WETLAND WILDLIFE POPULATIONS

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

2011 WATERFOWL BREEDING POPULATION SURVEY MINNESOTA

Steve Cordts, Minnesota DNR, Waterfowl Staff Specialist, 21 June 2011

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 2011 aerial survey portion was flown from 3-16 May. Spring ice-out dates were near normal this year but 2-3 weeks later than 2010. Spring temperatures were below normal in April and May and precipitation was above normal. Overall, spring wetland habitat conditions were excellent across the survey area. Wetland numbers (Types II-V) increased 33% compared to 2010 and were well above both the 10-year (+37%) and long-term (+44%) averages and were the highest count on record. The estimated numbers of temporary (Type 1) wetlands was 36% above the long-term average. The estimated mallard breeding population was 283,000, which was 17% higher than 2010 but statistically unchanged from last year's estimate of 242,000 mallards (P = 0.49). Mallard numbers were similar (+3%) to the 10-year average and 26% above the long-term average of 225,000 breeding mallards. The estimated blue-winged teal breeding population was 214,000, which was 61% higher than 2010 but statistically unchanged from last year's estimate of 132,000 blue-winged teal (P=0.38). Blue-winged teal numbers were similar to both their 10-year (+6%) and long-term (-2%) averages. The combined population index of other ducks, excluding scaup, was 191,000, which was 22% higher than last year's estimate of 157,000, 16% below the 10-year average and 7% above the long-term average of 178,000 other ducks. Population estimates of wood duck (57,000), ring-necked duck (54,000), redhead (16,000) and gadwall (12,000) accounted for most (75%) of the total population of other ducks. The estimate of total duck abundance (687,000), which excludes scaup, was 30% higher than last year's estimate (531,000) and was 3% below the 10-year average and 11% above the long-term average of 622,000 ducks. The estimated number of Canada geese (corrected for visibility) was 156,000 and 6% higher than 2010. Based on the social status of mallards observed (number of pairs, lone males, and flocked birds), the survey timing was good and consistent with recent years. Survey timing for other ducks (e.g. blue-winged teal, ring-necked ducks) suggests that some migrants were still present in the state due to the late spring weather conditions.

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.

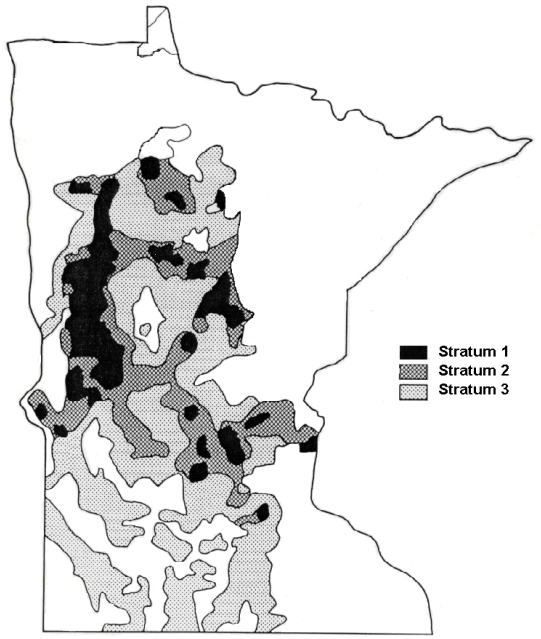

Figure. 1. Location of waterfowl breeding population survey strata in Minnesota.

Areas with less than two basins per township are not surveyed. Strata boundaries were based upon "An Inventory of Minnesota Lakes" (Minnesota Conserv. Dept. 1968:12). Standard procedures for the survey follow those outlined in "Standard Operating Procedures for Aerial Waterfowl Breeding Ground Populations and Habitat Surveys in North America" (USFWS/CWS 1987). Changes in survey methodology were described in the 1989 Minnesota Waterfowl Breeding Population Survey report. Pond and waterfowl data for 1968-74 were calculated from Jessen (1969-72) and Maxson and Pace (1989).

All aerial transects in Strata I-III (Table 1) were flown using 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.

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

The SAS computer program was modified in 1992 to obtain standard errors for mallard and blue-winged teal breeding population estimates. These calculations were based upon SAS computer code written by Graham Smith, USFWS-Office of Migratory Bird Management. Estimates for 2010 and 2011 were compared using two-tailed Z-tests.

SURVEY CHRONOLOGY: The 2011 aerial survey began on 3 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 3-4, 6-7, 10-12, and 15-16; flights began no earlier than 7 AM and were completed by 12:00 PM each day.

WEATHER AND HABITAT CONDITIONS: Ice out on most lakes across the state was near average but 2-3 weeks later than last year. Temperatures in April averaged 0.9°F below normal statewide. April precipitation was 0.8 inches above normal statewide and ranged from 0.5 inches below normal in west central Minnesota to 1.9 inches above normal in north central Minnesota. May temperatures averaged 2.2°F below normal statewide. May precipitation was 1.1 inches above normal statewide and ranged from 0.5 inches below normal in north central and northeast Minnesota to 2.4 inches above normal in central Minnesota (http://climate.umn.edu). Additional temperature and precipitation data are provided in Appendix A.

In early May 2011, statewide topsoil moisture indices were rated as 56 % adequate and 44% surplus moisture. By late May, statewide indices were rated as 1% short, 65% adequate and 35% surplus moisture. For comparison, in early May 2010 statewide topsoil moisture indices were rated as 24% short or very short, 70% adequate, and 6% surplus moisture.

Planting dates for row crops were extremely late in 2011. By 1 May, only 1% of the corn acres had been planted statewide compared to 84% in 2010 and 46% for the previous 5-year average. By 29 May, only 2% of alfalfa hay had been cut compared to 44% in 2010 and a 5-year average of 21% (Minnesota Agricultural Statistics Service Weekly Crop Weather Reports, (http://www.nass.usda.gov/mn/).

Wetland numbers (Type II-V) increased 33% from 2010 and were 37% above the 10-year average, 44% above the long-term average (Table 2; Figure. 2), and the highest number recorded since the survey was initiated. The number of temporary (Type 1) wetlands was 36% above the long-term average.

Leaf-out dates were 2-3 weeks later than last year, which greatly increased visibility from the air. The emergence of wetland vegetation was also much later than last year, which also improved 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 2011 breeding population estimate of mallards was 283,329 (SE = 49,845), which was unchanged from 2010 (Z = 0.69, P = 0.49) (Table 7, Figure 3). Mallard numbers were 3% above the 10-year average and 26% above the long-term average of 225,000. In 2010, 3% of the total mallards were in flocks compared to 5% in 2010. Pairs comprised 15% of the mallards observed, compared to 12% in 2010. This suggests that the survey timing for mallards was similar to recent years based on the social status observed.

The estimated blue-winged teal population was 213,584 (SE = 88,720), which was unchanged from 2010 (Z = 0.88, P = 0.38). Blue-winged teal numbers were 6% above the 10-year average and 2% below the long-term average (Table 7, Figure 4). Pairs comprised 44% of the blue-winged teal observed. Lone males comprised 9% of the blue-winged teal and flocks comprised 47% of the blue-winged teal observed. In 2010, 21% of the blue-winged teal observed were in flocks. The social structure of blue-winged teal (e.g. more birds observed in flocks) this year was influenced by a few large flocks of blue-winged teal counted during the first 2 days of the survey.

Other duck numbers (excluding scaup) were 191,000, which was 22% higher than last year's estimate of 157,000 and 16% below the 10-year average and 7% above the long-term average (Table 7, Figure 5). Population estimates of wood duck (57,000), ring-necked duck (54,000), redhead (16,000) and gadwall (12,000) accounted for most (75%) of the total population of other ducks. Scaup numbers were higher than last year but 40% below the 10-year average, indicating most scaup had already migrated through the state before the survey began.

The total duck population index, excluding scaup, was 687,000, which was 30% higher than last year's index of 531,000 ducks but similar (-3%) to the 10-year average and 11% above the long-term average (Table 7, Figure 6).

Visibility Correction Factors (VCFs) for mallards, blue-winged teal, and other ducks were similar to 2010 (Table 7). The mallard VCF (2.77) was 4% above the 10-year average. The blue-winged teal VCF (3.46) was 17% below the 10-year average. The VCF for other ducks (2.39) was 34% lower than the 10-year average.

Canada goose numbers (uncorrected for visibility) decreased 8% compared to 2010 but remained 36% above the long-term average (Table 7). The VCF for Canada geese was 2.57 and similar to the long-term average of 2.37. The population estimate of Canada geese (adjusted for visibility) was 156,000, which was 4% below the long-term average of 162,000 geese (Table 7, Figure 7). A total of 10 Canada goose broods were observed, which was the fewest number observed in the past 5 years.

The estimated coot population, uncorrected for visibility, was 4,000 in 2011 compared to 700 in 2010.

The number of swans (likely all trumpeters) counted was a record high this year as breeding swan populations continue to increase and expand across the survey area.

SUMMARY: Overall wetland conditions were excellent. Mallard abundance in 2011 (283,000) was similar to 2010 (242,000). Mallard numbers were 26% above the long-term average (225,000) and similar to the 10-year average. Blue-winged teal abundance (214,000) was 61% higher than 2010 (132,000) but near the 10-year average and the long-term average (219,000). The combined population index of other ducks (191,000) was 22% higher than 2010 and 7% above the long-term average. Total duck abundance (687,000), excluding scaup, was 30% higher than 2010 (531,000) and was 3% below the 10-year average and 11% above the long-term average. Canada goose numbers, adjusted for visibility bias, increased 6% from 2010.

ACKNOWLEDGMENTS: Thanks to the ground crews and the pilot for all of their efforts.
Air Crew: Pilot/Observer: Tom Pfingsten, Conservation Officer Pilot, MNDNR, Division of Enforcement; Observer: Steve Cordts, Waterfowl Staff Specialist, MNDNR, Division of Wildlife;
Ground Crew Leaders: Sean Kelly, Asst. Chief, Migratory Bird & Refuges, USFWS, Region III, Twin Cities; Wayne Brininger, USFWS, Tamarac National Wildlife Refuge, Dan Hertel, USFWS, HAPET, Fergus Falls, Tom Cooper, Jim Kelley, Bob Russell, and Paul Richert; USFWS, Region III, Twin Cities; Kim Bousquet, USFWS, Big Stone National Wildlife Refuge; Lizzy Berkley and Paul Soler, USFWS, Sherburne National Wildlife Refuge
Ground Crew Assistants: Jihadda Govan, USFWS, Big Stone National Wildlife Refuge; Lowell Deede and Gina Kemper, USFWS, Tamarac National Wildlife Refuge; Ron Beam and Greg Dehmer, USFWS, Sherburne National Wildlife Refuge, Ryan Drum and Seth Fisher, USFWS, HAPET, Fergus Falls

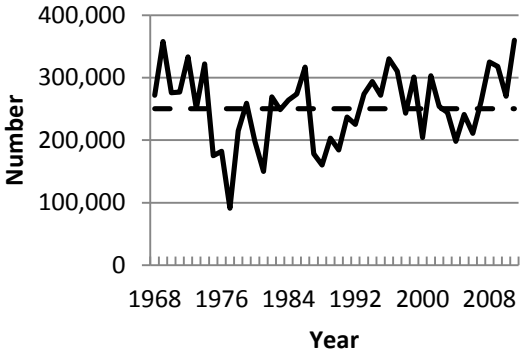

Figure 2. Number of May ponds (Types II-V) and long-term average (dashed line) in Minnesota, 1968-2011.

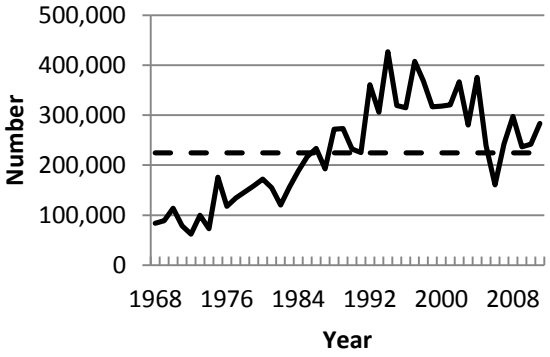

Figure 3. Mallard population estimates (adjusted for visibility bias) and long-term average (dashed line) in Minnesota, 1968-2011.

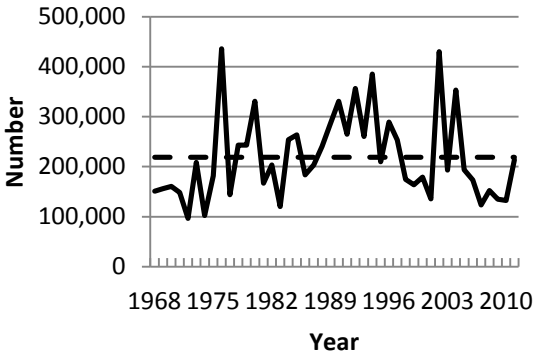

Figure 4. Blue-winged teal population estimates (adjusted for visibility bias) and long-term average (dashed line) in Minnesota, 1968-2011.

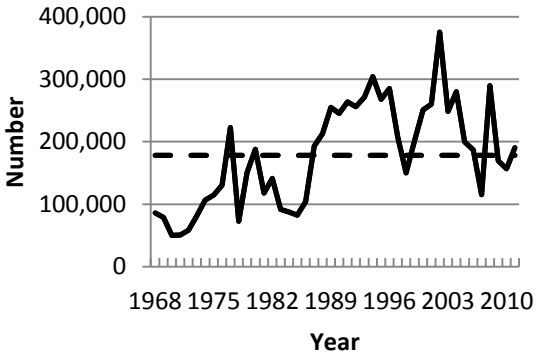

Figure. 5. Other duck (excluding scaup) population estimates (adjusted for visibility bias) and long-term average (dashed line) in Minnesota, 1968-2011

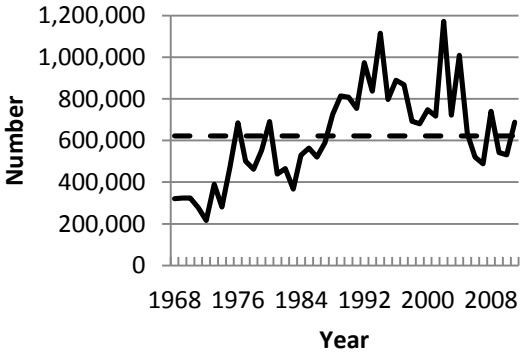

Figure. 6. Total duck (excluding scaup) population estimates (adjusted for visibility bias) and long-term average (dashed line) in Minnesota, 1968-2011

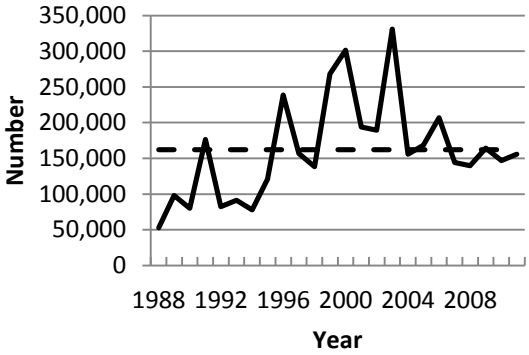

Figure. 7. Canada goose population (adjusted for visibility bias) and long-term average (dashed line) in Minnesota, 1988-2011.

LITERATURE CITED:

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

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

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

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

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

MINNESOTA CONSERVATION DEPARTMENT. 1968. An inventory of Minnesota Lakes. Waters Section, Division of Waters, Soils, and Minerals, Bull. No. 25. 498pp.

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

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

Table 1. Survey design for Minnesota, May 2011.[1]

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

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

Table 2. Estimated May ponds (Type 1 and Types II-V), 1968-2011.

	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
	2011	89,218	360,000
Averages:	10-year	39,621	263,000
	Long-term	65,518	251,000
% change from:	2010	232%	33%
	10-year	125%	37%
	Long-term	36%	44%

[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, 1993-2011.

	Year																		
Species	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Dabblers:																			
Mallard	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	19,856
Black Duck	0	56	0	0	0	0	0	0	0	0	0	0	56	0	0	0	0	0	0
Gadwall	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	167
American Wigeon	0	0	194	0	0	56	56	56	111	0	56	555	167	0	56	111	56	56	111
Green-winged Teal	111	278	0	278	56	333	0	278	56	278	222	444	56	56	167	278	167	56	56
Blue-winged Teal	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	4,665
Northern Shoveler	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	111
Northern Pintail	611	167	167	167	111	111	167	167	389	56	111	56	0	56	0	56	56	0	111
Wood Duck	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	3,416
Dabbler Subtotal	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	28,493
Divers:																			
Redhead	1,416	1,972	639	722	778	944	500	583	1,444	750	333	805	666	666	916	1,389	472	944	805
Canvasback	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	833
Scaup	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	2,222
Ring-necked Duck	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	4,804
Goldeneye	111	222	111	167	0	111	56	56	333	111	0	222	222	56	222	278	278	222	56
Bufflehead	0	444	56	278	0	56	111	56	111	222	111	389	167	222	56	1,611	833	389	278
Ruddy Duck	1,250	639	167	139	528	11,052	972	0	83	1,305	417	305	1,222	305	0	1,027	861	28	56
Hooded Merganser	222	111	278	611	555	389	722	500	722	555	333	278	333	555	111	666	944	555	500
Large Merganser	0	56	0	0	56	0	0	0	111	0	972	0	111	0	278	333	333	333	111
Diver Subtotal	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	9,665
Total Ducks	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	38,158
Other:																			
Coot	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	2,194
Canada Goose	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	13,691

Table 4. Minnesota waterfowl breeding populations by species for Stratum II (medium wetland density), expanded for area but not visibility, 1993-2011.

