WETLAND WILDLIFE POPULATIONS

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2010 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 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 2010 aerial survey portion was flown from 4-16 May. Ice-out dates were 2-3 weeks earlier than normal spring temperatures during March-May were one of the warmest on record across the state. Overall, spring wetland habitat conditions were near average across the state. Wetland conditions were fairly dry across much of the survey area in late April and early May but improved considerably with rain events in mid-May. Wetland numbers decreased 15% compared to 2009 but were similar to both the 10-year (+4%) and long-term (+8%) averages. The estimated numbers of temporary (Type 1) wetlands decreased 31% from 2009 and were 61% below the long-term average. The estimated mallard breeding population was 242,000, which was unchanged from last year's estimate of 236,000 mallards (P = 0.91). Mallard numbers were 15% below the 10-year average but 8% above the long-term average of 224,000 breeding mallards. The estimated blue-winged teal breeding population was 132,000, which was unchanged from last year's estimate of 135,000 (P=094) but below both the 10-year (-36%) and long-term (-40%) averages. The combined population index of other ducks, excluding scaup, was 157,000, which was lower than last year's estimate of 170,000 and remained 34% below the 10-year average and 12% below the long-term average of 179,000 other ducks. Population estimates of wood duck (64,000), northern shoveler (30,000), ring-necked duck (24,000), and gadwall (10,000) accounted for most (82%) of the total population of other ducks. The estimate of total duck abundance (531,000), which excludes scaup, was similar to last year's estimate (541,000) and was 27% below the 10-year average, 15% below the long-term average (624,000) and the 4th lowest estimate since 1985. The estimated number of Canada geese (corrected for visibility) was 147,000 and 11% lower than 2009. Based on the social status of mallards and blue-winged teal observed (number of pairs, lone males, and flocked birds), the survey timing was consistent with recent years. Low numbers of late migrating species (scaup, ring-necked ducks, coots) were recorded, suggesting most migrants had already moved through the state before the survey was initiated.

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. Strata boundaries were based upon "An Inventory of Minnesota Lakes" (Minnesota Conserv. Dept.

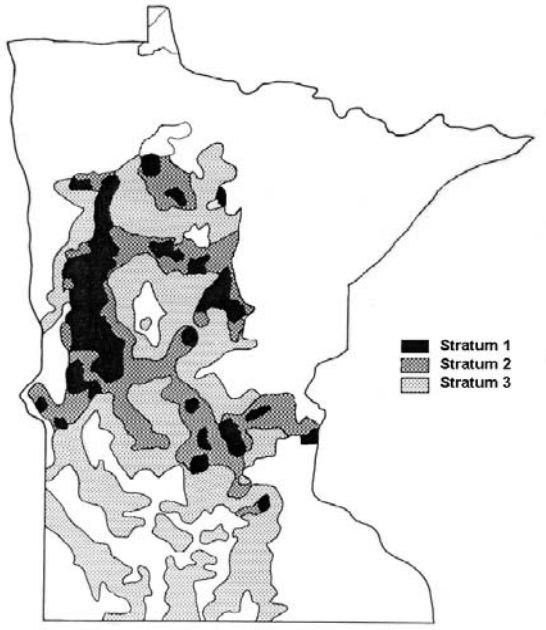

Figure. 1. Location of waterfowl breeding population survey strata in Minnesota.

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 (N605NR). 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 transcribed from the digital WAV files.

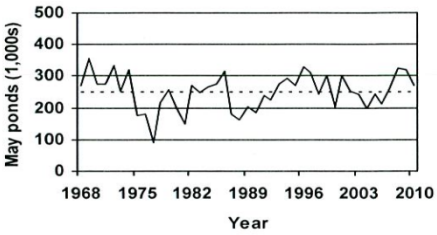

Fig. 2. Number of May ponds (Types II-V) and long-term average (dashed line) in Minnesota, 1968-20010.

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.

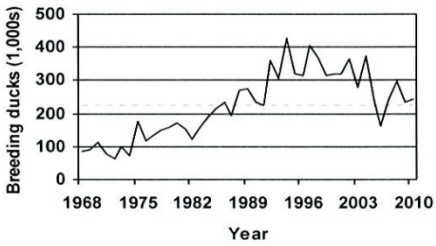

Fig. 3. Mallard population estimates (adjusted for visibility bias) and long-term average (dashed line) in Minnesota, 1968-2010.

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 2009 and 2010 using two-tailed Z-tests.

SURVEY CHRONOLOGY: The 2010 aerial survey began on 4 May in southern Minnesota and concluded in northern Minnesota on 16 May. The survey was completed in 9 days of flight time. Transects were flown May 4, 6, 8-10, 12, and 14-16; flights began no earlier than 7 AM and were completed by 12:00 PM each day.

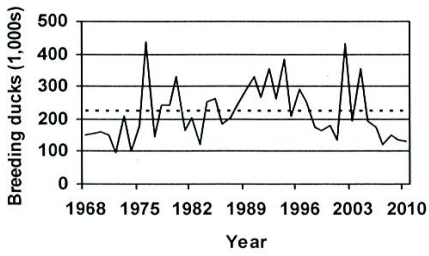

Fig. 4. Blue-winged teal population estimates (adjusted for visibility bias) and long-term average (dashed line) in Minnesota, 1968-2010.

WEATHER AND HABITAT CONDITIONS: Ice out on most lakes across the state was 2-3 weeks earlier than average. Temperatures in April averaged 7.4˚F above normal statewide; regional temperatures ranged from 5.9˚F above average in northeast Minnesota to 8.7˚F above average in northwest Minnesota. April precipitation was 0.7 inches below normal statewide and ranged from 0.06 inches below normal in northwest Minnesota to 1.4 inches below normal in south central Minnesota. This was the first April since modern records began in 1891 that no measurable snow was recorded in the state and was the 2nd warmest April on record. May temperatures averaged 0.3°F above normal statewide. May precipitation was 0.1 inches below normal statewide and ranged from 0.8 inches below normal in south central Minnesota to 1.8 inches above normal in northwest Minnesota (http://climate.umn.edu). Additional temperature and precipitation data are provided in Appendix A.

In early May 2010, statewide topsoil moisture indices were rated as 33 % short or very short, 65 % adequate, and 2% surplus moisture. By late May, statewide indices were rated as 6% short or very short, 87% adequate and 7% surplus moisture. For comparison, in early May 2009 statewide topsoil moisture indices were rated as 11% short or very short, 66% adequate, and 23% surplus moisture.

Planting dates for row crops were earlier in 2010 than recent years. By 2 May, 87% of the corn acres had been planted statewide compared to 56% in 2009 and 41% for the previous 5-year average. By 1 June, 48% of alfalfa hay had been cut compared to 15% in 2009 and a 5-year average of 15% (Minnesota Agricultural Statistics Service Weekly Crop Weather Reports, (http://www.nass.usda.gov/mn/).

Wetland numbers (Types II – V) declined 15% from 2009 but were similar to both the 10-year average (+4%) and long-term averages (+8%) (Table 2; Figure 2). The numbers of temporary (Type I) wetlands decreased 31% from 2009 and were 61% below the long-term average.

Leaf-out dates were 2-3 weeks earlier than normal, which greatly decreased visibility from the air. The emergence of wetland vegetation was also much earlier than average, which also decreased visibility.

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 2010 breeding population estimate of mallards was 241,884 (SE = 33,940), which was unchanged from 2009 (Z = 0.11, P = 0.91) (Table 7, Figure 3). Mallard numbers were 15% below the 10-year average and 8% above the long-term average of 224,000. In 2010, 5% of the total mallards were in flocks, which was identical to last year. Pairs comprised 12% of the mallards observed, compared to 15% in 2009. This suggests that survey timing was similar to recent years based on the social status observed.

The estimated blue-winged teal population was 132,261 (SE = 27,430), which was unchanged from 2009 (Z = 0.71, P = 0.94). Blue-winged teal numbers remained 36% below the 10-year average and 40% below the long-term average (Table 7, Figure 4). Pairs comprised 56% of the blue-winged teal observed. Lone males comprised 23% of the blue-winged teal and flocks comprised 21% of the blue-winged teal observed. The social structure observed was similar to the most recent 5 year average.

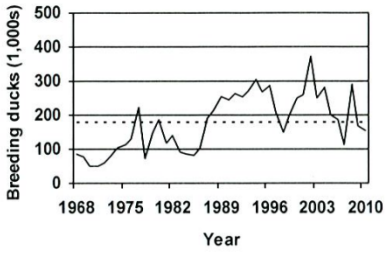

Fig. 5. Other duck (excluding scaup) populations (adjusted for visibility bias) and long-term average (dashed line) in Minnesota, 1968-2010.

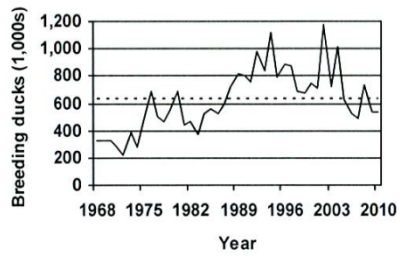

Fig. 6. Total duck (excluding scaup) population estimate and long-term average (dashed line) in Minnesota, 1968-2010.

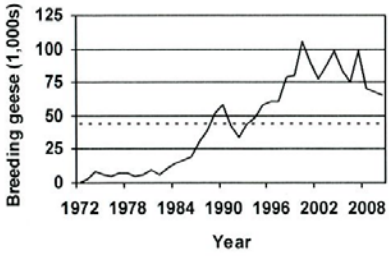

Fig. 7. Canada goose population estimates (not adjusted for visibility bias) and long-term average in Minnesota, 1972-2010.

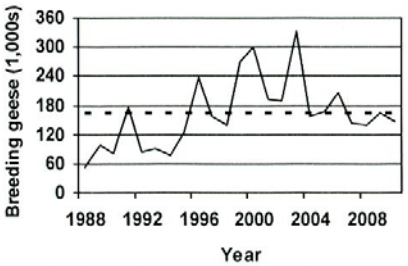

Fig. 8. Canada goose population estimates (adjusted for visibility bias) and long-term average in Minnesota, 1988-2010.

Other duck numbers (excluding scaup) were 157,000, which was 8% lower than last year's estimate of 170,000 and 34% below the 10-year average and 12% below the long-term average (Table 7, Figure 5).

Population estimates of wood duck (64,000), northern shovelers (30,000), ring-necked duck (24,000), and gadwall (10,000) accounted for over 80% of the total population of other ducks. Scaup numbers were 72% lower than last year and 86% below the long-term average. Scaup are rare nesting ducks in Minnesota and late spring migrants and low scaup counts indicate most migrant scaup had moved through the state prior to the survey this year.

The total duck population index, excluding scaup, was 531,000, which was similar to last year's index of 541,000 ducks but below the 10-year (-27%) and long-term (-15%) averages (Table 7, Figure 6).

Visibility Correction Factors (VCFs) for mallards, blue-winged teal, and other ducks were similar to 2009 (Table 7). The mallard VCF (2.99) was 37% above the long-term average. The blue-winged teal VCF (4.04) was similar to the long-term average (3.90). The VCF for other ducks (2.84) was 10% lower than the long-term average (3.17).

Canada goose numbers (uncorrected for visibility) decreased 2% compared to 2009 but remained 51% above the long-term average (Table 7, Figure 7). The VCF for Canada geese was 2.22 and similar to the long-term average of 2.37. The population estimate of Canada geese (adjusted for visibility) was 147,000, which was 10% below the long-term average of 163,000 geese (Table 7, Figure 8).

The estimated coot population, uncorrected for visibility, was 700 in 2010 compared to 9,200 in 2009, indicating most migrant coots had already moved through the state.

SUMMARY: Overall wetland conditions were near average. Mallard abundance in 2010 (242,000) was similar to 2009 (236,000). Mallard numbers were 8% above the long-term average (224,000) but 15% below the 10-year average (284,000). Blue-winged teal abundance (132,000) was similar to 2009 (135,000) but 36% below the 10-year average (207,000) and 40% below the long-term average (221,000). The combined population index of other ducks (157,000) was 8% lower than 2009 and 12% below the long-term average. Total duck abundance (531,000), excluding scaup, was similar to 2009 (541,000) and was 27% below the 10-year average and 15% below the long-term average. Canada goose numbers, adjusted for visibility bias, decreased 11% from 2009.

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Table 1. Survey design for Minnesota, May 2010.[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 I and Types II-V). 1968-2010.

	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
	2009	39,078	318,000
	2010	26,880	270,000
Averages:	10-year	47,925	260,000
	Long-term	67,552	250,000
% change from:	2009	-31%	-15%
	10-year	-44%	4%
	Long-term	-61%	8%

[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, 1992-2010.

	Year																		
Species	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Dabblers:																			
Mallard	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	19,467	18,439
Black Duck	0	0	56	0	0	0	0	0	0	0	0	0	0	56	0	0	0	0	0
Gadwall	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	1,055	1,000
American Wigeon	56	0	0	194	0	0	56	56	56	111	0	56	555	167	0	56	111	56	56
Green-winged Teal	0	111	278	0	278	56	333	0	278	56	278	222	444	56	56	167	278	167	56
Blue-winged Teal	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	5,998	7,304
Northern Shoveler	1,000	111	278	111	1,277	1,500	500	555	1,055	305	1,277	278	1,166	333	167	56	1,000	666	1,027
Northern Pintail	222	611	167	167	167	111	111	167	167	389	56	111	56	0	56	0	56	56	0
Wood Duck	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	4,277	3,999
Dabbler Subtotal	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	31,742	31,881
Divers:																			
Redhead	3,499	1,416	1,972	639	722	778	944	500	583	1,444	750	333	805	666	666	916	1,389	472	944
Canvasback	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	1,333	1,222
Scaup	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	8,553	2,777
Ring-necked Duck	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	6,859	3,138
Goldeneye	222	111	222	111	167	0	111	56	56	333	111	0	222	222	56	222	278	278	222
Bufflehead	722	0	444	56	278	0	56	111	56	111	222	111	389	167	222	56	1,611	833	389
Ruddy Duck	500	1,250	639	167	139	528	11,052	972	0	83	1,305	417	305	1,222	305	0	1,027	861	28
Hooded Merganser	444	222	111	278	611	555	389	722	500	722	555	333	278	333	555	111	666	944	555
Large Merganser	111	0	56	0	0	56	0	0	0	111	0	972	0	111	0	278	333	333	333
Diver Subtotal	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	20,466	9,608
Total Ducks	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	52,208	41,489
Other:																			
Coot	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	2,166	139
Canada Goose	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	16,523	16,440

Table 4. Minnesota waterfowl breeding populations by species for Stratum II (medium wetland density), expanded for area but not visibility, 1992-2010.

	Year																		
Species	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Dabblers:																			
Mallard	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	23,494	21,507
Black Duck	0	0	0	0	0	0	0	0	0	117	0	0	0	0	0	0	0	0	0
Gadwall	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	1,169	1,286
American Wigeon	351	0	117	0	468	351	818	0	468	0	0	0	2,513	117	0	0	351	0	351
Green-winged Teal	0	351	117	0	935	234	351	117	117	117	468	234	234	0	117	0	0	234	117
Blue-winged Teal	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	11,104	8,474
Northern Shoveler	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	701	2,513
Northern Pintail	234	351	468	234	117	234	468	117	117	117	0	117	0	0	0	234	0	0	0
Wood Duck	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	5,260	6,312
Dabbler subtotal	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	41,962	40,560
Divers:																			
Redhead	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	584	760
Canvasback	0	584	1,052	0	234	701	117	117	935	0	468	1,052	234	0	0	1,169	468	234	117
Scaup	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	2,104	0
Ring-necked Duck	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	9,117	2,396
Goldeneye	351	584	701	701	1,753	818	234	935	584	468	234	234	351	117	117	0	351	584	468
Bufflehead	526	117	234	0	117	117	0	0	0	0	1,169	117	468	351	117	117	1,403	818	643
Ruddy Duck	1,227	3,390	409	117	58	117	0	468	0	0	1,870	2,688	0	351	58	0	0	175	409
Hooded Merganser	351	584	468	117	234	468	117	701	935	1,403	701	701	234	234	351	234	584	701	117
Large Merganser	117	0	0	0	0	0	0	0	117	117	0	0	234	351	0	0	351	0	0
Diver subtotal	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	14,317	4,910
Total Ducks	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	56,279	45,470
Other:																			
Coot	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	0	117
Canada Goose	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	22,675	18,935

Table 5. Minnesota waterfowl breeding populations by species for Stratum III (low wetland density), expanded for area but not visibility, 1992-2010.

