,633	6,290	55,927
Canada Goose	58,425	42,231	33,965	43,858	48,595	58,066	60,870	60,449	79,147	80,012	105,932	89,418	78,200	87,663	98,339	83,384	75,688	98,316	70,311

Table 7. Estimated waterfowl populations during the Minnesota Waterfowl breeding population survey, 1968-2008.

	Mallard				Blue-winged teal				Other ducks (exc. scaup)		
Year	Unad. PI	VCF	PI	SE	Unad. PI	VCF	PI	SE	Unad. PI	VCF	PI
1968[2]	41,030	2.04	83,701		61,943	2.44	151,141		41,419	2.08	86,152
1969[2]	53,167	1.67	88,789		45,180	3.45	155,871		34,605	2.27	78,553
1970[2]	67,463	1.69	113,945		31,682	5.06	160,343		30,822	1.62	49,932
1971[2]	47,702	1.65	78,470		42,445	3.49	148,218		29,520	1.71	50,450
1972[2]	49,137	1.27	62,158		49,386	1.96	96,895		34,405	1.69	58,127
1973[3]	56,607	1.76	99,832		53,095	3.92	208,292		33,155	2.45	81,362
1974[3]	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
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
Averages:											
10-year (1998-2007)	128,851	2.41	298,659	39,873	53,091	4.01	212,094	41,959	73,802	3.38	226,526
Long-term (1968-2007)	103,567	2.15	222,280	36,215	60,568	3.91	224,827	42,730	59,615	3.19	176,025
% change from:											
2007	34%	-9%	23%	-7%	39%	-11%	23%	20%	222%	-22%	151%
10-year average	-20%	20%	0%	-30%	-23%	-7%	-28%	-42%	35%	-14%	28%
Long-term average	0%	34%	34%	-23%	-33%	-4%	-32%	-43%	67%	-9%	65%

[1] Unad. PI - unadjusted population index, VCF - Visibility Correction Factor, PI - adjusted population index, SE - standard error.
[2] Calculated from data in Minn. Game Res. Quarterly Reps. The 1968 and 1969 other duck VCF is total duck VCF.
[3] Calculated from data in Maxson and Pace (1989).

Table 7. Cont.

Year	Scaup			Total ducks (ex. scaup)		Total Ducks		Canada geese		
	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
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	2.10	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	3.98	49,340	177,663	631,980	190,060	681,320	83,384	2.02	168,469
2006	1,971	4.22	8,322	153,504	521,109	155,475	529,431	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
Averages:										
10-year (1998-2007)	15,588	3.33	42,934	258,088	738,095	273,677	781,029	87,610	2.41	209,768
Long-term (1968-2007)	22,910	3.18	67,639	223,700	623,308	246,610	690,947	42,515	2.38	163,661
% change from:										
2007	684%	-22%	512%	77%	51%	86%	58%	-28%	35%	-3%
10-year average	-5%	-13%	1%	-6%	0%	-6%	0%	-20%	-17%	-33%
Long-term average	-35%	-8%	-36%	9%	19%	5%	13%	65%	-16%	-15%

[1] Unad. PI - unadjusted population index, VCF - Visibility Correction Factor, PI - adjusted population index, SE - standard error.

Appendix A. Temperature and precipitation at selected cities in, or adjacent to, Minnesota May Waterfowl Survey Strata, 20 April - 18 May 2008 (Source: Minnesota Climatological Working Group, http://climate.umn.edu/cawap/nwssum/nwssum.asp).

		Temperature (F) for week ending:										Total weekly precipitation (inches)					Precipitation departure from normal
		20-April		27-April		4-May		11-May		18-May							
Region	City	Avg[1]	Depart[2]	Avg[1]	Depart[2]	Avg[1]	Depart[2]	Avg[1]	Depart[2]	Avg[1]	Depart[2]	20-April	27-April	4-May	11-May	18-May	1 Apr-18 May
NW	Crookston	45.8	3.1	39.2	-7.2	41.9	-8.1	45.4	-7.9	51.2	-5.1	0.01	0.93	0.02	0.14	0.06	-1.35
NC	Grand Rapids	43.0	1.1	41.2	-4.0	42.5	-5.8	46.6	-4.8	49.8	-4.4	0.00	2.19	0.38	1.14	0.49	4.29
	Itasca	39.9	1.2	38.2	-4.1	38.2	-7.7	43.3	-6.0	49.2	-3.2	0.00	1.79	0.12	0.93	0.29	2.87
WC	Alexandria	45.8	2.4	41.4	-5.5	43.8	-6.5	49.6	-3.8	53.8	-2.4	0.00	1.40	0.08	0.91	0.16	-0.16
	Fergus Falls	45.0	1.4	41.6	-5.7	40.6	-10.1	51.4	-2.5	51.9	-4.8	0.00	2.52	0.65	1.13	0.03	2.35
	Montevideo	47.2	2.1	44.8	-3.8	46.4	-5.5	51.7	-3.4	55.0	-3.0	0.00	0.90	0.36	1.67	0.15	0.72
	Morris	43.7	-1.3	43.8	-4.7	39.8	-12.0	51.4	-3.5	53.4	-4.3	0.00	1.32	0.26	1.38	0.09	1.12
C	Becker	44.4	0	48.2	0.4	43.8	-7.1	52.4	-1.4	54.6	-1.9	0.17	2.49	0.86	1.42	0.35	2.75
	Hutchinson	46.6	0.6	49.8	0.3	44.3	-8.4	53.3	-2.5	56.4	-2.2	0.00	1.75	1.30	0.81	0.18	2.16
	St. Cloud	46.2	1.8	45.3	-2.5	45.4	-5.5	50.6	-3.2	54.0	-2.5	0.00	1.93	0.87	1.14	0.10	1.42
	Staples	42.0	-0.9	45.0	-1.3	40.3	-9.1	47.8	-4.5	51.0	-3.9	0.00	0.87	0.38	0.80	0.16	0.75
	Willmar	44.9	-0.2	47.4	-1.1	43.2	-8.7	52.8	-2.3	54.3	-3.6	0.00	1.77	0.62	1.72	0.25	2.22
EC	Aitkin	42.0	0.2	46.1	1.1	40.3	-7.7	48.2	-2.7	49.4	-4.1	0.00	1.30	0.47	0.80	0.38	2.16
	Cambridge	Missing															
	Msp Airport	49.0	1.6	49.8	-0.8	47.2	-6.4	54.5	-1.9	57.1	-2.0	0.27	1.46	1.34	0.51	0.01	0.96
SW	Pipestone	44.5	-0.9	44.3	-4.3	44.2	-7.5	52.6	-2.1	53.1	-4.4	0.00	1.45	0.18	1.68	0.00	0.37
	Redwood Falls	48.3	0.6	46.2	-4.8	47.0	-7.2	52.7	-4.6	55.7	-4.4	0.00	2.42	1.19	1.19	0.22	1.71
	Worthington	43.8	-0.4	46.8	-0.7	43.4	-7.5	52.8	-1.2	55.4	-1.6	0.07	1.07	1.70	0.88	0.00	0.69
SC	Faribault	44.2	-0.7	51.4	3.3	43.4	-7.9	52.4	-1.9	54.9	-2.2	0.10	1.90	1.23	0.67	0.05	1.56
	Waseca	44.8	-0.9	50.9	1.9	44.0	-8.2	55.0	-0.3	55.8	-2.4	0.69	1.09	1.39	0.67	0.00	0.68
	Winnebago	45.6	-1.2	51.8	1.9	45.2	-7.7	56.0	0.2	57.5	-1.0	0.36	1.55	2.04	0.86	0.00	3.03
Statewide		45.0	1.0	45.4	-1.9	43.1	-7.3	49.8	-3.7	53.0	-3.2	0.26	1.76	0.76	0.82	0.24	

[1] Average temperature (°F) for the week ending on the date shown.
[2] Departure from normal temperature.
m = missing data

Waterfowl information is taken from the U.S. Fish and Wildlife Service report **Waterfowl Population Status, 2008** by Pamela R. Garrettson, Timothy J. Moser, Nathan Zimpfer, and Kathy Fleming. The entire report is available on the Division of Migratory Bird Management home page (http://www.fws.gov/migratorybirds/reports/reports.html .

Table 1. Canada goose population indices (in thousands) of the eastern prairie flock, 1971-2008 (from: U.S. Fish and Wildlife Service. 2008. Waterfowl population status, 2008. U.S. Department of the Interior, Washington, D.C. U.S.A.).