	Year																		
Species	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Dabblers:																			
Mallard	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	30,974
Black Duck	0	0	0	0	0	0	0	0	117	0	0	0	0	0	0	0	0	0	0
Gadwall	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	935
American Wigeon	0	117	0	468	351	818	0	468	0	0	0	2,513	117	0	0	351	0	351	0
Green-winged Teal	351	117	0	935	234	351	117	117	117	468	234	234	0	117	0	0	234	117	0
Blue-winged Teal	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	12,390
Northern Shoveler	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	1,052
Northern Pintail	351	468	234	117	234	468	117	117	117	0	117	0	0	0	234	0	0	0	234
Wood Duck	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	6,955
Dabbler subtotal	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	52,540
Divers:																			
Redhead	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	1,578
Canvasback	584	1,052	0	234	701	117	117	935	0	468	1,052	234	0	0	1,169	468	234	117	584
Scaup	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	1,929
Ring-necked Duck	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	11,455
Goldeneye	584	701	701	1,753	818	234	935	584	468	234	234	351	117	117	0	351	584	468	468
Bufflehead	117	234	0	117	117	0	0	0	0	1,169	117	468	351	117	117	1,403	818	643	1,403
Ruddy Duck	3,390	409	117	58	117	0	468	0	0	1,870	2,688	0	351	58	0	0	175	409	58
Hooded Merganser	584	468	117	234	468	117	701	935	1,403	701	701	234	234	351	234	584	701	117	2,221
Large Merganser	0	0	0	0	0	0	0	117	117	0	0	234	351	0	0	351	0	0	234
Diver subtotal	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	19,930
Total Ducks	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	72,470
Other:																			
Coot	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	292
Canada Goose	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	14,201

Table 5. Minnesota waterfowl breeding populations by species for Stratum III (low wetland density), expanded for area but not visibility, 1993-2011.

	Year																		
Species	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Dabblers:																			
Mallard	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	51,415
Black Duck	0	0	0	0	0	0	0	0	0	0	0	174	0	0	174	174	0	0	0
Gadwall	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	4,089
American Wigeon	348	1,218	0	1,044	348	696	0	522	174	1,218	174	1,566	1,044	174	348	348	174	348	1,044
Green-winged Teal	348	174	0	957	348	174	0	1,218	1,392	522	174	0	174	522	0	0	0	0	174
Blue-winged Teal	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	44,716
Northern Shoveler	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	2,088
Northern Pintail	1,218	696	174	870	522	870	870	696	522	0	174	348	174	174	348	174	0	174	0
Wood Duck	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	13,659
Dabbler subtotal	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	117,185
Divers:																			
Redhead	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	4,350
Canvasback	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	1,044
Scaup	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	5,133
Ring-necked Duck	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	6,264
Goldeneye	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	870
Bufflehead	348	696	0	1,044	174	348	0	0	0	1,218	783	2,088	0	174	696	1,218	870	174	2,871
Ruddy Duck	1,218	2,175	2,349	1,740	348	0	174	0	696	18,878	87	2,262	870	696	261	87	348	0	3,828
Hooded Merganser	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	1,044
Large Merganser	0	174	174	0	0	0	0	0	0	522	0	0	261	957	348	348	348	348	174
Diver subtotal	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	25,578
Total Ducks	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	142,763
Other:																			
Coot	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	1,479
Canada Goose	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	32,711

Table 6. Minnesota waterfowl breeding populations by species for Stratum I-III combined, expanded for area coverage but not for visibility, 1993-2011.

	Year																		
Species	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Dabblers:																			
Mallard	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	102,245
Black Duck	0	56	0	0	0	0	0	0	117	0	0	174	56	0	174	174	0	0	0
Gadwall	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	5,191
American Wigeon	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	1,155
Green-winged Teal	810	569	0	2,170	638	858	117	1,613	1,564	1,267	630	678	230	694	167	278	400	172	230
Blue-winged Teal	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	61,772
Northern Shoveler	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	3,251
Northern Pintail	2,180	1,331	575	1,154	867	1,449	1,153	979	1,028	56	402	404	174	230	582	230	56	174	345
Wood Duck	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	24,029
Dabbler subtotal	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	198,218
Divers:																			
Redhead	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	6,733
Canvasback	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	2,461
Scaup	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	9,283
Ring-necked Duck	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	22,523
Goldeneye	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	1,393
Bufflehead	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	4,551
Ruddy Duck	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	3,942
Hooded Merganser	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	3,765
Large Merganser	0	230	174	0	56	0	0	117	228	522	972	234	723	957	626	1,032	681	681	519
Diver subtotal	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	55,170
Total Ducks	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	253,388
Other:																			
Coot	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	3,965
Canada Goose	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	60,603

Table 7. Estimated waterfowl populations in Minnesota from May breeding waterfowl survey, 1968-2011.

	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
2011	102,245	2.77	283,329	49,845	61,772	3.46	213,584	88,720	79,743	2.39	190,586
Averages: 10-year (01-10)	106,061	2.67	276,060	35,906	49,753	4.03	202,342	40,117	66,330	3.60	228,011
Long-term (1968-10)	102,451	2.20	224,816	35,891	58,919	3.90	218,906	41,341	60,511	3.16	178,065
% change from: 2010	26%	-7%	17%	47%	89%	-14%	61%	223%	45%	-16%	22%
10-year average	-4%	4%	3%	39%	24%	-14%	6%	121%	20%	-34%	-16%
Long-term average	0%	26%	26%	39%	5%	-11%	-2%	115%	32%	-24%	7%

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

Table 7. Cont.

	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
2011	9,283	2.39	22,186	244,105	687,499	253,043	709,685	60,603	2.57	155,750
Averages: 10-year (00-10)	11,177	3.60	37,069	221,944	707,119	233,123	744,188	81,488	2.28	184,078
Long-term (1968-10)	22,076	3.17	65,022	221,835	621,951	243,861	686,973	44,472	2.36	161,926
% change from: 2010	181%	-16%	137%	45%	30%	47%	31%	-8%	16%	6%
10-year average	-17%	-34%	-40%	10%	-3%	9%	-5%	-26%	13%	-15%
Long-term average	-58%	-25%	-66%	10%	11%	4%	3%	36%	9%	-4%

[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 2011 (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
		17-April		24-April		1-May		8-May		15-May							
Region	City	Avg[1]	Depart[2]	Avg[1]	Depart[2]	Avg[1]	Depart[2]	Avg[1]	Depart[2]	Avg[1]	Depart[2]	17-April	24-April	1-May	8-May	15-May	1 April-15 May
NW	Crookston	36.8	-4.2	38.4	-6.4	49.8	1.3	48.2	-3.8	51.8	-3.3	0.55	0.41	0.23	0.22	0.21	0.16
NC	Grand Rapids	38.2	-2.2	37.8	-6.0	44.8	-2.2	48.0	-2.2	52.9	-0.1	0.49	0.53	1.43	0.72	0.16	1.09
	Itasca	36.9	-0.2	35.0	-5.7	45.8	1.4	43.4	-4.5	50.6	-0.5	2.12	0.55	0.53	0.08	0.83	2.66
WC	Alexandria	40.0	-1.9	39.4	-6.0	46.5	-2.4	50.4	-1.7	55.0	-0.1	0.07	0.52	0.40	0.73	0.63	-0.07
	Fergus Falls																
	Montevideo	42.6	-1.1	39.6	-7.5	47.6	-2.9	49.3	-4.5	56.0	-0.8	0.16	0.59	0.56	0.85	0.85	0.12
	Morris	40.5	-2.9	38.1	-8.9	46.6	-3.8	47.5	-6.1	53.2	-3.4	0.10	0.71	0.39	0.51	1.72	0.92
C	Becker	45.0	1.1	39.4	-7.8	45.4	-4.9	47.4	-5.8	56.8	1.0	0.04	0.55	1.54	1.01	1.07	2.98
	Hutchinson	44.6	0.5	39.4	-8.1	46.7	-4.1	48.4	-5.6	57.0	0.0	0.23	0.62	1.68	0.64	1.30	3.28
	St. Cloud	43.2	0.2	40.2	-6.2	44.7	-4.9	50.0	-2.6	56.7	1.3	0.02	0.45	1.04	0.92	0.58	2.03
	Staples	Missing															
	Willmar	42.0	-0.5	38.4	-7.5	45.4	-3.9	46.2	-6.5	55.6	-0.2	0.16	0.74	1.02	0.77	1.08	1.68
EC	Aitkin	40.0	-0.4	36.6	-7.0	43.9	-2.8	44.0	-5.7	49.2	-3.2	0.44	0.67	1.49	0.97	0.54	3.11
	Cambridge																
	Msp Airport	45.8	-0.2	42.4	-6.8	46.4	-5.9	52.4	-2.8	59.2	1.2	0.13	0.49	1.99	0.33	0.59	1.85
SW	Pipestone	41.0	-3.0	36.7	-10.5	44.4	-6.0	50.0	-3.5	55.4	-0.9	0.73	0.57	0.57	0.50	1.70	2.70
	Redwood Falls	43.5	-2.7	41.9	-7.7	46.4	-6.4	52.5	-3.5	57.8	-1.1	0.30	0.66	0.93	0.78	1.54	3.30
	Worthington	43.9	1.1	36.0	-10.1	46.0	-3.4	49.9	-2.8	56.0	0.3	0.77	0.80	0.69	0.04	1.44	1.38
SC	Faribault	45.7	2.2	39.0	-7.8	45.1	-4.8	46.3	-6.7	59.1	3.2	0.28	0.55	1.84	0.14	1.48	1.48
	Waseca	45.2	1.0	39.0	-8.6	45.3	-5.5	48.0	-6.0	59.2	2.2	0.67	0.50	1.35	0.02	1.16	1.08
	Winnebago	45.8	0.4	39.2	-9.4	47.0	-4.6	51.6	-3.0	59.2	1.9	1.00	0.89	1.14	0.01	0.98	1.40
Statewide		41.6	-0.7	38.6	-7.1	45.6	-3.3	47.8	-4.2	54.9	0.0	0.46	0.56	1.13	0.35	0.89	

[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, 2011 by Kathy Fleming, Pamela Garrettson, 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, 1971-2011 (from: U.S. Fish and Wildlife Service. 2011. Waterfowl population status, 2011. U.S. Department of the Interior, Washington, D.C. U.S.A.).

Year	Population[a]
1971-72	95.0
1972-73	116.6
1973-74	96.7
1974-75	121.5
1975-76	168.4
1976-77	110.8
1977-78	111.2
1978-79	72.8
1979-80	n.a.
1980-81	78.9
1981-82	96.4
1982-83	92.8
1983-84	112.0
1984-85	105.6
1985-86	126.4
1986-87	145.9
1987-88	137.0
1988-89	132.1
1989-90	163.4
1990-91	167.4
1991-92	158.4
1992-93	136.2
1993-94	136.2
1994-95	139.0
1995-96	141.0
1996-97	130.5
1997-98	99.3
1998-99	139.5
1999-00	130.0
2000-01	122.2
2001-02	152.0
2002-03	122.4
2003-04	145.5
2004-05	161.6
2005-06	134.8
2006-07	153.4
2007-08	161.1
2008-09	169.2
2009-10	172.6
2010-11	133.1

[a] Surveys conducted in Spring.

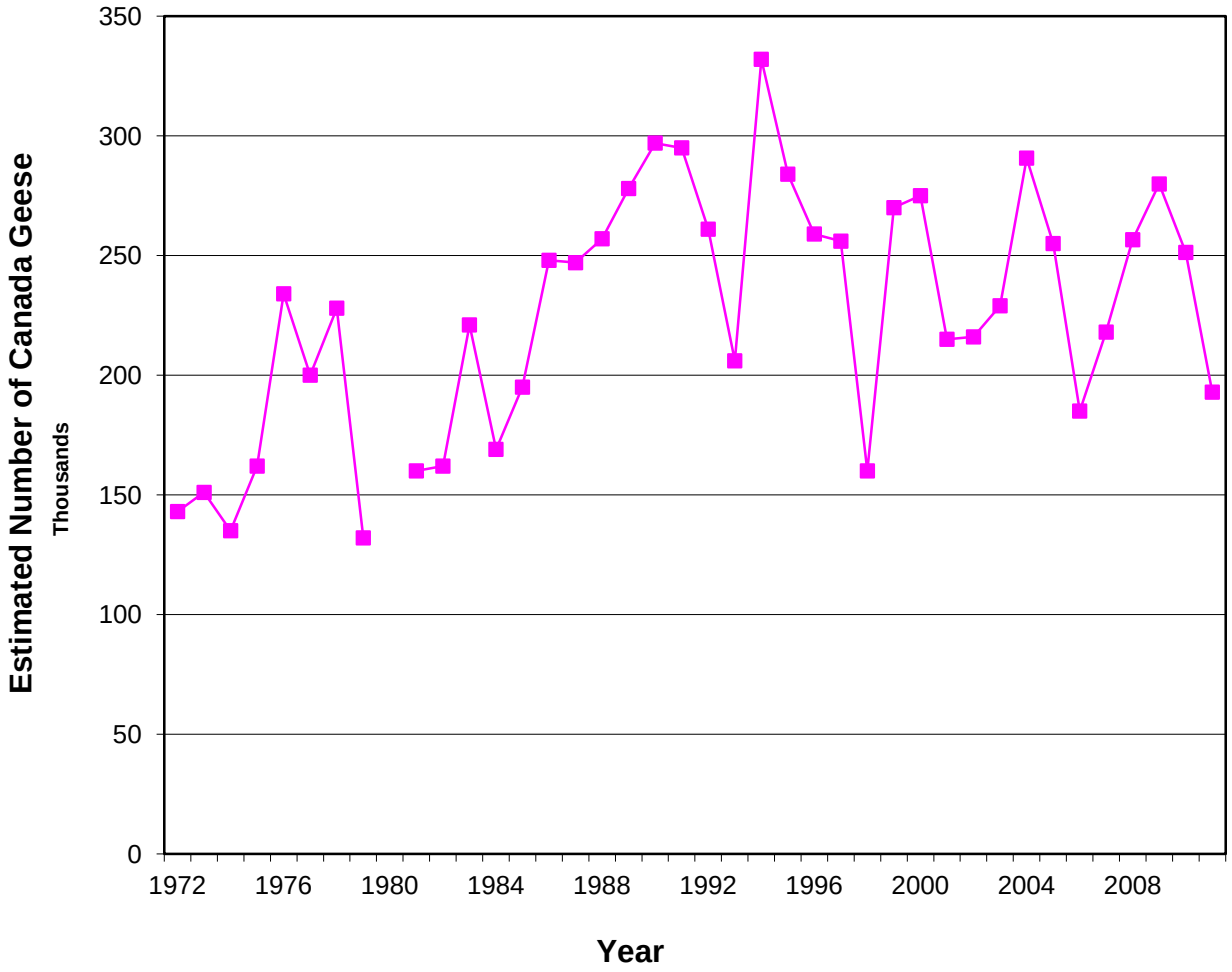

Figure 1. Breeding ground survey estimates of the Eastern Prairie Population of Canada geese, 1972-2011. (from: U.S. Fish and Wildlife Service. 2011. Waterfowl population status, 2011. U.S. Department of the Interior, Washington, D.C. U.S.A.). Surveys conducted in spring. Indirect or preliminary estimates. Data not available for 1980.

Table 2. Estimated number of May ponds (adjusted for visibility) in Prairie Canada (portions of Alberta, Saskatchewan and Manitoba) 1967-2011 and north-central U.S. (North Dakota, South Dakota and Montana) 1974-2011. (from: U.S. Fish and Wildlife Service. 2011. Waterfowl population status, 2011. U.S. Department of the Interior, Washington, D.C. U.S.A.)

	Ponds (thousands)	
Year	Prairie Canada	North Central U.S.[a]
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	3,729	2,936
2011	4,893	3,239
Average	3,439	1,608
% Change in 2011 from:		
2010	+ 31	+ 10
Long term Average	+ 43	+ 102

[a] No comparable survey data available for the north-central U.S. during 1967-73.

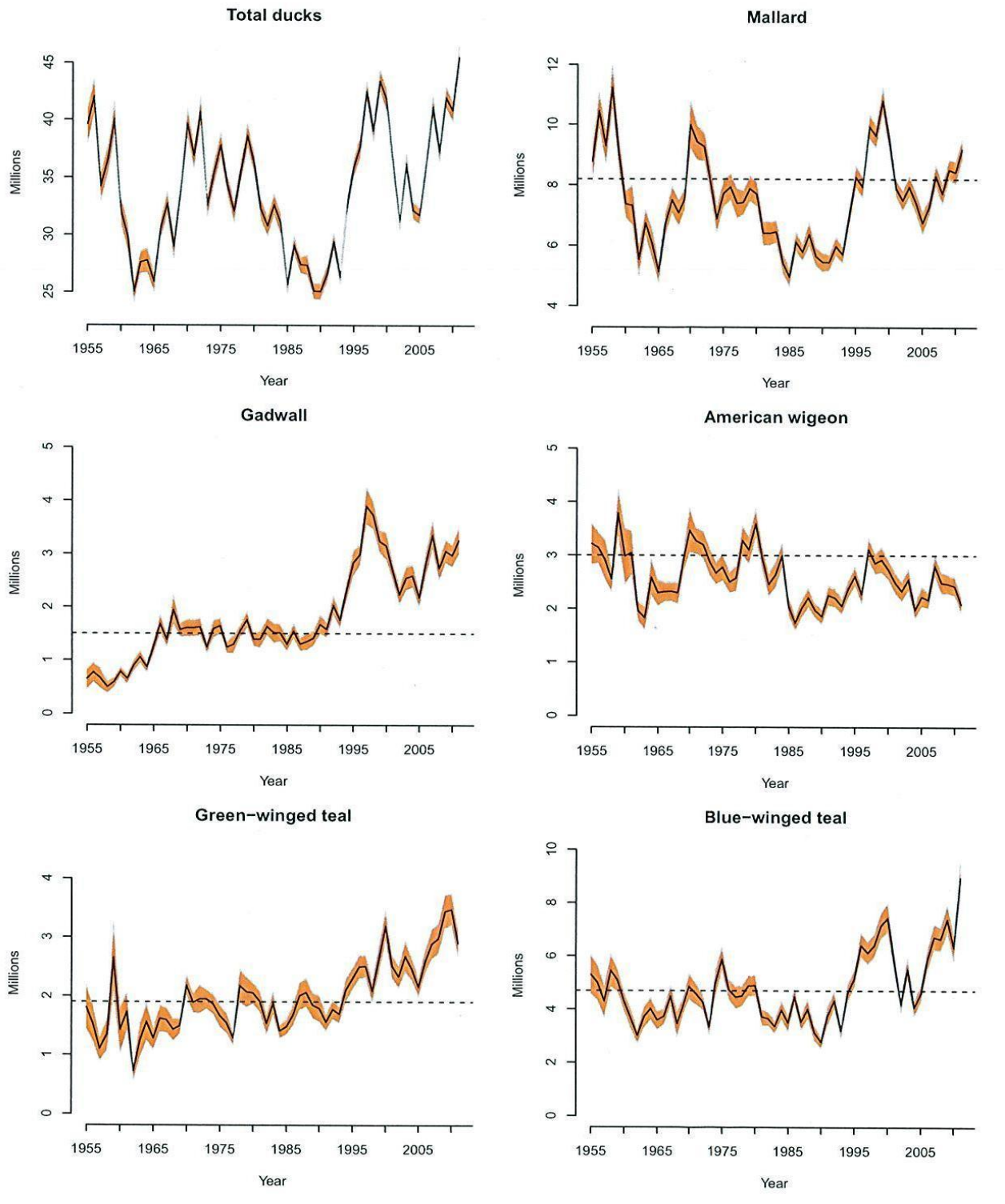

Figure 2. Estimates of North American breeding populations, 95% confidence intervals, and North American Waterfowl Management Plan population goal (dashed line) for selected species and number of water areas in May in Prairie Canada and Northcentral U.S. (from: U.S. Fish and Wildlife Service. 2011. Waterfowl population status, 2011. U.S. Department of the Interior, Washington, D.C. U.S.A.)