	Year																		
Species	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Dabblers:																			
Mallard	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	35,408	40,976
Black Duck	0	0	0	0	0	0	0	0	0	0	0	0	174	0	0	174	174	0	0
Gadwall	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	1,392	1,392
American Wigeon	522	348	1,218	0	1,044	348	696	0	522	174	1,218	174	1,566	1,044	174	348	348	174	348
Green-winged Teal	0	348	174	0	957	348	174	0	1,218	1,392	522	174	0	174	522	0	0	0	0
Blue-winged Teal	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	20,183	16,964
Northern Shoveler	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	2,088	6,873
Northern Pintail	870	1,218	696	174	870	522	870	870	696	522	0	174	348	174	174	348	174	0	174
Wood Duck	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	10,266	12,354
Dabbler subtotal	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	69,511	79,081
Divers:																			
Redhead	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	870	174
Canvasback	0	348	696	174	1,392	0	3,306	174	3,915	522	696	1,131	2,784	0	0	348	1,566	1,218	348
Scaup	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	1,914	522
Ring-necked Duck	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	6,525	3,045
Goldeneye	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	522	174
Bufflehead	696	348	696	0	1,044	174	348	0	0	0	1,218	783	2,088	0	174	696	1,218	870	174
Ruddy Duck	6,786	1,218	2,175	2,349	1,740	348	0	174	0	696	18,878	87	2,262	870	696	261	87	348	0
Hooded Merganser	348	348	696	1,044	1,566	696	696	1,218	957	174	2,175	174	1,740	1,218	870	174	696	348	1,218
Large Merganser	348	0	174	174	0	0	0	0	0	0	522	0	0	261	957	348	348	348	348
Diver subtotal	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	12,963	6,003
Total Ducks	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	82,474	85,084
Other:																			
Coot	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	7,047	435
Canada Goose	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	28,274	30,710

Table 6. Minnesota waterfowl breeding populations by species for Stratum I - III combined, expanded for area coverage but not visibility, 1992-2010.

	Year																		
Species	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Dabblers:																			
Mallard	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	78,368	80,922
Black Duck	0	0	56	0	0	0	0	0	0	117	0	0	174	56	0	174	174	0	0
Gadwall	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	3,616	3,677
American Wigeon	929	348	1,335	194	1,512	699	1,570	56	1,045	285	1,218	230	4,634	1,327	174	404	810	230	754
Green-winged Teal	0	810	569	0	2,170	638	858	117	1,613	1,564	1,267	630	678	230	694	167	278	400	172
Blue-winged Teal	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	37,286	32,742
Northern Shoveler	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	3,456	10,413
Northern Pintail	1,326	2,180	1,331	575	1,154	867	1,449	1,153	979	1,028	56	402	404	174	230	582	230	56	174
Wood Duck	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	19,802	22,664
Dabbler subtotal	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	143,214	151,518
Divers:																			
Redhead	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	1,926	1,878
Canvasback	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	2,785	1,687
Scaup	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	12,571	3,299
Ring-necked Duck	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	22,501	8,579
Goldeneye	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	1,384	864
Bufflehead	1,944	465	1,374	56	1,439	291	404	111	56	111	2,609	1,011	2,944	517	513	868	4,231	2,521	1,206
Ruddy Duck	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	1,384	437
Hooded Merganser	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	1,993	1,890
Large Merganser	576	0	230	174	0	56	0	0	117	228	522	972	234	723	957	626	1,032	681	681
Diver subtotal	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	47,746	20,521
Total Ducks	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	190,960	172,039
Other:																			
Coot	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	9,213	691
Canada Goose	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	67,473	66,085

Table 7. Estimated waterfowl populations during the Minnesota Waterfowl breeding population survey, 1968-2010.

	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		61,943	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
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
Averages:											
10-year (2000-2009)	113,754	2.57	283,685	36,198	52,508	3.92	207,022	40,593	72,838	3.52	237,410
Long-term (1968-2009)	102,964	2.18	224,409	35,953	59,542	3.90	220,969	41,790	60,640	3.17	178,576
% change from: 2009	3%	-1%	2%	-7%	-12%	11%	-2%	-15%	-12%	5%	-8%
10-year average	-29%	16%	-15%	-6%	-38%	3%	-36%	-32%	-24%	-19%	-34%
Long-term average	-21%	37%	8%	-6%	-45%	4%	-40%	-34%	-9%	-10%	-12%

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

Table 7. Continued.

	Scaup			Total ducks (ex. 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
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	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
Averages:										
10-year (2000-2009)	14,085	3.52	42,883	238,900	728,822	252,987	771,705	85,472	2.34	199,512
Long-term (1968-2009)	22,472	3.17	66,347	223,099	624,123	245,571	690,470	43,903	2.37	162,606
% change from: 2009	-74%	5%	-72%	-5%	-2%	-10%	-6%	-2%	-9%	-11%
10-year average	-77%	-19%	-78%	-29%	-27%	-32%	-30%	-23%	-5%	-26%
Long-term average	-85%	-11%	-86%	-24%	-15%	-30%	-22%	51%	-6%	-10%

[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, 12 April – 17 May 2010 (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
		19-April		26-April		3-May		10-May		17-May							
Region	City	Avg[1]	Depart[2]	Avg[1]	Depart[2]	Avg[1]	Depart[2]	Avg[1]	Depart[2]	Avg[1]	Depart[2]	19-April	26-April	3-May	10-May	17-May	1 Apr17 May 17
NW	Crookston	49.0	7.4	56.2	10.8	52.5	3.5	43.2	-9.2	52.6	-2.9	0.39	0.00	0.89	1.31	0.41	0.63
NC	Grand Rapids	51.4	10.5	50.0	5.7	49.0	1.5	43.8	-6.8	49.9	-3.5	0.05	0.34	0.82	1.05	0.79	-0.05
	Itasca	47.6	10.0	49.6	8.4	49.2	4.3	41.2	-7.2	49.0	-2.5	0.48	0.37	1.15	1.05	0.75	1.02
WC	Alexandria	54.0	11.6	52.8	6.9	50.2	0.9	44.5	-8.0	49.9	-5.5	0.62	0.12	0.34	0.47	1.46	-0.14
	Fergus Falls	Missing															
	Montevideo	55.7	11.5	53.0	5.4	53.2	2.2	46.8	-7.4	48.0	-9.2	0.00	0.55	0.39	0.54	1.10	-1.12
	Morris	53.6	9.6	53.8	6.3	51.3	0.4	44.6	-9.5	48.8	-8.2	1.09	0.27	0.44	0.26	1.38	0.15
C	Becker	54.8	10.4	52.4	4.7	54.0	3.3	48.0	-5.6	49.2	-7.0	1.01	0.55	0.23	0.71	1.68	0.11
	Hutchinson	56.4	11.4	55.4	6.9	54.0	2.2	49.4	-5.6	49.7	-8.2	3.92	0.22	0.21	1.10	1.47	3.41
	St. Cloud	53.8	10.3	51.2	4.4	52.2	2.2	45.8	-7.2	51.1	-4.6	0.90	0.29	0.22	0.48	1.48	-0.05
	Staples	53.1	11.2	51.6	6.3	50.5	2.0	43.5	-8.0	48.9	-5.3	0.25	0.00	0.57	0.80	1.51	-0.21
	Willmar	55.4	11.4	54.2	6.6	53.3	2.3	46.7	-7.5	49.5	-7.6	3.05	0.11	0.33	0.39	1.58	1.96
EC	Aitkin	52.2	11.3	49.2	5.1	48.8	1.6	43.6	-6.5	47.8	-5.0	0.15	0.32	1.05	1.26	1.83	1.19
	Cambridge	Missing															
	Msp Airport	57.1	10.6	55.2	5.5	56.6	3.9	48.4	-7.3	53.2	-5.2	1.36	0.54	0.07	0.64	1.31	0.54
SW	Pipestone	54.4	10.0	54.0	6.3	51.5	0.7	45.9	-8.0	48.6	-8.1	0.31	1.04	0.41	0.40	2.55	0.97
	Redwood Falls	57.7	11.0	55.5	5.5	55.3	2.0	48.2	-8.2	52.8	-6.5	0.46	0.71	0.48	0.46	1.53	-0.12
	Worthington	54.8	11.5	54.6	8.0	51.6	1.7	47.7	-5.4	47.8	-8.4	0.97	0.30	0.77	0.28	1.37	0.16
SC	Faribault	54.9	10.9	53.8	6.6	54.8	4.4	49.8	-3.6	50.0	-6.3	0.44	0.26	0.17	0.87	1.32	-1.21
	Waseca	57.4	12.7	55.7	7.7	54.6	3.3	48.4	-6.0	49.5	-7.9	0.87	0.54	0.14	0.75	1.25	-1.33
	Winnebago	57.0	11.2	56.4	7.4	53.9	1.8	51.7	-3.3	49.9	-7.8	0.62	0.53	0.45	0.69	0.97	-1.39
Statewide		53.1	10.3	51.8	5.6	51.7	2.3	45.8	-6.6	49.4	-5.9	0.50	0.33	0.61	0.70	1.26	

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

Waterfowl information is taken from the U.S. Fish and Wildlife Service report Waterfowl Population Status, 2010 by Kathy Fleming, Timothy Moser, Walt Rhodes, and Nathan Zimpfer. 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, 1971-2010 (from: U.S. Fish and Wildlife Service. 2010. Waterfowl population status, 2010. U.S. Department of the Interior, Washington, D.C. U.S.A.).

Year	Population[a]
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
2008-09	279,900
2009-10	251,300

[a] Surveys conducted in Spring.

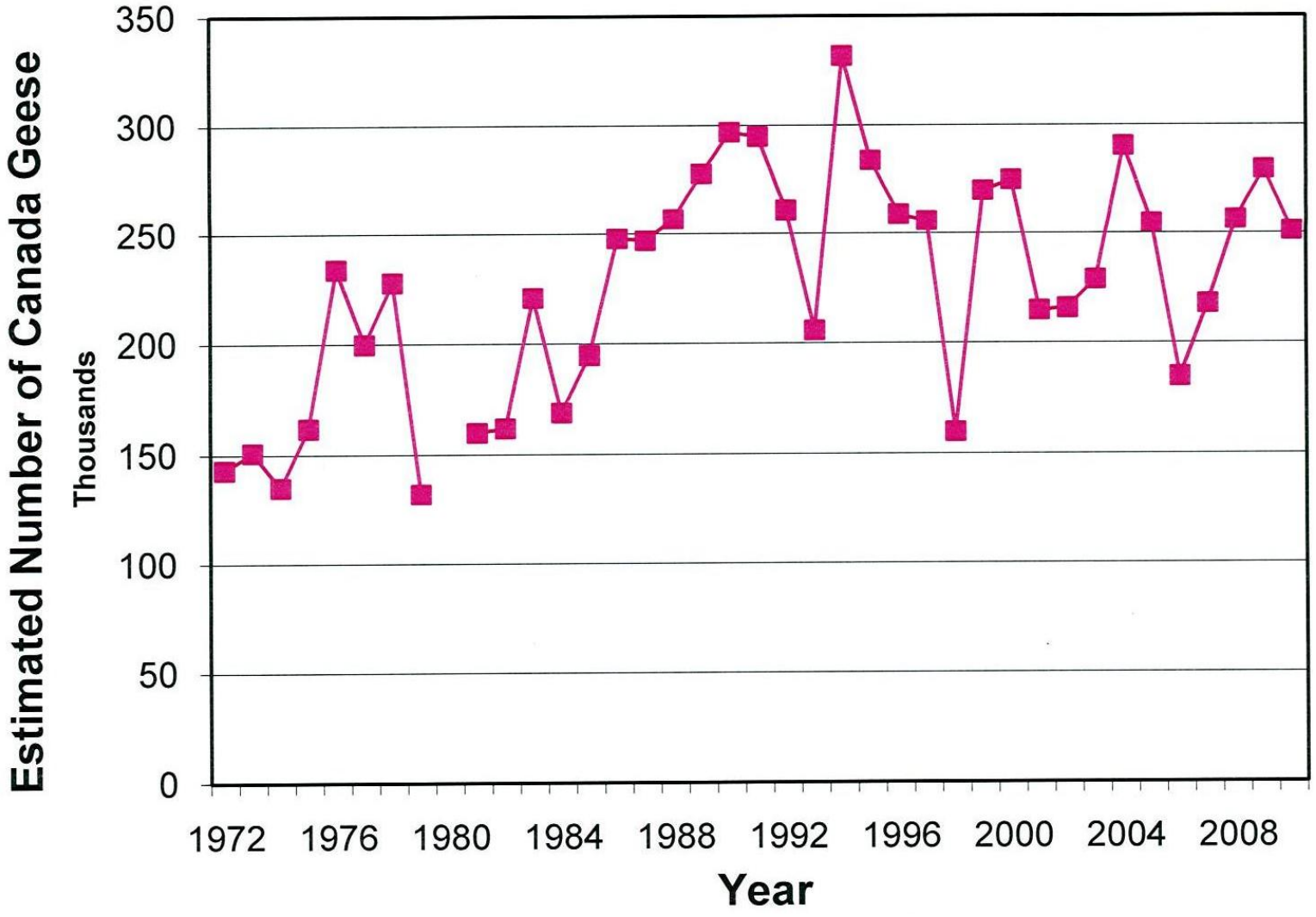

Figure 1. Breeding ground survey estimates of the Eastern Prairie Population of Canada geese, 1972-2010. (from: U.S. Fish and Wildlife Service. 2010. Waterfowl population status, 2010. U.S. Department of the Interior, Washington, D.C. U.S.A.). Surveys conducted in spring. Indirect or preliminary estimates. Data not available for 1980.

Table 2. Estimated number of May ponds (adjusted for visibility) in Prairie Canada (portions of Alberta, Saskatchewan and Manitoba) 1965-2010 and north-central U.S. (North Dakota, South Dakota and Montana) 1974-2010. (from: U.S. Fish and Wildlife Service. 2010. Waterfowl population status, 2010. U.S. Department of the Interior, Washington, D.C. U.S.A.)

	Ponds (thousands)	
Year	Prairie Canada	North Central U.S.[a]
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	1,377
2009	3,568	2,866
2010	3729	2,936
Average	3,439	1,608
% Change in 2010 from:		
2009	+ 5	+ 2
Long term Average	+ 8	+ 83

[a] No comparable survey data available for the north-central U.S. during 1965-73.