Year	Population[a,b]
1971-72	125,000
1972-73	138,000
1973-74	120,000
1974-75	144,000
1975-76	216,000
1976-77	164,000
1977-78	180,000
1978-79	99,000
1979-80	n.a.
1980-81	125,000
1981-82	132,000
1982-83	155,000
1983-84	136,000
1984-85	158,000
1985-86	195,000
1986-87	203,000
1987-88	209,000
1988-89	210,000
1989-90	232,000
1990-91	212,000
1991-92	202,000
1992-93	157,000
1993-94	211,000
1994-95	205,000
1995-96	190,000
1996-97	199,000
1997-98	126,000
1998-99	207,000
1999-00	275,000
2000-01	215,000
2001-02	216,000
2002-03	229,000
2003-04	291,000
2004-05	255,000
2005-06	185,000
2006-07	218,000
2007-08	256,600

[a] Surveys conducted in Spring.
[b] Indirect or preliminary estimate.

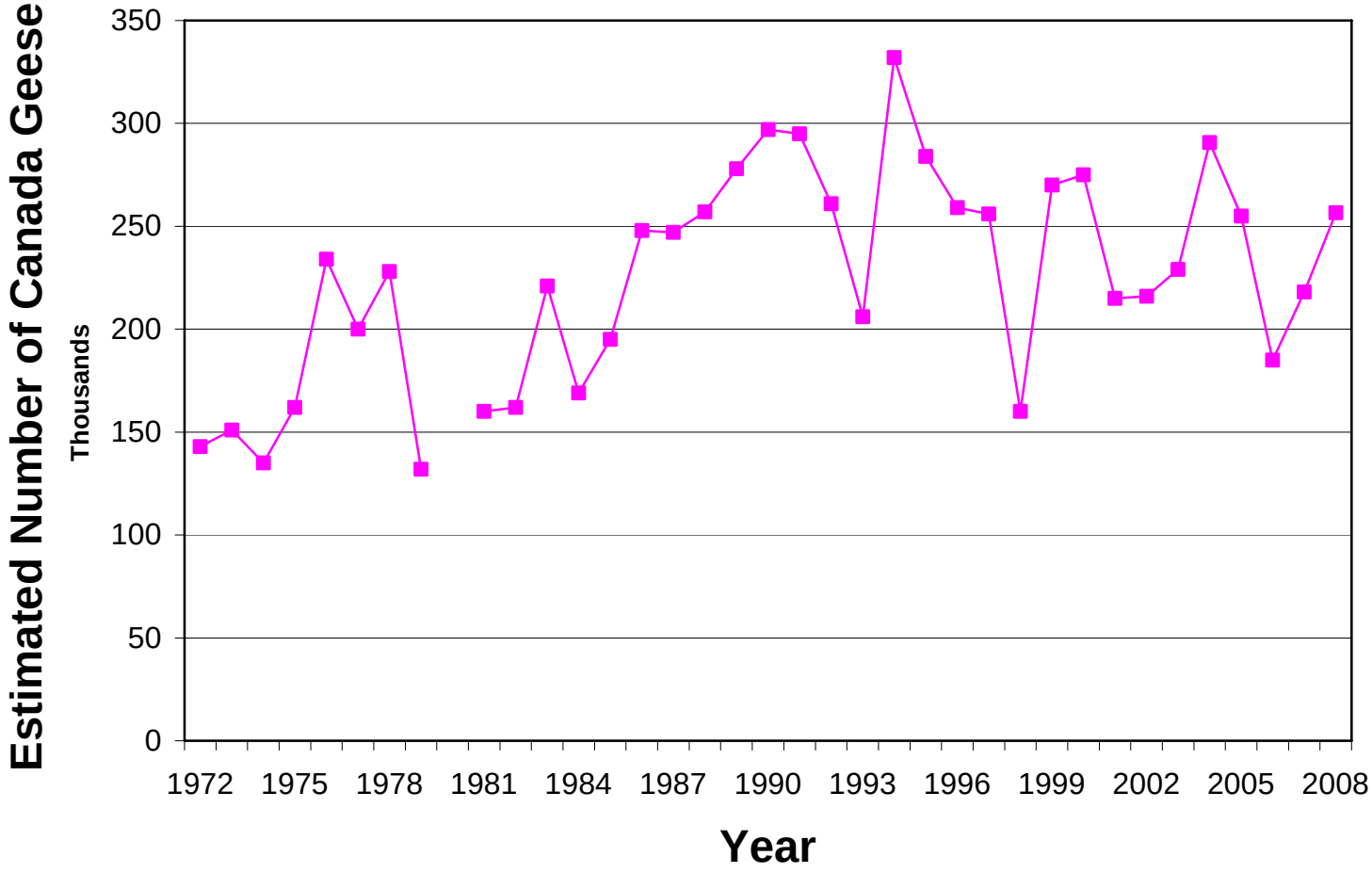

Figure 1. Breeding ground survey estimates of the Eastern Prairie Population of Canada geese, 1972-2008. (from: U.S. Fish and Wildlife Service. 2008. Waterfowl population status, 2008. U.S. Department of the Interior, Washington, D.C. U.S.A.). Surveys conducted in spring. Indirect or preliminary estimates. Data not available for 1980.

Table 2. Estimated number of May ponds (adjusted for visibility) in Prairie Canada (portions of Alberta, Saskatchewan and Manitoba) 1964-2008 and north-central U.S. (North Dakota, South Dakota and Montana) 1974-2008. (from: U.S. Fish and Wildlife Service. 2008. Waterfowl population status, 2008. U.S. Department of the Interior, Washington, D.C. U.S.A.)

	Ponds (thousands)	
Year	Prairie Canada	North Central U.S.[a]
1964	3,371	--
1965	4,379	--
1966	4,555	--
1967	4,691	--
1968	1,986	--
1969	3,548	--
1970	4,875	--
1971	4,053	--
1972	4,009	--
1973	2,950	--
1974	6,390	1,841
1975	5,320	1,911
1976	4,599	1,392
1977	2,278	771
1978	3,622	1,590
1979	4,859	1,522
1980	2,141	761
1981	1,443	683
1982	3,185	1,458
1983	3,906	1,259
1984	2,473	1,766
1985	4,283	1,327
1986	4,025	1,735
1987	2,524	1,348
1988	2,110	791
1989	1,693	1,290
1990	2,817	691
1991	2,494	706
1992	2,784	825
1993	2,261	1,351
1994	3,769	2,216
1995	3,893	2,443
1996	5,003	2,480
1997	5,061	2,397
1998	2,522	2,065
1999	3,862	2,842
2000	2,422	1,524
2001	2,747	1,893
2002	1,439	1,281
2003	3,522	1,668
2004	2,513	1,407
2005	3,921	1,461
2006	4,450	1,644
2007	5,040	1,963
2008	3,055	1,534
Average	3,439	1,538
% Change in 2008 from:		
2007	- 39	- 30
Long term Average	+ 47	+ 28

[a] No comparable survey data available for the north-central U.S. during 1964-73.

