FARMLAND WILDLIFE POPULATIONS

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2011 MINNESOTA AUGUST ROADSIDE SURVEY

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ABSTRACT

Population indices for ring-necked pheasants and mourning doves fell significantly from last year, and population indices for gray partridge, cottontail rabbits, and white-tailed jackrabbits were similar to 2010 but below the 10-year and long-term averages. The population index for white-tailed deer was similar to 2010 and the 10-year average. Sandhill crane indices were also unchanged from last year. Conservation Reserve Program (CRP) enrollment in Minnesota declined by 21,000 acres from 2010, including 9,000 acres from the pheasant range, but increases in enrollment of other farm programs and acquisition of public lands exceeded CRP losses, yielding a net gain of about 8,000 acres of protected habitat in the pheasant range. The winter of 2010-11 was the second consecutive severe winter for much of the farmland region, and it was followed by a cold, wet spring. Thus, conditions for overwinter survival of farmland wildlife in 2011 were below average, and reproductive conditions were similarly poor.

The 2011 pheasant index (23.0 birds/100 mi) fell 64% from 2010, and was 71% below the 10-year average, 77% below the long-term average, and 79% below the benchmark years of 1955-64 (soil-bank years with marginal cropland in long-term set-aside, a diversified agricultural landscape, more small grains and tame hay, and less pesticide use). The 2011 hen pheasant index was 63% below last year and 72% below the 10-year average, reflecting poor over-winter survival. The number of broods observed was 69% below last year and 75% below the 10-year average, which reflected fewer hens available for nesting and poor reproductive conditions. Projecting from the roadside index, an estimated 249,000 roosters may be harvested this fall, similar to 2001, another year with a severe winter followed by a cold, wet spring. The best opportunity for harvesting pheasants appears to be in the East Central region, where winter weather was slightly less severe than in western Minnesota.

The gray partridge index was similar to last year, but 75% below the 10-year mean and 76% below the long-term average. Observed regional changes were not significant, but were based on small samples. Gray partridge counts were highest in the South Central, Southwest, and Southeast regions.

The cottontail rabbit index was similar to last year, but 42% below the 10-year average and 24% below the long-term average. Counts of cottontail rabbits were highest in the East Central, Southeast, and South Central regions. The jackrabbit index did not change significantly in 2011, but was 96% below the long-term average. The range-wide jackrabbit population peaked in the late 1950's and declined to low levels in the 1980s, from which populations have not recovered. Counts of white-tailed jackrabbits were highest in the Southwest region.

The number of mourning doves observed in 2011 was below last year, the 10-year average, and the long-term average. In contrast, the white-tailed deer index was similar to last year and the 10-year average, but significantly higher than the long-term average. Sandhill crane indices were unchanged from 2010 except in the Northwest region, where they declined by 43%.

INTRODUCTION

This report summarizes the 2011 Minnesota August roadside survey. The annual survey is conducted annually during the first half of August by Minnesota Department of Natural Resource (MNDNR) enforcement and wildlife personnel throughout the farmland region of Minnesota (Figure 1). The August

roadside survey consists of 171 25-mile routes (1-4 routes/county); 152 routes are located in the ring-necked pheasant range.

Observers drove each route in the early morning at 15-20 miles/hour and recorded the number of pheasants, gray (Hungarian) partridge, cottontail rabbits, white-tailed jackrabbits, and other wildlife they saw. Counts conducted on cool, clear, calm mornings with heavy dew yield the most consistent results because wildlife, especially pheasants, gray partridge, and rabbits, move to warm, dry areas (e.g., gravel roads) during early-morning hours. These data provide an **index of relative abundance** and have been used to monitor annual changes and long-term trends in regional and range-wide populations. Results were reported by agricultural region (Figure 1) and range-wide; however, population indices for species with low detection rates are imprecise and should be interpreted cautiously.

ACKNOWLEDGMENTS

I thank all cooperators for their efforts in completing routes in 2011; without their help the survey would not be possible. Tonya Klinkner provided assistance with data entry. John Giudice and Marrett Grund reviewed an early draft of this report. Tabor Hoek of the Minnesota Board of Water & Soil Resources (BWSR) provided enrollment data on cropland-retirement programs in Minnesota.

WEATHER SUMMARY

The winter of 2010-11 was the second consecutive severe winter for much of the farmland region of Minnesota. Snow cover exceeded 6 inches throughout most of the farmland zone from early-December through late March, and snow depths exceeded 18 inches for 12 consecutive weeks in many areas (Minnesota Climatology Working Group [MCWG], http://climate.umn.edu/doc/snowmap.htm). In addition, monthly temperatures averaged 3°F below normal (range -1°F to -7°F, MCWG, http://climate.umn.edu/cawap/monsum/monsum.asp) in all farmland regions from December through March. Cold, wet conditions continued through April, May, and June in most farmland regions. Thus, conditions for over-winter survival of farmland wildlife and production of young were poor throughout most of the farmland region in 2011.

HABITAT CONDITIONS

CRP enrollment continued a declining trend with losses from 2010 of 9,000 acres in Minnesota's pheasant range, 16,000 acres in the prairie-chicken range, and 21,000 acres statewide. In addition, 17,000 acres of Reinvest in Minnesota (RIM) enrollments were lost statewide. However, gains in RIM-Wetlands Reserve Program (RIM-WRP) enrollments and acquisitions of Wildlife Management Areas (WMA) and Waterfowl Production Areas (WPA) in the pheasant range exceeded CRP and RIM losses, yielding a net gain of about 8,000 acres of protected habitat since 2010. Habitat enrolled in farm programs (e.g., CRP, CREP, RIM, WRP) declined from a 2007 peak of 1.1 million acres to 948,000 acres in the pheasant range, whereas habitat protected as WMAs and WPAs increased to 719,000 acres. Within the pheasant range, protected grasslands account for about 6.4% of the landscape (range: 3.0-10.1%; Table 1).

Farm programs make up the largest portion of protected grasslands in the state. The expiration of a large proportion of existing CRP contracts is still a major concern for future wildlife populations, with over 550,000 acres in Minnesota scheduled to expire in the next 3 years. Furthermore, the 41st general CRP signup held during spring, 2011, enrolled far fewer acres (33,180) than are expiring on September 30, 2011 (127,535 acres). The future of farmland retirement programs remains under threat due to competing economic opportunities (e.g., high land rental rates, ethanol production).

The MNDNR continues to expand the habitat base through accelerated WMA acquisition with 4,585 acres of new WMAs in the pheasant range in the last year. New funding from the Lessard-Sams Outdoor Heritage account has accelerated acquisition of WMAs and WPAs throughout Minnesota's farmland zone. In addition, the Working Lands Initiative (http://www.dnr.state.mn.us/workinglands/index.html) will attempt to protect and expand large wetland-grassland complexes in 12 counties in western Minnesota.

SURVEY CONDITIONS

Observers completed 166 of the 171 routes in 2011. Weather conditions during the survey ranged from excellent (calm, heavy dew, clear sky) to medium (light dew and overcast skies). Medium-to-heavy dew conditions were present at the start of 96% of the survey routes, which was similar to 2010 (95%) but better than the 10-year average (92%). Clear skies (<30% cloud cover) were present at the start of 76% of routes, with wind speeds <7 mph recorded for 96% of routes. The survey period was extended to July 28th - August 19th to allow most routes to be completed.

RING-NECKED PHEASANT

The average number of pheasants observed (23.0/100 mi) fell 64% (Table 2) from 2010 and was 71% below the 10-year average (Table 2; Figure 2A), 77% below the long-term average (Table 2), and 79% below the benchmark years of 1955-64. Total pheasants observed per 100 miles ranged from 5.3 in the Southeast to 50.8 in the East Central region (Table 3). Declines from last year were significant in the West Central (-62%), Central (-75%), Southwest (-82%), and South Central regions (-59%; Table 3).