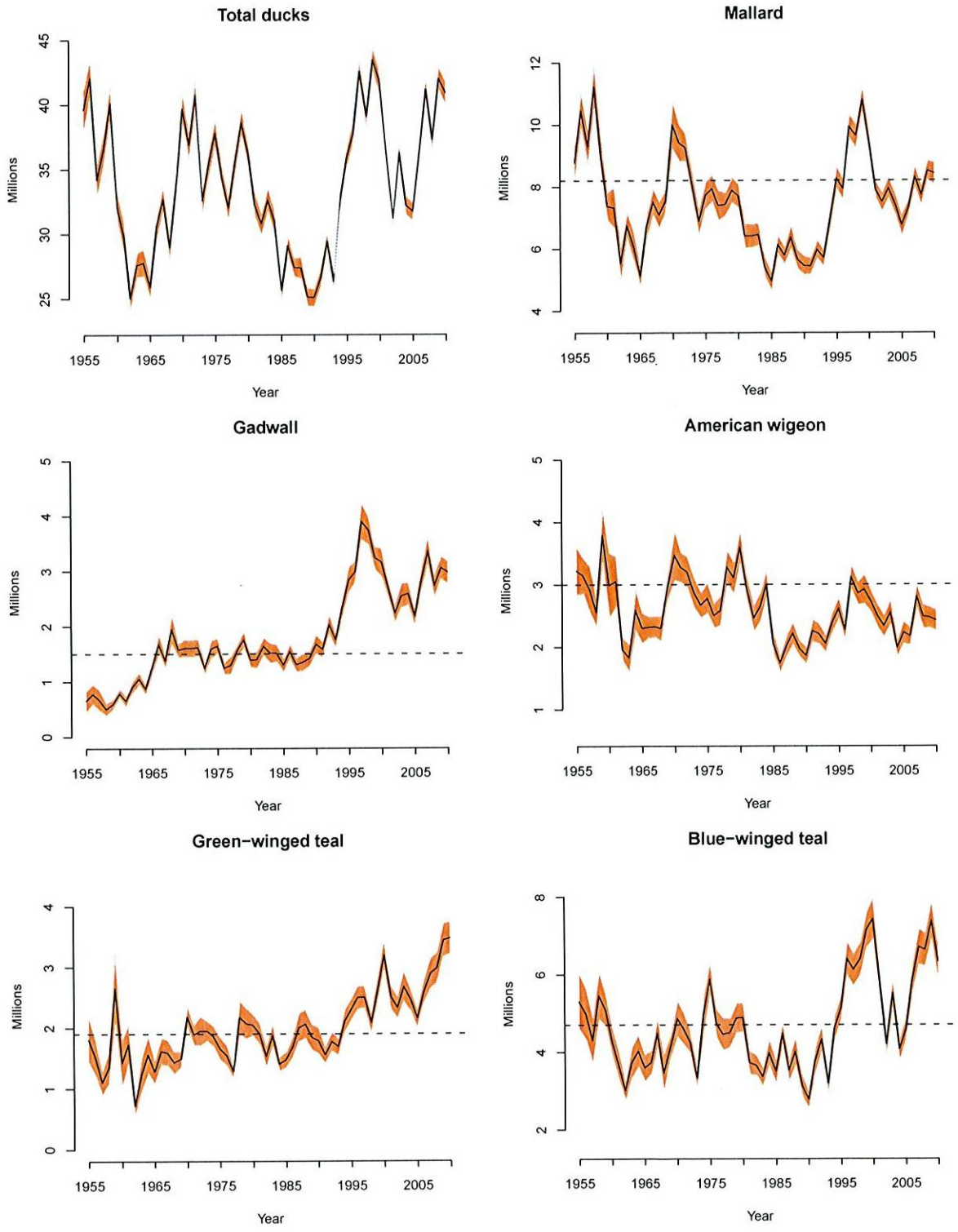

Figure 2. Estimates of North American breeding populations, 95% confidence intervals, and North American Waterfowl Management Plan population goal (dashed line) for selected species and number of water areas in May in Prairie Canada and Northcentral U.S. (from: U.S. Fish and Wildlife Service. 2010. Waterfowl population status, 2010. U.S. Department of the Interior, Washington, D.C. U.S.A.)

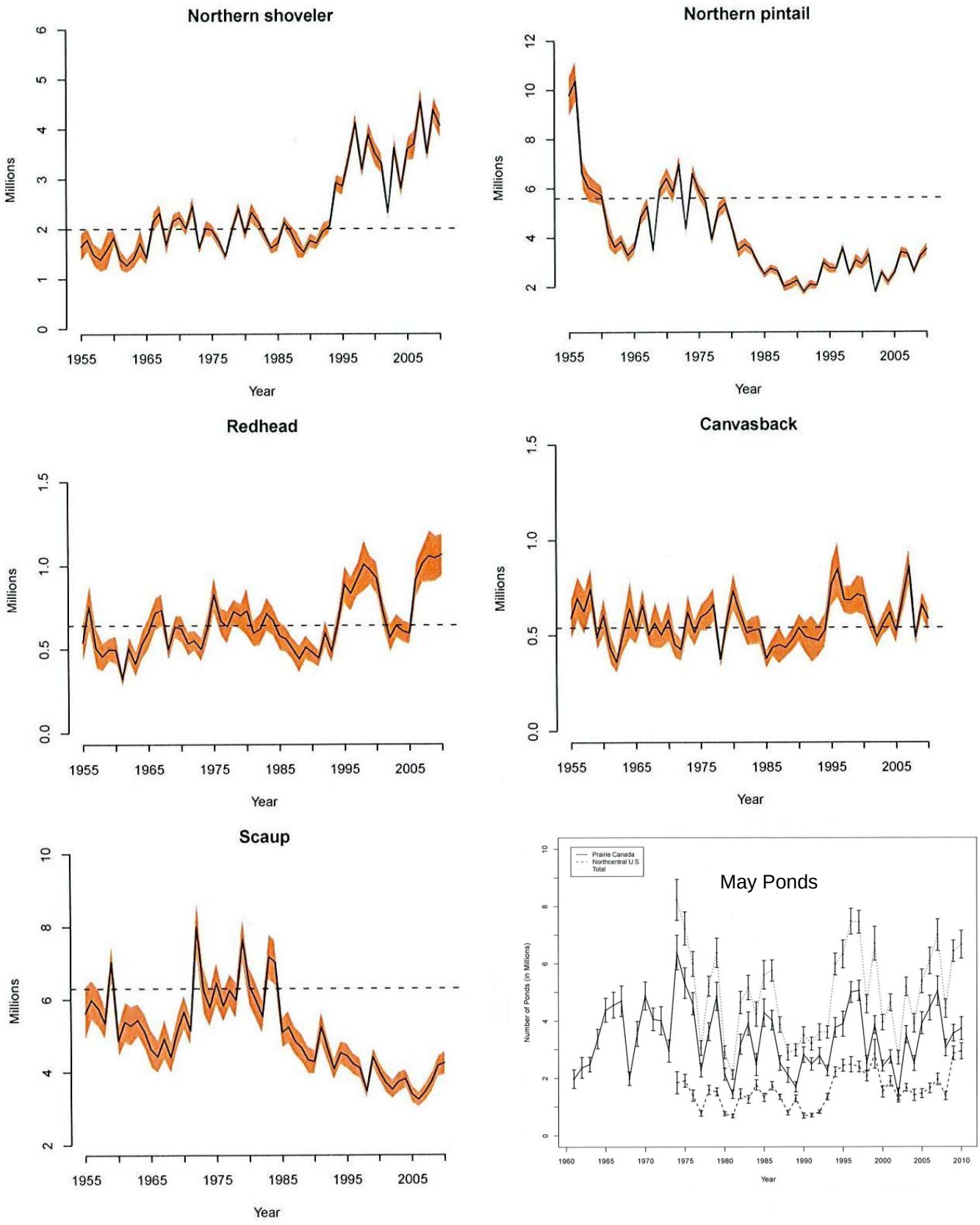

Figure 2. (continued).

2010 MINNESOTA SPRING CANADA GOOSE SURVEY

David Rave, Wetland Wildlife Populations and Research Group

INTRODUCTION

This report presents results from the tenth 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). I eliminated the double sampling design in 2008 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). 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.

Because of a very early spring, and early statewide lake ice-out dates, the survey was started about 4 days earlier in 2010 than in most previous years (Table 2). Pilot John Heineman and I flew the survey on five days between 15 and 20 April, 2010. 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 and pairs 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 2010 was 293,234 (±70,760). Adding 17,500 for the Twin Cities metro area (Cooper 2004) yields a statewide estimate of 310,734 (Table 1). Relative error (95% CI half-width) was 24.1% of the estimate, close to the goal of 25.0%. The survey tallied 42.5% singles, 48.2% pairs, and 9.3% 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) was obtained by combining singles and pairs associated with nests. In 2010, 46.6% of the geese seen were classified as Productive Geese (Table 2).

The 2010 Canada goose breeding population estimate for the surveyed area was similar to the 2009 estimate, although goose numbers appeared to be slightly lower in the Prairie region and slightly higher in the Forest and Transition regions (Table 1). A time-series plot suggested the goose population in the survey area has been reasonably stable over the last 9 years (Figure 1).

Weather conditions in 2010 were characterized by earlier spring temperatures statewide, and dry, warm weather throughout most of the incubation period and during the survey period. The early spring and the number of productive geese observed this year indicates that 2010 will likely be a very good year for Canada goose production. Weather conditions throughout May and June will influence goose productivity. Regardless, the 2010 Canada goose population estimate remained above the state Canada goose population goal of 250,000 geese.

Wetland and habitat quality were variable in the state this year. Wetland conditions were drier than average in about the southern half of the state, while wetland levels appeared to be average to well above average in the northern half of the state. Due to the large percentage of productive geese in the population, and good wetland conditions in much of the state, I expect above average Canada goose production throughout the state in 2010.

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. Chris Scharenbroich 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. John Giudice provided statistical assistance.

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COOPER, J. 2004. Canada goose program report 2004. Unpublished report. 20 pp.

MAXSON, S.J. 2002. 2002 Minnesota Spring Canada Goose Survey. Unpublished Report.

Table 1. Spring Canada goose population estimates in Minnesota, 2001-2010.

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*	113,483	127,490	30,400	271,372	±69,055	17,500	**288,872**
2009	129,115	114,737	23,644	267,496	±70,607	17,500	**284,996**
2010	83,911	151,902	57,421	293,234	±70,760	17,500	**310,734**

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

Table 2. Percent of Canada Geese seen as singles, pairs, groups, and productive geese on the Minnesota Spring Canada Goose Survey, 2001-2010.

Year	Singles[1]	Pairs[1]	Groups	Productive Geese[2]	Dates of Survey
2001	27.0	63.9	9.1	36.4	4/14 to 5/02/2001
2002	30.7	52.0	17.2	41.5	4/26 to 5/11/2002
2003	27.9	58.2	13.9	29.3	4/22 to 5/01/2003
2004	26.5	57.5	16.0	35.5	4/22 to 5/04/2004
2005	33.0	50.2	16.8	40.7	4/20 to 5/03/2005
2006	43.5	45.9	10.6	50.3	4/24 to 5/05/2006
2007	31.0	51.5	17.5	36.2	4/23 to 4/28/2007
2008	38.4	55.4	6.2	42.6	4/23 to 5/05/2008
2009	41.8	50.7	7.5	45.2	4/21 to 5/01/2009
2010	42.5	48.2	9.3	46.6	4/15 to 4/20/2010

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

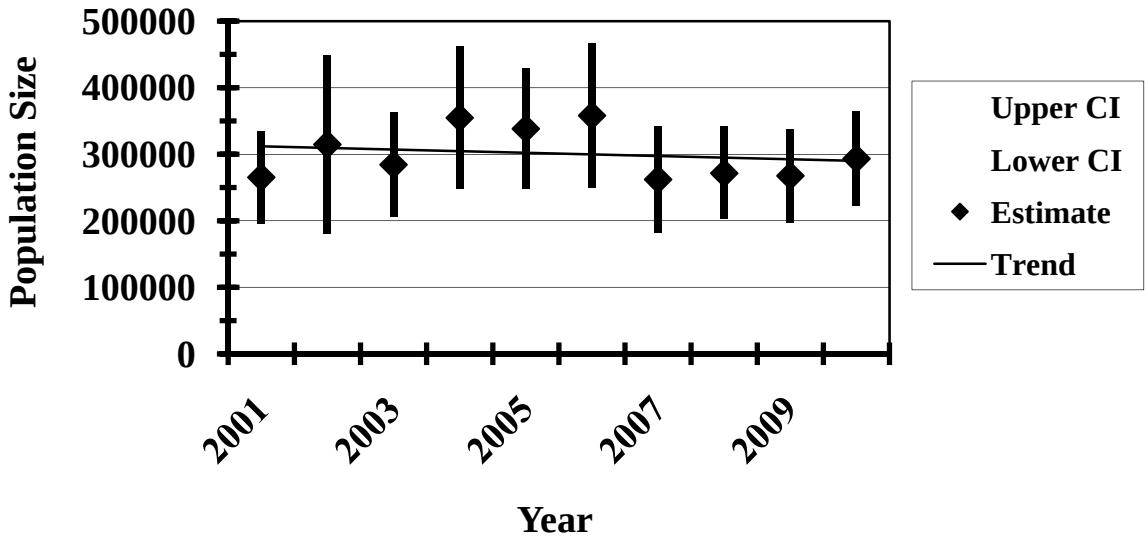

Figure 1. Spring Canada goose population estimates (±95% CI) in Minnesota, 2001-2010. (Does not include Metro area.)

Mourning dove information is taken from the U.S. Fish and Wildlife Service report by Sanders T. A. and K. Parker. 2010. Mourning dove population status, 2010. U.S. Department of the Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Washington, D.C. 28 pp. The entire report is available on the Division of Migratory Bird Management web site (http://www.fws.gov/migratorybirds/NewReportsPublications/PopulationStatus.html).

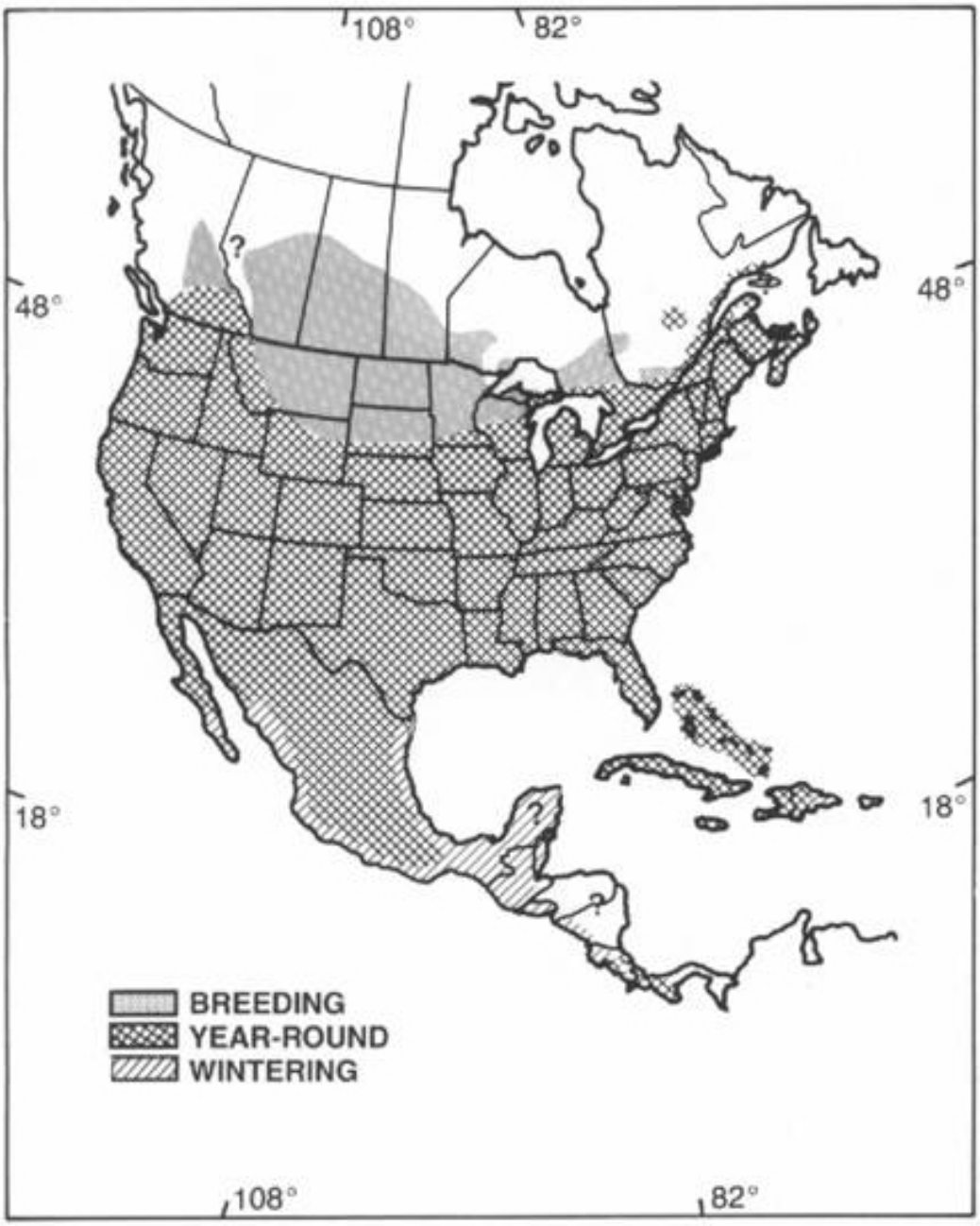

Figure 1. Breeding and wintering ranges of the mourning dove (adapted from Mirarchi and Baskett 1994). (From: Sanders T. A. and K. Parker. 2010. Mourning dove population status, 2010. U.S. Department of the Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Washington, D.C. 28 pp.)