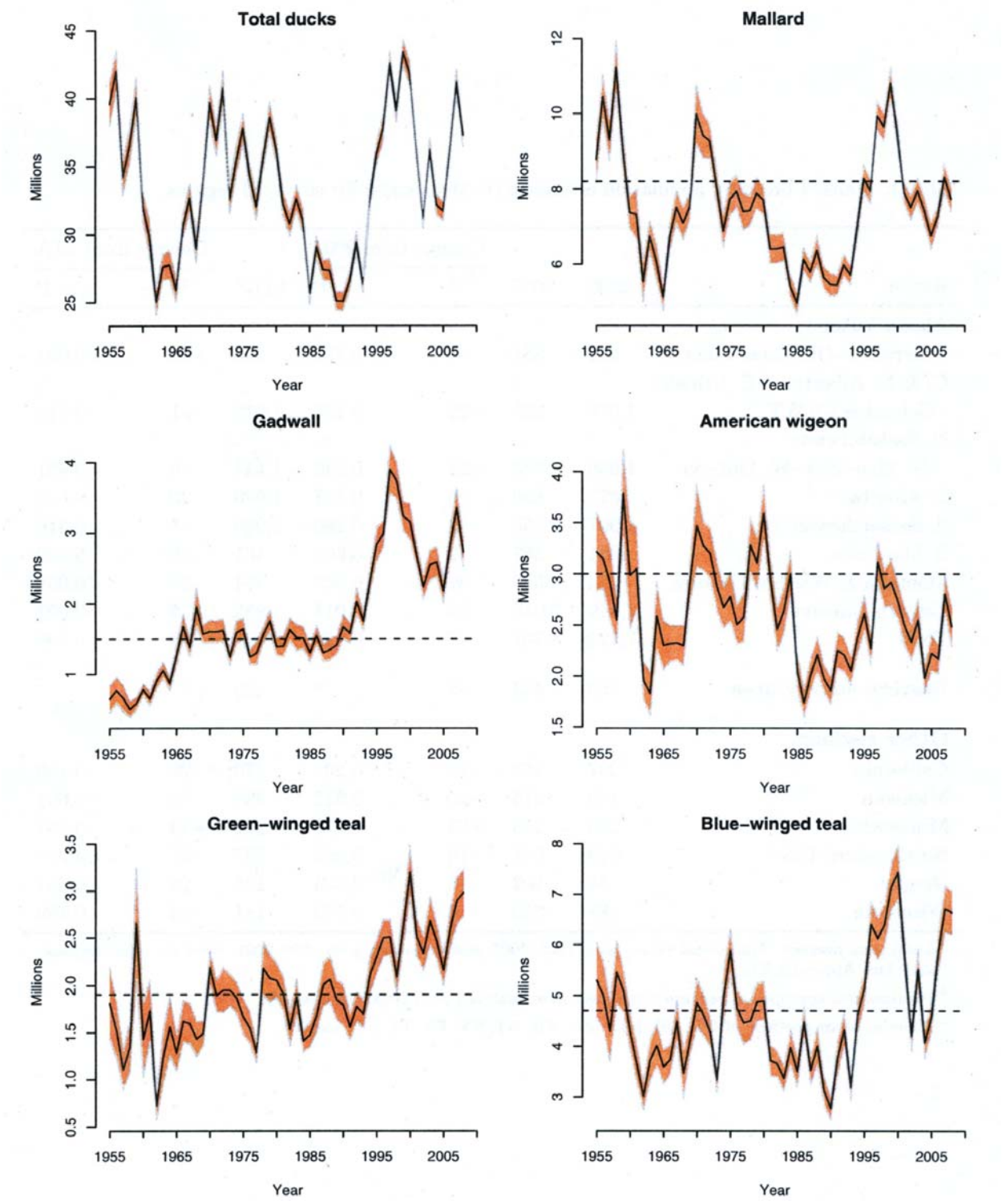

Figure 2. Estimates of North American breeding populations, 95% confidence intervals, and North American Waterfowl Management Plan population goal (dashed line) for selected species and number of water areas in May in Prairie Canada and Northcentral U.S. (from: U.S. Fish and Wildlife Service. 2008. Waterfowl population status, 2008. U.S. Department of the Interior, Washington, D.C. U.S.A.)

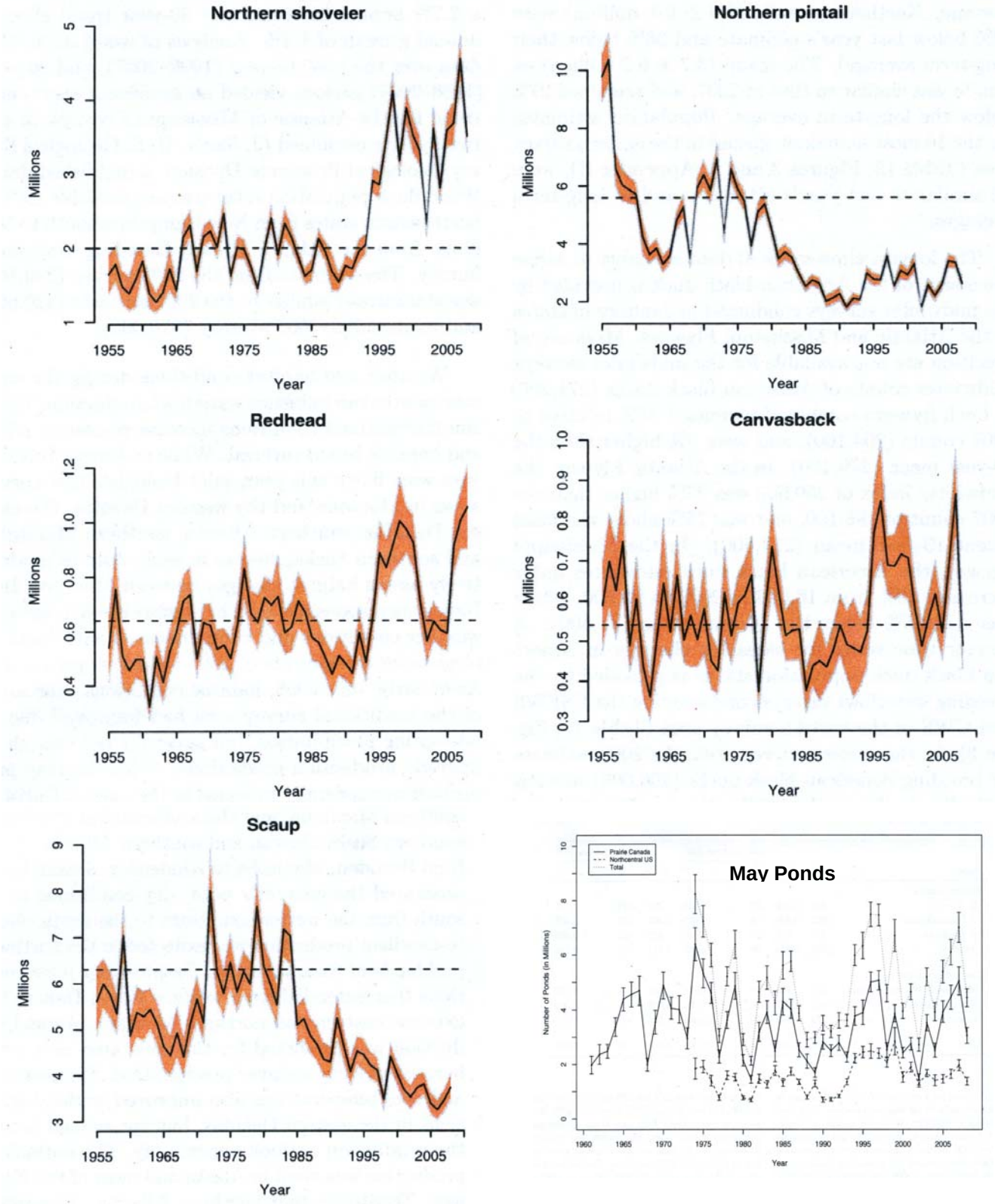

Figure 2. (continued).

MINNESOTA SPRING CANADA GOOSE SURVEY, 2008

David Rave, Wetland Wildlife Populations and Research Group

INTRODUCTION

This report presents results from the eighth year of a spring helicopter survey of resident Canada geese in Minnesota. The survey was developed to comply with a Mississippi Flyway Council request to produce a statewide population estimate of resident giant Canada geese having 95% confidence intervals (C.I.'s) that are within ± 25% of the estimate.

METHODS

The original survey was initiated in 2001 using a double sampling design where an annual stratified sample was randomly selected from 900 plots in each ecoregion (Maxson 2002). We eliminated the double sampling design this year by stratifying all potential plots in each ecoregion, and randomly sampling from the entire sampling frame (i.e., it is now a simple stratified sampling design with new sample plots drawn each year). However, stratification criteria and survey protocols were the same as in previous years; thus, results should be comparable among years.

As in the original stratification, the state was divided into three ecoregions (Prairie Parkland, Eastern Broadleaf Forest/Tallgrass Aspen Parklands, Laurentian Mixed Forest) hereafter referred to as Prairie, Transition, and Forest. The 7- county Metro area was excluded from the Transition ecoregion. Similarly, Lake and Cook Counties plus the Boundary Waters Canoe Area and the Northwest Angle were excluded from the Forest ecoregion. Four Statewide ArcView shapefiles were then unioned together: National Wetlands Inventory circular 39, DNR 1:24k lakes, Public Land Survey Quarter section Boundaries, and ECS provinces, to assign each quarter section plot to the appropriate strata.

Four new fields were then computed: total acres of Type 3, 4, and 5 wetlands per quarter section (Circ39_acr) , total acres of 1:24k lakes per quarter section (Lakes_acr), total acres of type 3 wetlands per quarter section (Sum_type3_acr) and total acres of river per quarter section (Sum_Riv_acr). A summary table was created with text fields for each of the 8 strata (habitat-quality class x ecoregion). Using the query builder in ArcMap, quarter sections in each ecoregion were assigned to habitat-quality classes for resident geese: 1) not nesting habitat – expect no geese, 2) limited nesting habitat – habitat capable of supporting 1 or 2 pairs of geese, 3) prime nesting habitat – habitat capable of supporting 3 or more pairs. Habitat-classification criteria for each ecoregion was:

Prairie

No geese =	Type 3-4-5 <0.5 acres and rivers <10 acres or plot is all water. (n = 61,597 plots).
1-2 pairs =	Type 3-4-5 > 0.5 acres but Type 3 <15 acres or Type 3-4-5 <0.5 acres and rivers >10 acres. (n = 30,874 plots).
3+ pairs =	Type 3 >15 acres, but plot is not all water. (n = 9,537 plots).

Transition

No geese =	Type 3-4-5 <1 acre and rivers <8 acres or plot is all water. (n = 39,484 plots).
1-2 pairs =	Type 3-4-5 = 1-25 acres or Type 3-4-5 >25 acres, but Type 3 <15 acres or Type 3-4-5 <1 acre and rivers >8 acres. (n = 31,091 plots).
3+ pairs =	Type 3-4-5 >25 acres, but Type 3 >15 acres and plot is not all water. (n = 7,988 plots).