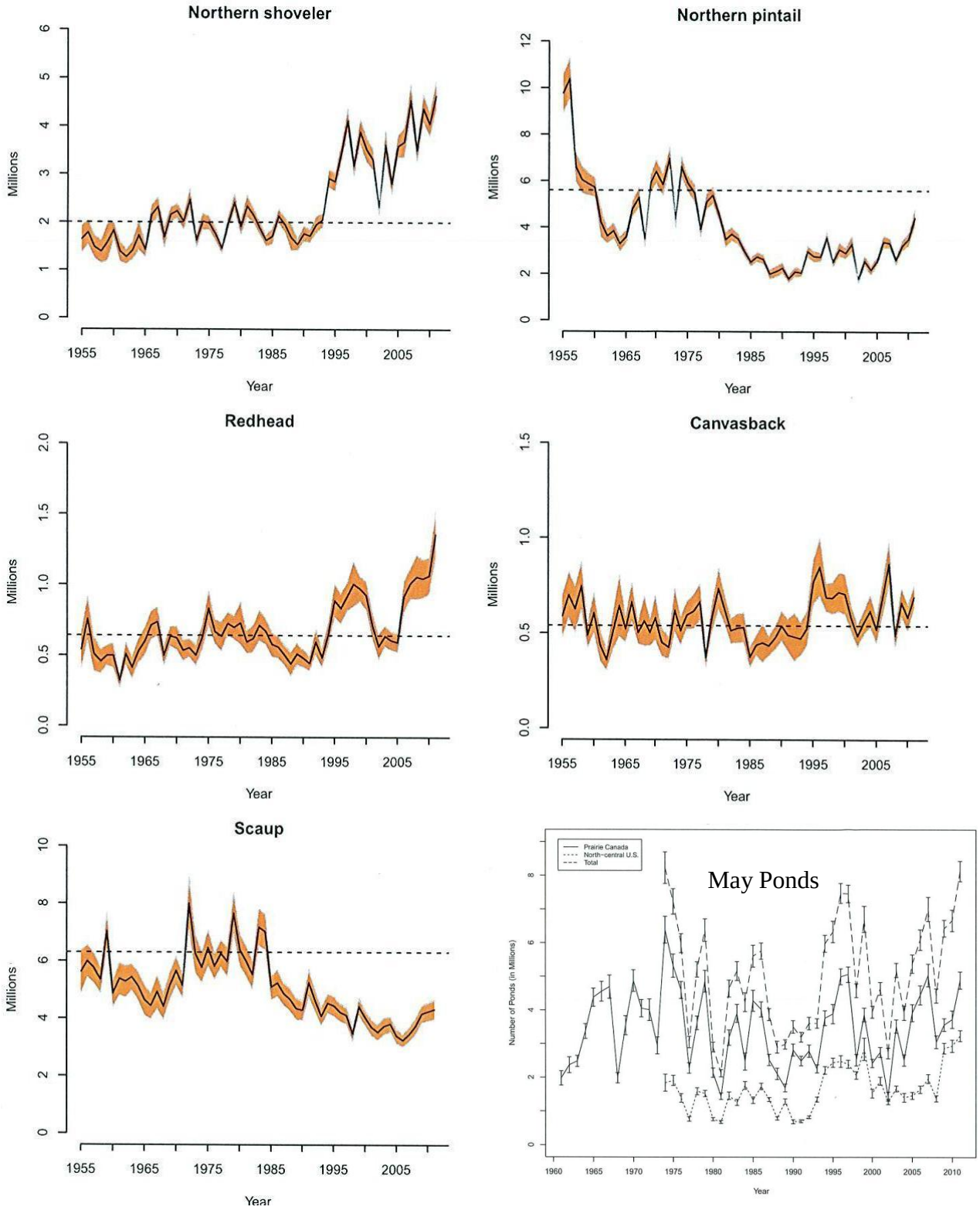

Figure 2. (continued).

2011 MINNESOTA SPRING CANADA GOOSE SURVEY

David Rave, Wetland Wildlife Populations and Research Group

INTRODUCTION

This report presents results from the eleventh 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 $\pm$ 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).

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 $\geq$ 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. Prior to 2011, 30 plots were randomly selected in each of the 5 remaining strata using ArcView's AlaskaPak extension, and these 150 plots were surveyed at low level using a helicopter. The stratification was modified slightly in 2011 to include a binary stratification variable (zone), which permitted a domain analysis of total geese in a proposed new hunting zone (Figure 1). Thus, the 9 strata for 2011 were Forest–12, Transition–12new, Transition–12other, Transition–3new, Transition– 3other, Prairie–12new, Prairie–12other, Prairie–3new, and Prairie–3other. Thirty plots (quartersections) were randomly selected from strata in the new zone (using proportional allocation) and 130 plots were selected from strata not in the new zone for a total of 160 sample plots (Figure 1). Ideally, the survey should be conducted during mid-incubation.

Pilots John Heineman (7 days) and Mike Trenholm (1 day), and I flew the survey on eight days between 20 and 29 April, 2011. 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.

RESULTS AND DISCUSSION

The total Canada goose population estimate in the surveyed area for 2011 was 352,175 (±119,814). Adding 17,500 for the Twin Cities metro area (Cooper 2004) yields a statewide estimate of 369,675 (Table 1). Relative error (95% CI half-width) was 34.0% of the estimate. The survey tallied 50.3% singles, 47.2% pairs, and 2.6% 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 2011, 55.7% of the geese seen were classified as Productive Geese (Table 2).

The 2011 Canada goose breeding population estimate for the surveyed area was similar to the 2010 estimate, although goose numbers appeared to be slightly lower in the Transition region and slightly higher in the Forest and Prairie regions (Table 1). A time-series plot suggested the goose population in the survey area has been reasonably stable over the last 11 years (Figure 2). The estimated breeding population in the proposed new hunting zone was 151,669 (±105,319), or approximately 41% of the state population.

Weather conditions in 2011 were characterized by normal spring temperatures statewide, and cool weather throughout most of the incubation period and during the survey period. The normal spring and the number of productive geese observed this year indicates that 2011 will likely be a very good year for Canada goose production. Weather conditions throughout May and June will influence goose productivity. Regardless, the 2011 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 wetter than average throughout 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 again in 2011.

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 and Michael Trenholm piloted the helicopter and served as the second observer. John Giudice provided statistical assistance.

BIBLIOGRAPHY

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, 2001-2011.

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**
2011	143,266	117,711	91,199	352,175	±119,814	17,500	**369,674**

*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 2008-2011 are based on the updated sampling frame.

Table 2. Percent of Canada Geese seen as singles, pairs, groups, and productive geese on the Minnesota Spring Canada Goose Survey, 2001-2011.

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
2011	50.3	47.2	2.6	55.7	4/21 to 4/29/2011

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

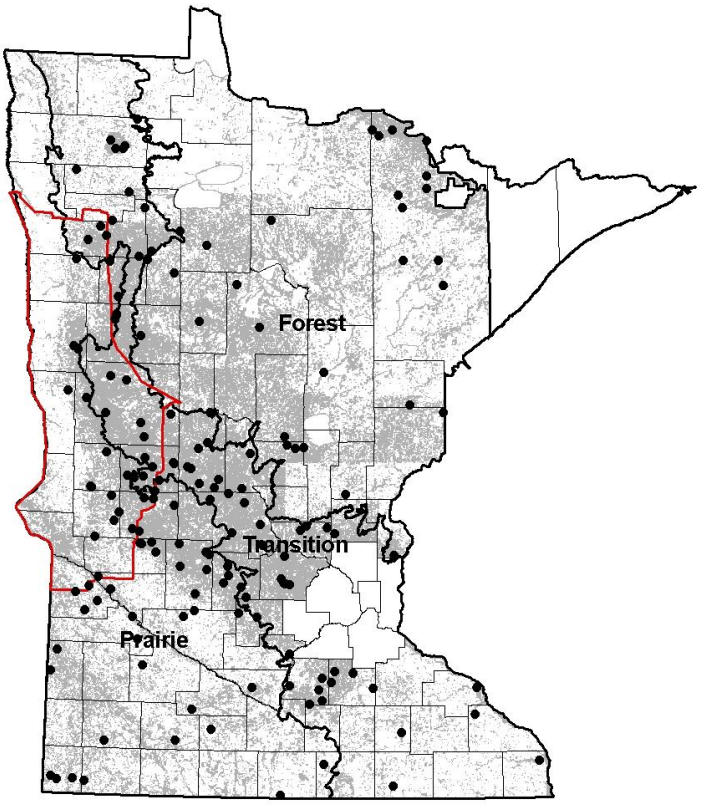

Figure 1. Location of 160 ¼ mi^2 plots surveyed for the 2011 Canada goose breeding pair survey within 3 ecoregions of Minnesota; forest, transition, and prairie. Red outlined polygon is the location of a possible "new" Early Season Canada goose hunting zone.

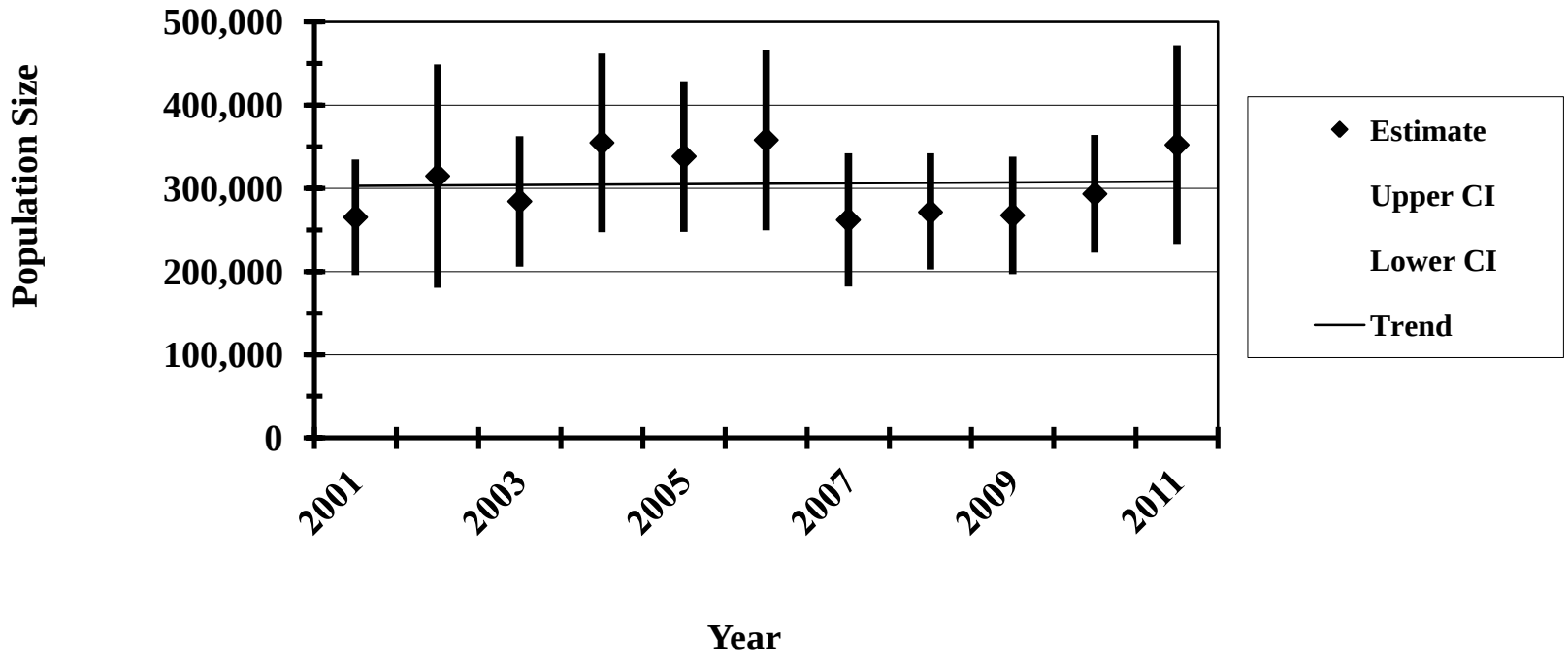

Figure 2. Spring Canada goose population estimates (±95% CI) in Minnesota, 2001-2011. (Does not include Metro area.)

Mourning dove information is taken from the U.S. Fish and Wildlife Service report by Seamans, M.E., K. Parker, and T.A. Sanders. 2011. Mourning dove population status, 2011. 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).

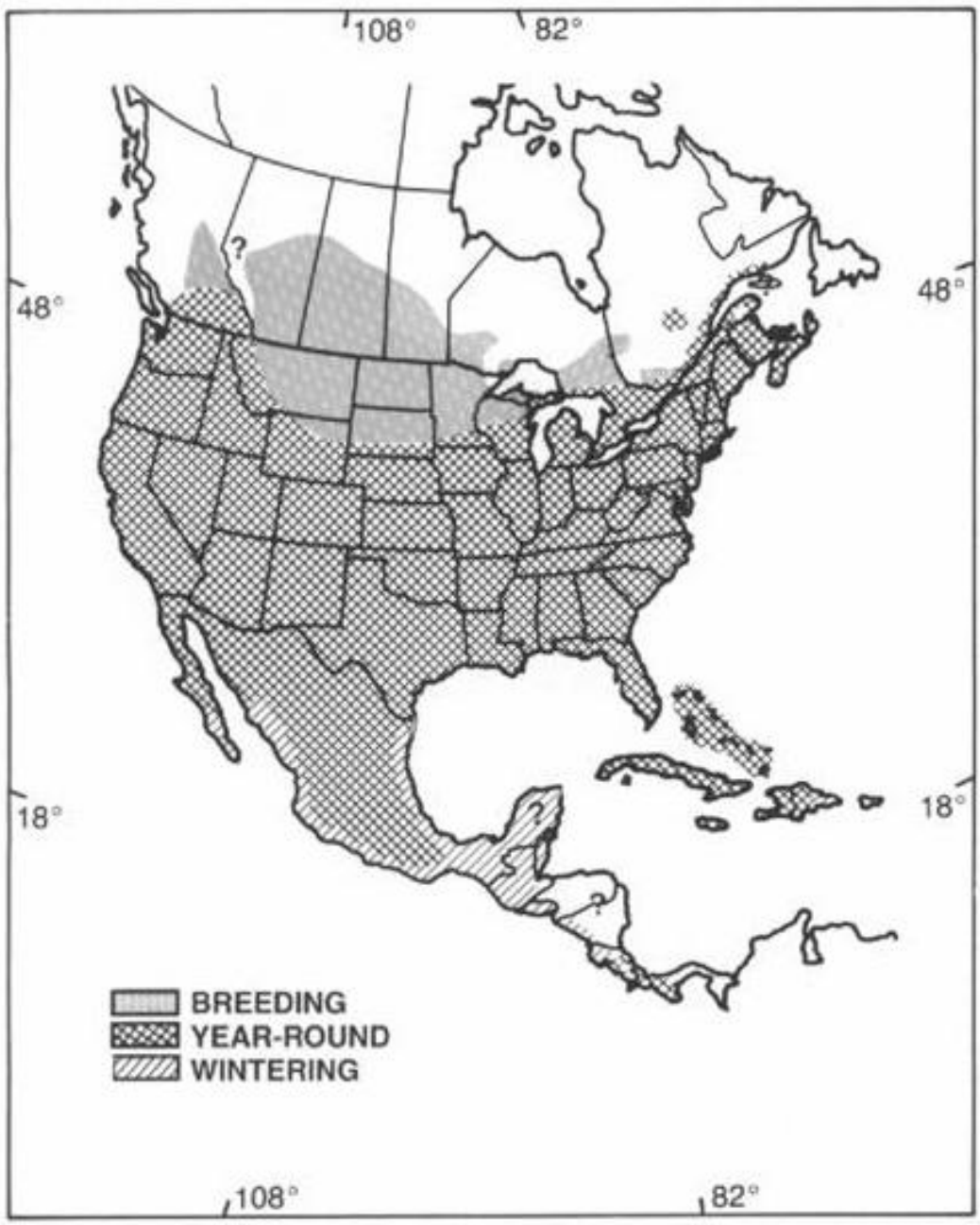

Figure 1. Breeding and wintering ranges of the mourning dove (adapted from Mirarchi and Baskett 1994). (From: Seamans, M.E., K. Parker, and T.A. Sanders. 2011. Mourning dove population status, 2011. U.S. Department of the Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Washington, D.C. 28 pp.)