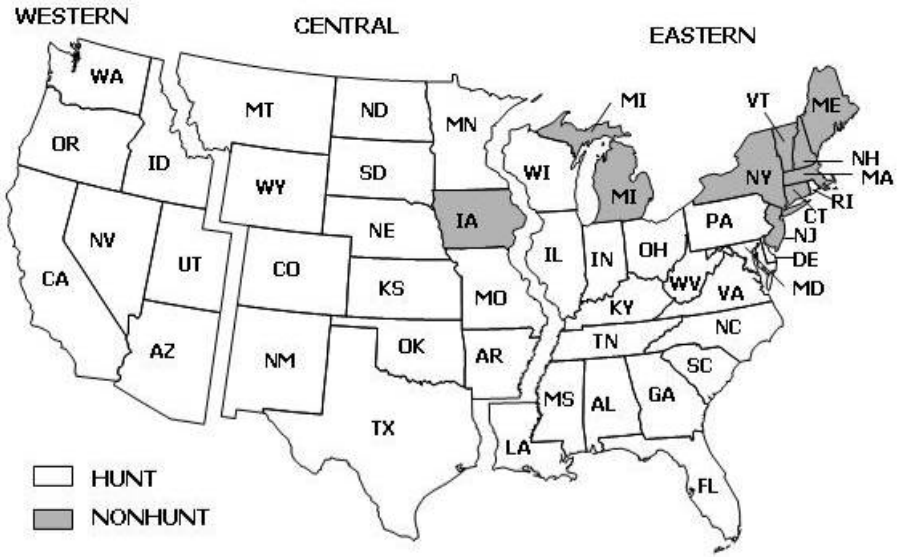

Figure 2. Mourning dove management units with 2009 hunting and non-hunting states. (From: Sanders T. A. and K. Parker. 2010. Mourning dove population status, 2010. U.S. Department of the Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Washington, D.C. 28 pp.)

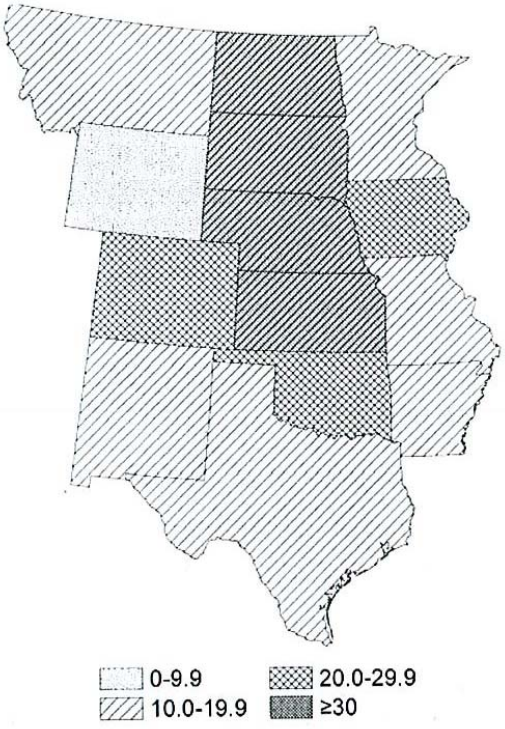

Figure 3. Mourning dove abundance in the Central Management Unit, based on the mean of the 2 CCS-heard index values from the last 2 years (2009-10). (From: Sanders T. A. and K. Parker. 2010. Mourning dove population status, 2010. U.S. Department of the Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Washington, D.C. 28 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 2007, 2008 and 2009 seasons [a]. (From: Sanders T. A. and K. Parker. 2010. Mourning dove population status, 2010. U.S. Department of the Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Washington, D.C. 28 pp.)

Management unit / State	Hunters			Hunter Days Afield			Total Harvest		
	2007[1]	2008[1]	2009	2007	2008	2009	2007	2008	2009
CENTRAL	485,700 [2]	443,900	393,400 †[3]	1,803,900 ± 9	1,496,900 ± 9	1,312,700	9,180,200 ± 9	7,520,000 ± 10	7,474,600 ± 12
AR	37,000 ± 16	23,300 ± 18	22,400 ±19	115,900 ± 23	76,600 ± 33	53,800 ± 26	791,700 ± 24	422,000 ± 23	353,500 ± 21
CO	21,800 ±11	23,200 ± 12	20,300 ± 13	57,800 ± 14	60,400 ± 18	45400 ± 18	315,000 ± 14	288,400 ± 19	242,400 ± 17
KS	36,300 ±8	26,800 ± 11	29,400 ± 10	119,100 ± 11	78,500 ± 15	97,000 ± 14	725,100 ± 13	443,700 ± 15	572,600 ± 16
MN	7,700 ± 35	11,300 ± 28	6,800 ± 36	27,600 ± 49	34,900 ± 42	24,100 ± 64	67,400 ± 52	83,500 ± 48	61,500 ± 67
MO	42,600 ± 8	34,300 ± 9	21,500 ± 16	124,400 ± 13	93,400 ± 14	58,700 ± 21	603,300 ± 15	467,800 ± 16	294,700 ± 26
MT	1,700 ± 31	2,100 ± 45	2,500 ± 32	4,000 ± 34	3,700 ± 44	6,400 ± 46	20,900 ± 43	18,400 ± 51	12,700 ± 32
NE	17,000 ± 12	13,600 ± 33	16,000 ± 12	55,300 ± 16	48,800 ± 52	51,800 ± 15	319,600 ± 18	238,600 ± 49	277,600 ± 17
NM	8,600 ± 18	6,300 ± 18	7,800 ±16	40,100 ± 33	26,200 ± 29	35,700 ± 26	198,700 ± 25	138,100 ± 30	170,200 ± 26
ND	3,200 ± 27	2,700 ± 30	2,800 ± 28	9,900 ± 26	9,200 ± 44	10,800 ± 50	48,700 ± 27	26,400 ± 31	40,000 ± 31
OK	24,600 ± 14	19,300 ± 17	18,600 ± 12	73,100 ± 19	57,800 ± 17	55,500 ± 15	480,000 ± 24	361,200 ± 18	378,400 ± 17
SD	6,000 ± 20	7,300 ± 18	6,500 ± 19	18,200 ± 25	27,500 ±34	21,700 ± 23	104,000 ± 30	152,100 ± 30	105,400 ± 24
TX	275,200 ± 10	271,300 ± 10	236,600 ± 10	1,149,600 ± 13	974,100 ± 13	846,200 ± 12	5,463,300 ± 14	4,849,600 ± 14	4,945,100 ± 18
WY	4,000 ± 20	2,500 ± 25	2,300 ± 27	8,800 ± 24	5,900 ± 33	5,800 ± 31	42,600 ± 27	30,100 ± 36	20,600 ± 31

[1] This represents the 95% confidence interval expressed as a percent of the point estimate.

[2] 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.

[3] No estimate available.

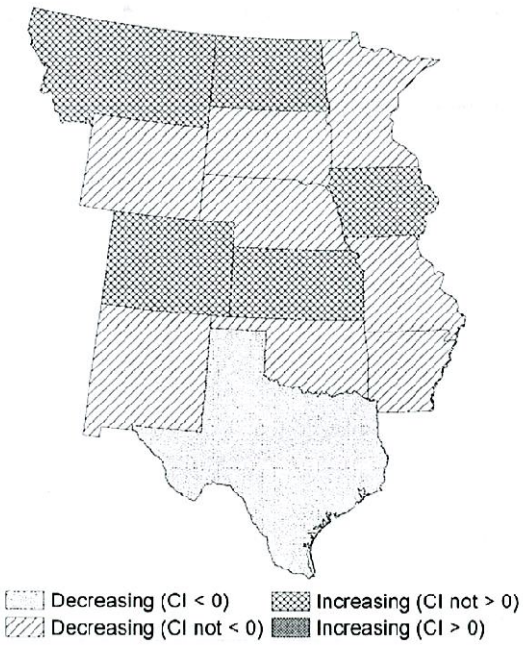

Figure 4. Trend in mourning dove abundance by state in the Central Management Unit over the last 10 years (2001-2010) based on CCS-heard data. Credible intervals (CI, 95%) that exclude zero provide evidence for an increasing or decreasing trend (From: Sanders T. A. and K. Parker. 2010. Mourning dove population status, 2010. U.S. Department of the Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Washington, D.C. 28 pp.)

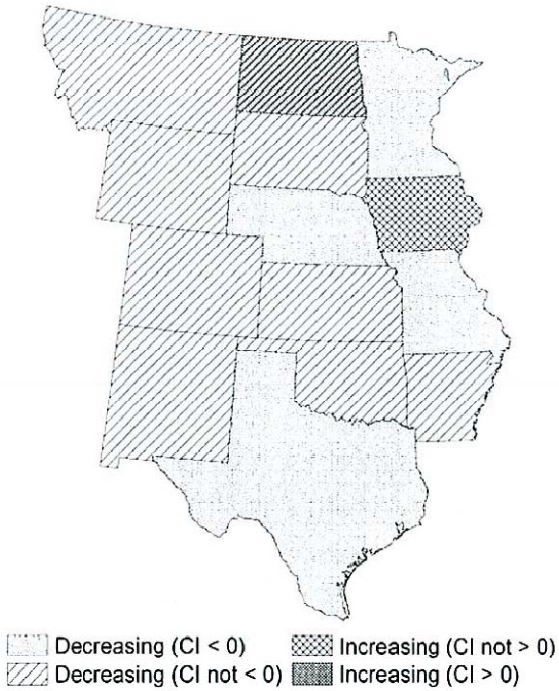

Figure 5. Trend in mourning dove abundance by state in the Central Management Unit over the last 45 years (1966-2010) based on CCS-heard data. Credible intervals (CI, 95%) that exclude zero provide evidence for an increasing or decreasing trend. (From: Sanders T. A. and K. Parker. 2010. Mourning dove population status, 2010. U.S. Department of the Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Washington, D.C. 28 pp.)

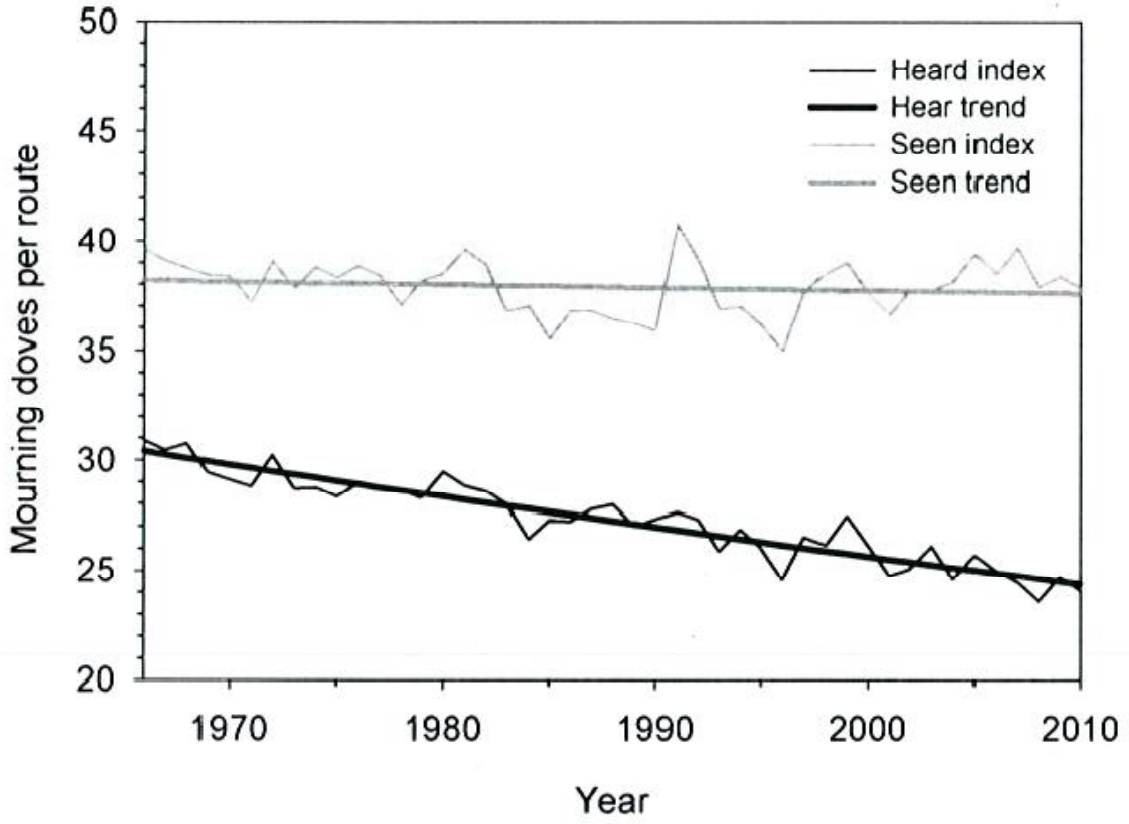

Figure 6. Mourning dove abundance indices and predicted trends in the Central Management Unit based on CCS data, 1966-2010. Trend lines are exponentiated predicted values from fitting a regression line through the log transformed annual indices. (From: Sanders T. A. and K. Parker. 2010. Mourning dove population status, 2010. U.S. Department of the Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Washington, D.C. 28 pp.)

American Woodcock information is taken from the U.S. Fish and Wildlife Service report American Woodcock Population Status, 2010. Cooper, T.R. and K. Parker. Us. Fish and Wildlife Service, Laurel, MD. 16 pp. The entire report is available on the Division of Migratory Bird Management home page (http://www.fws.gov/migratorybirds/NewReportsPublications/PopulationStatus.html).