The range-wide hen index (3.4 hens/100 mi) was 63% below last year, and 72% below the 10-year average (Table 2). The hen index varied from 0.8 hens/100 miles in the Southeast to 8.3 hens/100 miles in the East Central region, and was lower than last year for the West Central (-60 ± 26% [95% CI]), Central (-77 ± 47%), Southwest (-82 ± 40%), and South Central regions (-59 ± 41%). The range-wide cock index (5.2 cocks/100 mi) declined 36% from 2010 and 39% from the 10-year average (Table 2). The cock index was significantly lower than last year in the Central (-48 ± 34%), Southwest (-48 ± 40%), and Southeast regions (-88 ± 57%). The 2011 hen:cock ratio was 0.65, which was the second lowest ratio on record and far below average (1.47 ± 0.33 [SD]) for the CRP years (1987-2010). A low sex ratio may reflect a delayed nesting effort, or greater mortality for hens than cocks.

The number of pheasant broods observed (3.2/100 mi) was 69% below last year, 75% below the 10-year average, and 76% below the long-term average (Table 2). The brood index remains far below the benchmark years of 1955-64 (34.9 broods/100 mi). Regional brood indices ranged from 0.8 broods/100 miles in the Southeast to 7.1 broods/100 miles in the East Central region. Average brood size in 2011 (4.6 ± 0.2 [SE] chicks/brood) was similar to last year (4.5 ± 0.2 [SE] chicks/brood), but below the 10-year mean (4.8 ± 0.1 [SE] chicks/brood) and the long-term average (5.5 ± 0.1 [SE] chicks/brood; Table 2). The median hatch date for pheasants was June 9 (n = 116), the same as the 10-year average (Table 2). The distribution of estimated hatch dates for observed broods was unimodal but skewed to the right, which suggests that many early nesting attempts were unsuccessful. Successful late-season nests tend to be underrepresented in roadside data. Median age of broods observed was 8 weeks (range: 2-16 weeks).

A severe winter throughout the pheasant range (the second consecutive severe winter) was expected to result in reduced hen counts, and this was observed in the survey data. In addition, cool, wet weather during April - June likely contributed to reduce brood survival rates. Thus, a decline in the range-wide pheasant index due to weather was expected, but the magnitude of the decline was disappointing.

Projecting from the roadside index, an estimated 249,000 roosters may be harvested this fall, similar to 2001 (Figure 2A), another year with a severe winter followed by a cold, wet spring. The best opportunity for harvesting pheasants appears to be in the East Central region, where winter weather was slightly less severe than in western Minnesota.

GRAY PARTRIDGE

Range-wide, the gray partridge index (1.7 partridge/100 miles) was similar to last year but 75% below the 10-year average and 76% below the long-term average (Table 2, Figure 2B). Within regions, the partridge index ranged from 0.0/100 miles in the Northwest, Central, and East Central regions to 4.3/100 miles in the South Central region (Table 3). There were no significant regional changes from last year (Table 3). Observations of gray partridge were too few for analysis by age class (n=7 broods statewide).

Conversion of diversified agricultural practices to more intense land-use with fewer haylands, pastures, small grain fields, and hedgerows have reduced the amount of suitable habitat for the gray partridge in Minnesota. Gray partridge in their native range (southeastern Europe and northern Asia) are associated with arid climates and their reproductive success is limited in the Midwest except during successive dry or drought years. Consequently, gray partridge are more strongly affected by weather conditions during nesting and brood rearing than are pheasants. The Southwest, Southeast, and South Central regions offer the best opportunity for harvesting gray partridge in 2011.

COTTONTAIL RABBIT and WHITE-TAILED JACKRABBIT

The eastern cottontail rabbit index (3.6 rabbits/100 mi) was similar to last year, but 42% below the 10-year average and 24% below the long-term average (Table 2, Figure 3A). The cottontail rabbit index ranged from 0.0 rabbits/100 miles in the Northwest to 8.9 rabbits/100 miles in the East Central region (Table 3). Among regions, cottontail indices declined significantly from last year only in the Central region (-55%; Table 3). The best opportunities for harvesting cottontail rabbits are in the East Central, Southeast, and South Central regions.

The index of white-tailed jackrabbits did not change significantly from 2010, but was 53% below the 10-year average and 96% below the long-term average (Table 2, Figure 3B). The range-wide jackrabbit population peaked in the late 1950's and declined to low levels in 1980s (Figure 3B). The long-term decline in jackrabbits reflects the loss of their preferred habitats (i.e., pasture, hayfields, and small grains). The greatest potential for white-tailed jackrabbit hunting is likely in the Southwest region (Table 3). However, indices of relative abundance and annual percent change should be interpreted cautiously because estimates are based on a small number of sightings.

WHITE-TAILED DEER

The index for white-tailed deer (14.8 deer/100 mi) was similar to last year and the 10-year average, but 69% above the long-term average (Table 2, Figure 4A). Among regions, deer indices were significantly different from 2010 only in the Southwest (Table 3).

MOURNING DOVE

The number of mourning doves observed (158.8 doves/100 mi) in 2011 was below last year, the 10-year average, and the long-term average (Table 2, Figure 4B). The mourning dove index ranged from 99.4 doves/100 miles in the Northwest region to 201.7 doves/100 miles in the West Central Region (Table 3). The number of mourning doves heard along U.S. Fish and Wildlife Service call-count survey (CCS) routes (n = 14) in Minnesota was similar to last year. Trend analyses indicated the number of mourning

doves heard along the CCS routes declined 1.6% per year (95% CI: -3.7 to 0.3%) during 2002-2011 and declined 1.4% per year (95% CI: -2.2 to -0.6%) during 1966-2011 (Seamans et al. 2011).

SANDHILL CRANE

For only the third consecutive year, observers were asked to report the number of adult and juvenile sandhill cranes observed on the August Roadside Survey. Range-wide, the 2011 index averaged 9.9 cranes/100 miles of survey, including 2.5 juveniles/100 miles (Table 2). Compared to 2010, we detected no change in the total number of cranes observed or the number of juvenile cranes observed (Table 2). Among regions, crane indices ranged from 0.0/100 miles in the Southwest and Southeast regions to 45.2 cranes/100 miles in the East Central region (Table 3). Regional crane indices were significantly different from last year only in the Northwest, where they declined 43% (Table 3). Juvenile cranes were observed in the Central (3.3/100 mi), East Central (16.9/100 mi), South Central (0.1/100 mi), and Northwest (4.5/100 mi) regions.

OTHER SPECIES

Notable incidental sightings: bald eagle (Wright County), Coopers hawk (Redwood County), great blue heron (Stevens County), belted kingfishers (Dodge and Douglas Counties), trumpeter swan (Pine County), magpies (Polk and Red Lake Counties), indigo bunting (Stevens County), upland sandpiper (Watonwan County), prairie chickens (Clay and Norman Counties), sharp-tailed grouse (Kittson, Polk, and Red Lake Counties), wild turkeys (Big Stone, Chippewa, Chisago, Dodge, Fillmore, Freeborn, Kandiyohi, Le Sueur, Marshall, Morrison, Mower, Polk, Pope, Red Lake, Sherburne, Sibley, Stearns, Steele, Todd, Traverse, Washington, and Wright Counties), coyotes (Lac Qui Parle, Le Sueur, Roseau, and Traverse Counties), badger (Lincoln County), and red fox (Traverse County).

LITERATURE CITED

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.

[MCWG] MINNESOTA CLIMATOLOGY WORKING GROUP. 2011. MCWG Home Page http://climate.umn.edu/. Accessed on August 3, 2011.

Table 1. Abundance (total acres) and density (acres/mi^2) of undisturbed grassland habitat within Minnesota's pheasant range, 2011[a].