Forest

No geese =	Type 3-4-5 <2 acres and rivers <2 acres or plot all water. (n = 75,835 plots).
1-2 pairs =	Type 3-4-5 >2 acres, but not all water or Type 3-4-5 <2 acres and rivers >2 acres. (n = 51,155 plots).
3+ pairs =	None.

Plots in the "no geese class" are not flown and there are no plots in the "3+ pairs" class in the Forest ecoregion. Each year 30 plots are randomly selected in each of the 5 remaining strata using ArcView's AlaskaPak extension, and these 150 plots are surveyed at low level using a helicopter. Ideally, the survey should be conducted during mid-incubation.

Pilot John Heineman and I flew the survey 23 April through 5 May, 2008. Canada geese seen within plot boundaries were recorded as singles, pairs, and groups. We also recorded whether singles and pairs were observed with a nest. The number of singles was doubled when the total number of geese per plot was calculated (unless 2 singles were observed to associate as a pair after being flushed).

RESULTS AND DISCUSSION

The total Canada goose population estimate in the surveyed area for 2008 was 276,697 ($\pm$71,564). Adding 17,500 for the Twin Cities metro area (Cooper 2004) yields a statewide estimate of 294,197 (Table 1). Relative error (95% CI half-width) was 25.9% of the estimate, close to the target of 25.0%. The survey tallied 38.4% singles (after doubling, as noted above), 55.4% pairs, and 6.2% groups (Table 2). Typically, many of the pairs seen on this survey are not associated with nests and are likely nonbreeders. An index to nesting effort (i.e., Productive Geese) can be obtained by combining singles (after doubling) and pairs associated with nests. In 2008, 42.6% of the geese seen were classified as Productive Geese (Table 2). While confidence intervals overlap among years, a linear trend line applied to these data suggests the population in the surveyed area has been stable over the 8 years of this survey (Figure 1).

The 2008 Canada goose breeding population estimate for the surveyed area was unchanged from the 2007 estimate. The goose number estimates from the Transition and Forest regions increased somewhat, whereas the estimate from the Prairie region decreased slightly compared to last year (Table 1). While the survey design is robust, results potentially could be influenced by other factors. Survey methods were the same as previous years, but the sampling frame was restratified in 2008. Although the same criteria were used for habitat classification, ecogregion boundary assignments may have changed slightly for some plots because the data sets we used better defined ecoregion boundaries than data sets available in 2001. Furthermore, we eliminated double-sampling for stratification, which may also have contributed to some of the observed changes in stratum sizes (total plots per stratum per ecoregion) and, thus, total estimated geese in each ecoregion. Finally, weather conditions in 2008 were characterized by a late spring with several April winter storm events, and unusually late ice-out on lakes in the northern half of the state. Late springs typically result in a poorer goose reproduction effort. However, the number of geese observed on nests this year indicates that 2008 will likely be a more productive year for Canada geese than 2007. Weather conditions throughout May and June will influence goose productivity. Regardless, the 2008 Canada goose population estimate was 18 % above the state Canada goose population goal, and indicates that the goose population in the state is healthy.

Wetland and habitat quality were variable in the state this year. Water levels throughout the state appeared to be normal to above normal. The unusually late spring and ice out may influence production by affecting egg hatchability, gosling survival due to exposure, and amount of food available to goslings in the form of green vegetation. This may result in fewer and/or smaller goose broods in the state. Based

upon the number of productive geese from the survey, I expect average to above average Canada goose production throughout the state, depending upon May and June weather conditions.

ACKNOWLEDGEMENTS

Frank Martin (Univ. of MN) and Steve Maxson were instrumental in the original design of this survey. Steve also was the principal observer during the first 6 years of the survey. Tim Loesch, Christopher Pouliot, and Shelly Sentyrz set up the original 2,700 ¼-section plots using ArcView and were very helpful in getting the survey up and running in 2001. Shelly Sentyrz was also instrumental in helping to restratify plots statewide for the 2008 survey. John Giudice helped design the 2008 survey, wrote the SAS program and analyzed the survey data. Shelly Sentyrz provided GPS coordinates of plots to the pilot, and printed out maps of the 150 plots flown this year. John Heineman piloted the helicopter and served as the second observer.

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Table 1. Spring Canada goose population estimates in Minnesota, 2001-2008.

Year	Prairie	Transition	Forest	Subtotal	95% CI	Metro	**TOTAL**
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	113,663	132,341	30,693	276,697	± 71,564	17,500	**294,197**

Table 2. Percent of Canada Geese seen as singles, pairs, groups, and productive geese on the Minnesota Spring Canada Goose Survey, 2001-2008.

Year	Singles[1]	Pairs[1]	Groups	Productive Geese[2]
2001	27.0	63.9	9.1	36.4
2002	30.7	52.0	17.2	41.5
2003	27.9	58.2	13.9	29.3
2004	26.5	57.5	16.0	35.5
2005	33.0	50.2	16.8	40.7
2006	43.5	45.9	10.6	50.3
2007	31.0	51.5	17.5	36.2
2008	38.4	55.4	6.2	42.6

[1]Numbers of singles and pairs were doubled before calculating proportions.
[2]Productive geese equals Singles + Pairs with nests.

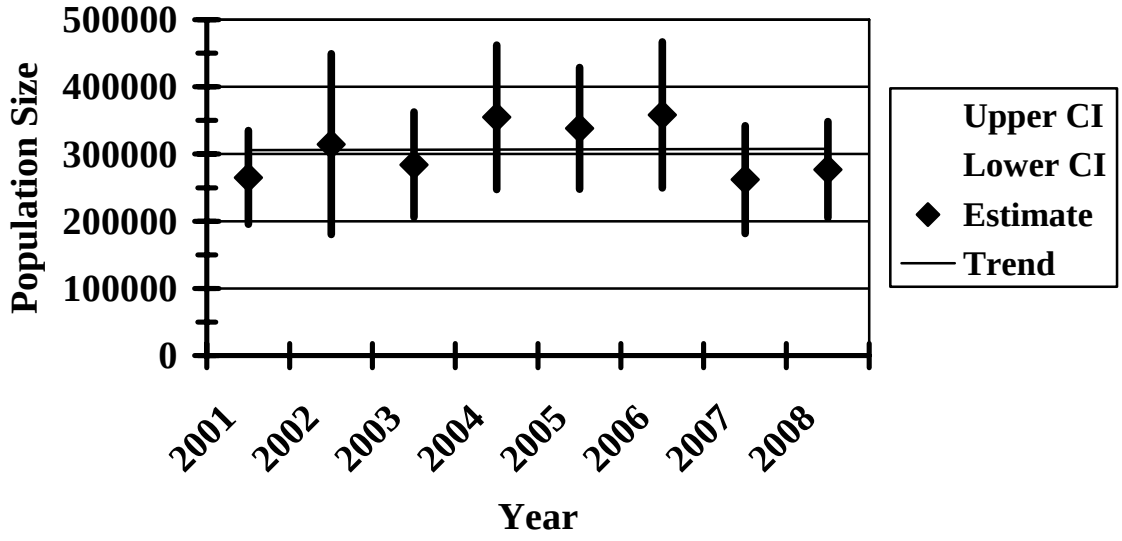

Figure 1. Spring Canada goose population estimates (±95% CI) in Minnesota, 2001-2008. (Does not include Metro area.)

Mourning dove information is taken from the U.S. Fish and Wildlife Service report by Dolton, D.D., K. Parker, and R.D. Rau. 2008. **Mourning dove, White-winged dove, and Band-tailed Pigeon population status, 2008.** U.S. Fish and Wildlife Service, Laurel, Maryland, USA. 43 pp. The entire report is available on the Division of Migratory Bird Management home page (http://migratorybirds.fws.gov).