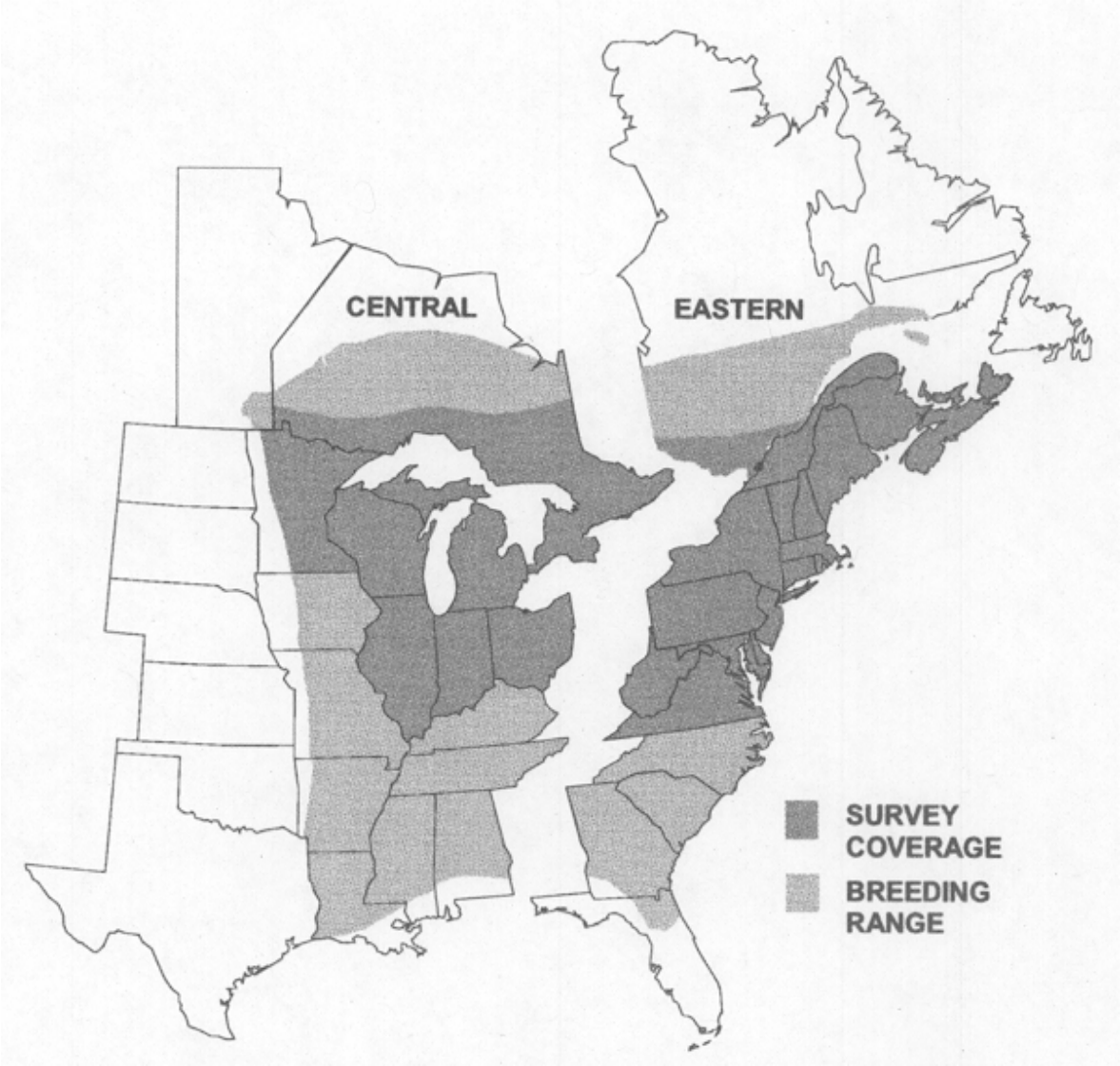

Figure 1. Woodcock management regions, breeding range, singing-ground survey coverage, (from: Cooper, T.R. and K. Parker. 2010. American woodcock population status, 2010. U.S. Fish and Wildlife Service, Laurel, MD. 16pp.)

Table 24. Short term (2009 – 10), 10 –year (2000-2010), and long-term (1968-2010) 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: Cooper, T.R. and K. Parker. 2010. American woodcock population status, 2010. U.S. Fish and Wildlife Service, Laurel, MD. 16pp.).

Management Unit/State	Number of Routes[b]	n[c]	(2009-10) % Change	(2000-10) % Change	(1968-10) % Change
CENTRAL	453	639	4.39	-1.19	- 0.97
IL	46	26	33.33	1.43	1.23
IN	11	40	4.52	- 2.69	- 3.92
MB[d]	17	23	- 1.81	- 1.24	- 1.65
MI	112	148	2.80	- 1.30	- 1.12
MN	74	103	21.00	0.69	0.46
OH	27	57	- 2.49	- 0.86	- 1.80
ON	89	139	- 4.24	- 2.97	- 1.05
WI	77	103	- 0.30	- 0.58	- 0.67

[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 2010 for which data were received by 2 June, 2010.

[c] Number of routes with >2 years of data and at least 1 observed woodcock between 1968 and 2010.

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

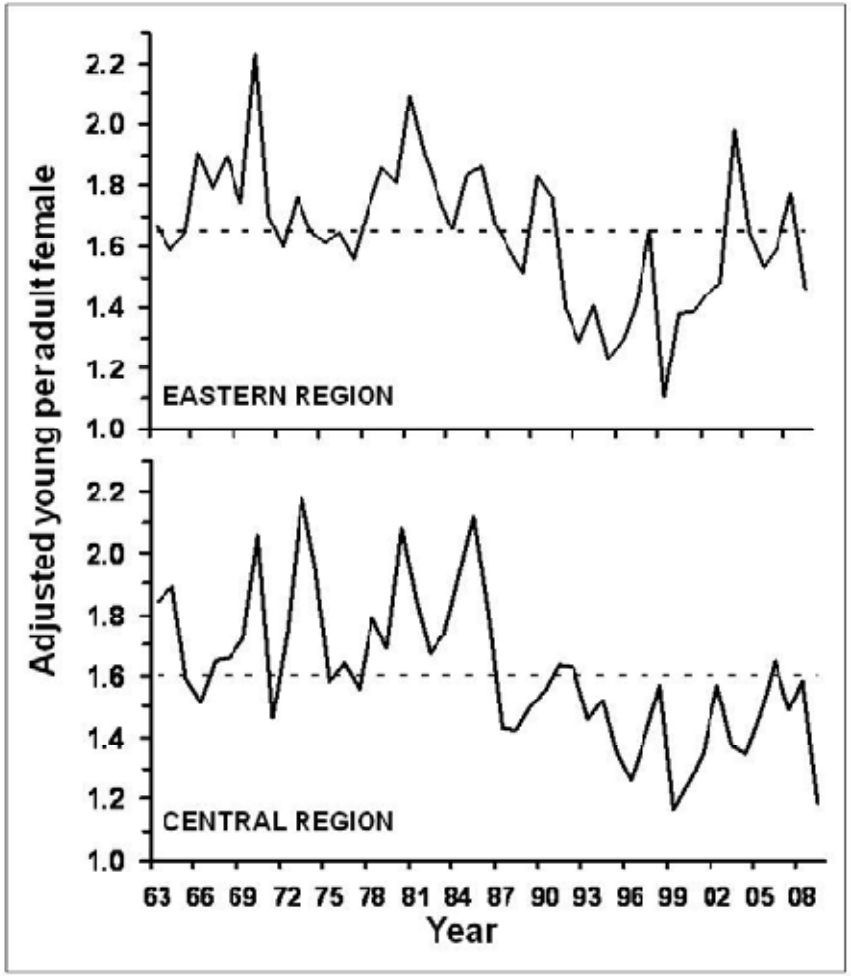

Figure 2. Weighted annual indices of American woodcock recruitment, 1963-2009. Dashed line is the 1963-2008 average. (from: Cooper, T.R. and K. Parker. 2010. American woodcock population status, 2010. U.S. Fish and Wildlife Service, Laurel, MD. 16pp.).

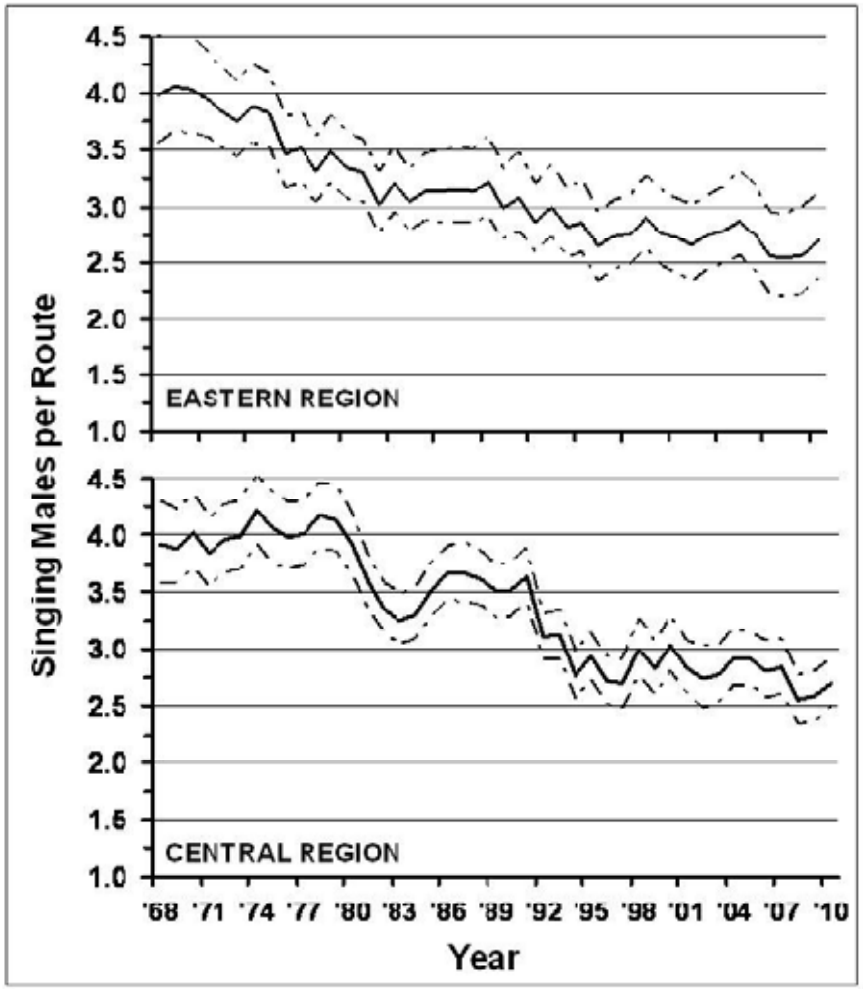

Figure 3. Annual indices of the number of woodcock heard on the Singing-ground Survey, 1968-2010. The dashed lines represent the 95th percentile credible interval. (from: Cooper, T.R. and K. Parker. 2010. American woodcock population status, 2010. U.S. Fish and Wildlife Service, Laurel, MD. 16pp.).

Table 25. Preliminary estimates of woodcock hunter numbers, days afield, and harvest for selected states, from the 2006-07, 2007-08, 2008-09, and 2009-10. Harvest Information Program surveys. Note: for 2009-10 all estimates rounded to the nearest 100 for harvest, hunters, and days afield. (from: Cooper, T.R. and K. Parker. 2010. American woodcock population status, 2010. U.S. Fish and Wildlife Service, Laurel, MD. 16pp.).

Management Unit / State	Active woodcock hunters				Days afield				Harvest			
	2006-07	2007-08	2008-09	2009-10 ([a])	2006-07	2007-08	2008-09	2009-10 ([a])	2006-07	2007-08	2008-09	2009-10([a])
Central Region	n.a.[b]	n.a.[b]	n.a. [b]	n.a. [b]	344,262 ± 12%	358,480 ± 14%	369,800 ± 16%	322,300 ± 14	232,557 ± 17%	214,162 ± 16%	174,300 ± 16%	175,100 ± 17
IL	1,973 ± 87%	3,111 ± 73%	2,100 ± 90%	1,800 ± 98	8,944 ± 115%	7,644 ± 72%	6,100 ± 103%	6,200 ± 91	2,171 ± 160%	3,819 ± 149%	4,300 ± 100%	5,300 ± 142
IN	1,000 ± 58%	1,788 ± 71	900 ± 69%	1,100 ± 63	4,377 ± 75%	3,342 ± 58%	2,400 ± 63%	4,000 ± 80	2,403 ± 69%	1,203 ± 53%	800 ± 31%	1,700 ±79
MI	30,017 ± 14%	28,412 ± 13%	34,600 ± 13%	26,400 ± 15	155,333 ± 17%	138,881 ±15%	156,000 ± 17%	146,200 ± 21	116,216 ± 27%	86,825 ± 17%	78,900 ± 17%	80,900 ± 22
MN	14,934 ± 24%	15,295 ± 29%	8,700 ± 37%	9,700 ± 37	60,160 ± 31%	62,810 ± 36%	37,900 ± 43%	38,300 ± 44	38,738 ± 41%	34,400 ± 38%	19,900 ± 67%	16,00 ± 48
OH	2,249 ± 68%	2,611 ± 73%	2,900 ± 69%	1,600 ± 82	9,764 ± 67%	9,259 ± 72%	10,300 ± 70%	7,200 ± 94	4,060 ± 51%	2,598 ± 68%	2,300 ± 68%	1,200 ± 63
WI	19,390 ± 22%	17,258 ± 23%	14,200 ± 24%	19,400 ± 22	72,365 ± 25%	79,139 ± 31%	65,400 ± 35%	77,100 ±24	42,958 ± 25%	48,027 ± 31%	36,000 ± 27%	29,200 ± 24

[a] 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.

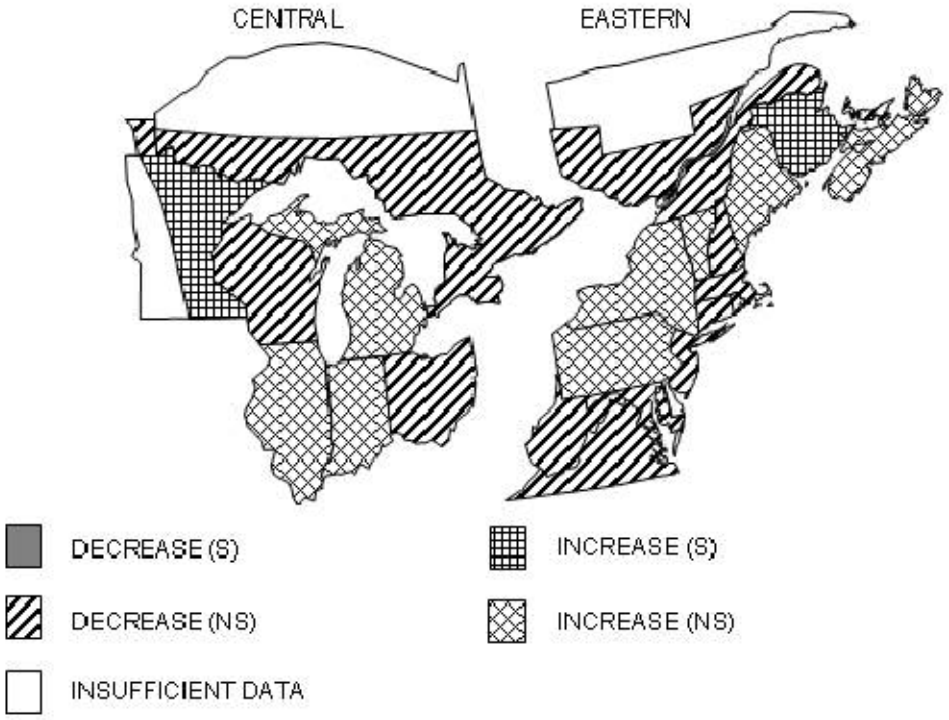

Figure 4. Short-term trends in number of American woodcock heard on the Singing-ground Survey; 2009-10, as determined by the hierarchical modeling method. A significant trend (S) does not include zero in the 95% credible interval, while a non-significant (NS) trend does include zero. (from: Cooper, T.R. and K. Parker. 2010. American woodcock population status, 2010. U.S. Fish and Wildlife Service, Laurel, MD. 16pp.).