	Cropland Retirement									Density
AGREG	CRP	CREP	RIM	RIM-WRP	WRP	USFWS[c]	MNDNR[d]	Total	%	ac/mi^2
WC[b]	313,629	39,203	18,458	9,139	18,453	181,062	109,080	689,023	10.1	64.9
SW	100,364	25,286	14,619	1,094	766	19,519	57,462	219,109	5.8	37.1
C	137,655	15,320	17,154	2,594	3,100	86,094	46,898	308,817	5.1	32.7
SC	85,750	28,181	11,192	5,846	8,791	8,515	31,721	179,996	4.5	28.5
SE	75,321	2,718	6,770	570	771	36,240	52,161	174,550	4.7	30.1
EC	4,515	0	1,127	0	4	4,720	85,832	96,198	3.0	19.2
Total	717,233	110,707	69,319	19,243	31,886	336,151	383,154	1,667,693	6.4	40.9

[a] Unpublished data, Tabor Hoek, BWSR, 23 August 2011.

[b] Does not include Norman County.

[c] Includes Waterfowl Production Areas (WPA) and USFWS refuges.

[d] MNDNR Wildlife Management Areas (WMA).

Table 2. Range-wide trends (% change) in number of wildlife observed per 100 miles driven, Minnesota August roadside survey, 1955-2011.

Species	Change from 2010[a]					Change from 10-year average[b]				Change from long-term average[c]			
Subgroup	*n*	2010	2011	%	95% CI	*n*	2001-10	%	95% CI	*n*	LTA	%	95% CI
Ring-necked pheasant													
Total pheasants	146	64.1	23.0	-64	±18	146	81.4	-71	±13	146	101.5	-77	±8
Cocks	146	8.2	5.2	-36	±17		8.6	-39	±14		11.5	-54	±12
Hens	146	9.1	3.4	-63	±19		12.4	-72	±14		14.7	-77	±10
Broods	146	10.3	3.2	-69	±18		12.7	-75	±14		13.3	-76	±9
Chicks per brood	116	4.5	4.6	2			4.8	-5			5.5	-18	
Broods per 100 hens	116	112.9	92.1	-19			103.5	-11			101.4	-9	
Median hatch date	113	Jun 9	Jun 9				Jun 09						
Gray partridge													
Total partridge	163	3.0	1.7	-42	±72	163	7.0	-75	±30	148	16.1	-76	±18
Eastern cottontail	163	4.7	3.6	-23	±26	163	6.3	-42	±15	148	6.8	-24	±17
White-tailed jackrabbit	163	0.1	0.2	74	±178	163	0.4	-53	±41	148	1.8	-96	±13
White-tailed deer	163	14.8	14.8	0	±24	163	14.4	2	±22	167	9.2	69	±34
Mourning dove	163	213.8	158.8	-26	±16	163	222.7	-29	±10	148	273.2	-16	±13
Sandhill Crane													
Total cranes	163	10.3	9.9	-4	±47								
Juveniles	163	2.0	2.5	25	±64								

[a] Includes Northwest region, except for pheasants. Estimates based on routes (*n*) surveyed in both years.

[b] Includes Northwest region, except for pheasants. Estimates based on routes (*n*) surveyed at least 9 of 10 years.

[c] LTA = 1955-2010, except for deer = 1974-2010. Estimates for all species except deer based on routes (*n*) surveyed ≥40 years; estimates for deer based on routes surveyed ≥25 years. Thus, Northwest region (8 counties in Northwest were added to survey in 1982) included only for deer.

Table 3. Regional trends (% change) in number of wildlife observed per 100 miles driven, Minnesota August roadside survey, 1955-2011.

Region	Change from 2009[a]				Change from 10-year average[b]				Change from long-term average[c]			
Species	*n*	2010	2011	%	95% CI	*n*	2001-10	%	95% CI	*n*	LTA	%	95% CI
Northwest[d]													
Gray partridge	17	0.0	0.0			17	0.4	-100	±104	17	4.0	-100	±70
Eastern cottontail		0.2	0.0	-100	±212		1.0	-100	±81		1.0	-100	±63
White-tailed jackrabbit		0.2	0.0	-100	±212		0.5	-100	±47		0.7	-100	±46
White-tailed deer		41.2	31.8	-23	±66		44.1	-28	±44		26.9	18	±78
Mourning dove		77.7	99.4	28	±146		83.6	19	±123		129.1	-23	±67
Sandhill Crane		46.8	26.9	-43	±41								
West Central													
Ring-necked pheasant	33	74.7	28.2	-62	±33	33	85.2	-67	±30	33	105.0	-73	±18
Gray partridge		2.4	0.0	-100	±204		2.7	-100	±58		10.0	-100	±23
Eastern cottontail		0.8	0.7	-14	±135		3.2	-77	±27		4.3	-83	±18
White-tailed jackrabbit		0.1	0.1	0	±293		0.5	-74	±82		2.1	-94	±22
White-tailed deer		17.6	18.2	3.5	±37		12.8	42	±46		9.1	99	±75
Mourning dove		342.1	201.7	-41	±36		267.7	-25	±21		371.3	-46	±12
Sandhill Crane		0.0	1.2										
Central													
Ring-necked pheasant	30	76.4	18.9	-75	±35	29	70.2	-72	±22	29	76.2	-74	±19
Gray partridge		0.0	0.3				3.5	-92	±64		9.9	-97	±42
Eastern cottontail		6.1	2.7	-57	±55		6.5	-57	±36		6.4	-57	±21
White-tailed jackrabbit		0.0	0.0				0.2	-100	±74		1.3	-100	±22
White-tailed deer		9.0	12.7	41	±45		7.2	83	±70		4.3	204	±123
Mourning dove		183.2	155.5	-15	±34		196.5	-19	±27		235.5	-32	±23
Sandhill Crane		10.8	17.2	59	±112								
East Central													
Ring-necked pheasant	13	49.8	50.8	1.9	±81	14	55.5	-9	±57	14	85.9	-41	±36
Gray partridge		0.0	0.0				0.0				0.1	-100	±133
Eastern cottontail		12.0	8.9	-26	±77		10.1	-10	±70		8.7	5	±68
White-tailed jackrabbit		0.0	0.0				0.0				0.2	-100	±57
White-tailed deer		10.4	20.3	95	±152		16.0	20	±127		8.1	137	±248
Mourning dove		97.8	101.9	4	±32		100.1	-1	±30		127.1	-22	±36
Sandhill Crane		40.9	45.2	11	±133								

Table 3. Continued.

Region	Change from 2009					Change from 10-year average				Change from long-term average			
Species	*n*	2010	2011	%	95% CI	*n*	2001-10	%	95% CI	*n*	LTA	%	95% CI
Southwest													
Ring-necked pheasant	19	104.2	19.2	-82	±38	19	159.8	-88	±20	19	119.5	-84	±15
Gray partridge		8.2	4.0	-51	±145		23.3	-83	±46		42.4	-91	±27
Eastern cottontail		3.4	3.8	13	±104		7.6	-50	±40		8.2	-54	±33
White-tailed jackrabbit		0.4	0.6	51	±286		1.0	-39	±93		3.9	-84	±30
White-tailed deer		20.0	9.7	-52	±39		14.5	-33	±38		8.2	17	±58
Mourning dove		238.7	189.6	-21	±27		334.1	-43	±18		314.9	-40	±18
Sandhill Crane		0.0	0.0										
South Central													
Ring-necked pheasant	32	56.5	23.1	-59	±42	32	85.1	-73	±26	32	133.3	-83	±13
Gray partridge		5.7	4.3	-26	±88		12.4	-66	±49		19.3	-78	±28
Eastern cottontail		5.4	4.6	-14	±44		9.0	-48	±21		7.7	-40	±23
White-tailed jackrabbit		0.0	0.4				0.2	73	±158		1.8	-79	±32
White-tailed deer		3.4	6.0	79	±116		5.5	9	±62		3.4	79	±98
Mourning dove		294.4	177.4	-40	±29		278.3	-36	±15		259.0	-32	±16
Sandhill Crane		1.0	0.6	-37	±170								
Southeast													
Ring-necked pheasant	19	8.6	5.3	-39	±94	19	26.6	-80	±30	19	73.7	-93	±27
Gray partridge		3.4	3.2	-6	±277		5.7	-44	±133		13.9	-77	±59
Eastern cottontail		8.0	7.6	-5	±60		8.0	-5	±51		7.7	-2	±51
White-tailed jackrabbit		0.0	0.0				0.1	-100	±90		0.6	-100	±43
White-tailed deer		12.8	12.9	0	±61		15.9	-19	±47		10.2	26	±47
Mourning dove		79.9	119.7	50	±36		194.6	-39	±19		225.1	-47	±17
Sandhill Crane		0.0	0.0										

[a] Based on routes (*n*) surveyed in both years.

