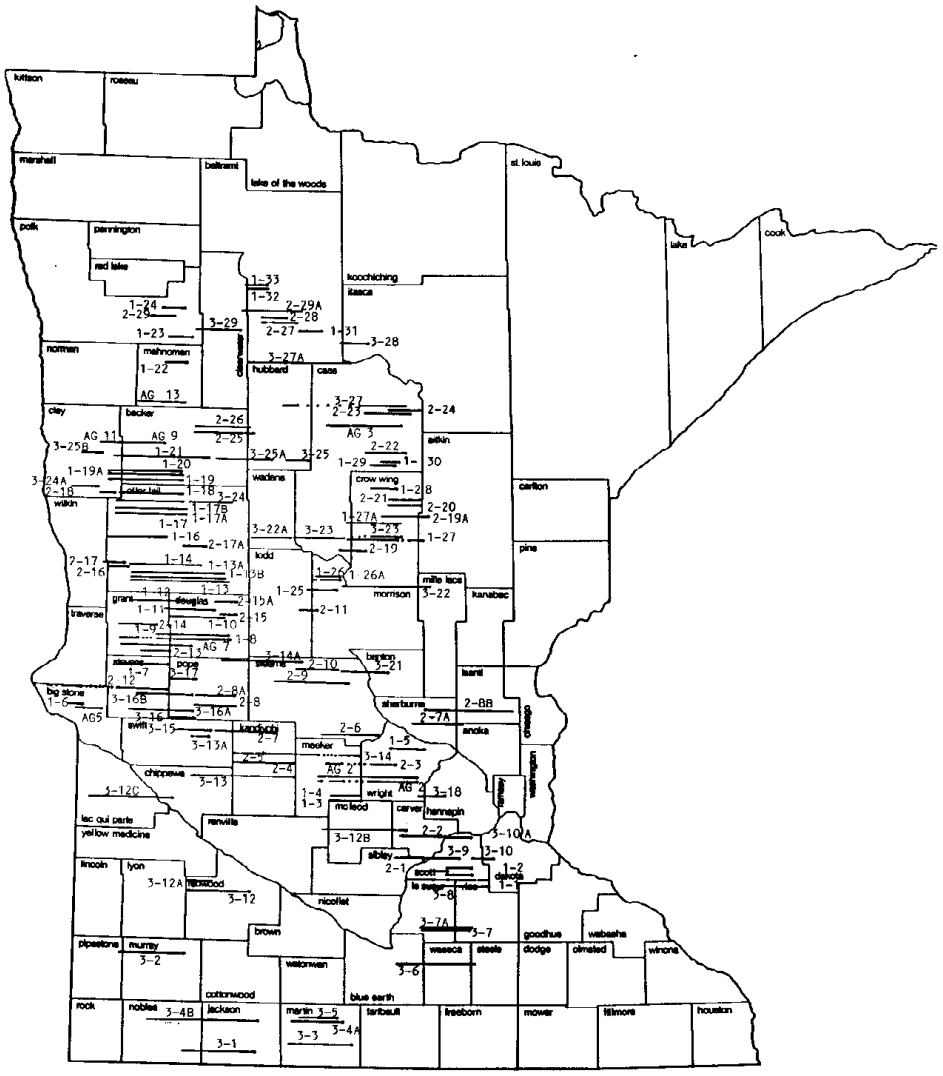
2011
WATERFOWL BREEDING POPULATION SURVEY
MINNESOTA



Minnesota
DEPARTMENT OF NATURAL RESOURCES

U.S. FISH & WILDLIFE SERVICE
DEPARTMENT OF THE INTERIOR

TITLE: Waterfowl Breeding Population Survey for Minnesota

STRATA SURVEYED: Minnesota Strata 1, 2, and 3

DATES: 3-16 May 2011

DATA SUPPLIED BY: Minnesota Department of Natural Resources (MNDNR)
U.S. Fish and Wildlife Service (USFWS)

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

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, Fig. 1). The strata cover 39% of the state area and are defined by density of lake basins (>10 acres) exclusive of the infertile northeastern lake region. The strata include the following:

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

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

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

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

All aerial transects in Strata I-III (Table 1) were flown using a Cessna 185 (N605NR). Wetlands were counted on the observer's side of the plane (0.125 mile wide transect) only; a correction factor obtained in 1989 was used to adjust previous data (1968-88) that was obtained when the observer counted wetlands on both sides of the plane (0.25 mile wide transect). Data were recorded on digital voice recorders for both the pilot and observer and transcribed from the digital WAV files.

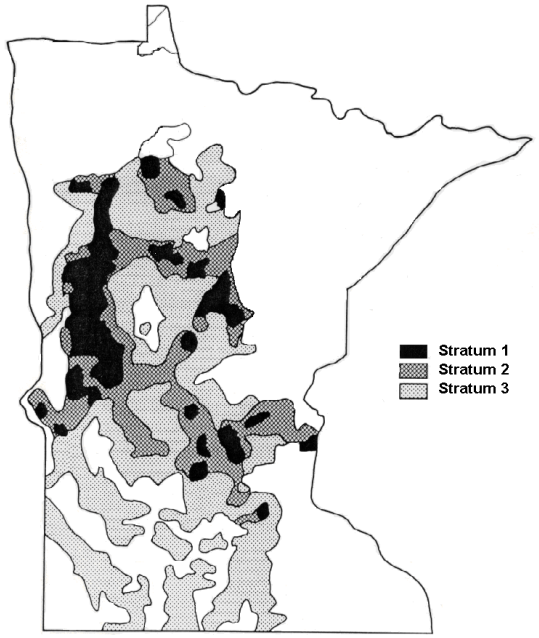


Fig. 1. Location of waterfowl breeding population survey strata in Minnesota.