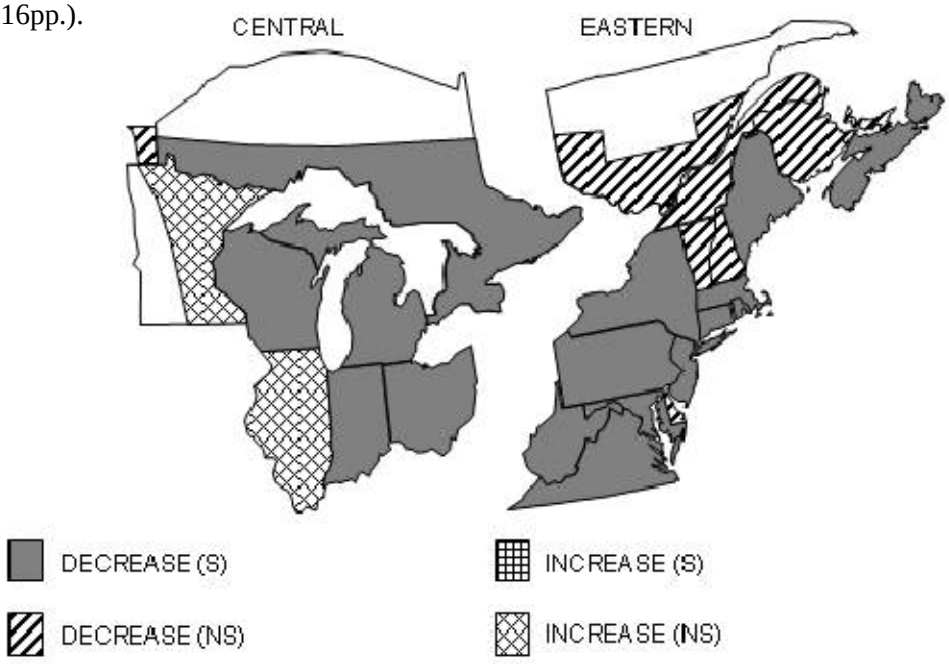

Figure 5. Long-term trends in number of American woodcock heard on the Singing-ground Survey; 1968-2010, as determined by the hierarchical modeling method. A significant trend (S) does not include zero in the 95% credible interval, while a non-significant (NS) trend does include zero. (from: Cooper, T.R. and K. Parker. 2010. American woodcock population status, 2010. U.S. Fish and Wildlife Service, Laurel, MD. 16pp.).

2010 RING-NECKED DUCK BREEDING PAIR SURVEY

Christine M. Herwig, Wetland Wildlife Populations and Research Group

SUMMARY OF FINDINGS

A pilot study was conducted in 2004 – 2006 to develop a survey for Minnesota's ring-necked duck (*Aythya collaris*) resident breeding population because little was known about the distribution and abundance of breeding ring-neck ducks in the state. We employed the survey design and methods developed during the pilot study (Zicus et al. 2008) to estimate the breeding population in 2007. In 2008 – 2010, we surveyed only 3 of 6 geographic strata and 2 of 4 habitat classes due to budget limitations. We surveyed 173 plots, similar to the surveys in 2008 – 2010, but we also sampled 49 plots that had been surveyed in 2009 to look at inter-annual variation. Helicopter-based counts in 2010 entailed 9 survey-crew days from 7 – 16 June totaling ~45 hrs of flight time. In 2010, based on data from 222 plots surveyed, the resident breeding population for the 3 geographic strata was estimated to be 5,300 indicated breeding pairs (IBP) and 12,000 birds. These estimates are much lower than previous estimates from 2006 – 2009, which ranged from 9,440 – 10,947 IBP and 18,533 – 22,987 birds.

INTRODUCTION

Growing concern among biologists about the status of ring-necked ducks in Minnesota prompted the initiation of a pilot study to develop a breeding pair survey (Zicus et al. 2008). At the time, little was known about the breeding distribution and abundance of resident ring-necked ducks in Minnesota. Concerns were raised, in part, due to counts from 10 wetlands in the Bemidji area, which have shown a ~70% decline in ring-necked duck breeding pairs since 1969 (Zicus et al. 2004). Counts from this geographically limited survey suggest that the Minnesota population may be declining despite continental increases (U.S. Fish and Wildlife Service 2008). Additionally, the species was identified as a forest indicator because of its unique habitat associations (Minnesota Department of Natural Resources 2006). The importance of this species to Minnesota is also reflected in the number of ring-necked ducks harvested annually, often the 3rd most common duck taken by hunters (U.S. Fish and Wildlife Service, unpublished reports). The primary objectives of this survey have been to estimate breeding pair numbers and monitor population trends in northern Minnesota.

METHODS

Number of breeding pairs and population size within a stratified random sample of survey plots have been estimated using 2 stratification variables: (1) Ecological Classification System (ECS) section; and (2) presumed nesting-cover availability (i.e., a surrogate for predicted breeding ring-necked duck density, Zicus et al. 2008). The pilot study and the first year of the operational survey (2007) were restricted to an area believed to be primary breeding range of ring-necked ducks for logistical efficiency (Zicus et al. 2008) and included 6 ECS sections (Figure 1). In 2008 – 2010, 3 of the ECS sections were dropped from the survey (Figure 1). Public Land Survey (PLS) sections (~2.6-km^2 plots, range = 1.2 – 3.0 km^2) were used as primary sampling units. The PLS sections at the periphery of the survey area that were <121 ha in size were removed from the sampling frame to reduce the probability of selecting these small plots. We used the same habitat class definitions that were used for stratification in 2006 (Table 1; Zicus et al. 2008).

To evaluate scaling back the survey to every other year, a sample of the plots surveyed in 2009 was resurveyed in 2010 to examine annual variation within a plot. Plots sampled in 2009 (N=174) were first treated as a separate stratum, then ordered by stratum (i.e., 3 ECS sections x 2 habitat classes), total number of ring-neck ducks observed in 2009, and total acres of nesting habitat. Once ordered, a random

systematic sample of was drawn from each combination of ECS and habitat class. The end result was 50 plots to be surveyed in 2010 drawn from across a range of total number of ducks observed and potential nesting habitat.

To select plots for the 2010 survey, the sampling frame consisted of 6 strata (i.e., 3 ECS sections x 2 habitat classes, Figure 1A), and we proportionally allocated 175 plots to the 6 strata with a restriction that a minimum of 10 plots occur in each stratum. The 174 plots surveyed in 2009 were not included as possible plots when the sample was allocated. As in 2008 and 2009, we did not survey plots in habitat class 3 and 4 plots. Data collected for the resampled plots were included in the 2010 survey estimates.

For each plot, location, date, and time were recorded as were all ring-necked ducks observed on study plots and their sex and social status (Zicus et al. 2008). We considered pairs, lone males, and males in flocks of 2 – 5 to indicate breeding pairs (IBP; J. Lawrence, MNDNR, personal communication). The resident breeding population in the survey area was considered to be twice the IBP plus the number of lone females, flocked females, mixed sex groups, and single-sex groups >5 birds. We used the R library survey (Lumley 2009, R Development Core Team 2009) to estimate IBP and resident breeding population totals for habitat class 1 and 2 plots in each ECS section, the 2009 plots surveyed again in 2010, and the entire survey area, which included 7 strata (3 ECS sections x 2 habitat classes and the resampled plots).

RESULTS

In 2010, plots were well distributed throughout the study area (Figure 1B). Most plots (102) were located in the Northern Minnesota Drift and Lake Plains section, while the fewest plots (20) were located in the Lake Agassiz, Aspen Parklands section (Table 2). The sampling rate was higher in the Lake Agassiz, Aspen Parklands section than the other 2 ECS sections (5.9% versus 1.4% and 1.5%; Table 2). We were unable to survey 1 of the plots in the Northern Minnesota Drift and Lake Plains section and 2 plots in the Minnesota and Northeast Iowa Morainal section due to mechanical problems with the helicopter and time restrictions. Additionally, a substitute plot was selected to replace 1 plot that fell within National Guard's Camp Ripley in Little Falls, Minnesota due to access limitations.

The survey was conducted 7 – 16 June and entailed 9 survey-crew days totaling ~45 hrs of flight time. A total of 230 ring-necked ducks were observed in 56 (25%) of 222 plots (Table 3). By habitat type, birds were detected on 38 (33%) of habitat class 1 plots and 18 (16%) of habitat class 2 plots. Overall, counts on occupied plots ranged from 1 to 18 birds (median = 2 birds/plot). Numbers of IBP on occupied plots ranged from 0 to 12 (median = 2 IBP/plot). Numbers of birds on occupied plots ranged from 1 to 25 ducks (median = 3.5 breeding birds/plot). Of the birds observed, 49% were classified as pairs, 20% lone males, 20% flocked males, and <1% mixed groups, lone females, and flocked females. Of IBP, 38% were classified as pairs, 31% lone males, and 31% flocked males. These IBP ratios suggest that survey timing may have been later phenologically in 2010 than in previous years (Figure 2).

Estimated IBP in the survey area was 5,338 pairs (SE = 1,082; Table 4, Figure 3A). The estimated resident breeding population of ring-necked ducks in the survey area was 11,843 birds (SE = 2,525; Table 4, Figure 3B). Because of sampling frame changes in 2008 – 2010, estimates from 2006 and 2007 were re-calculated with a 3 ECS sampling frame. Data from 2004 and 2005 were not re-calculated, because habitat classifications also changed since those surveys were conducted. Estimates (IBP and breeding population) from 2010 appear to be much lower than previous estimates from 2006 – 2009, which ranged from 9,440 – 10,947 IBP and 18,533 – 22,987 birds. The resident breeding population ranged from a high of 3,376 pairs and 7,781 breeding birds in the Northern Minnesota Drift and Lake Plains section to a low of 790 pairs and 1,714 breeding birds and in the Lake Agassiz, Aspen Parklands section (Table 5).

When the plots sampled in both 2009 and 2010 were examined, 68 ducks in 2009 and 65 ducks in 2010 were observed in 14 (29%) of 49 plots in both 2009 and 2010. Although overall counts and plot occupancy were similar between years, when examined on a plot-by-plot basis, there was no relationship (Figure 5). Comparing habitat types, birds were detected on 10 (40%) of habitat class 1 plots and 4 (17%) of habitat class 2 plots in 2009. In 2010, birds were detected on 8 (32%) of habitat class 1 plots and 6

(25%) of habitat class 2 plots. Number of birds, IBP and resident breeding population on occupied plots were similar between years (Table 6). In 2009, of the birds observed, 26% were classified as pairs, 31% flocked males, 20% lone males, 19% mixed groups, 4% lone females, and no flocked females. In 2010, 51% were classified as pairs, 26% lone males, 21% flocked males, 2% lone females, and no mixed groups or flocked females. The IBP ratios for the 49 resampled plots (Figure 6) were opposite for the broader survey, which had higher IBP ratios in 2009 than 2010 (Figure 2). Comparing these IBP ratios suggest that survey timing for these resampled plots may have been later in the breeding cycle in 2009 than 2010.

DISCUSSION

The resident breeding population appeared to be relatively stable since 2006, remaining between 18,000 and 23,000 breeding birds based on the estimates for the 3 ECS. In 2010, there appeared to be a notable drop in the estimates of IBP and breeding birds. While this decline could be real, other possible explanations include survey timing and sampling variability. Many additional years are needed, however, to detect population trends.

Resampled plots provided useful information for examining annual variation within plots. Contrary to expectations, we did not find any relationship between ring-necked duck counts on plots sampled in adjacent years. Based on social status of the IBP, it appears that the survey was conducted at a slightly different stage of nesting in 2009 than 2010, but this difference in timing likely does not account for all of the variability observed. Regardless, there was more sampling variability within plots among years than expected. Although there is some interest in scaling back the survey to every other year, more study is needed to better understand sampling variation and its affect on the detection of population trends.

ACKNOWLEDGMENTS

We thank pilots John Heineman and Mike Trenholm for help with survey planning and for flying the survey. Frank Swendsen has served as observer for a portion of the plots. John Giudice conducted the statistical analyses and provides assistance interpreting the data. David Rave not only provided help with the methodology but continues to help with any questions I have about the survey. Shelly Sentyrz and Chris Scharenbroich created the navigation maps used during the survey. We also acknowledge the Red Lake band of the Ojibwe, National Guard personnel at Camp Ripley, and managers at Agassiz, Tamarac, and Sherburne National Wildlife Refuges for allowing plots under their purview to be surveyed. Brian Hargrave and Nancy Dietz provided the initial Minnesota Gap Analysis Program (MNGAP) data, and Dan Hertel supplied the Habitat and Population Evaluation Team (HAPET) data used to define the primary breeding range.

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Table 1. Habitat classes assigned to Public Land Survey section plots in the Minnesota ring-necked duck breeding pair survey area, June 2004 – 2010.

Habitat class	Definition[a]		Percent of survey area			
	2004	2005 - 2010[b]	2004	2005	2006- 2007	2008-2010
1	Plots with $\geq$ the median amount of MNGAP class 14 and/or 15 cover within 250 m of and adjacent to MNGAP class 12 cover (i.e., high pair potential).	Plots with $\geq$ the median amount of MNGAP class 10, 14, and/or 15 cover within 250 m of and adjacent to MNGAP class 12 and/or 13 cover (i.e., high pair potential).	15.3	24.5	21.5	70.7
2	Plots with < the median amount of MNGAP class 14 and/or 15 cover within 250 m of and adjacent to MNGAP class 12 cover (i.e., moderate pair potential).	Plots with < the median amount of MNGAP class 10, 14, and/or 15 cover within 250 m of and adjacent to class 12 and/or 13 cover (i.e., moderate pair potential).	15.3	24.5	21.5	29.3
3	Plots with no MNGAP class 14 and/or 15 cover that include MNGAP class 12 cover that is within 250 m of a shoreline (i.e., low pair potential).	Plots with no MNGAP class 10, 14, and/or 15 cover that include class 12 and/or 13 cover that is within 100 m of a shoreline (i.e., low pair potential).	25.2	7.7	13.5	0.0
4	Plots with no MNGAP class 14 and/or 15 cover and no MNGAP class 12 cover within 250 m of a shoreline (i.e., no pair potential).	Plots with no MNGAP class 10, 14, and/or 15 cover and no class 12 and/or 13 cover within 100 m of a shoreline (i.e., no pair potential).	44.2	43.3	43.5	0.0

[a]Plots are Public Land Survey sections. MNGAP = Minnesota GAP level 4 land cover data. Class 10 = lowlands with <10% tree crown cover and >33% cover of low-growing deciduous woody plants such as alders and willows. Class 12 = lakes, streams, and open-water wetlands. Class 13 = water bodies whose surface is covered by floating vegetation. Class 14 = wetlands with <10% tree crown cover that is dominated by emergent herbaceous vegetation such as fine-leaf sedges. Class 15 = wetlands with <10% tree crown cover that is dominated by emergent herbaceous vegetation such as broad-leaf sedges and/or cattails.

[b]Habitat class definitions in 2005 – 2010 were the same, but MNGAP class 10, 14, and 15 cover associated with lakes having a General or Recreational Development classification under the Minnesota Shoreland Zoning ordinance was not considered nesting cover in 2006 – 2010.

Table 2. Sampling rates in the habitat class 1 and 2 strata by Ecological Classification System (ECS) section for Minnesota's ring-necked duck breeding-pair survey, June 2004 – 2010.

ECS section	No. of plots[a]				No. of plots surveyed (Sampling rate [%])					
	2004	2005	2006-2007	2008-2010	2004	2005	2006-2007	2008	2009	2010
W & S Superior Uplands[b]	1,638	2,461	2,218	-	18 (1.1)	22 (0.9)	20 (0.9)	-	-	-
Northern Superior Uplands	1,810	4,648	4,209	-	13 (0.7)	36 (0.8)	33 (0.8)	-	-	-
N Minnesota & Ontario Peatlands	1,817	2,737	2,389	-	26 (1.4)	35 (1.3)	30 (1.3)	-	-	-
N Minnesota Drift & Lake Plains	5,048	8,383	7,145	7,145	78 (1.5)	94 (1.1)	77 (1.1)	108 (1.5)	104 (1.5)	126 (1.8)
Minnesota & NE Iowa Morainal	3,510	4,033	3,561	3,561	50 (1.4)	35 (0.9)	32 (0.9)	53 (1.5)	51 (1.4)	66 (1.9)
Lake Agassiz, Aspen Parklands	316	363	340	340	15 (4.7)	8 (2.2)	8 (2.4)	13 (3.8)	20 (5.9)	30 (8.8)

[a]Number of Public Land Survey sections in the ECS section(s).
[b]Western and Southern Superior Uplands sections combined due to the small area of the Southern Superior Uplands occurring in the survey area.

Table 3. Survey results for habitat class 1 and 2 strata in the Minnesota ring-necked duck breeding pair survey area, June 2004 – 2010.