[b] Based on routes (*n*) surveyed at least 9 of 10 years.

[c] LTA = 1955-2010, except for Northwest region (1982-2010) and white-tailed deer (1974-2010). Estimates based on routes (*n*) surveyed ≥40 years (1955-2010), except for Northwest (≥20 years) and white-tailed deer (≥25 years).

[d] Eight Northwestern counties (19 routes) were added to the August roadside survey in 1982.

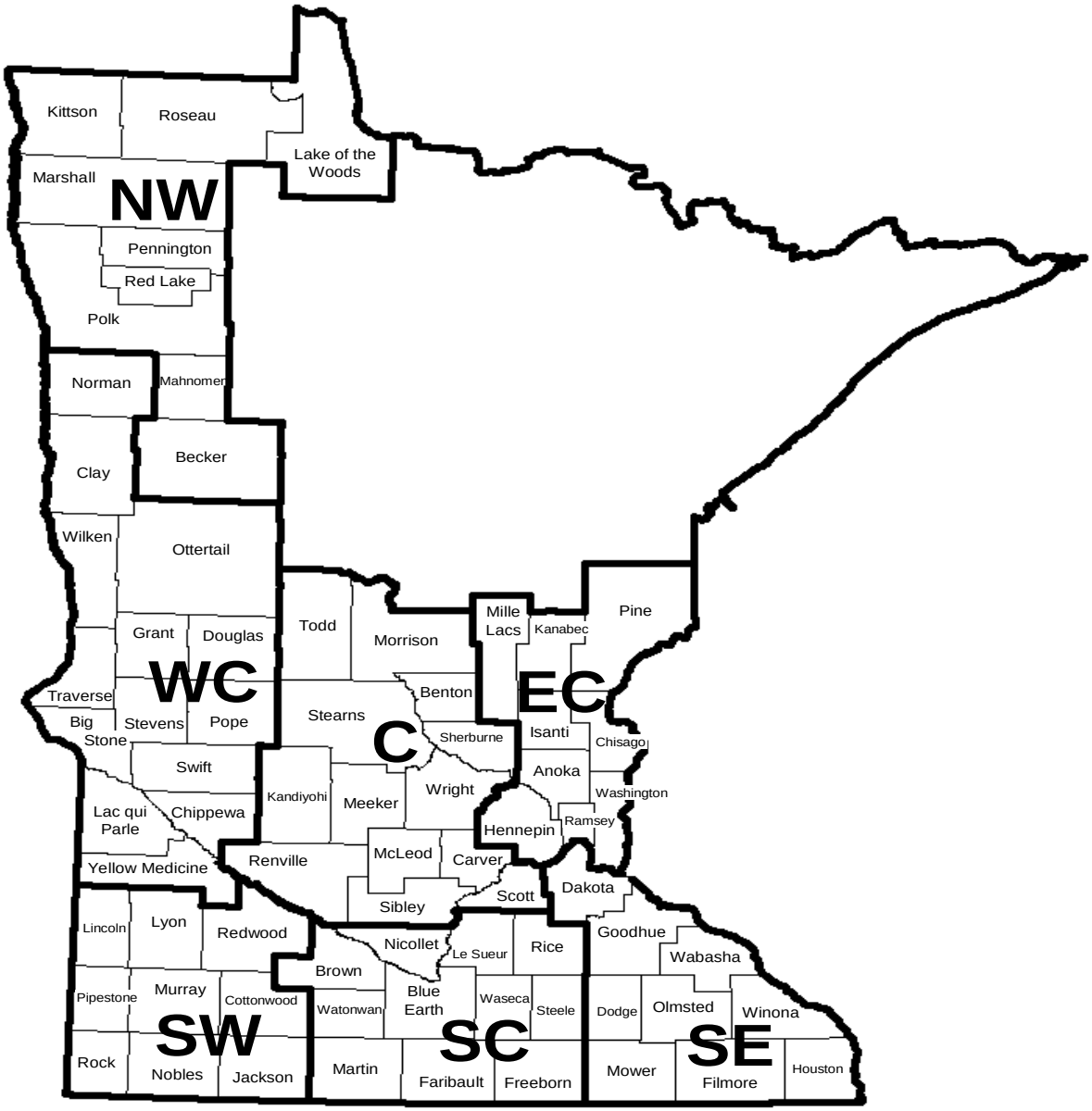

Figure 1. Survey regions for Minnesota's August roadside survey, 2011.