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; Fig. 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, Fig. 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, Fig. 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, Fig. 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, Fig. 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, Fig. 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.

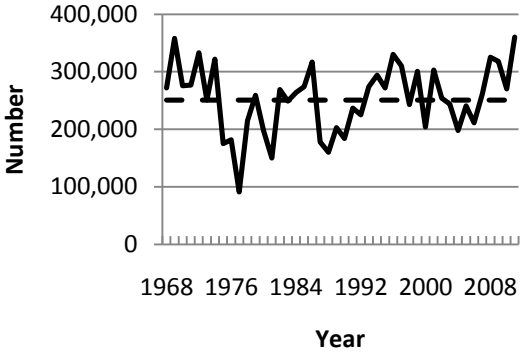


Fig. 2. Number of May ponds (Types II-V) and long-term average (dashed line) in Minnesota, 1968-2011.

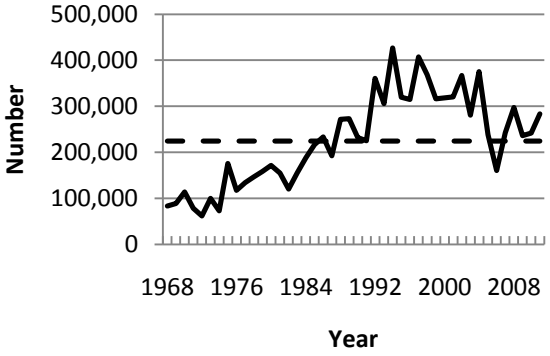


Fig. 3. Mallard population estimates (adjusted for visibility bias) and long-term average (dashed line) in Minnesota, 1968-2011.

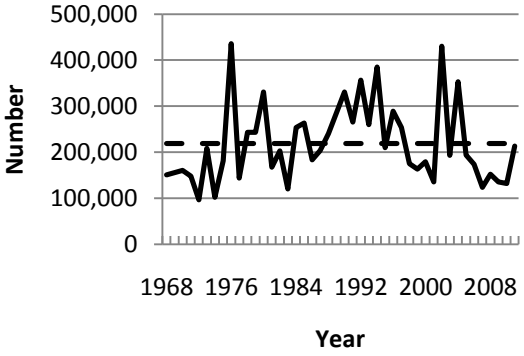


Fig. 4. Blue-winged teal population estimates (adjusted for visibility bias) and long-term average (dashed line) in Minnesota, 1968-2011.

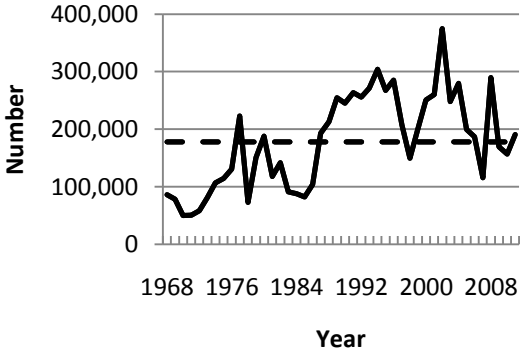


Fig. 5. Other duck (excluding scaup) population estimates (adjusted for visibility bias) and long-term average (dashed line) in Minnesota, 1968-2011

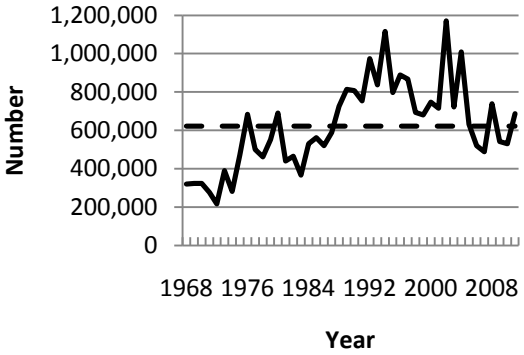


Fig. 6. Total duck (excluding scaup) population estimates (adjusted for visibility bias) and long-term average (dashed line) in Minnesota, 1968-2011

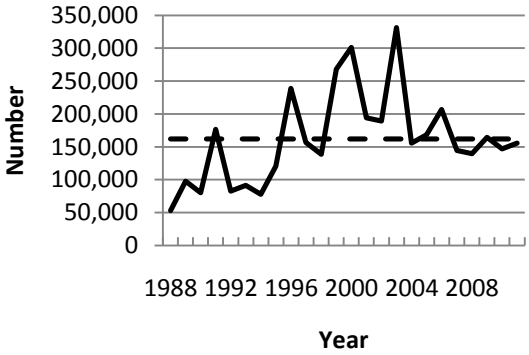


Fig. 7. Canada goose population (adjusted for visibility bias) and long-term average (dashed line) in Minnesota, 1988-2011.

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.

Prepared by: Steve Cordts, Minnesota DNR, Waterfowl Staff Specialist, 21 June 2011

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.