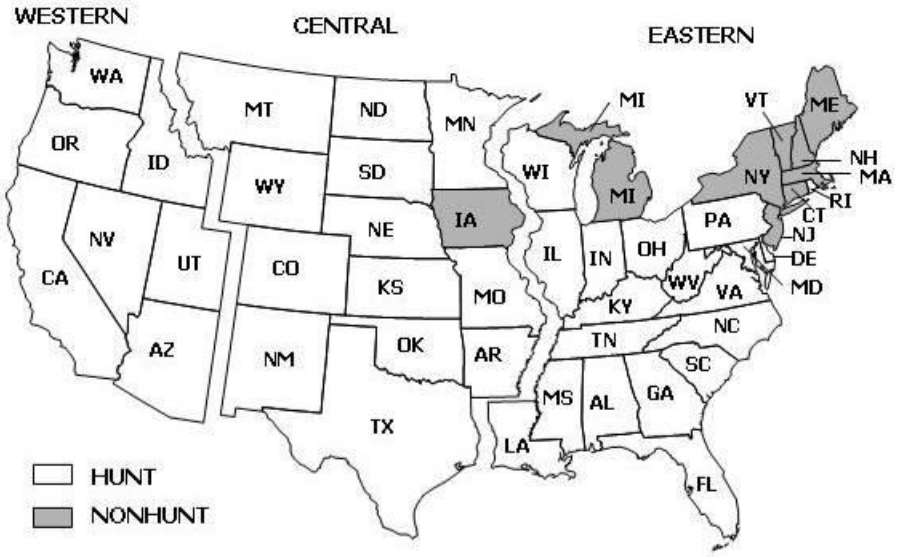

Figure 2. Mourning dove management units with 2010 hunting and non-hunting states. (From: Seamans, M.E., K. Parker, and T.A. Sanders. 2011. Mourning dove population status, 2011. Mourning dove population status, 2011. U.S. Department of the Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Washington, D.C. 28 pp.)

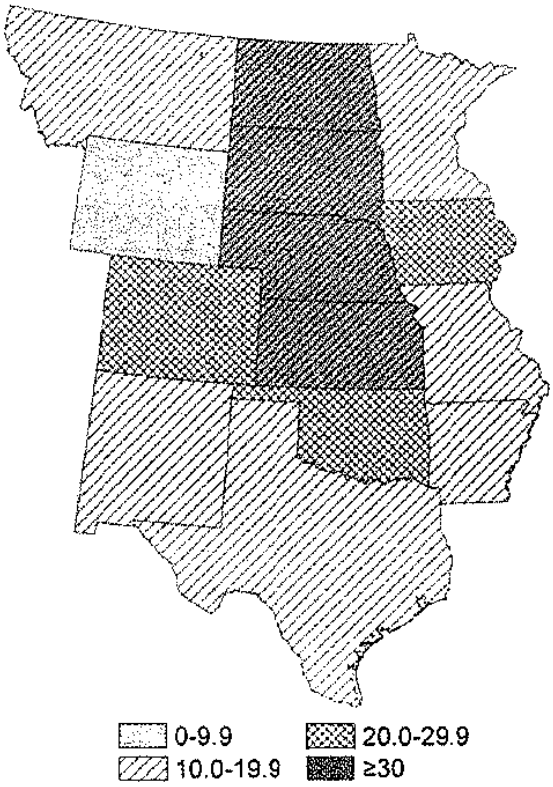

Figure 3. Mourning dove abundance in the Central Management Unit, based on the mean of the 2 CCS-heard index values from the last 2 years (2010-11). (From: Seamans, M.E., K. Parker, and T.A. Sanders. 2011. Mourning dove population status, 2011. Mourning dove population status, 2011. U.S. Department of 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 2008, 2009 and 2010 seasons [a]. (From: Seamans, M.E., K. Parker, and T.A. Sanders. 2011. Mourning dove population status, 2011. 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		
	2008[1]	2009	2010	2008	2009	2010	2008	2009	2010
CENTRAL	443,900	393,400 †[3]	406,100 †[3]	1,496,900 ± 9	1,312,700	1,362,300	7,520,000 ± 10	7,474,600 ± 12	7,194,900 ± 10
AR	23,300 ± 18	22,400 ±19	23,900 ±20	76,600 ± 33	53,800 ± 26	63,300 ± 28	422,000 ± 23	353,500 ± 21	446,400 ± 28
CO	23,200 ± 12	20,300 ± 13	15,900 ± 14	60,400 ± 18	45400 ± 18	38,400 ± 19	288,400 ± 19	242,400 ± 17	172,000 ± 18
KS	26,800 ± 11	29,400 ± 10	28,200 ± 10	78,500 ± 15	97,000 ± 14	93,900 ± 13	443,700 ± 15	572,600 ± 16	511,200 ± 15
MN	11,300 ± 28	6,800 ± 36	10,000 ± 42	34,900 ± 42	24,100 ± 64	55,300 ± 115	83,500 ± 48	61,500 ± 67	98,900 ± 58
MO	34,300 ± 9	21,500 ± 16	29,300 ± 10	93,400 ± 14	58,700 ± 21	75,200 ± 14	467,800 ± 16	294,700 ± 26	426,000 ± 20
MT	2,100 ± 45	2,500 ± 32	1,600 ± 35	3,700 ± 44	6,400 ± 46	4,700 ± 44	18,400 ± 51	12,700 ± 32	17,400 ± 36
NE	13,600 ± 33	16,000 ± 12	15,800 ± 14	48,800 ± 52	51,800 ± 15	49,700 ± 21	238,600 ± 49	277,600 ± 17	276,400 ± 19
NM	6,300 ± 18	7,800 ±16	5,900 ±20	26,200 ± 29	35,700 ± 26	21,000 ± 20	138,100 ± 30	170,200 ± 26	128,000 ± 29
ND	2,700 ± 30	2,800 ± 28	3,800 ± 28	9,200 ± 44	10,800 ± 50	11,800 ± 37	26,400 ± 31	40,000 ± 31	54,200 ± 38
OK	19,300 ± 17	18,600 ± 12	19,500 ± 14	57,800 ± 17	55,500 ± 15	51,300 ± 22	361,200 ± 18	378,400 ± 17	268,700 ± 28
SD	7,300 ± 18	6,500 ± 19	5,000 ± 21	27,500 ±34	21,700 ± 23	14,200 ± 26	152,100 ± 30	105,400 ± 24	64,300 ± 23
TX	271,300 ± 10	236,600 ± 10	244,600 ± 10	974,100 ± 13	846,200 ± 12	876,500 ± 10	4,849,600 ± 14	4,945,100 ± 18	4,699,300 ± 14
WY	2,500 ± 25	2,300 ± 27	2,700 ± 26	5,900 ± 33	5,800 ± 31	7,100 ± 32	30,100 ± 36	20,600 ± 31	32,100 ± 36

[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.

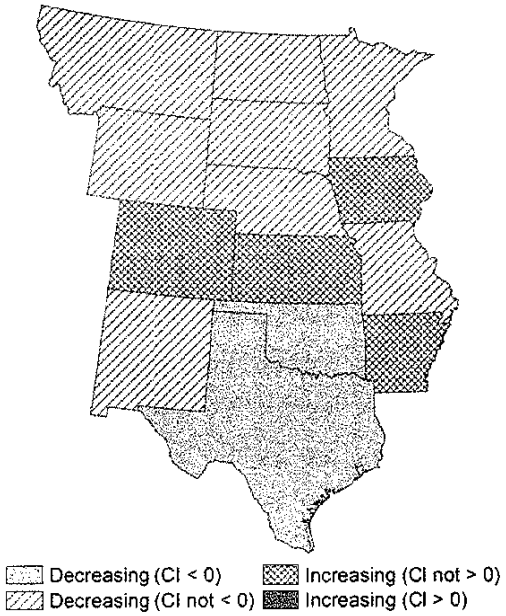

Figure 4. Trend in mourning dove abundance by state in the Central Management Unit over the last 10 years (2002-2011) based on CCS-heard data. Credible intervals (CI, 95%) that exclude zero provide evidence for an increasing or decreasing trend (From: Seamans, M.E., K. Parker, and T.A. Sanders. 2011. Mourning dove population status, 2011. U.S. Department of the Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Washington, D.C. 28 pp.)

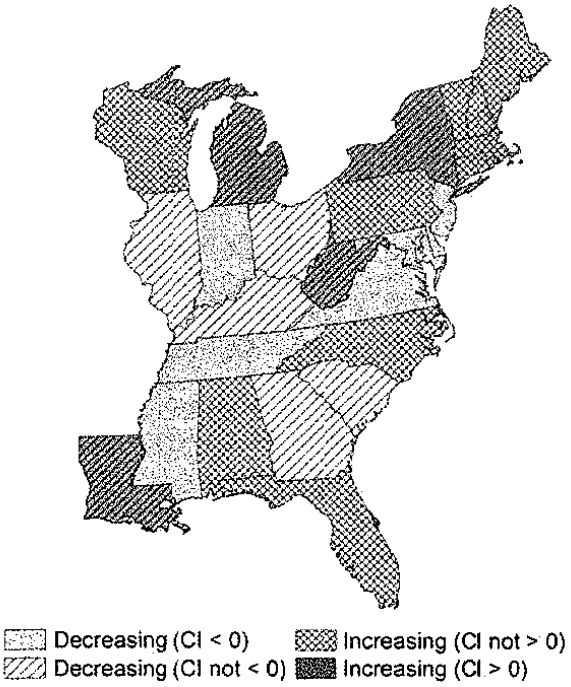

Figure 5. Trend in mourning dove abundance by state in the Central Management Unit over the last 46 years (1966-2011) based on CCS-heard data. Credible intervals (CI, 95%) that exclude zero provide evidence for an increasing or decreasing trend. (From: Seamans, M.E., K. Parker, and T.A. Sanders. 2011. Mourning dove population status, 2011. U.S. Department of the Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Washington, D.C. 28 pp.)

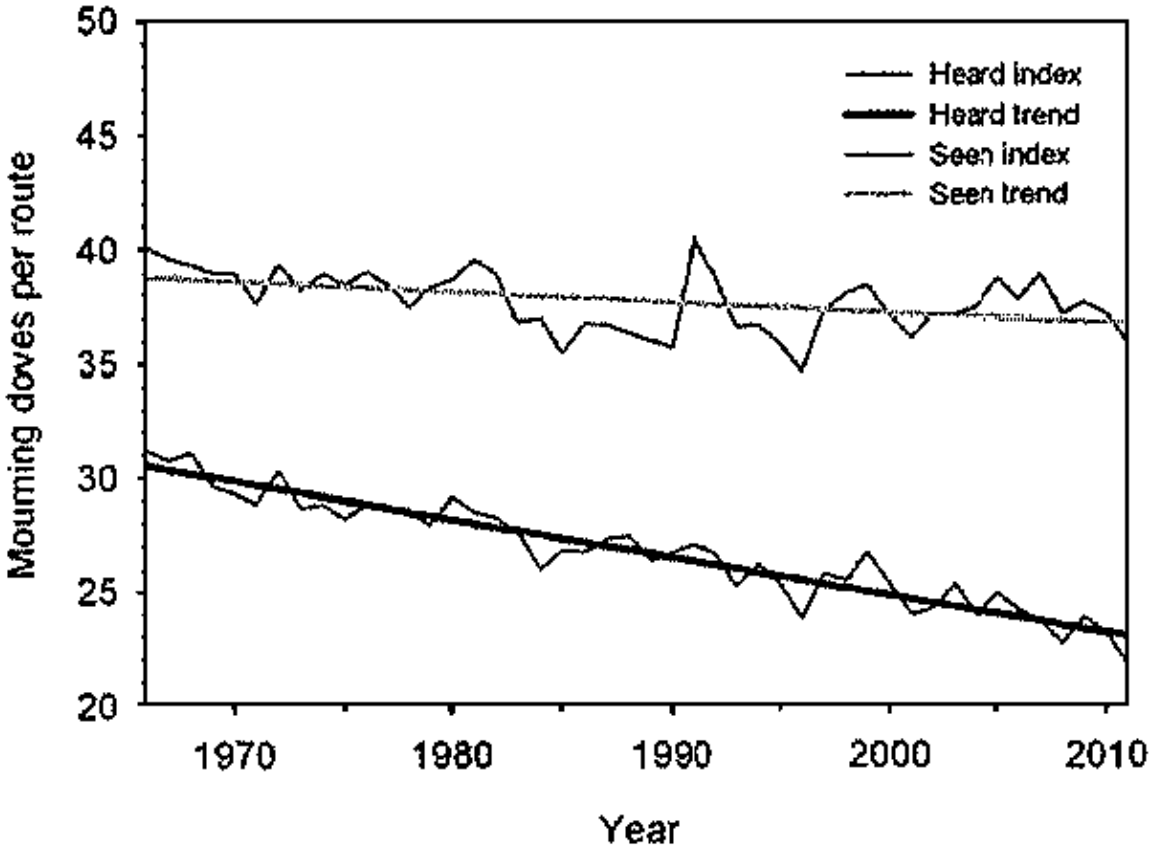

Figure 6. Mourning dove abundance indices and predicted trends in the Central Management Unit based on CCS data, 1966-2011. Trend lines are exponentiated predicted values from fitting a regression line through the log transformed annual indices. (From: Seamans, M.E., K. Parker, and T.A. Sanders. 2011. Mourning dove population status, 2011. 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, 2011. Cooper, T.R. and K. Parker. Us. Fish and Wildlife Service, Laurel, MD. 17 pp. The entire report is available on the Division of Migratory Bird Management home page (http://www.fws.gov/migratorybirds/NewReportsPublications/PopulationStatus.html).

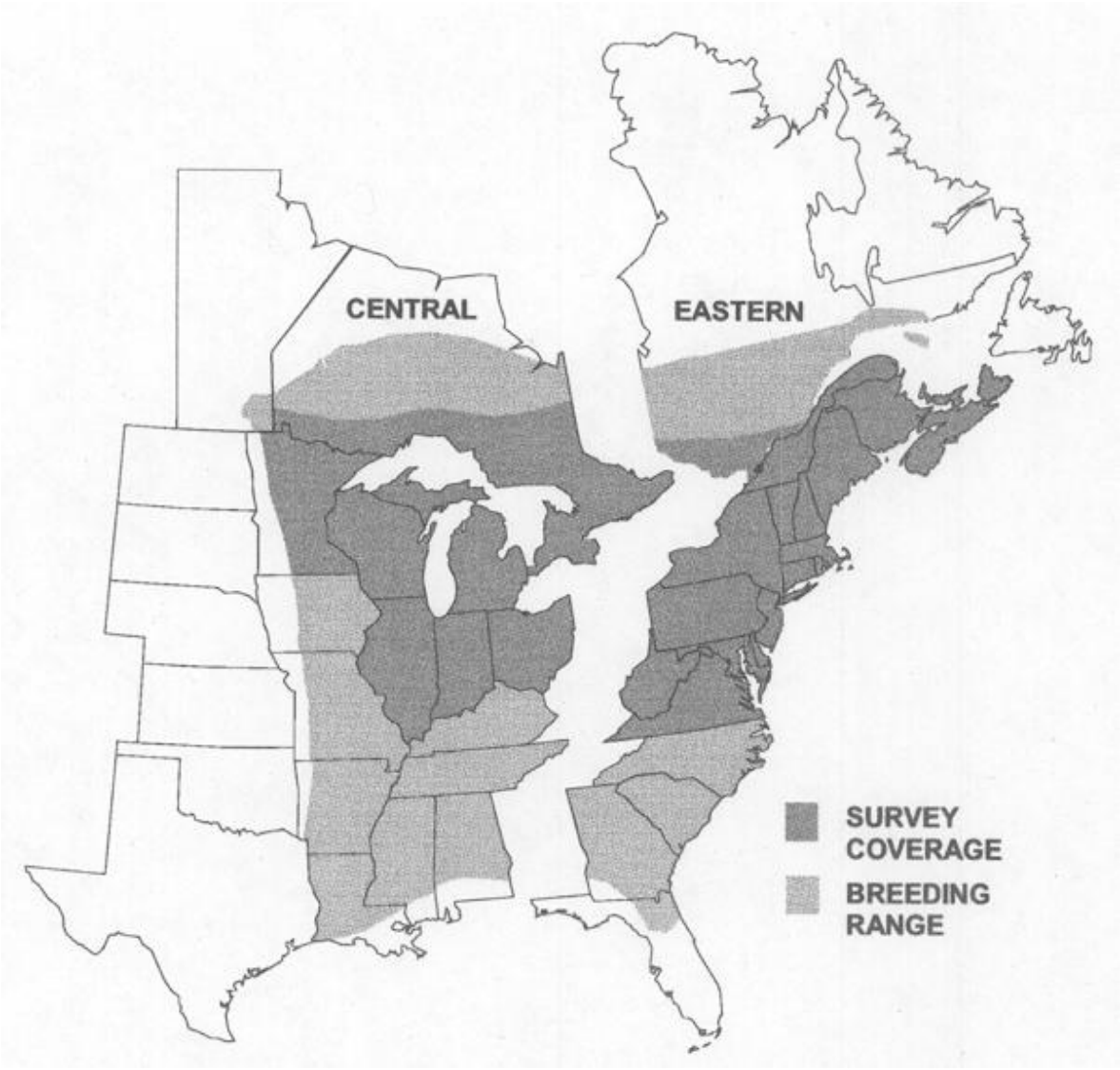

Figure 1. Woodcock management regions, breeding range, singing-ground survey coverage, (from: Cooper, T.R. and K. Parker. 2011. American woodcock population status, 2011. U.S. Fish and Wildlife Service, Laurel, MD. 17pp.)