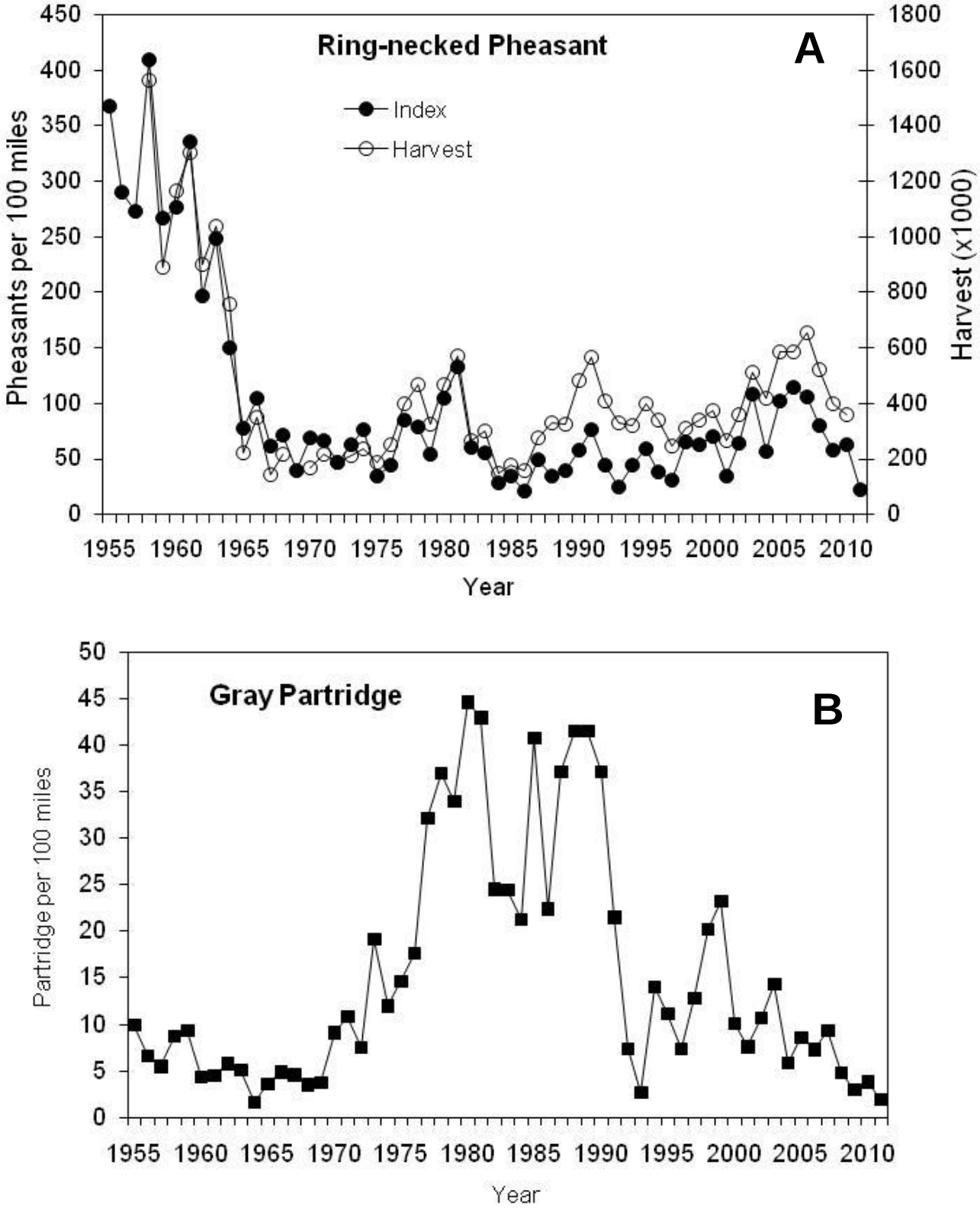

Figure 2. Range-wide index of ring-necked pheasants (**A**) and gray partridge (**B**) seen per 100 miles driven in Minnesota, 1955-2011. Does not include the Northwest region. Based on all survey routes completed.

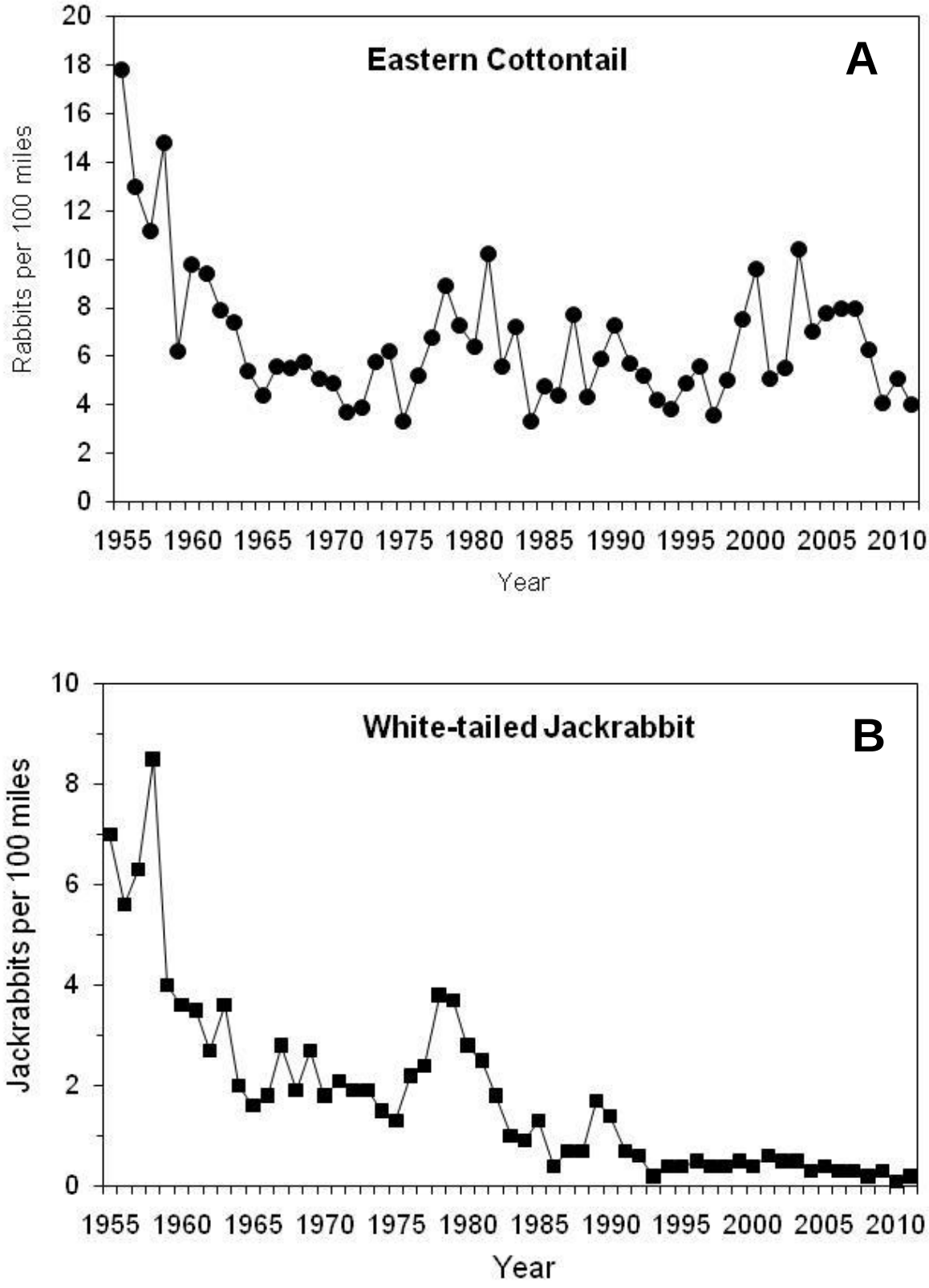

Figure 3. Range-wide index of eastern cottontail (**A**) and white-tailed jackrabbits (**B**) seen per 100 miles driven in Minnesota, 1955-2011. Does not include the Northwest region. Based on all survey routes completed.