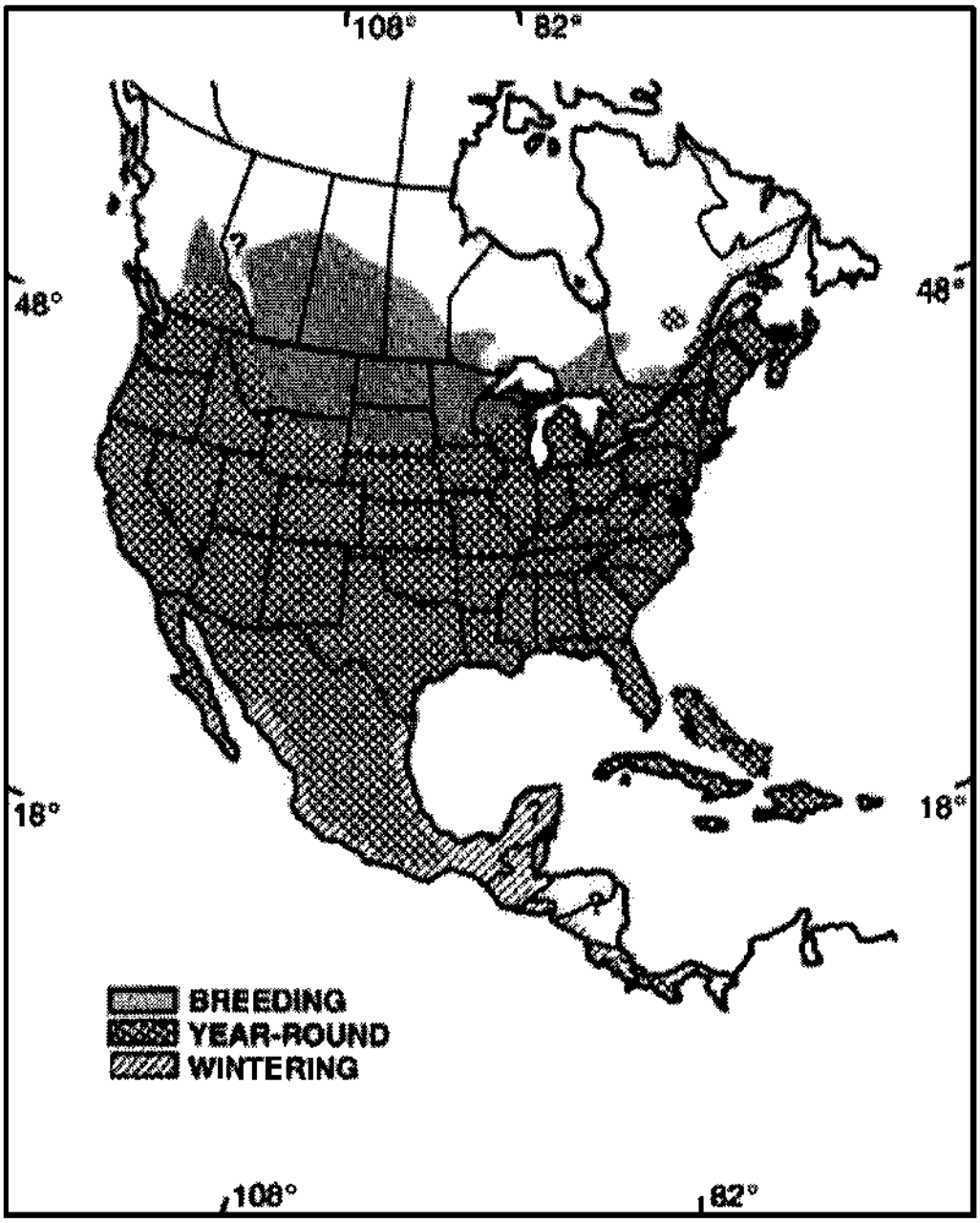

Figure 1. Breeding and wintering ranges of the mourning dove (adapted from Mirarchi and Baskett 1994). (From: Mourning dove, White-winged dove, and Band-tailed Pigeon population status, 2008. Dolton, D.D., K. Parker, and R.D. Rau. U.S. Fish and Wildlife Service, Laurel, Maryland, USA. 43 pp.)

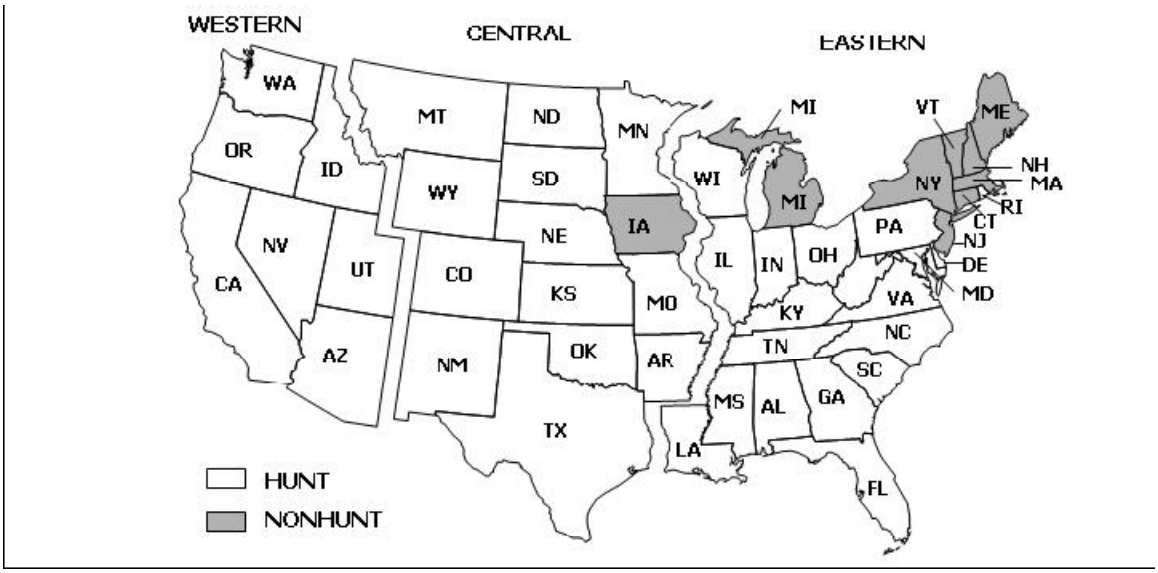

Figure 2. Mourning dove management units with 2007 hunting and nonhunting states. (From: Mourning dove, White-winged dove, and Band-tailed Pigeon population status, 2008. Dolton, D.D., K. Parker, and R.D. Rau. U.S. Fish and Wildlife Service, Laurel, Maryland, USA. 43 pp.)

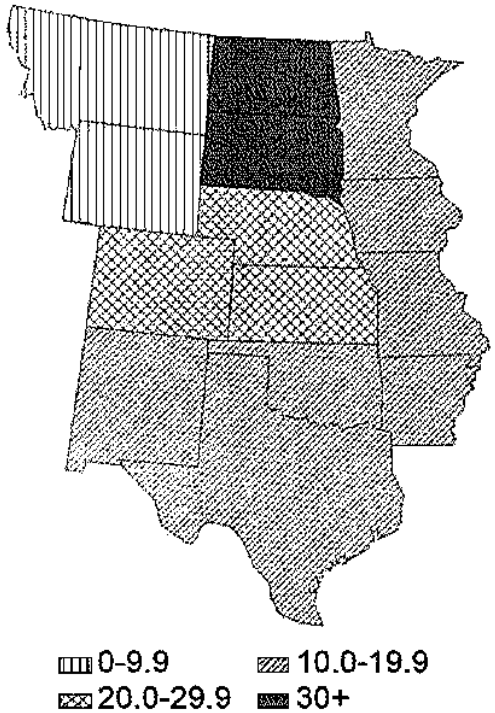

Figure 3. Mean number of mourning doves heard per route by state in the Central Management Unit, 2007-08. (From: Mourning dove, White-winged dove, and Band-tailed Pigeon population status, 2008. Dolton, D.D., K. Parker, and R.D. Rau. U.S. Fish and Wildlife Service, Laurel, Maryland, USA. 43 pp.).

Table 1. Preliminary estimates of the number of hunters, days hunted, and total bag from Harvest Information Program surveys for the 2005-06, 2006-07, and 2007-08 seasons. (From: Mourning dove, White-winged dove, and Band-tailed Pigeon population status, 2008. Dolton, D.D., K. Parker, and R.D. Rau. U.S. Fish and Wildlife Service, Laurel, Maryland, USA. 43 pp.)