Table 24. Short term (2010 – 11), 10 –year (2001-2011), and long-term (1968-2011) 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. 2011. American woodcock population status, 2011. U.S. Fish and Wildlife Service, Laurel, MD. 17pp.).

Management Unit/State	Number of Routes[b]	n[c]	(2010-11) % Change	(2001-11) % Change	(1968-11) % Change
CENTRAL	415	712	4.87	-0.14	- 0.76
IL	32	45	- 15.27	- 1.62	1.27
IN	13	60	- 16.21	- 5.26	- 4.40
MB[d]	11	28	17.82	1.23	- 0.18
MI	103	149	12.10	0.39	- 0.77
MN	73	120	- 1.99	0.82	0.35
OH	29	72	- 1.11	- 0.83	- 1.57
ON	87	149	6.55	- 1.19	- 1.08
WI	67	117	8.52	0.67	- 0.38

[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 2011 for which data were received by 8 June, 2011.

[c] Number of routes with >2 years of data and at least 1 observed woodcock between 1968 and 2011.

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

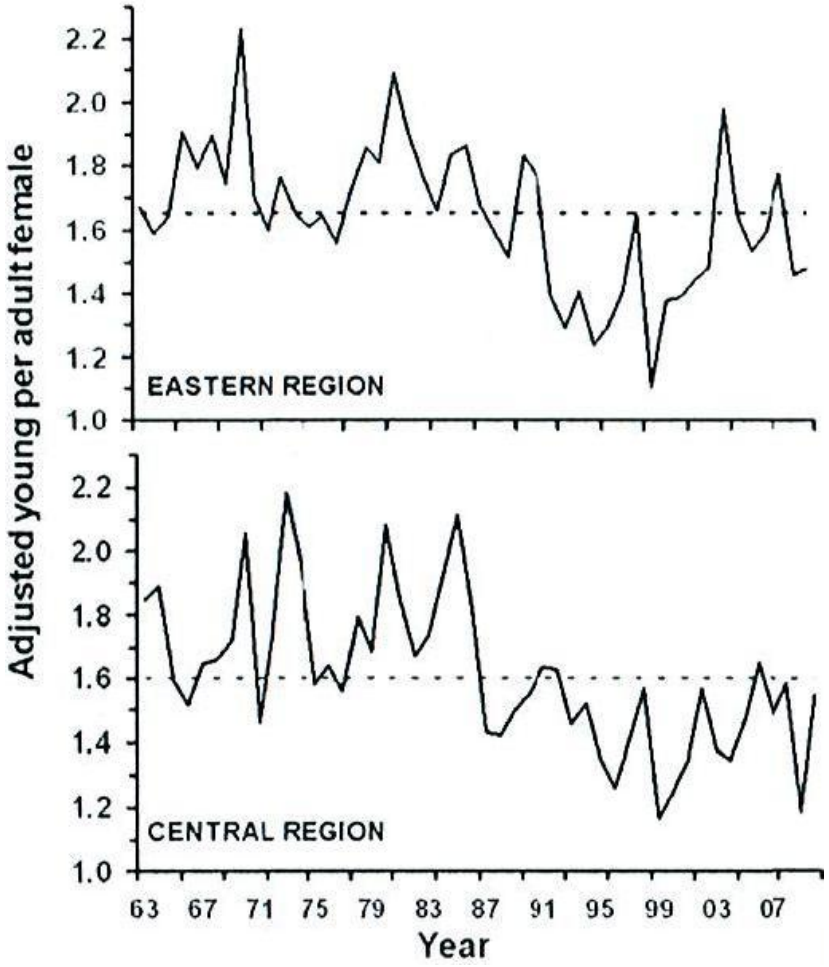

Figure 2. Weighted annual indices of American woodcock recruitment, 1963-2010. Dashed line is the 1963-2009 average. (from: Cooper, T.R. and K. Parker. 2011. American woodcock population status, 2011. U.S. Fish and Wildlife Service, Laurel, MD. 17pp.).

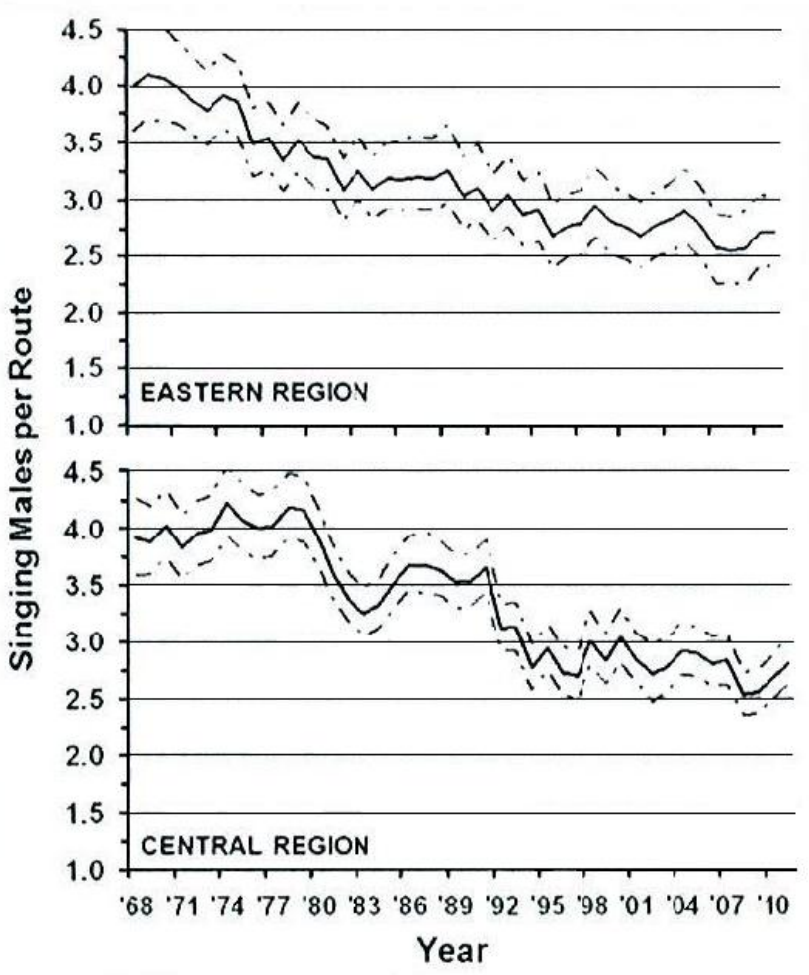

Figure 3. Annual indices of the number of woodcock heard on the Singing-ground Survey, 1968-2011. The dashed lines represent the 95th percentile credible interval. (from: Cooper, T.R. and K. Parker. 2011. American woodcock population status, 2011. U.S. Fish and Wildlife Service, Laurel, MD. 17pp.).

Table 25. Preliminary estimates of woodcock hunter numbers, days afield, and harvest for selected states, from the 2007-08, 2008-09, 2009-10 and 2010-11 Harvest Information Program surveys. Note: beginning 2008-09 all estimates rounded to the nearest 100 for harvest, hunters, and days afield. (from: Cooper, T.R. and K. Parker. 2011. American woodcock population status, 2011. U.S. Fish and Wildlife Service, Laurel, MD. 17pp.).

Management Unit / State	Active woodcock hunters ([a])				Days afield ([a, c])				Harvest ([a, c])			
	2007-08	2008-09	2009-10	2010-11	2007-08	2008-09	2009-10	2010-11	2007-08	2008-09	2009-10	2010-11
Central Region	n.a.[b]	n.a.[b]	n.a.[b]		358,480 ± 14%	369,800 ± 16%	322,300 ± 14	392,400 ± 20	214,162 ± 16%	174,300 ± 16%	175,100 ± 17	233,100 ± 20
IL	3,111 ± 73%	2,100 ± 90%	1,800 ± 98	800 ± 171	7,644 ± 72%	6,100 ± 103%	6,200 ± 91	1,200 ± 123	3,819 ± 149%	4,300 ± 100%	5,300 ± 142	900 ± 106
IN	1,788 ± 71	900 ± 69%	1,100 ± 63	1,000 ± 66	3,342 ± 58%	2,400 ± 63%	4,000 ± 80	3,900 ± 89	1,203 ± 53%	800 ± 31%	1,700 ±79	3,000 ± 134
MI	28,412 ± 13%	34,600 ± 13%	26,400 ± 15	31,100 ± 14	138,881 ±15%	156,000 ± 17%	146,200 ± 21	159,200 ± 19	86,825 ± 17%	78,900 ± 17%	80,900 ± 22	93,200 ± 21
MN	15,295 ± 29%	8,700 ± 37%	9,700 ± 37	13,900 ± 32	62,810 ± 36%	37,900 ± 43%	38,300 ± 44	55,400 ± 33	34,400 ± 38%	19,900 ± 67%	16,00 ± 48	34,800 ± 39
OH	2,611 ± 73%	2,900 ± 69%	1,600 ± 82	1,800 ± 98	9,259 ± 72%	10,300 ± 70%	7,200 ± 94	4,300 ± 70	2,598 ± 68%	2,300 ± 68%	1,200 ± 63	1,700 ± 93
WI	17,258 ± 23%	14,200 ± 24%	19,400 ± 22	14,600 ± 25	79,139 ± 31%	65,400 ± 35%	77,100 ±24	65,700 ± 40	48,027 ± 31%	36,000 ± 27%	29,200 ± 24	42,300 ± 22

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

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

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

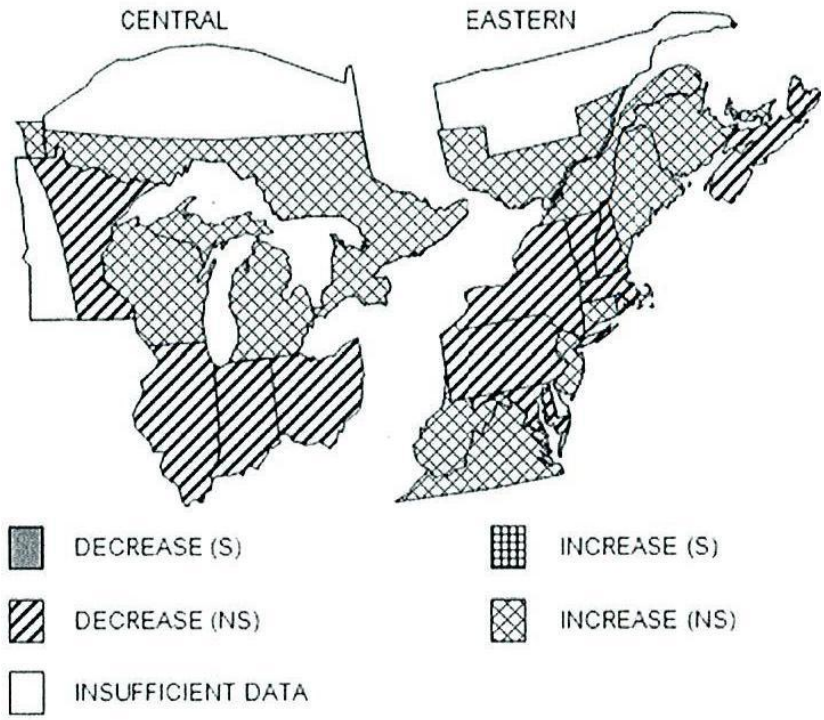

Figure 4. Short-term trends in number of American woodcock heard on the Singing-ground Survey; 2010-11, as determined by the hierarchical modeling method. A significant trend (S) does not include zero in the 95% credible interval, while a non-significant (NS) trend does include zero. (from: Cooper, T.R. and K. Parker. 2011. American woodcock population status, 2011. U.S. Fish and Wildlife Service, Laurel, MD. 17pp.).

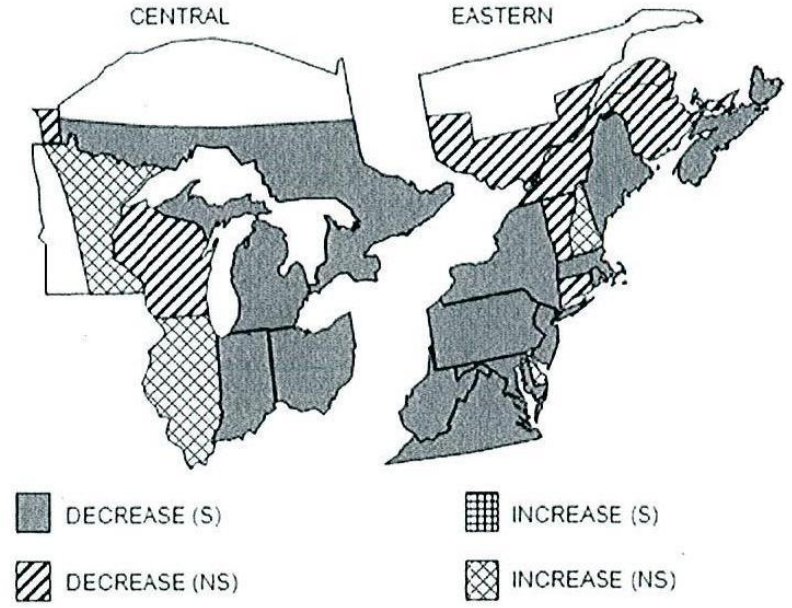

Figure 5. Long-term trends in number of American woodcock heard on the Singing-ground Survey; 1968-2011, as determined by the hierarchical modeling method. A significant trend (S) does not include zero in the 95% credible interval, while a non-significant (NS) trend does include zero. (from: Cooper, T.R. and K. Parker. 2011. American woodcock population status, 2011. U.S. Fish and Wildlife Service, Laurel, MD. 17pp.).

2011 RING-NECKED DUCK BREEDING PAIR SURVEY

Christine Herwig Wetland Wildlife Populations and Research Group and
John Giudice, Wildlife Biometrics Unit

SUMMARY OF FINDINGS

Ring-necked duck breeding populations have been surveyed with helicopters in portions of Minnesota since 2004. We used a stratified sampling design in all years, but in 2011 we switched to a generalized random tessellation stratified (GRTS) design to obtain a spatially balanced sample and to explore the feasibility of using a local variance estimator to account for spatial correlation in counts. We surveyed 225 plots in 2011, which consisted of 176 'new' (random) plots and 49 resample plots (also surveyed in 2009 and 2010). We treated resample plots as a separate stratum for population estimation, although their primary purpose was to help us evaluate the feasibility of using sampling with partial replacement to obtain more reliable estimates of population trends.

Helicopter-based counts in 2011 entailed 8 survey-crew days from 6–11 June totaling ~43 hrs of flight time. The estimated breeding population was 10,395 (SE = 1,325) indicated breeding pairs (IBP) and 22,727 (SE = 2,759) total birds, which was similar to estimates from 2006–2009 (range: 8,705–10,947 IBP, 18,533–22,987 birds) but greater than 2010 estimates (5,338 IBP, 11,843 birds). Accounting for spatial correlation in counts reduced sampling variance by ~30% (compared to using a standard variance estimator), which translated into in a small improvement in the relative precision of population estimates (i.e., coefficient of variation [CV] was reduced from 15.3% to 12.7% for the IBP estimate). Correlation among annual counts within resample plots was moderately strong (intra-class correlation = 0.476), and estimates of among- and within-plot variance was similar, which suggests that sampling with partial replacement may be beneficial in future ring-necked duck surveys. We plan to explore this further with simulation studies and, possibly, a Bayesian analysis approach.

INTRODUCTION

Growing concern among biologists about the status of ring-necked ducks (*Aythya collaris*) in Minnesota prompted the initiation of a pilot study (2004–2005) to develop a breeding pair survey (Zicus et al. 2008). At the time, little was known about the breeding distribution and abundance of ring-necked ducks in Minnesota (Zicus et al. 2008). Concerns were raised, in part, due to counts from 10 wetlands in the Bemidji area, which showed a ~70% decline in ring-necked duck breeding pairs using these historically-important lakes since 1969 (Zicus et al. 2004). Counts from this geographically limited survey suggested 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).

A pilot study was conducted in 2004–2005 to develop an aerial survey for Minnesota's ring-necked duck breeding population (Zicus et al. 2008). We used survey protocols and methodologies developed in the pilot study to estimate abundance and trends of breeding ring-necked ducks in Minnesota during 2006–2011. Due to budget constraints, we reduced the spatial extent and focus of the survey beginning in 2008. More specifically, we reduced the sampling frame to the core area of the breeding range (based on pilot-study data) in Minnesota, and we excluded plots with no or relatively little predicted nesting cover (see Herwig 2010). Here, we present results from the portion of the state that has been consistently surveyed for the past 6 years. The primary objectives of this survey were to estimate breeding pair numbers and monitor population trends of ring-necked ducks in northern Minnesota.

METHODS

Public Land Survey (PLS) sections (~2.6-km^2 plots, range = 1.2 – 3.0 km^2) were used as primary sampling units (Zicus et al. 2008). We used a stratified sampling design to both distribute plots and to focus the survey in areas where ring-necked ducks were most likely to be found (Zicus et al. 2008). Stratification variables included estimated nesting-cover availability, which was based on habitat modeling using Minnesota Gap Analysis Program (MNGAP) data (Table 1), and Ecological Classification System (ECS) sections. Breeding habitat was comprised of two land-cover components: 1) nesting cover and 2) near-shore water. Habitat specifications for the model were tested and refined during the pilot study. Nesting cover served as a surrogate for predicted breeding ring-necked duck density (Zicus et al. 2008). Four habitat classes were surveyed from 2006–2007, and 2 habitat classes (1 and 2, Table 1) were surveyed from 2008–2011 (Zicus et al. 2008). From 2006–2007, 6 ECS sections were surveyed in the primary breeding range, but in 2008, the survey was reduced to the core area, which included 3 ECS sections (Sousa et al. 2008). The use of ECS sections as a stratification variable contributed little to variance reduction, but it helped to ensure a spatially representative sample. In 2011, we used a generalized random tessellation stratified (GRTS) design to obtain a spatially balanced sample (Stevens and Olsen 2004). The GRTS design is a probability-based model that allows for design-based estimators and variances (Stevens and Olsen 2004).