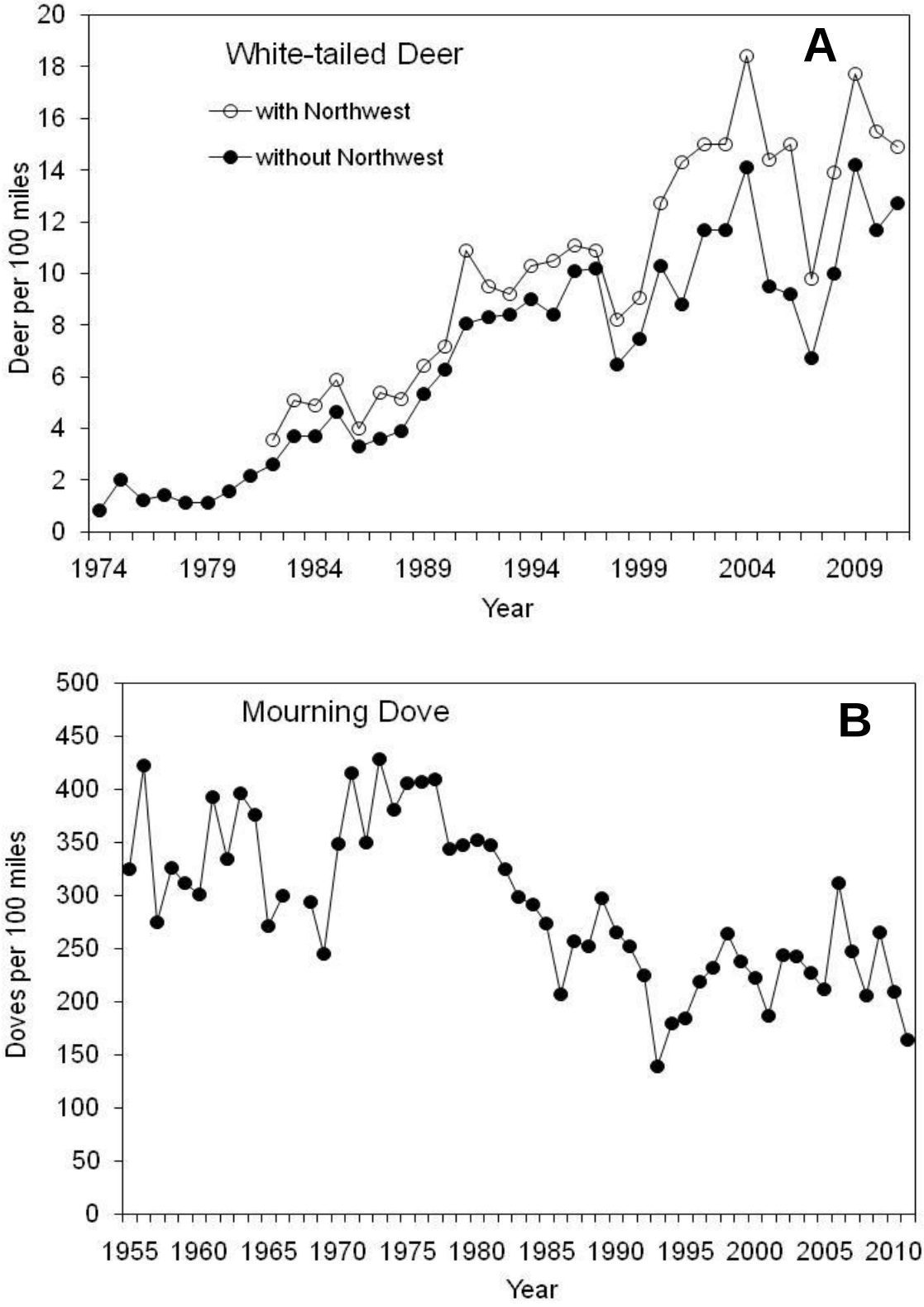

Figure 4. Range-wide index of white-tailed deer (**A**) and mourning doves (**B**) seen per 100 miles driven in Minnesota, 2011. Doves were not counted in 1967 and the dove index does not include the Northwest region. Based on all survey routes completed.

MONITORING POPULATION TRENDS OF WHITE-TAILED DEER IN MINNESOTA'S FARMLAND/TRANSITION ZONE – 2011

Marrett Grund, Farmland Wildlife Populations and Research Group

INTRODUCTION

White-tailed deer (*Odocoileus virginianus*) represent one of the most important big game mammals in Minnesota. Although viewed as being important by both hunters and non-hunters, deer also pose serious socioeconomic and ecological challenges for wildlife managers, such as deer-vehicle collisions, crop depredation, and forest regeneration issues. Thus, monitoring the status of deer populations is critical to determine appropriate harvest levels based on established management goals.

This document 1) identifies where the farmland population model was applied to model deer population dynamics in Minnesota, 2) describes the structure of and data inputs for the farmland population model, and 3) discusses general trends of deer density and current abundance.

METHODS

Minnesota Farmland/Transition Zone

The farmland/transition zone encompasses >46,000 square miles and 87 permit areas (PAs). I arbitrarily pooled PAs into 11 geographic units to describe general population trends and management issues at a broader scale (Figure 1). Several management strategies were available in 2011 including: 1) lottery with varying number of antlerless permits, 2) hunter's choice, 3) managed, and 4) intensive (Figure 2). The strategy employed during a given year depended upon where the population density was in relation to the population density goal (Figs. 3 and 4). The Twin Cities metro region (PA 601) was not modeled due to limited hunting opportunities, and PAs 224, 235 and 238 were not modeled due to demographic stochastic error associated with their small population sizes (Grund and Woolf 2004).

Population Modeling

The population model used to analyze past population trends and test harvest strategies can be best described as an accounting procedure that subtracts losses, adds gains, and keeps a running total of the number of animals alive in various sex-age classes during successive periods of the annual cycle. The deer population is partitioned into 4 sex-age classes (fawns, adults, males, and females). The 12-month year is divided into 4 periods representing important biological events in the deer's life (hunting season, winter, reproduction, and summer). The primary purposes of the farmland model were to 1) organize and synthesize data on farmland deer populations, 2) advance the understanding of farmland deer populations through population analysis, 3) provide population estimates and simulate vital rates for farmland deer populations, and 4) assist with management efforts through simulations, projections, and predictions of different management prescriptions (Figure 2).

The 3 most important parameters within the model reflect the aforementioned biological events, which include reproduction, harvest, and non-hunting mortality. Fertility rates were typically estimated at the regional level via fetal surveys conducted each spring (for details, see Dunbar 2005). Fertility rates were then used to estimate population reproductive rates for each deer herd

within a particular region. The deer population increased in size after reproduction was simulated. Non-hunting mortality rates occurring during summer months (prior to the hunting season) were estimated from field studies conducted in Minnesota and other agricultural regions. Although summer mortality rates were low, they did represent a reduction in the annual deer population. In farmland deer herds, previous research suggests virtually all mortality occurring during the year can be attributed to hunter harvests. Annual harvests were simulated in the model by subtracting the numerical harvest (adjusted for crippling and non-registered deer) from the pre-hunt population for each respective sex-age class. In heavily hunted deer populations, like those in the farmland/transition region, the numerical harvest data "drive" the population model by substantially reducing the size of the deer herd (Grund and Woolf 2004). Winter mortality rates were estimated from field studies conducted in Minnesota and other farmland regions, similar to summer mortality. After winter mortality rates were simulated, the population was at its lowest point during the 12-month period and the annual cycle began again with reproduction.

RESULTS

Population Trends and Densities

Northwest Management Units

Karlstad Unit – Deer numbers have declined 25-30% in this unit since 2007 and most populations are at or slightly below the goal density (Figs. 3 and 4). Thus, management strategies applied during the 2011 hunting season were more conservative than those used over the past 5-7 years. However, deer populations immediately to the west of PA 101 were managed more aggressively than what would have been used if Bovine TB was not a concern. Spring deer densities were 3.5-4.0 deer per square mile in this unit, which is substantially lower than the Spring 2007 deer density (>5.0 deer per square mile).

Crookston/TRF Unit – Deer densities have declined 15-20% in this unit due to the use of early antlerless seasons in 5 consecutive years (Table 1). Consequently, most of these herds are at goal and the PAs were designated as hunter's choice, managed or intensive; the early antlerless season was not used during the 2011 hunting season. These more conservative management strategies will reduce the antlerless harvest by >40% and will allow the populations to stabilize or increase toward goal densities. The unit deer density was 6-7 deer per square mile in Spring 2011.

Mahnomen Unit – Deer herd dynamics in this unit have been very stable over the last 5 years with deer densities varying between 4.5-5.5 deer per square mile (Table 1). All populations are at goal densities (Figs. 3 and 4) and hunter's choice was used throughout the unit (Figure 2) in attempt of maintaining a stable deer density.

Central Management Units

Morris Unit – Deer densities have increased from about 3 deer per square mile to just under 5 deer per square mile over the last 5 years (Table 1) and are now at goal densities (Figs. 3 and 4). Most 2011 management strategies used in this unit were designed to maintain stable deer densities through 2012 (Figure 2).

Osakis Unit – Deer densities have been very stable in the Osakis unit over the past 5 years with deer densities fluctuating between 13-14 deer per square mile (Table 1). All populations were at or near goal densities in 2011 (Figures 3 and 4). Management strategies used in 2011 were

slightly more liberal than in 2010 for some permit areas where deer densities may be considered on the high side of the goal density (Figure 2).

Cambridge Unit – Deer densities have been very stable with about 13 deer per square mile over the last 5 years (Table 1). However, almost all deer populations remain well above goal in 2011 (Figs. 3 and 4). This unit was an active participant in the ADM study and 3 of the PAs were managed with early antlerless seasons for 5 consecutive years. Aerial surveys conducted in 2010 confirmed deer densities did not decline as a result of the early antlerless seasons, however.

Hutchinson Unit – Deer densities have increased about 30% over the last 5 years in this unit. Deer densities were approximately 4 deer per square mile 5 years ago and they are now 5-5.5 deer per square mile in 2011. Most deer populations are at goal and management strategies used in 2011 were more liberal than those used in 2010 (Figure 2). Bucks-only management strategies were no longer needed in this unit and antlerless permit quotas were increased this year in attempt to slow population growth rates.