Management unit / State	Hunters			Days Hunted			Birds bagged		
	2005-06	2006-07	2007-08	2005-06	2006-07	2007-08	2005-06	2006-07	2007-08
CENTRAL	473,900	470,800 [2]	485,700 [2]	1,729,800 ± 8%	1,605,900 ± 9%	1,803,900 ± 9%	9,891,400 ± 9%	8,887,000 ± 9%	9,180,200 ± 9%
AR	43,400 ± 15%	31,300 ± 16% [2]	37,000 ± 16%	147,300 ± 24%	77,500 ± 18%	115,900 ± 23%	861,600 ± 20%	621,500 ± 20%	791,700 ± 24%
CO	18,400 ± 7%	19,800 ± 11%	21,800 ±11%	48,700 ± 9%	45,700 ± 13%	57,800 ± 14%	263,400 ± 10%	270,300 ± 19%	315,000 ± 14%
KS	32,400 ± 8%	35,400 ± 8%	36,300 ±8%	109,500 ± 12%	116,400 ± 11%	119,100 ± 11%	680,400 ± 11%	711,800 ± 12%	725,100 ± 13%
MN	6,000 ± 34%	8,000 ± 33%	7,700 ± 35%	14,700 ± 43%	24,200 ± 39%	27,600 ± 49%	48,800 ± 61%	50,000 ± 46%	67,400 ± 52%
MO	40,200 ± 10%	44,700 ± 7%	42,600 ± 8%	113,400 ± 16%	129,800 ± 12%	124,400 ± 13%	641,800 ± 20%	709,500 ± 15%	603,300 ± 15%
MT	2,000 ± 34%	1,800 ± 36%	1,700 ± 31%	4,800 ± 38%	3,900 ± 38%	4,000 ± 34%	17,800 ± 44%	14,800 ± 33%	20,900 ± 43%
NE	17,800 ± 10%	15,000 ± 12%	17,000 ± 12%	64,300 ± 14%	43,000 ± 12%	55,300 ± 16%	361,100 ± 15%	249,700 ± 12%	319,600 ± 18%
NM	9,300 ± 17%	7,100 ± 20%	8,600 ± 18%	42,000 ± 20%	33,900 ± 28%	40,100 ± 33%	250,100 ± 22%	226,900 ± 33%	198,700 ± 25%
ND	3,100 ± 27%	4,000 ± 23%	3,200 ± 27%	11,800 ± 38%	10,800 ± 24%	9,900 ± 26%	55,500 ± 48%	56,400 ± 25%	48,700 ± 27%
OK	34,500 ± 9%	36,100 ± 9%	24,600 ± 14%	111,500 ± 16%	108,300 ± 17%	73,100 ± 19%	828,500 ± 20%	704,400 ± 24%	480,000 ± 24%
SD	7,100 ± 18%	6,400 ± 16%	6,000 ± 20%	25,200 ± 26%	19,600 ± 17%	18,200 ± 25%	127,700 ± 28%	103,300 ± 18%	104,000 ± 30%
TX	257,200 ± 10%	258,900 ± 10%	275,200 ± 10%	1,030,000 ± 13%	986,200 ± 14%	1,149,600 ± 13%	5,710,700 ± 15%	5,138,700 ± 14%	5,463,300 ± 14%
WY	2,500 ± 27%	2,300 ± 29%	4,000 ± 20%	6,600 ± 27%	6,500 ± 36%	8,800 ± 24%	34,100 ± 31%	29,500 ± 37%	42,600 ± 27%

[1] This represents the 95% confidence interval expressed as a percent of the point estimate.
[2] This total is slightly exaggerated because people are counted more than once if they hunted in more than one state.

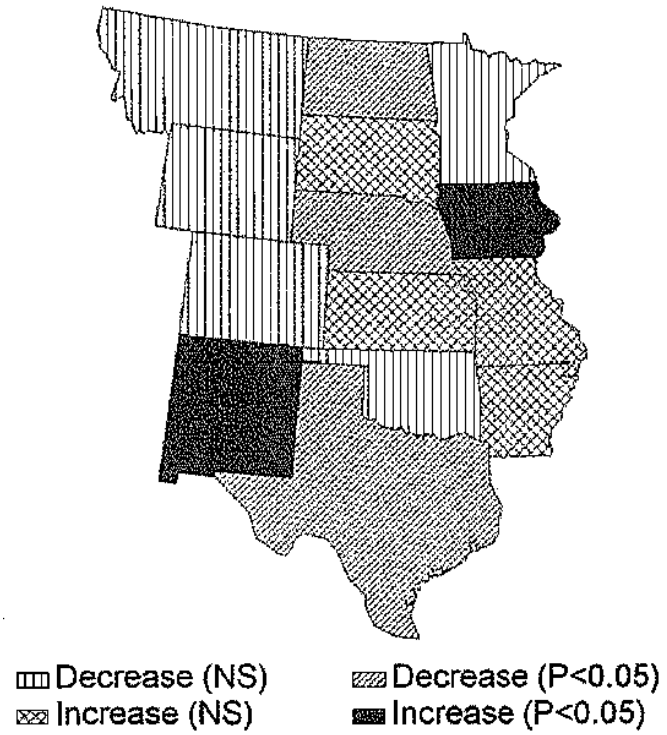

Figure 4. Trends in number of mourning doves heard per route by state in the Central Management Unit, 1999-2008. (From: Mourning dove, White-winged dove, and Band-tailed Pigeon population status, 2008. Dolton, D.D., K. Parker, and R.D. Rau. U.S. Fish and Wildlife Service, Laurel, Maryland, USA. 43 pp.).

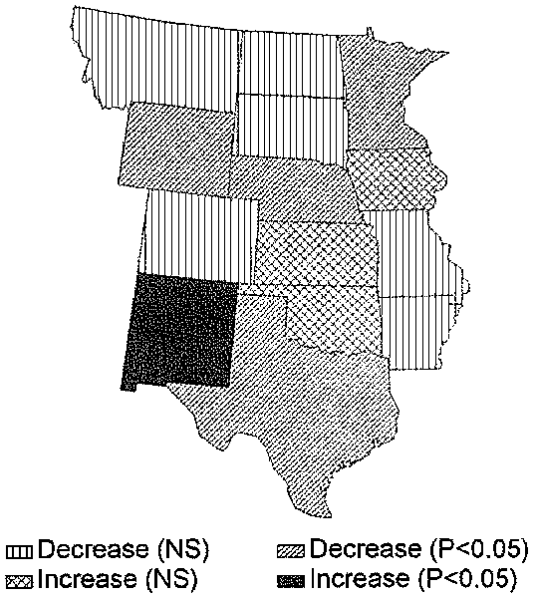

Figure 5. Trends in mourning doves heard per route by state in the Central Management Unit, 1966-2008 (From: Mourning dove, White-winged dove, and Band-tailed Pigeon population status, 2008. Dolton, D.D., K. Parker, and R.D. Rau. U.S. Fish and Wildlife Service, Laurel, Maryland, USA. 43 pp.).

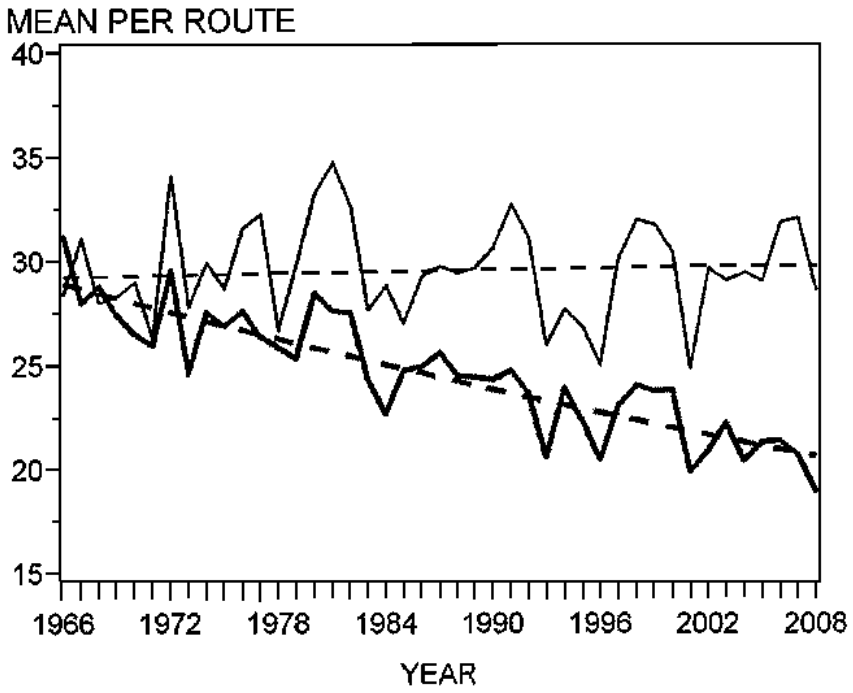

Figure 6. Population indices and trends of breeding mourning doves in the Central Management Unit, 1966-2006. Heavy solid line = doves heard; light solid line = doves seen. Light and heavy dashed lines = predicted trends. (From: Mourning dove, White-winged dove, and Band-tailed Pigeon population status, 2008. Dolton, D.D., K. Parker, and R.D. Rau. U.S. Fish and Wildlife Service, Laurel, Maryland, USA. 43 pp.)

American Woodcock information is taken from the U.S. Fish and Wildlife Service report **American Woodcock Population Status, 2008** by Thomas R. Cooper, Keri Parker, and Rebecca D. Rau. The entire report is available on the Division of Migratory Bird Management home page (http://migratorybirds.fws.gov).