For 2011, our sample of 225 plots included 49 resample plots. In 2010, these resample plots were randomly selected from plots sampled in 2009 to reflect a range of ring-necked duck counts and habitat (see Herwig 2010). Resample plots were sampled in 2010 and 2011. For population estimates, we treated the 49 resample plots as a third stratum (with sampling rate = 1).

Plots were surveyed from a helicopter (Bell OH-58 [Jet Ranger] or Enstrom 480B) flying at ~30–45 meters above ground level (agl) and ~75–130 km/h with a 2-person survey crew (pilot + 1 observer). We recorded all ring-necked duck observations by sex and social status (Zicus et al. 2008). We considered pairs, lone males, and males in flocks of 2–5 birds to indicate breeding pairs (IBP; Zicus et al. 2008). The 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 libraries survey (Lumley 2009, R Development Core Team 2009) and spsurvey (Kincaid and Olsen 2011) to estimate IBP and the total breeding population. Population estimates from 2006 and 2007 were re-calculated to reflect the reduced sampling frame.

RESULTS

Sample plots were well distributed throughout the study area (Figure 1B). Plots chosen with a stratified random sampling design tended to be spatially clustered; whereas the GRTS design resulted in less clustering. The GRTS design allowed us to use a local variance estimator, which improved the precision of the 2011 population estimates by reducing sample variance by ~30% (when compared to a stratified random sampling variance estimator). Most plots (143) were located in the Northern Minnesota Drift and Lake Plains section (Table 2). The fewest plots (15) were located in the Lake Agassiz, Aspen Parklands section, but the sampling rate was higher than the other 2 ECS sections (Table 2).

The survey was conducted 6–11 June and entailed 8 survey-crew days totaling ~43 hrs of flight time. A total of 338 ring-necked ducks were observed in 73 (32%) of 225 plots (Table 3, Figure 2). By habitat type, birds were detected on 48 (41%) of habitat class 1 plots and 25 (23%) of habitat class 2 plots (Figure 3). Overall, counts on occupied plots ranged from 1 to 18 birds (median = 3, mean = 4.6 birds/plot). Numbers of IBP on occupied plots ranged from 0 to 15 (median = 2, mean = 3.0 IBP/plot). Total breeding birds on occupied plots ranged from 1 to 30 ducks (median = 4.0, mean = 6.5 breeding birds/plot). Of the birds observed, 50% were classified as pairs, 25% flocked males, 15% lone males, 6% mixed groups, and 4% lone females; no flocked females were observed. Of IBP, 38% were classified as pairs, 39% flocked males, and 23% lone males. The IBP ratio (percentage of pairs to lone males plus

flocked males) provides information on the timing of nesting. For example, when the proportion of pairs is less than ~50%, the survey is considered late, as more of the birds observed are only males and their females are assumed to already be nesting. These IBP ratios suggest that survey timing may have been later phenologically in 2011 than in some of the previous years (Figure 4).

Estimated IBP in the survey area was 10,395 pairs (SE = 1,325; Figure 5A) and the estimated total breeding population was 22,727 ring-necked ducks (SE = 2,759; Figure 5B). Population estimates from 2011 were similar to estimates from 2006–2009 (annual range: 8,705–10,947 IBP, 18,533–22,987 breeding birds), but higher than in 2010 (5,338 IBP, 11,843 breeding birds). The sharp decrease in ring-necked ducks counted in 2010 was not observed within the resample strata (49 resampled plots; Table 5, Figure 6), which may reflect the relative importance of sampling uncertainty in our population estimates. To explore this question, we fit a log-linear mixed-effects model (ignoring sampling design) to IBP counts from 2009–2011 to estimate a temporal trend (fixed effect) and two random variance parameters (among-plot and residual [within-plot] variance). The estimated finite rate of change (0.997; 95% CI: 0.944–1.054) suggested a stable IBP index during 2009–2011, and the estimated among-plot variance (= 0.455, 95% CI: 0.392–0.527) was similar to within-plot variance (= 0.434, 95% CI: 0.381–0.493). In other words, temporal variation in counts within plots (~process variation) was similar to spatial variation in counts among plots (sampling uncertainty). However, intra-class correlation was moderately strong (0.476), which suggests that sampling with partial replacement may be beneficial in future surveys. We plan to explore this further via a simulation study and, possibly, a Bayesian approach that can more easily account for the sampling design as well as random effects. A Bayesian approach may also allow us to more easily deal with the problem of zero counts on many plots. For example, ring-necked ducks were observed in only 14 (29%) of the 49 resampled plots each year; and there were 21 plots (43%) where ducks were not detected in any year, 18 plots (37%) had ducks detected in one year, 6 plots (12%) had ducks detected in 2 years, and 4 plots (8%) had ducks detected all years.

DISCUSSION

The Minnesota breeding population of ring-necked ducks remained stable from 2006–2009 at 18,000–23,000 breeding birds. In 2010, there was a notable drop in the estimates of IBP and breeding birds, declining 49% and 52%, respectively, from 2009 levels. The lack of a large decline in total counts on resample plots suggests that the observed decline in estimated IBP and breeding population may have partly reflected sampling uncertainty and may not have been as great as depicted by the point estimates. Monitoring the same plots through time will give us a better understanding on how to interpret the results of the random plots. Future work will include exploring model-based approaches that use information from both the random plots and resampled plots to provide more efficient estimators of population sizes and trends (e.g., Fong 1990, Bokalo et al. 1996). Resampled plots provided useful information for examining annual variation within plots; we will continue to monitor these 49 resampled plots. In 2011, the population estimate rebounded within the range of estimates from 2006–2009. Although the population appears to have returned to pre-2010 levels, additional survey years will be needed to detect long-term, biologically-significant population trends.

Switching to a GRTS sampling design and local variance estimator improved precision of the 2011 population estimates. This survey was designed to provide information about abundance and to monitor population trends. Increased precision will allow us to better detect changes in the population.

Ring-necked ducks are an important, perhaps sentinel, Minnesota forest waterfowl species. There is some interest in conducting this survey every other year, but annual monitoring may provide a better understanding of sampling variation and allow enhanced detection of ring-necked duck population trends. Additionally, predictions that the spruce-fir forest will shift north of Minnesota as a result of global climate change (Iverson and Prasad 2001) may further limit available forest habitat for these birds. Given the importance of the ring-necked ducks to hunters and increasing development and recreational use in

Minnesota's forested habitats (Minnesota Department of Natural Resources 2006), it is important to continue to monitor these ducks annually in Minnesota.

ACKNOWLEDGMENTS

Michael Zicus and David Rave helped develop survey methodology and David continues to provide helpful advice to improve the survey and reviewed a draft of this document. I also thank pilots John Heineman and Mike Trenholm for help with survey planning and for flying the survey. Frank Swendsen and Jeff Lawrence (2011) have served as observers for a portion of the plots. Bob Wright conducted with the nesting habitat analysis. 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 Habitat and Population Evaluation Team (HAPET) data used to define the primary breeding range.

LITERATURE CITED

BOKALO, M., S. J. TITUS, and D. P. WIENS. 1996. Sampling with partial replacement extended to include growth projections. Forest Science 42:328–334.

FONG, W-K. 1990. A Bayesian approach to successive sampling with partial replacement of units on two occasions. Biometrika 77:383-388.

HERWIG, C. M. 2010. 2010 ring-necked duck breeding pair survey. Pages 143 – 157 *in* M. H. Dexter, editor. Status of Wildlife Populations, Fall 2010. Minnesota Department of Natural Resources, St. Paul.

IVERSON, L. R., and A. M. PRASAD. 2001. Potential changes in tree species richness and forest community types following climate change. Ecosystems 4:186-199.

KINCAID, T. M. and A. R. OLSEN. 2011. spsurvey: Spatial Survey Design and Analysis. R package version 2.2.

LUMLEY, T. 2009. Survey analysis in R. <http://faculty.washington.edu/tlumley/survey/>. Accessed 13 April 2010.

MINNESOTA DEPARTMENT OF NATURAL RESOURCES. 2006. *A vision for wildlife and its use – goals and outcomes 2006 – 2012*. Minnesota Department of Natural Resources, St. Paul.

R DEVELOPMENT CORE TEAM. 2009. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. http://www.R-project.org.

SOUSA, C. M., D. P. RAVE, M. C. ZICUS, J. R. FIEBERG, J. H. GIUDICE, and R. G. WRIGHT. 2009. 2008 ring-necked duck breeding pair survey. Pages 146 – 157 *in* M. W. DonCarlos, R. O. Kimmel, J. S. Lawrence, and M. S. Lenarz, editors. Summaries of Wildlife Research Findings 2008. Minnesota Department of Natural Resources, St. Paul.

STEVENS, D. L., JR. and A. R. OLSEN. 2004. Spatially balanced sampling of natural resources. Journal of American Statistical Association 99:262–278.

U. S. FISH AND WILDLIFE SERVICE. 2008. Waterfowl breeding population and habitat survey. U. S. Fish and Wildlife Service Division of Migratory Bird Management, Laurel, Maryland. http://mbdcapps.fws.gov/.

ZICUS, M. C., R. T. EBERHARDT, J. DIMATTEO, and L. L. JOHNSON. 2004. Bemidji area ring-necked duck survey. Pages 169 – 183 *in* M. W. DonCarlos, R. O. Kimmel, J. S. Lawrence, and M. S. Lenarz, editors. Summaries of Wildlife Research Findings 2003. Minnesota Department of Natural Resources, St. Paul.

ZICUS, M. C., D. P. RAVE, J. R. FIEBERG, J. H. GIUDICE, and R. G. WRIGHT. 2008. Distribution and abundance of Minnesota breeding ring-necked ducks *Aythya collaris*. Wildfowl 58:31 – 45.

Table 1. Habitat classes assigned to Public Land Survey section plots in the Minnesota ring-necked duck breeding pair survey area (sampling frame), June 2006–2011.

Habitat class	Definition[a]	Percent of survey area[b]	
		2006–2007	2008–2011
1	Plots with ≥ 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).	21.5	51.4
2	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).	21.5	48.6
3	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).	13.5	0.0
4	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).	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. 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 2006–2011.

[b]In 2006–2007, the survey area included 6 Ecological Classification System sections; in 2008 – 2011, the survey area included 3 Ecological Classification System sections. Individual plots retained their habitat class.

Table 2. Sampling rates for Minnesota's ring-necked duck breeding-pair survey by Ecological Classification System (ECS) section and by habitat class (1 and 2), June 2006–2011.

			No. of plots surveyed (Sampling rate [%])[b]									
	No. of plots[a]		2006–2007		2008		2009		2010		2011	
ECS section	1	2	1	2	1	2	1	2	1	2	1	2
N Minnesota Drift & Lake Plains	3,828	3,317	41 (1.1)	36 (1.1)	83 (2.2)	25 (0.8)	56 (1.5)	47 (1.4)	67 (1.8)	59 (1.8)	76 (2.0)	64 (1.9)
Minnesota & NE Iowa Morainal	1,638	1,923	15 (0.9)	17 (0.9)	31 (1.9)	22 (1.1)	24 (1.5)	27 (1.4)	32 (2.0)	34 (1.8)	32 (2.0)	38 (2.0)
Lake Agassiz, Aspen Parklands	216	124	5 (2.3)	3 (2.4)	9 (4.2)	4 (3.2)	10 (4.6)	10 (8.1)	15 (6.2)	15 (12.1)	8 (3.7)	7 (5.6)

[a]Number of Public Land Survey sections in the ECS section(s).
[b]Number of plots within each ECS sections by habitat class (1 and 2); percentage of the number of available plots that were surveyed is provided.

Table 3. Survey results for 3 Ecological Classification System sections and habitat class 1 and 2, combined, in the Minnesota ring-necked duck breeding pair survey area, June 2006–2011.

			Birds[a]			IBP[b]			Breeding birds[c]		
Year	No. of plots surveyed	No. plots with birds (%)	Total	Per plot	Per occupied plot	Total	Per plot	Per occupied plot	Total	Per plot	Per occupied plot
2006	117	27 (23)	201	1.72	7.44	120	1.03	4.44	263	2.25	9.74
2007	117	33 (28)	174	1.49	5.27	101	0.86	3.06	209	1.79	6.33
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 (25)	230	1.04	4.11	147	0.66	2.63	321	1.45	5.73
2011	225	73 (32)	338	1.50	4.63	220	0.98	3.01	474	2.11	6.49

[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 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. Total number of ring-necked ducks, indicated breeding pairs (IBP), and breeding birds for 49 resample plots surveyed in 2009, 2010, and 2011. The range and median per occupied plot (14 occupied in 2009, 14 in 2010, and 14 in 2011) are also provided.

	2009			2010			2011		
	Total	Range/plot	Median/plot	Total	Range/plot	Median/plot	Total	Range/plot	Median/plot
No. birds	68	1 - 19	3.0	65	1 - 17	4.0	82	1 - 17	5.0
IBP	42	1 - 7	2.5	42	1 - 12	2.0	54	1 - 15	3.0
Breeding birds	96	1 - 23	5.0	85	2 - 24	4.5	111	1 - 30	6.0

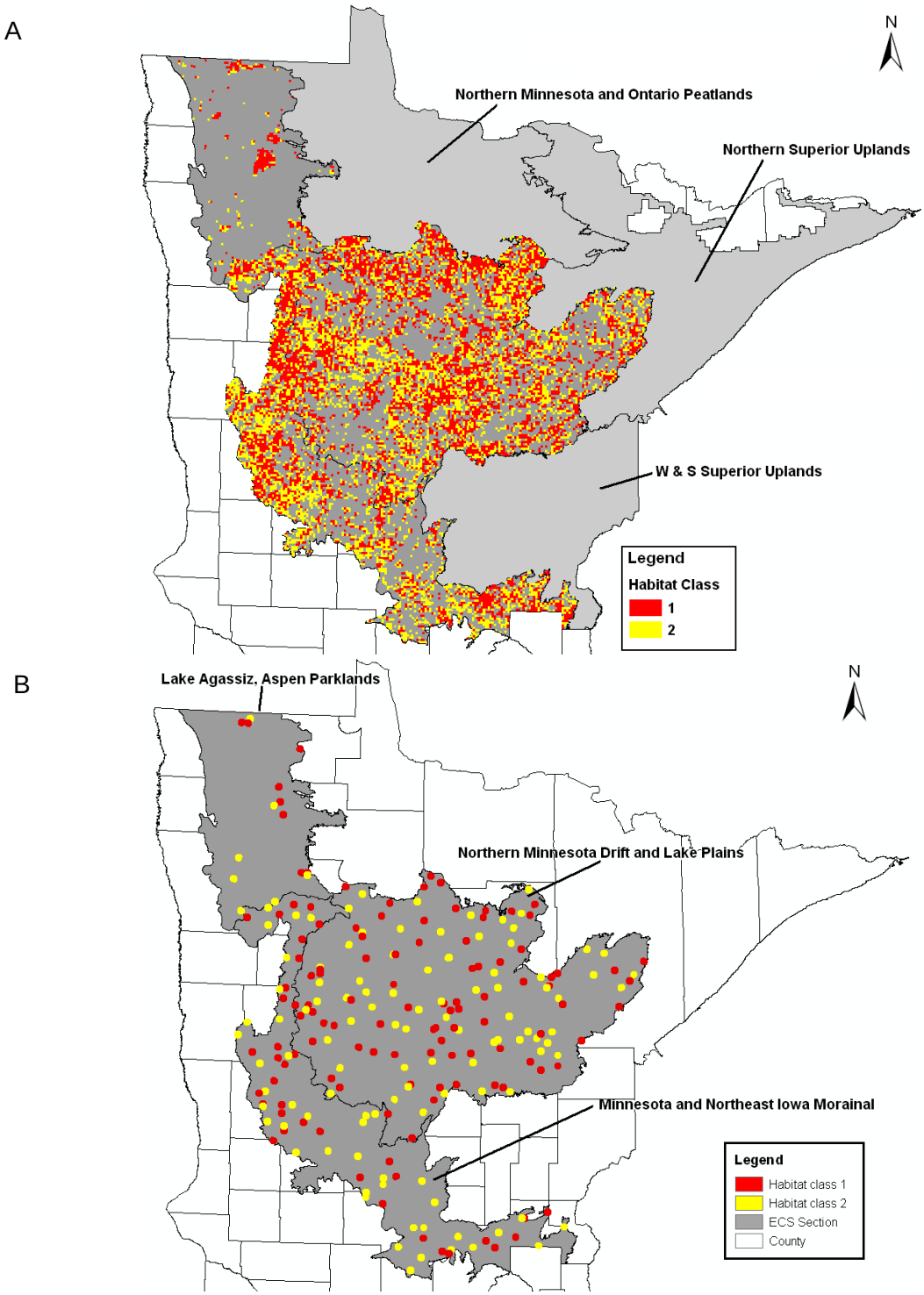

Figure 1. In the 3 Ecological Classification System (ECS) sections sampling frame (A) all Public Land Survey (PLS) plots, (B) 2011 survey plots (enlarged for visibility), and (C) plots from 2009 re-sampled in 2010 and 2011 indicated by habitat class for Minnesota's ring-necked duck breeding pair survey.