Southern Management Units

Minnesota River Unit – Deer densities have increased from about 4 deer per square mile in 2007 to approximately 6 deer per square mile in 2011 (Table 1). All deer populations are on the high side of goal (Figs 3 and 4) and management strategies used in 2011 were designed to stabilize or slightly decrease deer numbers (Figure 2).

Slayton Unit – Deer densities have increased approximately 30% over the past 5 years and were approximately 3 deer per square mile in Spring 2011. About half of the deer populations have deer densities at goal levels, the other half are still slightly below goal. Despite having densities below goal, all permit areas were designated as lottery and bucks-only strategies were not used in 2011. In all situations where the deer density remains below goal, the antlerless permit allocation remained conservative and the populations will continue to grow towards goal.

Waseca Unit – Population densities have been very stable over the past 5 years in this unit and most deer populations are at or near density goals (Table 1, Figs. 3 and 4). Hunter's choice was used in most PAs in attempt to maintain stable deer numbers. It is very likely that the PAs along the eastern side of the unit will return to using a managed strategy at some point in the future so that populations are managed according to goal levels.

Rochester Unit – Deer densities have been stable across the entire unit (Table 1). However, densities have grown in some PAs (e.g., PA 344) and have declined in others (e.g., PAs 346 and 349). Due to the excellent habitat available in this unit, higher deer numbers can be supported and using aggressive management strategies are needed just to maintain stable deer numbers (Figure 2). Most populations are at goal, but densities in PAs 346 and 349 remain above goal (Figs. 3 and 4). However, deer numbers are declining in both PAs and the early antlerless season was discontinued because modeling suggested the populations would continue to decline by simply designating each PA as intensive. Chronic Wasting Disease was discovered last winter along the western portion of PA 343 and a disease management unit was created similar to PA 101 where Bovine TB was discovered in northwest Minnesota (Figure 2).

LITERATURE CITED

DUNBAR, E. J. 2005. Fetus survey data result of white-tailed deer in the farmland/transition zone of Minnesota—2005 *in* Dexter, M. H., editor, Status of wildlife populations, fall 2005. Unpublished report, Division of Fish and Wildlife, Minnesota Department of Natural Resources, St. Paul, Minnesota, USA. 270pp.

GRUND, M. D., and A. WOOLF. 2004. Development and evaluation of an accounting model for estimating deer population sizes. Ecological Modeling 180:345-357.

Figure 1. Deer management units in the farmland zone of Minnesota, 2011.

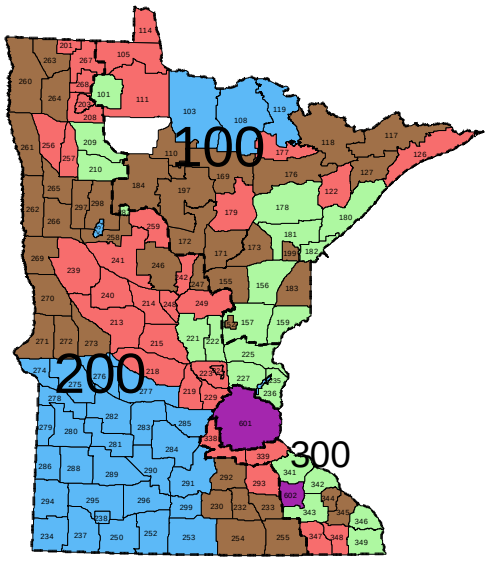

Figure 2. Deer management strategies used in permit areas throughout Minnesota, 2011. Permit areas are numbered and management strategies are color-coded. Permit areas are designated as: 1) lottery if colored blue, 2) hunter's choice if colored brown, 3) managed if colored red, and 4) intensive if colored green.

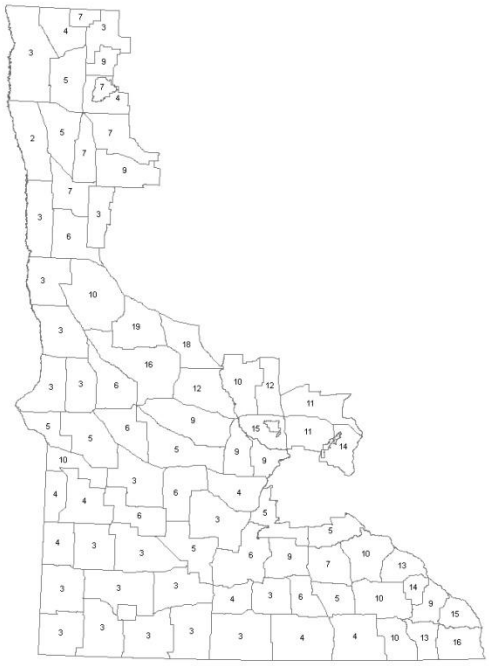

Figure 3. Population density goals in farmland deer permit areas in Minnesota, 2011.

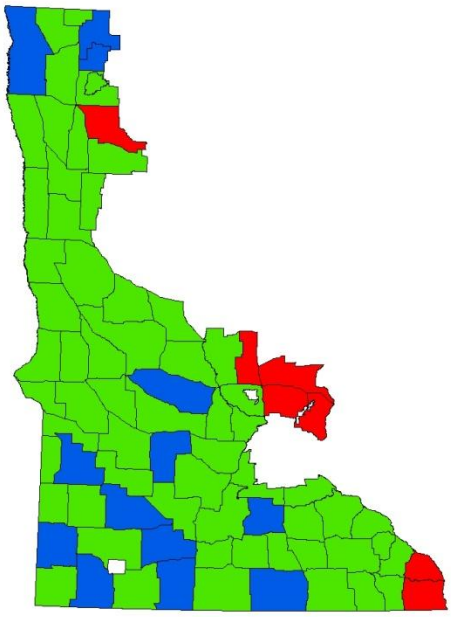

Figure 4. Population density relative to goal density in the farmland region of Minnesota, 2011. Permit areas colored in blue were below goal, permit areas colored in green were at goal, and permit areas colored in red were above goal.

Table 1. Pre-fawn deer density (deer/mi^2) as simulated from population modeling in each permit area of Minnesota's Farmland/Transition Zone, 1999-2011.

Region / Permit Area	Area (mi^2)	Pre-fawning Density												
		1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Karlstad														
201	161	3	4	4	5	5	4	5	6	6	6	6	6	6
260	1249									4	3	3	2	2
263	512									5	5	5	5	4
203	118	4	5	5	6	8	7	7	5	6	6	7	7	8
208	379	3	4	4	4	5	4	4	4	4	4	4	4	4
267	472									4	3	3	2	2
268	229									9	8	9	8	7
264	669									7	7	7	6	5
Total	3789	3	4	4	5	6	5	4	4	5	5	5	4	4
Crookston														
261	795									2	2	2	2	2
256	653	6	6	7	8	8	8	7	7	7	6	6	5	5
257	413	8	8	8	8	7	8	9	8	8	8	7	7	7
209	639	6	6	7	7	7	8	9	9	9	9	9	9	9
210	615	11	11	11	12	11	12	13	12	13	12	12	11	10
Total	3115	8	8	8	9	8	8	8	8	7	7	7	7	6
Mahnomen														
262	677									2	2	2	2	2
265	494									10	9	10	8	7
266	617									5	6	7	7	7
297	438								4	3	3	2	3	3
Total	2226									6	6	6	6	6