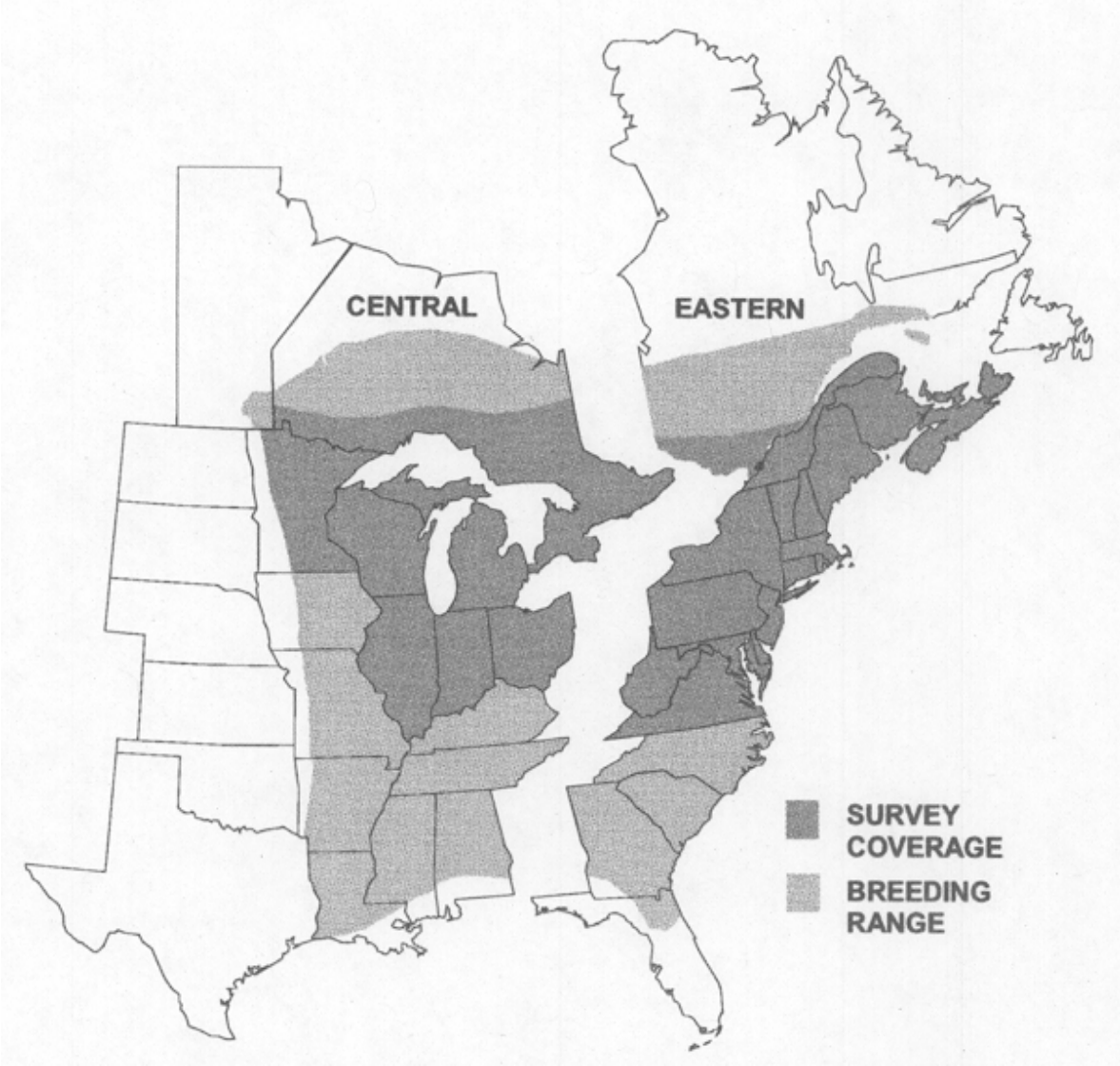

Figure 1. Woodcock management regions, breeding range, singing-ground survey coverage, (from: Cooper, T.R., K. Parker, and R.D. Rau. 2008. American woodcock population status, 2008. U.S. Fish and Wildlife Service, Laurel, MD. 15pp.)

Table 24. Trends (% change per year [a]) in number of American woodcock heard in singing-ground survey during 1968-2008, as determined by using the hierarchical log-linear modeling technique (Sauer et al. 2008) (from: Cooper, T.R., K. Parker, and R.D. Rau. 2008. American woodcock population status, 2008. U.S. Fish and Wildlife Service, Laurel, MD. 15pp.).

Management Unit/State	Number of Routes[b]	n[c]	(2007-08) % Change	(1998-08) % Change	(1968-08) % Change
CENTRAL	369	637	- 9.2	-1.5	- 1.1
IL	21	25	0.6	-0.7	1.2
IN	14	40	0.4	- 5.4	- 4.3
MB[d]	12	23	-5.5	- 2.7	- 3.3
MI	114	148	- 5.7	- 2.8	- 1.3
MN	70	102	- 6.1	- 0.3	- 0.2
OH	31	57	0.8	- 2.9	- 2.3
ON	35	139	- 13.1	- 1.2	- 0.8
WI	72	103	- 14.2	- 0.1	- 0.7

[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 2008 for which data were received by 28 May.

[c] Number of routes that could be used for trend analysis, routes with <2 years of data were not used.

[d] Manitoba began participating in the Singing-ground survey in 1990.

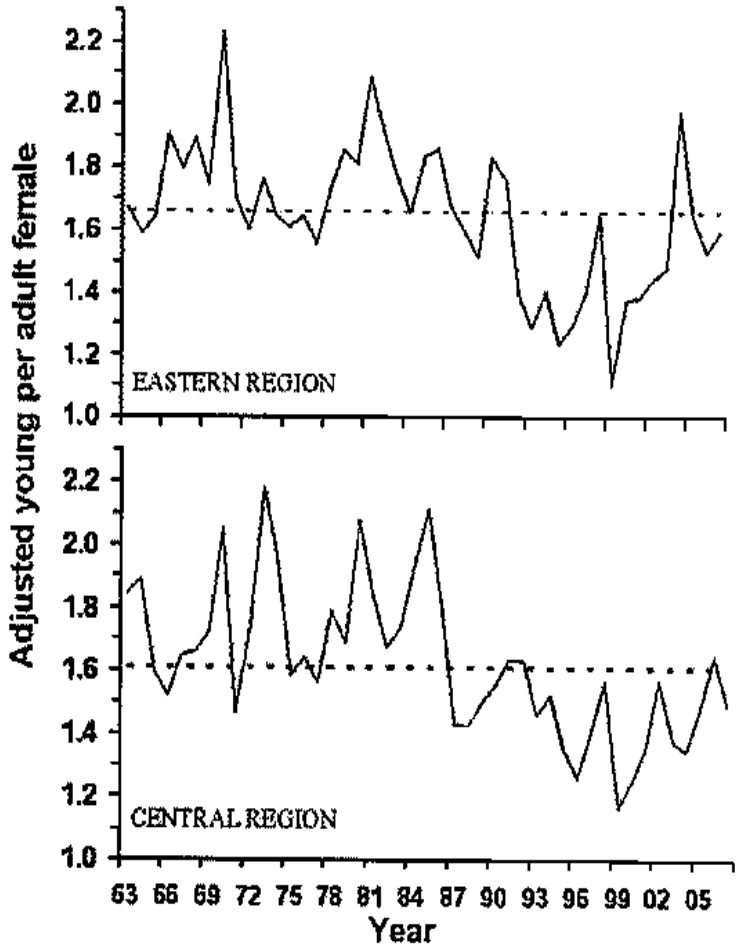

Figure 2. Adjusted index of American woodcock recruitment, 1963-2005. Dashed line is the index based on all 1963-2004 average. (from: Cooper, T.R., K. Parker, and R.D. Rau. 2008. American woodcock population status, 2008. U.S. Fish and Wildlife Service, Laurel, MD. 15pp.).