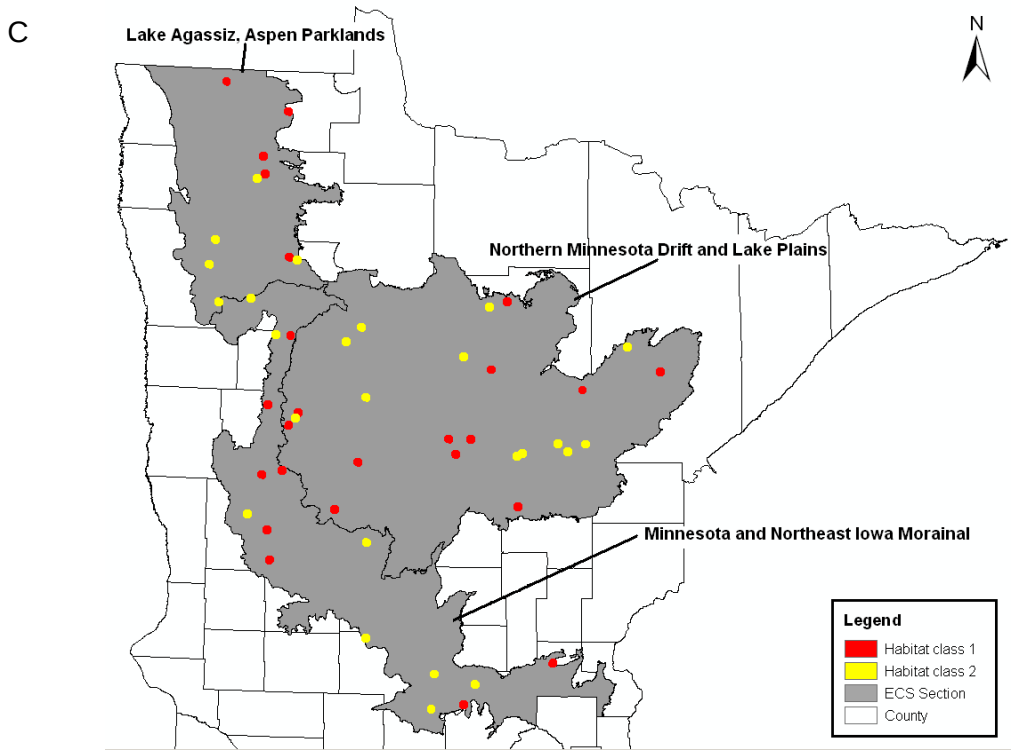

Figure 1. (Continued)

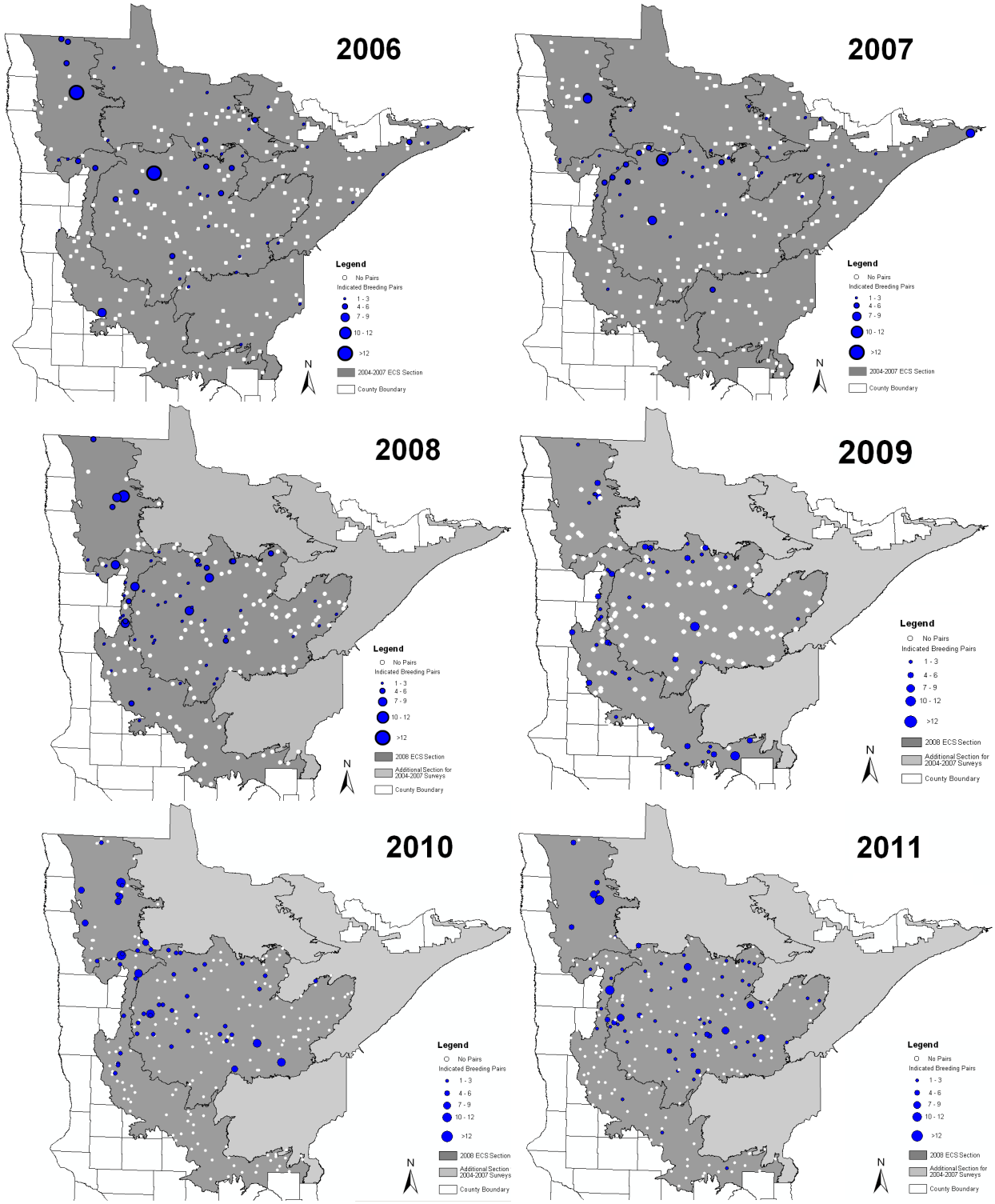

Figure 2. Plot locations and numbers of indicated breeding pairs (IBP) observed on survey plots in the Minnesota ring-necked duck breeding pair survey area in June 2006-2011. White circles indicate plots where no indicated pairs were seen. Maximum number of indicated breeding pairs per plot was 16 pairs in 2011 (16 in 2006; 11 in 2007; 10 in 2008; 8 in 2009, 12 in 2010, and 15 in 2011). The Ecological Classification System (ECS) sections are also shown.

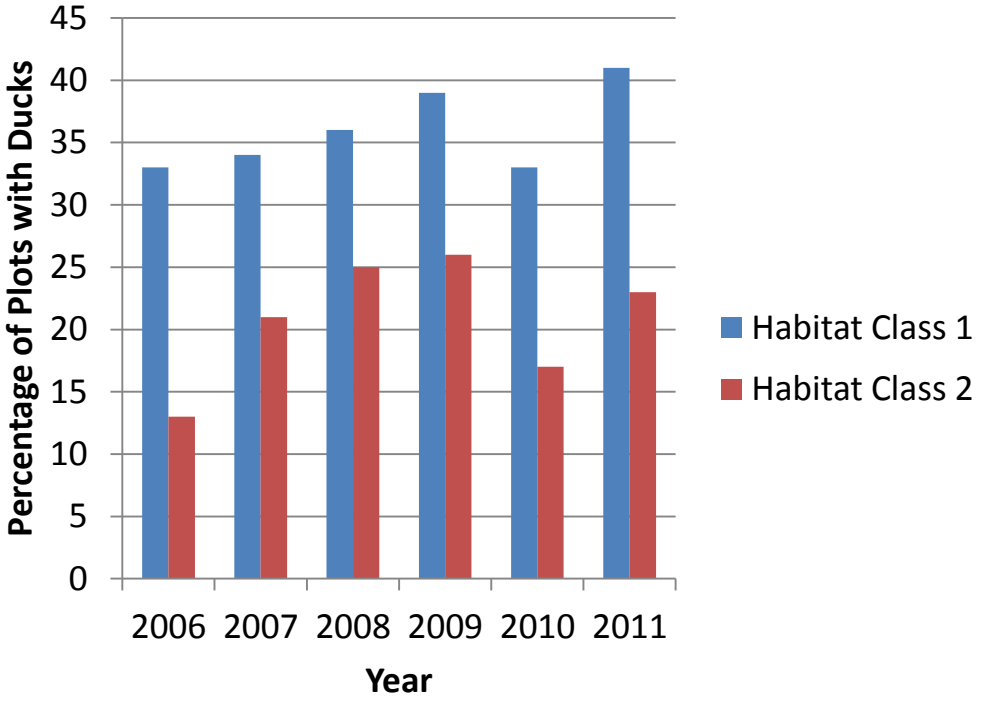

Figure 3. Percentage of plots occupied by ring-necked ducks by habitat class, June 2006–2011.

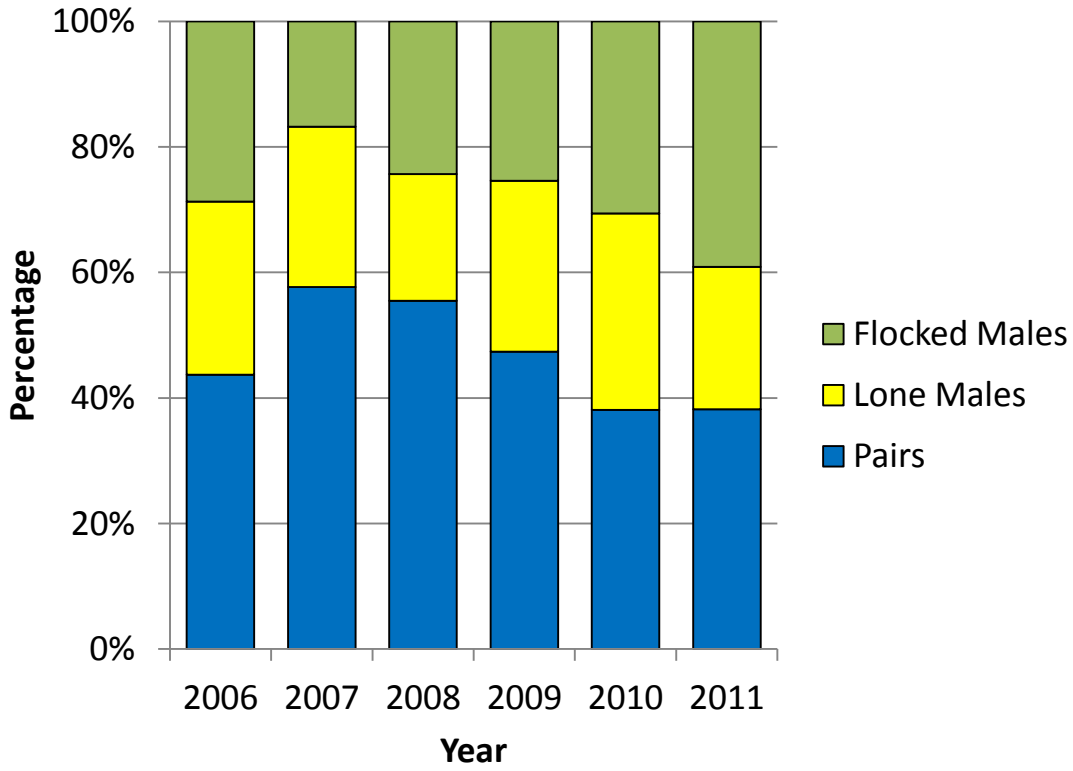

Figure 4. Social status of the indicated breeding pairs observed in the Minnesota ring-necked duck breeding pair survey area, June 2006–2011. Surveys were conducted 6–16 June 2006, 5–13 June 2007, 9–17 June 2008, 5–12 June 2009, 7–16 June 2010, and 6–11 June 2011.

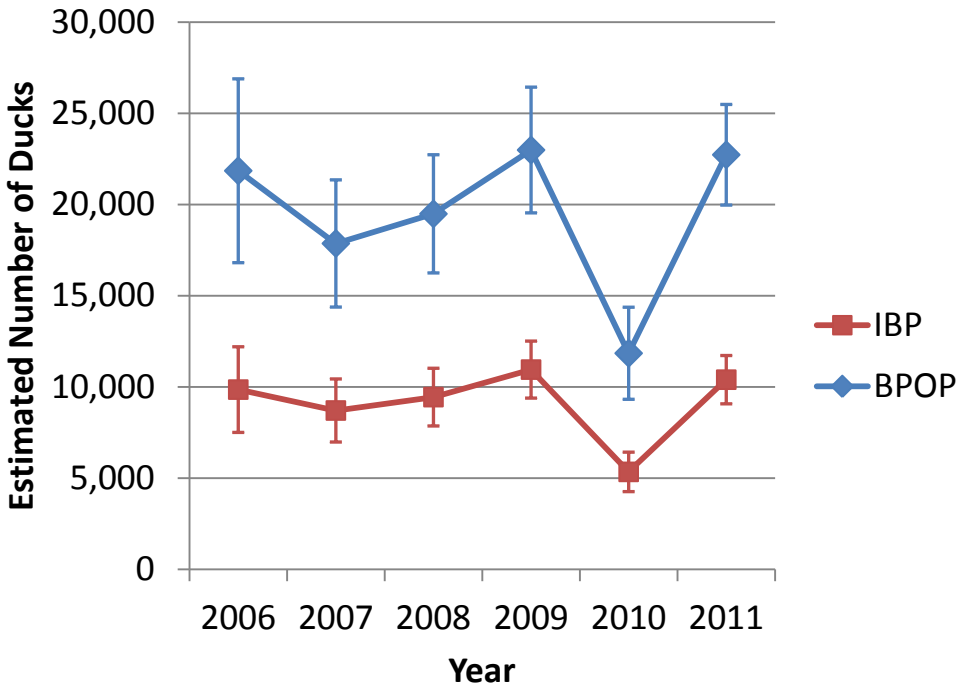

Figure 5. Estimated indicated breeding pairs (IBP) with SE bars and estimated breeding birds (BPOP) with SE bars for the habitat class 1 and 2 strata in the Minnesota ring-necked duck breeding pair survey area, June 2006–2011. Estimates from 2006 and 2007 were recalculated using the same sampling frame as 2008–2011 (3 Ecological Classification System sections instead of 6) for comparison.

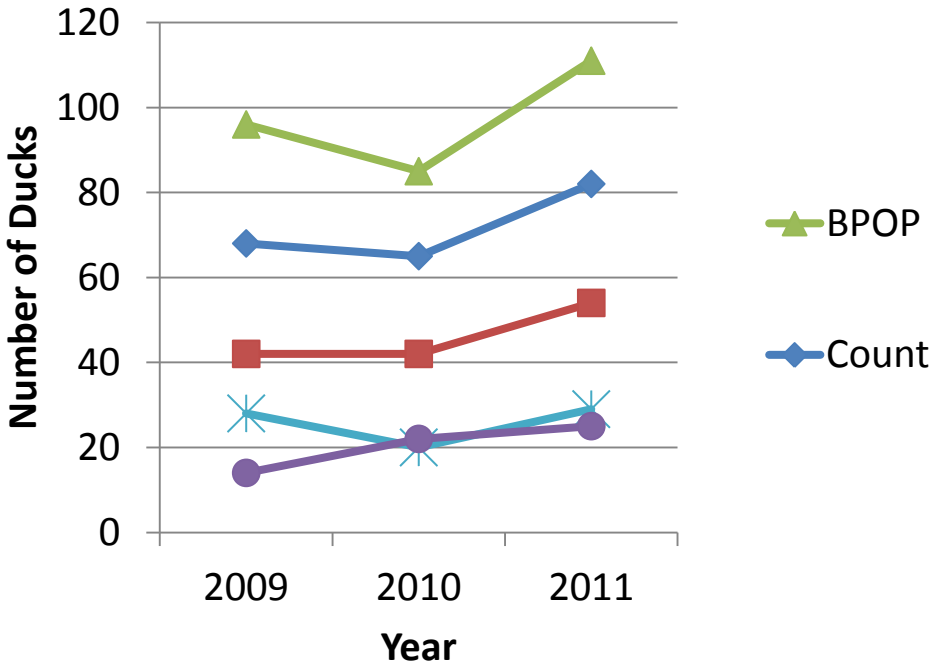

Figure 6. A comparison of the summary data collected for 49 plots re-sampled in 2009, 2010, and 2011. Breeding population (BPOP), total counts, indicated breeding pairs (IBP), number of lone males (LM) and flocked males (FM) combined, and the number of pairs for the 49 plots are shown.

RING-NECKED DUCK BREEDING PAIR COUNTS ON 14 LAKES IN NORTH-CENTRAL MINNESOTA, 1975-2011

Jeffrey S. Lawrence, Wetland Wildlife Populations and Research Group

SUMMARY OF FINDINGS

Ring-necked ducks (*Aythya collaris*) are an important breeding waterfowl species in Minnesota. Fourteen lakes/wetlands in north-central Minnesota have been surveyed annually for ring-necked duck indicated breeding pairs (IBP) since 1975. In 2011, 91 IBP were counted, an increase of 17% from the previous year, but 14% below the long-term average. The counts started at a high level in 1975, and have undergone 2 declining and 1 increasing periods. Concerns with variation in annual survey timing are discussed.

INTRODUCTION

Ring-necked ducks (*Aythya collaris*) breed throughout much of central and northern portions of Minnesota (Hohman and Eberhardt 1998) and have been surveyed or studied by Minnesota Department of Natural Resources (MN DNR) Wildlife staff since the 1950's. A survey was initiated in 1969 to monitor ring-necked duck breeding pair numbers on several lakes and wetlands (hereafter lakes) in north-central Minnesota. I present results on 14 lakes that have been surveyed consistently since 1975.

STUDY AREA

The 14 lakes are located in 4 counties in north-central Minnesota (Figure 1). They range in size from 8.8 ha (Four-legged Pond, from Landview 4.3.8 [MN DNR, St. Paul, Minnesota]) to 144.5 ha (Little Moose Lake, MN DNR 1968). All contained some adjacent bog habitat favored by nesting ring-necked duck hens and historically had been considered good ring-necked duck breeding lakes.

METHODS

Waterfowl were counted on 14 lakes in north-central Minnesota (Figure 1). Most counts were obtained while slowly motoring a canoe around the perimeter of a lake. Generally, counts were conducted with one observer counting, with binoculars when necessary, while another individual operating the canoe. In some cases one individual did both. Efforts were made to observe flight paths of flushed birds to avoid double counting. On a few lakes, birds were counted from shore using a spotting scope or binoculars.