Year	No. of plots surveyed	No. plots with birds (%)	Birds[a]			IBP[b]			Resident breeding birds[c]		
			Total	Per plot	Per occupied plot	Total	Per plot	Per occupied plot	Total	Per plot	Per occupied plot
2004	200	50 (25)	278	1.39	5.56	160	0.81	3.20	353	1.77	7.06
2005	230	37 (16)	147	0.64	3.97	92	0.43	2.49	218	0.95	5.89
2006	200	50 (25)	279	1.40	5.58	167	0.85	3.34	375	1.88	7.50
2007	200	52 (26)	152	0.76	2.92	137	0.72	2.63	296	1.48	5.69
2008	174	58 (33)	296	1.70	5.10	173	0.99	2.98	364	2.09	6.28
2009	174	57 (33)	273	1.57	4.79	173	0.99	3.04	362	2.08	6.35
2010	222	56 (22)	230	1.04	4.11	147	0.66	2.63	321	1.45	5.73

[a]Total number of ring-necked ducks counted during the survey.

[b]The number of indicated breeding pairs (IBP) is the sum of the pairs, lone males, and males in flocks of 2 – 5 birds.

[c]The total resident breeding population in the survey area was considered to be twice the IBP plus the number of lone females, flocked females, mixed sex groups, and single-sex groups >5 birds.

Table 4. Estimated indicated breeding pairs (IBP) and resident breeding population size in the habitat class 1 and 2 strata in the Minnesota ring-necked duck breeding pair survey area, June 2004 – 2010.

	IBP (CV[%])		Resident breeding population (CV[%])	
Year	6 ECS[a]	3 ECS[b]	6 ECS[a]	3 ECS[b]
2004	9,443 (17.8[c])	-	20,321 (18.1[c])	-
2005	7,496 (20.0[c])	-	17,279 (21.5[c])	-
2006	14,770 (17.6[c])	9,851 (23.8)	32,621 (17.4[c])	21,849 (23.1)
2007	12,787 (17.7)	8,705 (19.9)	26,026 (17.5)	17,863 (19.5)
2008	-	9,439 (16.8)	-	19,488 (16.6)
2009	-	10,947 (14.3)	-	22,987 (15.0)
2010	-	5,338 (20.3)	-	11,843 (21.3)

[a]Population estimates were based on a stratified random sample of habitat class 1 and 2 Public Land Survey (PLS) sections in 12 strata (2 habitat classes and 6 Ecological Classification System [ECS] sections).

[b] Population estimates were based on a stratified random sample of habitat class 1 and 2 Public Land Survey (PLS) sections in 6 strata (2 habitat classes and 3 Ecological Classification System [ECS] sections). Population estimates were not adjusted for 2004 and 2005, because the habitat classifications have also changed since those surveys were conducted.

[c]Variance estimate is biased low because no birds were observed in one or more strata. As a result, the confidence interval is too narrow and the CV is optimistic.

Table 5. Estimated indicated breeding pairs (IBP) and resident breeding population by Ecological Classification System (ECS) section in the habitat class 1 and 2 strata in the Minnesota ring-necked duck breeding pair survey area, June 2005 – 2010.

	IBP (CV [%])					
ECS section	2005	2006	2007	2008	2009	2010
W & S Superior Uplands[b]	444 (99.5[c])	669 (59.1)	671 (99.6)	-	-	-
Northern Superior Uplands	1,169 (46.8)	2,679 (33.7)	2,694 (46.5)	-	-	-
N Minnesota & Ontario Peatlands	239 (54.1[c])	1,572 (34.7)	717 (46.5)	-	-	-
N Minnesota Drift & Lake Plains	3,490 (33.0)	6,334 (31.5)	5,686 (26.0)	4,948 (24.6)	7,064 (17.1)	3,376 (27.1)
Minnesota & NE Iowa Morainal	918 (43.6)	2,102 (53.9)	2,118 (38.8)	3,689 (26.0)	3,449 (28.4)	1,025 (52.0)
Lake Agassiz, Aspen Parklands	1,235 (40.1[c])	1,414 (35.2)	902 (40.9)	803 (38.4)	436 (35.5)	790 (29.1)

[a]Western and Southern Superior Uplands sections combined due to the small area of the Southern Superior Uplands occurring in the survey area.

Table 5. Continued.

	Resident breeding population (CV [%])					
ECS section	2005	2006	2007	2008	2009	2010
W & S Superior Uplands[b]	889 (99.5[c])	1,338 (59.1)	1,342 (99.6)	-	-	-
Northern Superior Uplands	2,339 (46.8)	5,357 (33.7)	5,388 (46.5)	-	-	-
N Minnesota & Ontario Peatlands	477 (54.1[c])	4,076 (42.3)	1,434 (46.5)	-	-	-
N Minnesota Drift & Lake Plains	6,981 (33.0)	14,816 (29.6)	11,651 (25.4)	10,264 (24.3)	14,948 (18.2)	7,781 (28.7)
Minnesota & NE Iowa Morainal	4,122 (56.4)	4,204 (53.9)	4,236 (38.8)	7,377 (26.0)	7,170 (29.2)	2,048 (52.0)
Lake Agassiz, Aspen Parklands	2,471 (40.1[c])	2,829 (35.2)	1,976 (42.3)	1,846 (41.4)	871 (35.4)	1,714 (29.7)

[a]Western and Southern Superior Uplands sections combined due to the small area of the Southern Superior Uplands occurring in the survey area.

Table 6. Total number of ring-necked ducks, indicated breeding pairs (IBP), and resident breeding birds for 49 plots sampled in 2009 and 2010. The range and median per plot are also provided.

	2009			2010		
	Total	Range/plot	Median/plot	Total	Range/plot	Median/plot
No. birds	68	1 - 19	3	65	1 - 17	4
IBP	42	1 - 7	4	42	1 - 12	2
Resident breeding birds	69	1 - 23	2	85	2 - 24	4.5

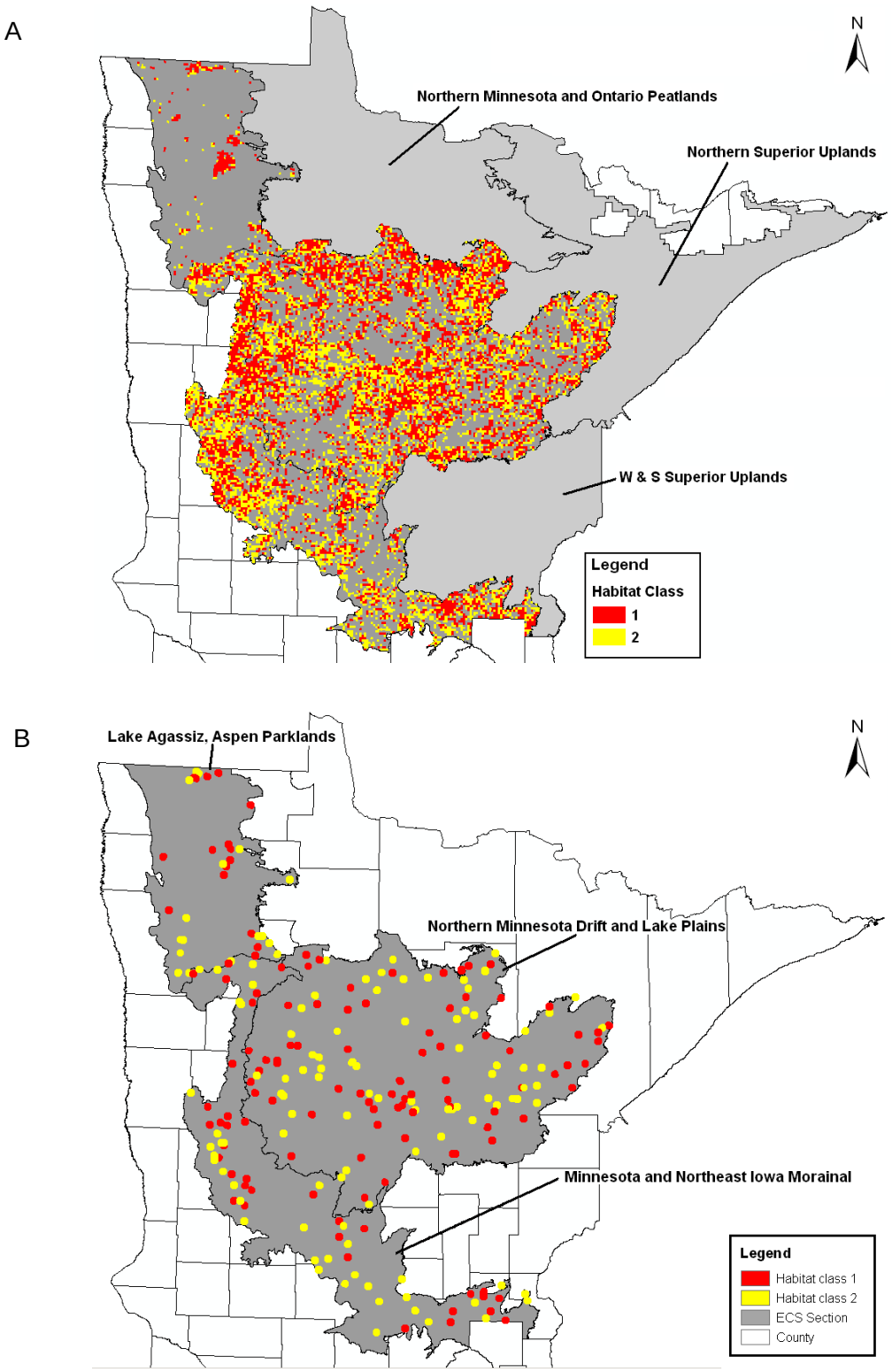


Figure 1. In the 3 Ecological Classification Section (ECS) sampling frame (A) all Public Land Survey (PLS) plots, (B) 2010 survey plots (enlarged for visibility), and (C) plots from 2009 resampled in 2010 indicated by habitat class for Minnesota's ring-necked duck breeding pair survey.

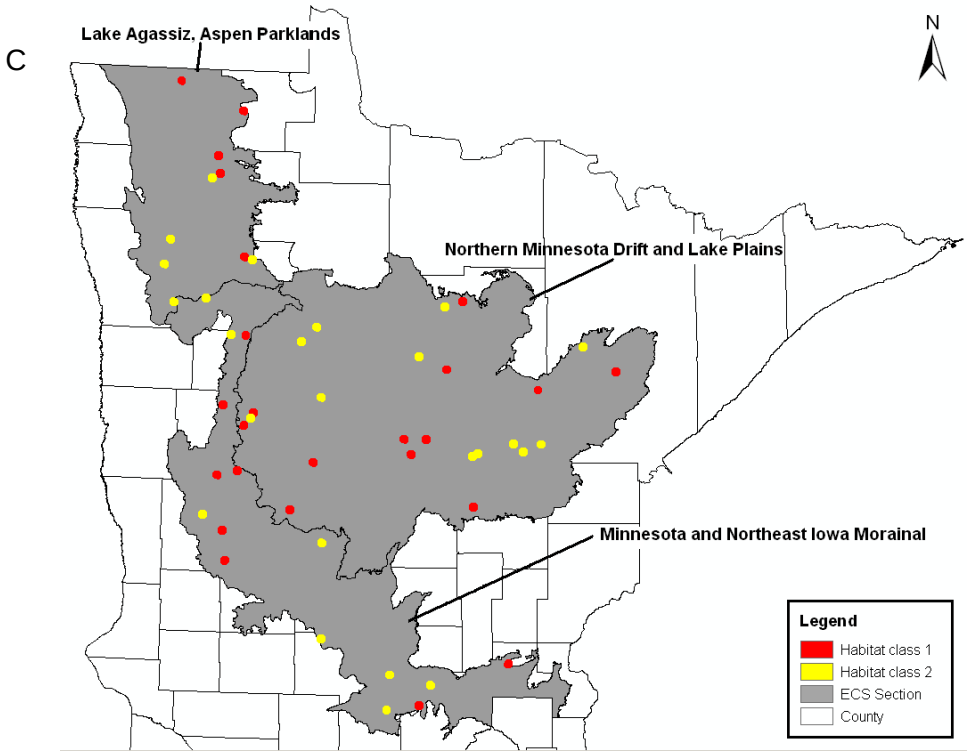


Figure1.Continued

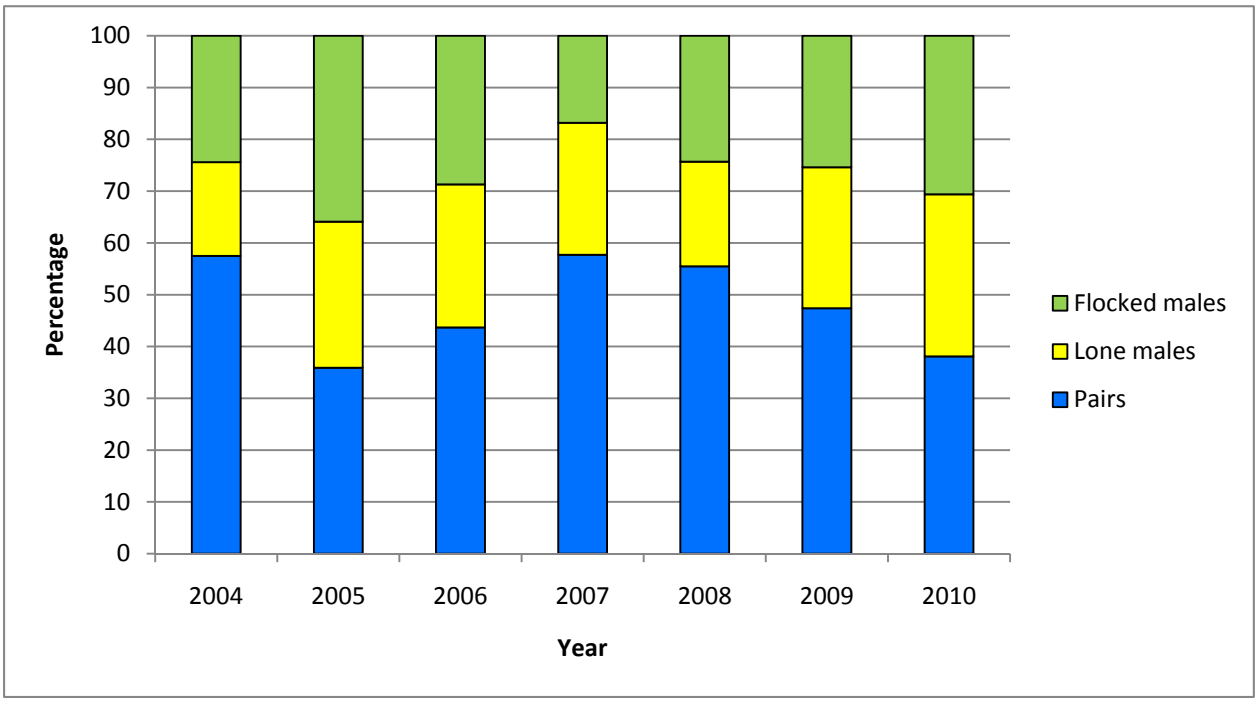
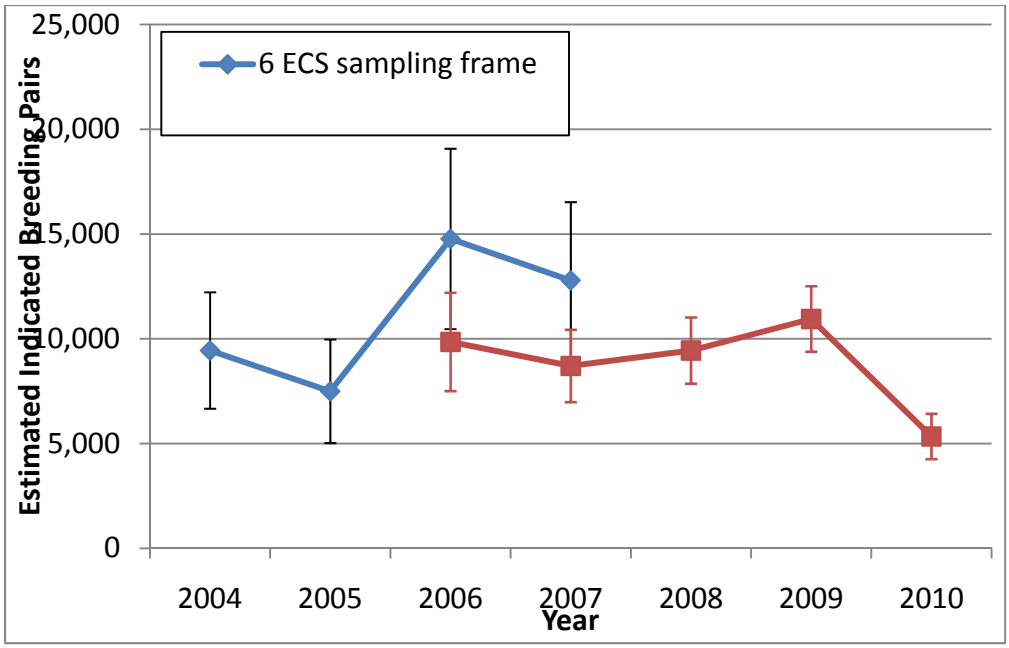


Figure 2. Social status of the indicated breeding pairs observed in the Minnesota ring-necked duck breeding pair survey area, June 2004 – 2009. Surveys were conducted 6 – 17 June 2004, 12 – 24 June 2005, 6 – 16 June 2006, 5 – 13 June 2006, 9 – 17 June 2008, 5 – 12 June 2009, and 7 – 16 June 2010.