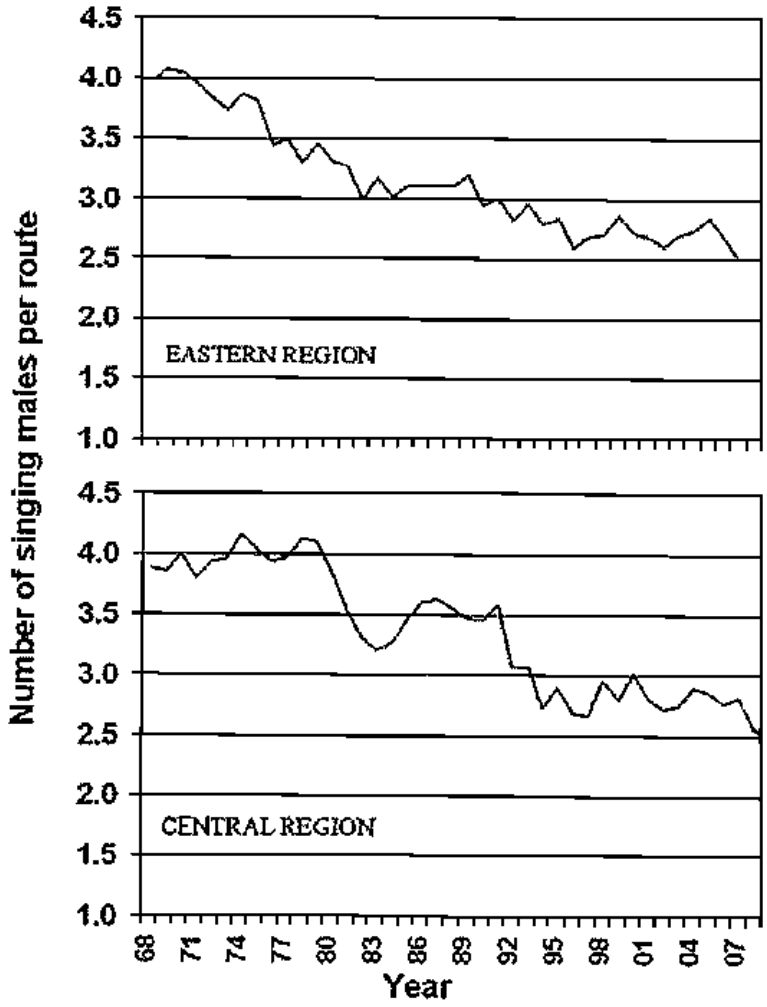

Figure 3. American woodcock singing ground survey long term trends and annual indices, 1968-2006. (from: Cooper, T.R., K. Parker, and R.D. Rau. 2008. American woodcock population status, 2008. U.S. Fish and Wildlife Service, Laurel, MD. 15pp.).

Table 25. Preliminary estimates of woodcock hunter numbers, days afield, and harvest for selected states, from the 2004-05, 2005-06, 2006-07 and 2007-08. Harvest Information Program surveys. (from: Cooper, T.R., K. Parker, and R.D. Rau. 2008. American woodcock population status, 2008. U.S. Fish and Wildlife Service, Laurel, MD. 15pp.).

Management Unit / State	Active woodcock hunters				Days afield				Harvest			
	2004-05	2005-06	2006-07	2007-08	2004-05	2005-06	2006-07	2007-08	2004-05	2005-06	2006-07	2007-08
Central Region	n.a.	n.a.	n.a.	n.a.	366,100 ± 15%	356,100 ± 14%	344,262 ± 12%	358,480 ± 14%	234,800 ± 20%	225,000 ± 19%	232,557 ± 17%	214,162 ± 16%
IL	1,200 ± 74%	2,100 ± 79%	1,973 ± 87%	3,111 ± 73%	3,500 ± 78%	5,300 ± 89%	8,944 ± 115%	7,644 ± 72%	1,900 ± 96%	3,900 ± 196%	2,171 ± 160%	3,819 ± 149%
IN	1,100 ±104%	2,100 ± 55%	1,000 ± 58%	1,788 ± 71	5,300 ±124%	7,400 ± 69%	4,377 ± 75%	3,342 ± 58%	7,900 ± 145%	4,400 ± 91%	2,403 ± 69%	1,203 ± 53%
MI	31,200 ± 13%	28,000 ± 13%	30,017 ± 14%	28,412 ± 13%	147,000 ± 14%	151,200 ±17%	155,333 ± 17%	138,881 ±15%	102,500 ± 21%	106,800 ± 27%	116,216 ± 27%	86,825 ± 17%
MN	14,500 ± 27%	12,000 ± 31%	14,934 ± 24%	15,295 ± 29%	67,000 ± 33%	60,200 ± 42%	60,160 ± 31%	62,810 ± 36%	38,500 ± 53%	42,200 ± 54%	38,738 ± 41%	34,400 ± 38%
OH	2,600 ± 82%	4,700 ± 65%	2,249 ± 68%	2,611 ± 73%	18,200 ± 126%	15,800 ± 79%	9,764 ± 67%	9,259 ± 72%	4,600 ±101%	6,900 ± 83%	4,060 ± 51%	2,598 ± 68%
WI	15,700 ± 30%	15,600 ± 25%	19,390 ± 22%	17,258 ± 23%	61,100 ± 30%	73,100 ± 31%	72,365 ± 25%	79,139 ± 31%	47,300 ±50%	37,600 ± 28%	42,958 ± 25%	48,027 ± 31%

[a] 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.

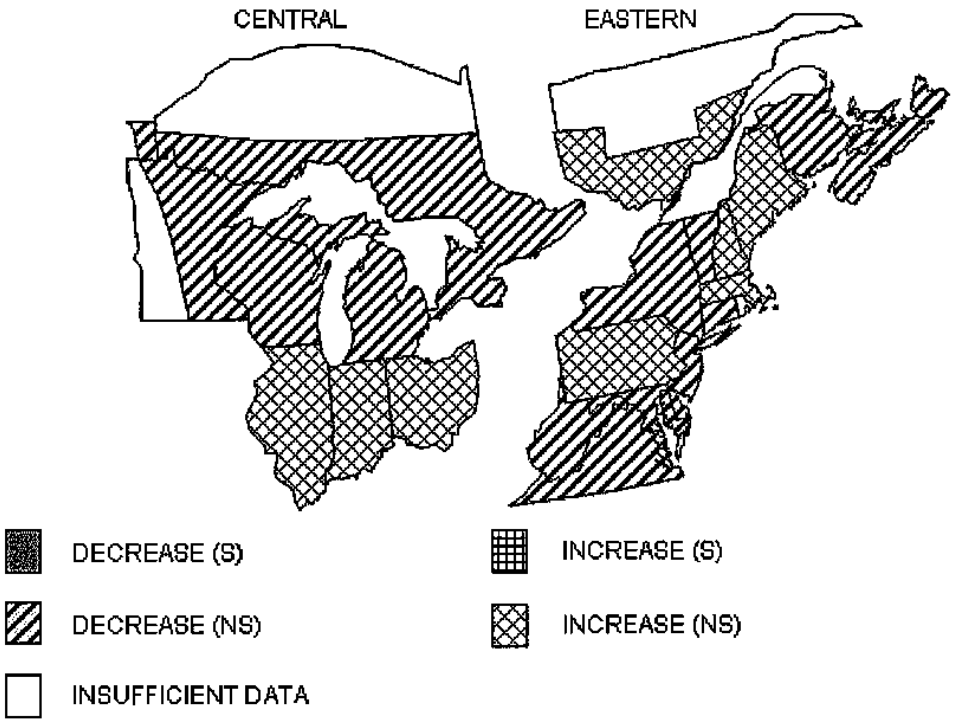

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Figure 4. Short-term trends in number of American woodcock heard on the Singing-ground Survey; 2005-06. (from: Cooper, T.R., K. Parker, and R.D. Rau. 2008. American woodcock population status, 2008. U.S. Fish and Wildlife Service, Laurel, MD. 15pp.)

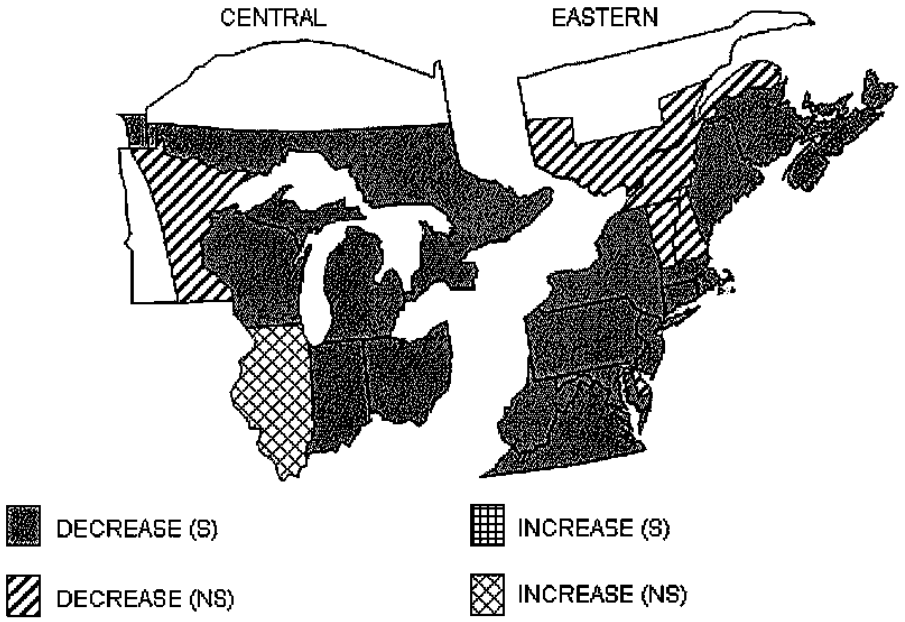

Figure 5. Long-term trends in number of American woodcock heard on the Singing-ground Survey; 1968-06. (from: Cooper, T.R., K. Parker, and R.D. Rau. 2008. American woodcock population status, 2008. U.S. Fish and Wildlife Service, Laurel, MD. 15pp.)