Ring-necked duck lone males, pairs, and flocked males in groups $\leq$5 were considered as indicated breeding pairs (IBP). Lone female ring-necked ducks are counted and considered IBP by ground crews during the May Waterfowl Breeding Ground Population and Habitat Survey (U.S. Fish and Wildlife Service/Canadian Wildlife Service 1987), but these were excluded from

this survey by Zicus et al. (2004). The survey was generally timed to occur when about ½ of the indicated breeding pairs were lone/flocked males; however, in most recent years the survey was conducted in early to mid-June without verifying the pair status (D. Rave, pers. comm.).

RESULTS

Ring-necked ducks increased 17% to 91 IBP, but were 14% below the long-term average (1975-2010 average = 106.1 IBP, Figure 2). Data for individual lakes show various trends over the 37 years (Table 1). In 2011, social status of the indicated breeding pairs was 24% lone males, 31% flocked males (≤5), and 45% pairs. In 2010, 32% were lone males, 24% were flocked males, and 44% were pairs. Survey start and end dates were available for most years since 1984 (Figure 3).

DISCUSSION

Ring-necked ducks on the 14 lakes have generally declined since 1975. However, counts declined 50% during the first 11 years of the survey and then rebounded to near the previous high in the next 5 years. Many of the years from 1985-1990 when the counts increased were characterized by drought conditions throughout Minnesota. After 1990, the count began a decline to a record low (60 IBP) in 2001, but has remained relatively stable averaging 84 IBP the last 10 years.

The weather conditions in 2011 were characterized by heavy precipitation prior to the survey and high water levels on many of the 14 lakes. Water levels vary on individual lakes due to precipitation amounts, beaver activity, and other factors. For example, Ten Lake had water in the vegetation surrounding the lake this year and we were able to launch the canoe near the trail on the SE portion of the lake. The previous 3 years we had walked through these vegetated areas around the lake and counted without putting in the canoe. Water levels on Popple Lake were 95, 98, 82, and 86 cm below the top of the road culvert (a fixed measure) in 2008-2011, respectively. At School Lake, water levels were 27, 36, and 41 cm below the top of the culvert in 2008-2010, respectively (no measurement in 2011). In 2010, a new water level gauge was established on Big Rice Pond. The reading was 5.60 ft in 2010 and 5.06 ft in 2011.

Survey timing has changed since 1984. Originally, the survey was conducted in late May or early June, with the survey beginning as early as mid-May in a few years (Figure 3). When lead observers changed in 2001, pre-survey observations were conducted to determine when the population was approximately 50% lone and flocked males before initiation of the survey. These observations resulted in the survey shifting to early to mid-June. Beginning in 2004, the survey was conducted during the 2nd or 3rd week of June without the pre-survey observations (D. Rave, pers. comm.). In 2011, we began the survey earlier in June. The survey was completed in 4 days, a shorter time frame than most recent years, due to good survey conditions and work schedules.

In 2010 and 2011, approximately ½ the population was comprised of lone and flocked males, even though the survey was conducted earlier in 2011. We observed a higher proportion of flocked males in 2011. Burns Lake had the largest count on record, 30 IBP, with 57% of the indicated pairs represented by flocked males. Muskrat Lake also had a group of 9 males with 1 female. It is difficult to distinguish migrant from resident birds, but groups and flocks of males

>5 are assumed to be nonbreeders. There may have been migrant ring-necked ducks in the area when the survey was conducted in 2011.

Christine Herwig, Wildlife Research Biologist with the Wetland Group, has been entering historical survey data from the field notes. We plan to examine these relationships and survey timing prior to next year's survey.

ACKNOWLEDGEMENTS

A variety of individuals have conducted this survey over the years. Lead observers included Leon Johnson, Todd Eberhardt, Jeff DiMatteo, Mike Zicus, and Jeff Lawrence. In 2011, Blane Klemek assisted with the survey of 9 of the lakes. Al Killian has also assisted with the survey in recent years. Rice Lake, east of Grand Rapids, was surveyed by Perry Loegering, Mark Spoden and Mike Broschart. Dave Rave and Christine Herwig reviewed a draft report.

LITERATURE CITED

HOHMAN, W. L., AND R. T. EBERHARDT. 1998. Ring-necked duck (*Aythya collaris*). *In* The Birds of North America, No. 329 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

MINNESOTA DEPARTMENT OF NATURAL RESOURCES. 1968. An inventory of Minnesota Lakes. Division of Waters, Soils, and Minerals Bulletin No. 25. 498 pages.

U.S. FISH AND WILDLIFE SERVICE/CANADIAN WILDLIFE SERVICE. 1987. Standard operating procedures for aerial waterfowl breeding ground population and habitat surveys in North America. U.S. Department of Interior, Fish and Wildlife Service and Environment Canada, Canadian Wildlife Service.

ZICUS, M. C., T. EBERHARDT, J DIMATTEO, AND L. L. JOHNSON. 2004. Bemidji area ring-necked duck survey. Pages 169-183 *in* M. W. DonCarlos, R. O. Kimmel, J. S. Lawrence, and M. S. Lenarz, editors. Summaries of wildlife research findings 2003. Minnesota Department of Natural Resources, St. Paul.

Table 1. Number of ring-necked duck indicated breeding pairs observed on 14 lakes in north-central Minnesota, 1969-2011[a].

Year	Big Rice Pond	Burns Lake	Dutchman Lake	Four-legged Lake	Four-legged Pond	Grass Lake	Little Moose Lake	Muskrat Lake	Popple Lake	Refuge Pond	Rice Lake	School Lake	Ten Lake	Tax Forfeit Lake	14 Lake Sum
1969	15		14	10	7	30	18		16	9	18	3	6		
1970	17	7	9	13	10	30	24		5	13	15	2			
1971	14	6	9	6	7	21	18		7	13	9	7	7	1	
1972	8	8	10	9	15	33	5		10	12	22	10	14	8	
1973	11	12	12	11	8	32	5		14	14	19	14	4	8	
1974	12	6	9	8	10	20	9		14	23	18	11		3	
1975	13	3	14	5	15	19	16	9	5	14	24	7	9	8	**161**
1976	14	2	7	9	5	15	1	16	6	16	20	6	5	1	**123**
1977	10	2	16	5	0	16	22	5	12	15	19	11	5	5	**143**
1978	7	0	15	12	3	17	18	12	7	10	29	3	13	4	**150**
1979	4	9	4	7	10	11	11	4	10	6	9	8	15	2	**110**
1980	1	0	3	6	7	12	16	7	14	12	14	3	9	6	**110**
1981	13	1	7	9	0	20	19	6	9	13	15	0	7	5	**124**
1982	6	3	4	13	0	18	20	2	14	11	20	4	8	2	**125**
1983	7	1	12	9	1	13	16	14	4	9	32	3	8	0	**129**
1984	7	3	6	9	2	6	8	15	0	8	19	2	10	0	**95**
1985	4	1	5	12	0	10	4	4	0	8	23	2	7	0	**80**
1986	3	2	7	12	4	10	8	7	0	7	28	2	7	0	**97**
1987	5	2	14	12	3	17	12	10	0	7	17	1	11	1	**112**
1988	12	8	16	20	4	21	13	6	2	9	12	1	14	4	**142**
1989	12	3	15	27	4	21	9	10	1	11	15	3	12	1	**144**
1990	11	7	10	29	1	25	5	14	3	12	8	4	19	2	**150**
1991	6	8	16	14	0	20	4	3	0	9	15	3	10	4	**112**
1992	3	7	14	19	2	19	8	21	5	13	10	2	9	5	**137**
1993	11	6	9	14	2	8	1	15	2	12	11	3	3	10	**107**
1994	6	3	12	14	2	17	11	16	4	9	15	3	7	3	**122**
1995	6	11	8	7	3	17	5	11	2	6	19	0	6	5	**106**
1996	7	6	2	5	3	12	3	8	0	2	16	2	7	0	**73**
1997	7	4	5	2	4	11	27	14	0	6	12	0	10	0	**102**

Table 1. continued.

Year	Big Rice Pond	Burns Lake	Dutchman Lake	Four-legged Lake	Four-legged Pond	Grass Lake	Little Moose Lake	Muskrat Lake	Popple Lake	Refuge Pond	Rice Lake	School Lake	Ten Lake	Tax Forfeit Lake	14 Lake Sum
1998	9	10	13	3	3	6	14	11	0	2	23	0	19	0	**113**
1999	11	14	3	3	3	8	8	5	0	2	7	0	17	0	**81**
2000	5	9	3	1	0	10	2	4	0	1	21	0	7	1	**64**
2001	10	6	6	1	0	4	7	5	0	1	5	3	12	0	**60**
2002	16	11	7	5	4	4	8	8	0	2	3	0	4	0	**72**
2003	9	13	14	9	7	8	7	2	0	1	8	0	9	1	**88**
2004	4	17	13	4	3	2	0	15	3	5	13	7	4	0	**90**
2005	15	5	13	3	2	5	11	21	0	5	9	10	3	0	**102**
2006	12	12	11	7	3	2	3	9	0	5	15	3	0	1	**83**
2007	4	0	16	8	0	1	8	16	2	0	6	9	2	5	**77**
2008	10	13	4	5	3	0	3	24	2	6	6	5	0	3	**84**
2009	4	16	8	6	4	0	5	15	2	5	3	1	0	3	**72**
2010	9	12	7	7	6	0	6	6	4	7	10	4	0	0	**78**
2011	6	30	9	8	6	3	7	14	2	3	1	1	0	1	**91**

[a] – blank cells indicate no survey.

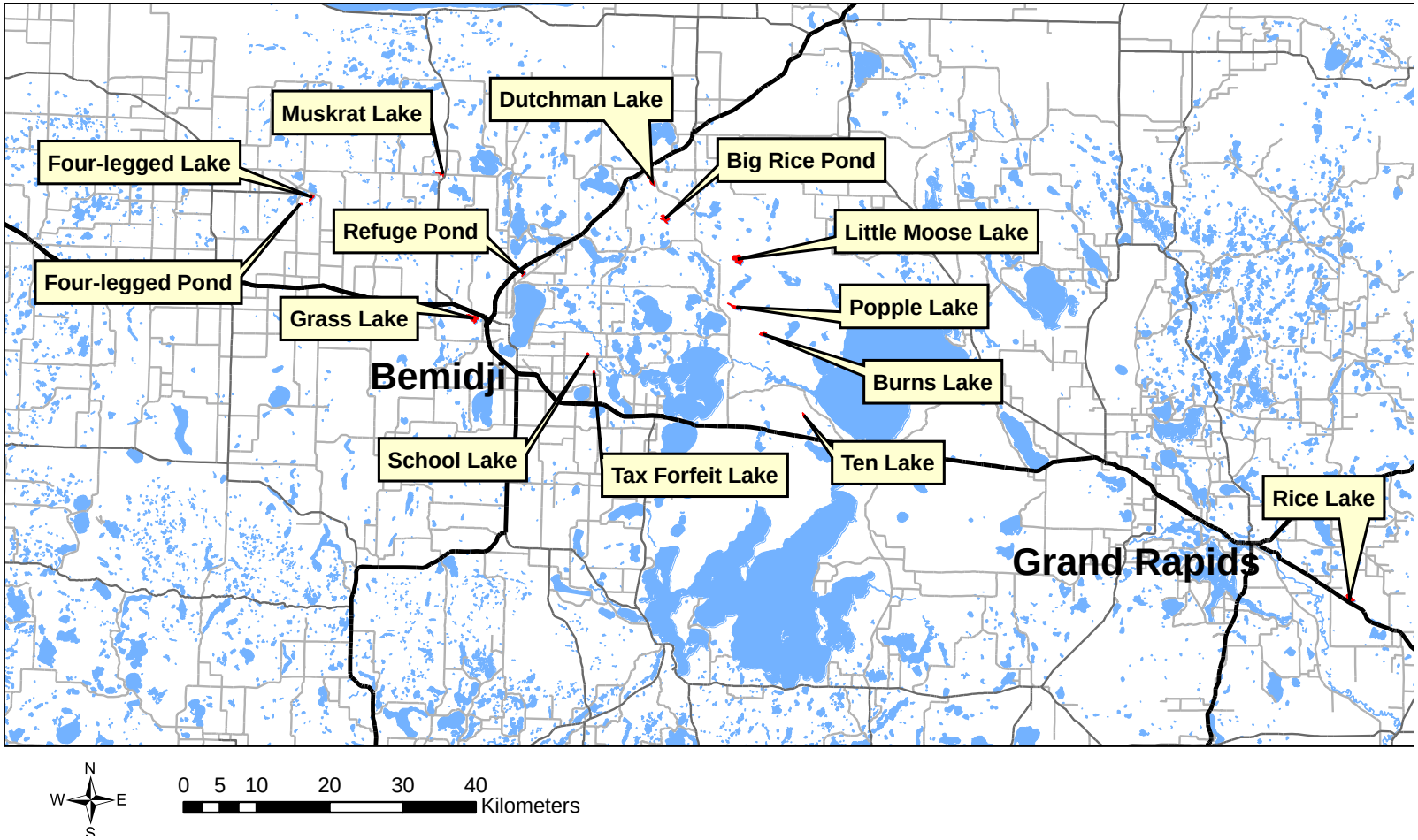

Figure 1. Location of 14 lakes surveyed for ring-necked ducks in north-central Minnesota.

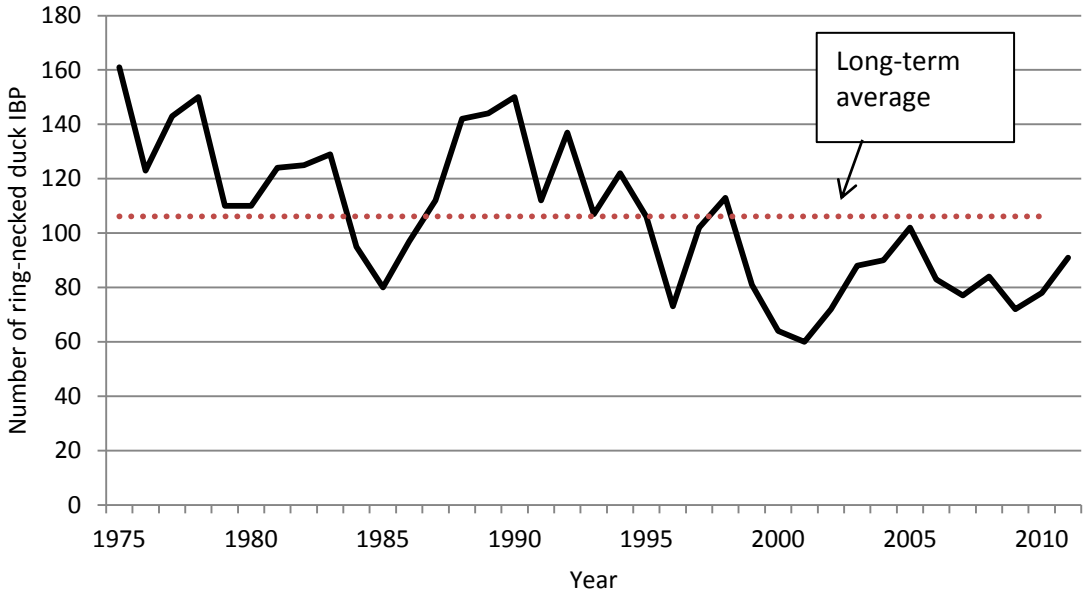

Figure 2. Number of ring-necked duck indicated breeding pairs (IBP) on 14 lakes in north-central Minnesota, 1975-2011.

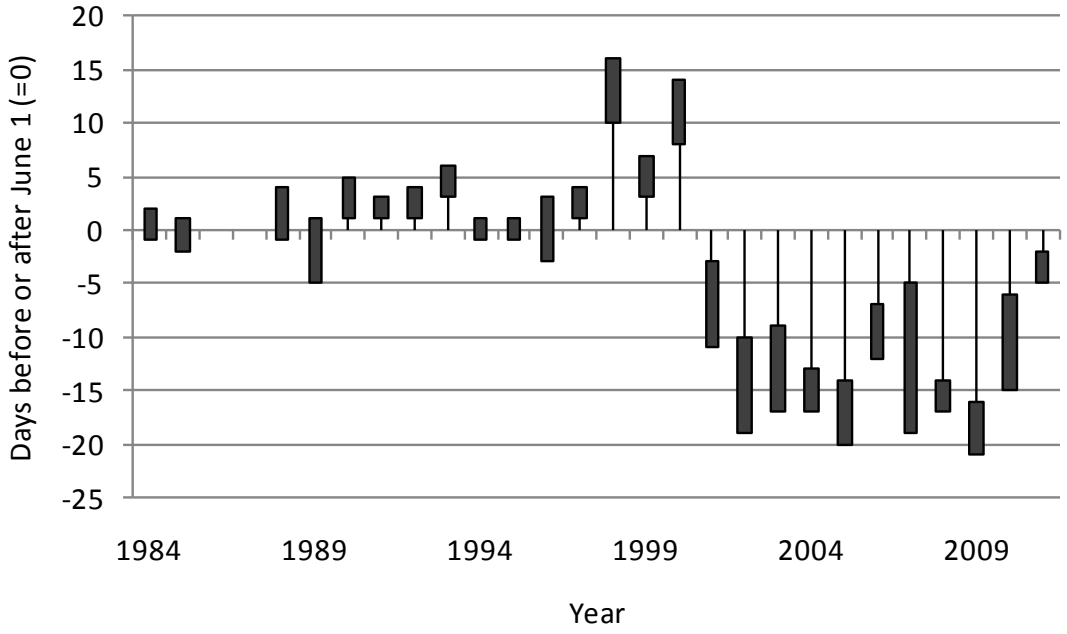

Figure 3. Survey periods (start date through end date) relative to June 1 (=0) for the ring-necked duck 14-lakes survey, 1984-2011.