A



B

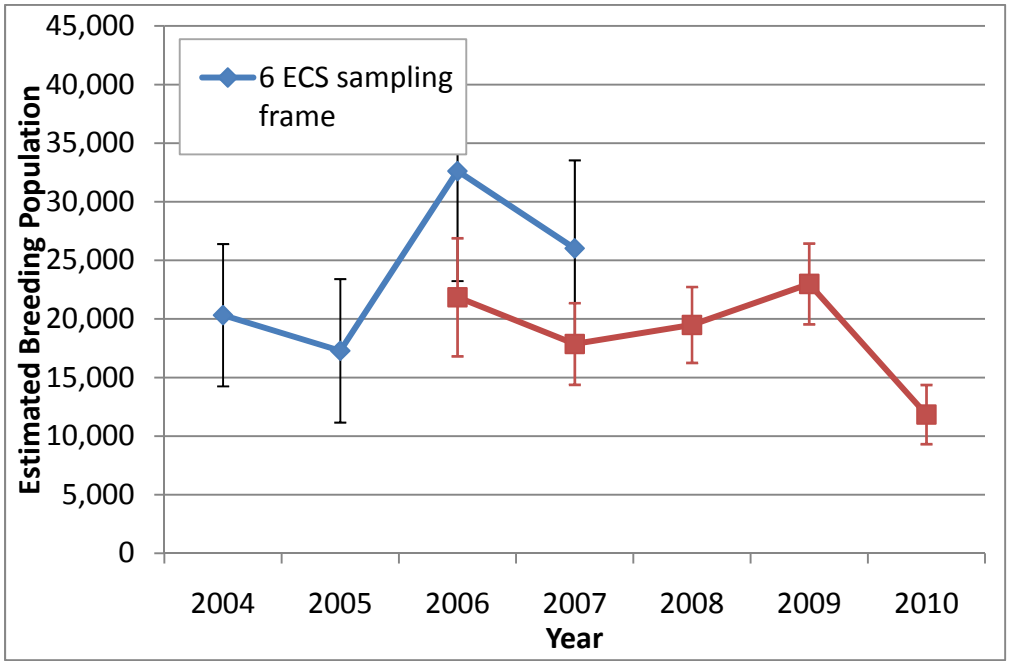


Figure 3. For the habitat class 1 and 2 strata (A) estimated indicated breeding pairs with SE bars and (B) estimated ring-necked duck resident breeding population with SE bars in the Minnesota ring-necked duck breeding pair survey area, June 2004 – 2010. Estimates were based on a stratified random sample of Public Land Survey (PLS) sections in habitat classes 1 and 2 for 6 Ecological Classification System (ECS) sections in 2004 – 2007 and for 3 ECS sections in 2008 – 2010. Estimates from 2006 and 2007 were recalculated using the same sampling frame as 2008 – 2010 (3 ECS instead of 6 ECS) for comparison; population estimates were not adjusted for 2004 and 2005, because the habitat classifications have also changed since those surveys were conducted.

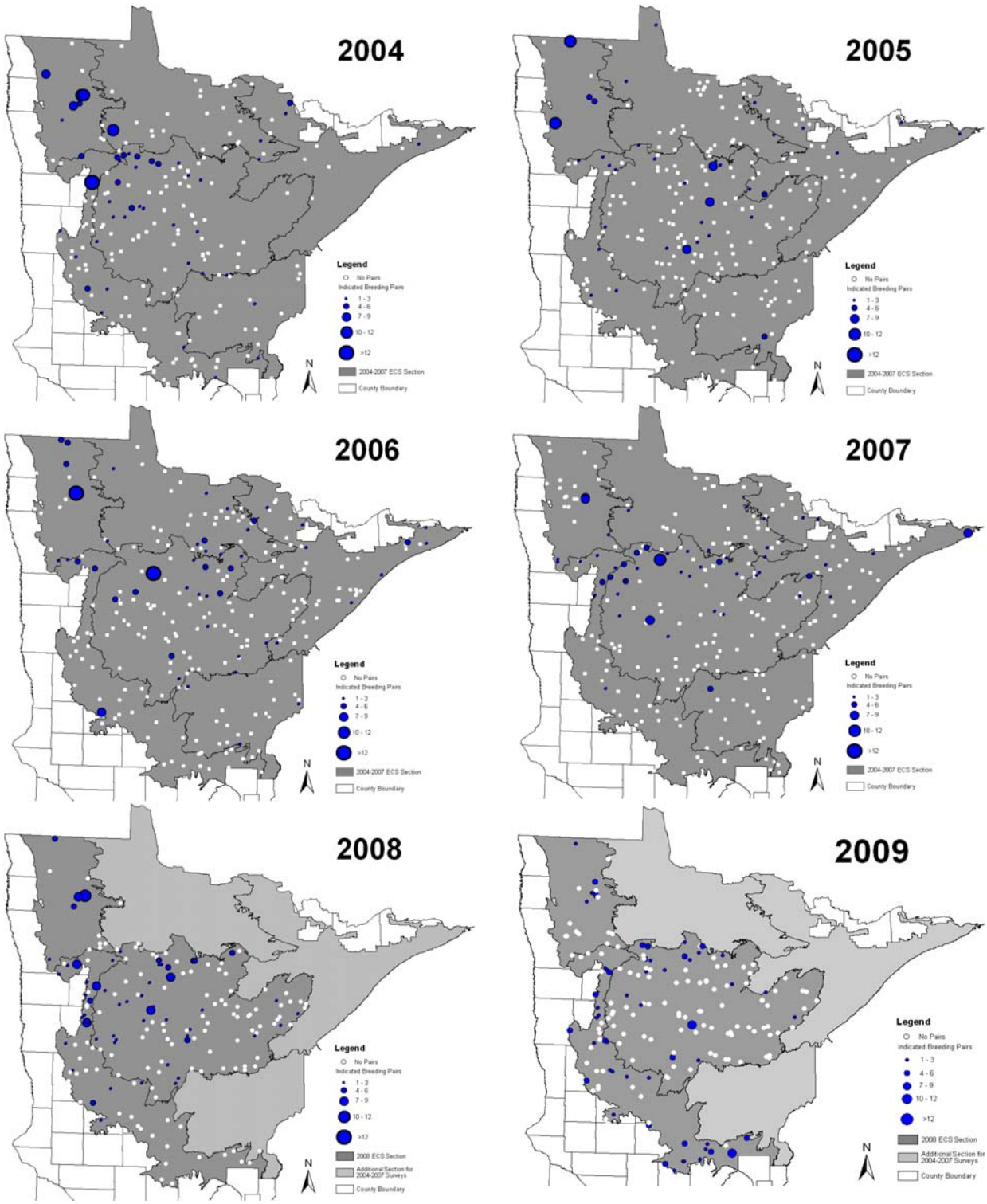


Figure 4. Plot locations and numbers of indicated breeding pairs (IBP) observed on survey plots in the Minnesota ring-necked duck breeding pair survey area in June 2009 (bottom right). White circles indicate plots where no indicated pairs were seen. Maximum number of indicated breeding pairs per plot was 11 pairs in 2010 (13 in 2004; 11 in 2005; 16 in 2006; 11 in 2007; 10 in 2008; 8 in 2009). The Ecological Classification System (ECS) sections are also shown.

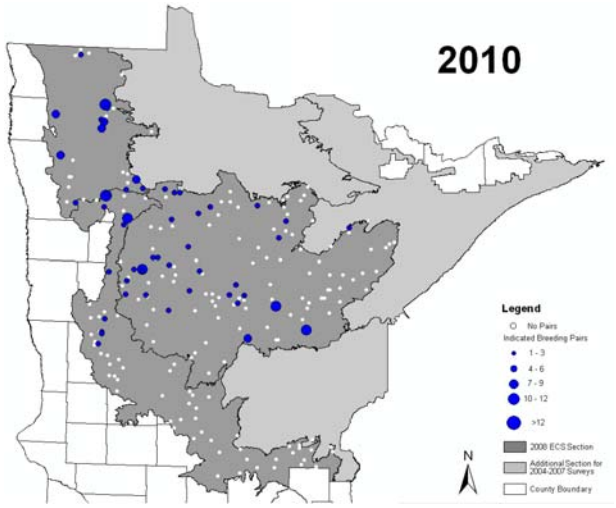


Figure 4. Continued.

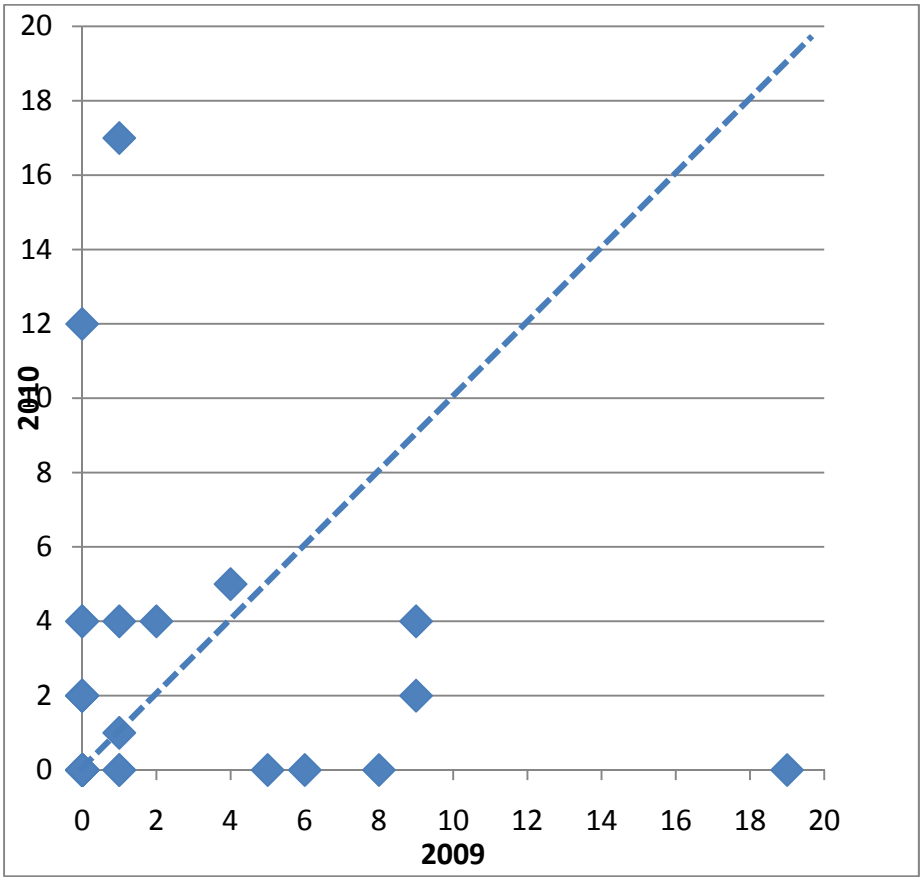


Figure 5. Scatterplot showing total counts of ring-necked ducks on plots sampled in both 2009 and 2010. Data did not show parity, as points did not fall along 1:1 dashed reference line.

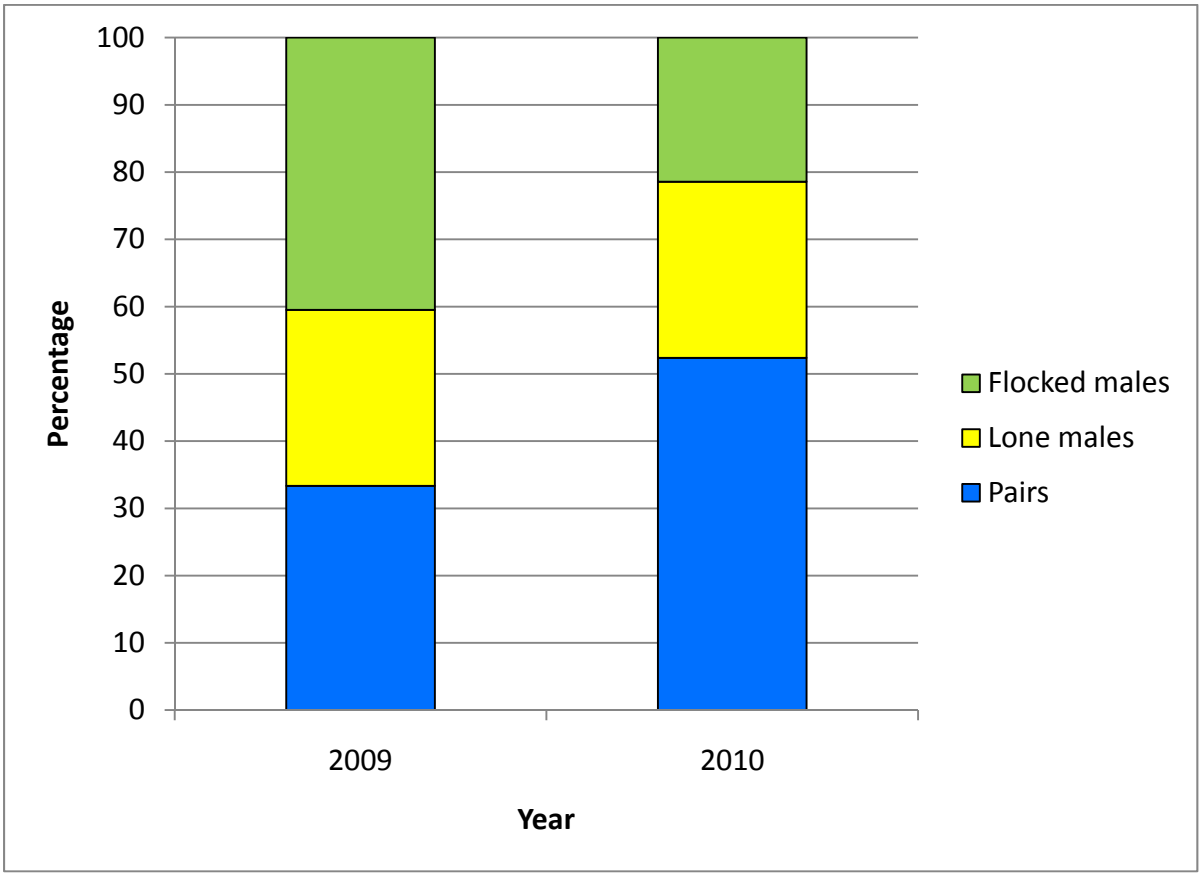


Figure 6. Social status of the indicated breeding pairs observed in 49 plots surveyed in 2009 and resampled in 2010.