Morris														
269	650	3	3	4	4	4	4	4	3	2	2	2	3	4
270	748	3	3	3	3	4	4	2	1	1	1	2	2	3
271	632	2	2	2	2	3	3	4	2	1	2	2	3	3
272	531	3	3	3	4	4	2	2	2	1	2	2	2	3
273	572								4	4	5	5	6	7
274	360	6	5	4	4	4	4	4	4	3	3	5	6	7
275	764	4	4	3	3	3	3	4	4	4	3	4	5	6
276	543	9	8	8	8	8	7	7	6	4	4	4	5	7
282	779	1	1	1	1	1	1	2	1	1	2	2	3	4
Total	5579	4	4	4	4	4	4	4	3	2	3	3	4	5
Osakis														
239	922	15	16	16	15	14	13	12	12	10	10	9	10	11
240	642	23	25	26	27	26	21	20	19	19	18	18	18	19
213	1057								13	12	12	13	15	15
214	557	18	18	19	19	19	20	19	18	20	20	19	19	19
215	701	9	9	9	10	10	9	8	9	9	9	10	10	10
Total	3879	16	17	18	18	17	16	15	15	13	13	13	13	14
Cambridge														
221	642	11	12	11	12	13	13	12	13	13	12	12	12	11
222	413	14	14	14	15	15	14	14	15	16	15	15	15	15
223	377	8	11	10	9	11	9	8	11	11	10	11	12	14
225	618	15	18	19	16	16	15	13	13	15	16	16	16	15
227	471	13	13	12	11	11	10	9	13	14	13	14	14	14
229	287	5	6	6	6	7	7	6	7	6	6	6	7	8
236	372	17	17	16	17	17	18	18	18	17	16	16	16	16
Total	3180	12	13	13	12	13	12	11	13	14	13	13	13	13

Hutchinson														
218	884								7	6	6	6	7	7
277	813								3	3	3	4	4	5
219	392	8	9	7	7	8	7	7	7	7	7	8	9	10
229	287	5	6	6	6	7	7	6	7	6	6	6	7	8
285	550	4	4	4	4	5	6	4	3	3	3	4	4	4
283	614	3	3	3	4	4	3	3	3	4	2	3	3	4
284	838	1	2	2	2	2	2	3	2	2	2	2	3	3
Total	4378	4	5	4	5	5	5	5	5	5	5	6	6	6
Minnesota River														
278	401	8	8	8	8	9	10	8	8	6	6	7	8	10
281	575	5	5	4	4	5	5	6	4	4	4	4	5	6
290	662	4	4	4	4	4	4	4	4	3	3	3	4	5
291	802	4	4	4	4	5	5	5	4	4	4	4	5	5
Total	2440	5	5	5	5	6	6	6	5	4	4	4	5	6
Slayton														
237	729	2	2	3	3	4	3	2	2	1	1	2	2	2
279	344	7	7	6	6	6	5	5	4	3	3	4	4	5
280	675	2	2	2	2	2	2	3	2	3	2	2	3	3
286	446	2	3	4	4	4	4	4	4	3	3	3	4	5
288	625	2	3	4	4	4	4	4	3	2	2	1	2	2
289	816	2	1	1	1	2	2	1	2	2	2	1	2	2
294	686	3	3	3	3	3	4	2	2	2	1	2	2	2
295	840	3	3	3	3	4	4	4	3	2	2	2	3	3
296	666	3	3	3	3	3	3	3	2	2	2	2	2	2
234	636	3	4	4	4	4	5	4	3	2	2	2	2	3
250	712	3	3	4	4	4	5	4	4	2	2	2	2	3
Total	5734	3	3	3	3	4	4	4	3	2	2	2	2	3

Waseca														
292	480	8	8	7	7	8	7	7	8	8	8	7	7	7
293	511	8	8	8	8	7	7	8	8	7	7	7	6	6
299	386	5	5	5	5	5	5	5	3	4	4	4	4	5
230	452	3	3	3	3	4	4	4	4	3	2	3	3	3
232	377	4	4	4	4	4	4	4	5	5	5	4	5	5
233	385	4	4	4	4	5	5	4	4	4	4	4	4	4
252	715	2	2	2	2	2	3	2	2	2	2	2	2	2
253	974	3	3	3	3	3	4	3	2	2	2	2	2	3
254	930	4	4	4	4	4	4	5	4	3	3	3	3	3
255	774	4	4	4	4	4	4	4	4	3	3	3	3	4
Total	5269	5	5	5	5	5	5	5	5	4	4	4	4	4
Rochester														
338	454	4	4	4	5	5	4	4	4	4	4	5	5	6
339	394	5	4	5	5	4	4	5	5	4	5	5	6	6
341	611	9	9	9	10	10	9	10	9	10	10	10	10	10
342	350	11	12	11	13	15	17	13	13	12	13	13	13	14
343	662	8	9	9	11	13	11	13	10	11	11	11	10	10
344	189	14	14	14	15	15	13	12	11	11	12	12	15	16
345	326	11	11	10	10	11	12	11	12	10	10	9	8	8
346	319	18	19	19	19	20	20	21	22	22	21	20	19	19
347	434	9	9	9	10	11	12	13	13	11	10	10	10	12
348	332	17	16	15	15	16	17	18	20	18	17	14	14	13
349	492	16	17	17	18	21	20	21	23	23	22	21	20	19
Total	4563	11	11	11	12	13	13	13	13	12	12	12	11	12

2010 MINNESOTA SPRING TURKEY HUNTER SURVEY REPORT

Eric Dunton, Farmland Wildlife Populations and Research Group

In Minnesota, the spring wild turkey hunting season is designed to regulate harvest and distribute hunting pressure by allocating permits across 77 permit areas (PAs) and 8 time periods (6, 5-day [Time Periods A – F] and 2, 7-day [Time Periods G – H]) using a quota system. The Minnesota Department of Natural Resources (MNDNR) attempts to issue the optimum number of permits to satisfy hunter demands while maintaining sustainable turkey populations and quality of hunting (Kimmel 2001, MNDNR 2007).

The objective of the spring turkey-hunter survey is to monitor hunter satisfaction and associated factors, including interference rates (between hunters), and relative ease of access to hunting land. We also used the 2010 spring turkey-hunter survey as a pilot study to evaluate the feasibility of collecting response data via the internet (vs. mail-back surveys).

METHODS

We randomly selected 2,421 hunters (resident and non-resident) that purchased a 2010 spring turkey-hunting license from 5 PAs (344, 345, 346, 348, and 349) based on Electronic Licensing System (ELS) database. Hunter samples were randomly selected for all 8 time periods (i.e., April 14 – May 27, 2010). To evaluate the feasibility of using the internet to collect response data, hunters were randomly assigned to 1 of 3 treatment groups based on the method of response: mailback, mixed-mode, and internet. The mailback group received a postage-paid paper survey that could be completed and returned via U.S. mail. The mixed-mode and internet groups received a postcard with a Uniform Resource Locator (URL) address for the survey website and were instructed to go to the website to complete the survey. Internet respondents (mixed-mode and internet treatment groups) were required to enter a unique identification number to prevent multiple responses by the same respondent or unverifiable responses (unknown respondents). The first mailing (to all 3 groups) was sent out on 7 June 2010. One follow-up mailing was sent to non-respondents (for all 3 groups) on 26 July 2010. Non-respondents from the mailback and mixed-mode groups received a postage-paid mailback survey for the second mailing, whereas the internet group received a second postcard reminding them to visit the website to complete the survey.

We also conducted a follow-up survey (postage-paid mailback survey) of non-respondents from the internet-only treatment group. The objective of the follow-up survey was to determine reasons for not responding (e.g., did not want to participate, did not own a computer or have access to internet, security concerns over using the internet, technical problems that precluded them from responding). Follow-up surveys were mailed on 26 August 2010.

RESULTS

The overall response rate after 2 mailings was 61%, but it varied by permit area, and especially, treatment group (Table 1). The lowest per-mailing response rates (range: 20–34%) were from hunters that received postcards directing them to a website (i.e., internet group and first mailing to mixed-mode group; Table 1). Conversely, per-mailing response rates in mail-back surveys ranged from 39–61%. Likewise, the overall response rate was lowest for the internet group (44%, 95% CI: 42–46%), highest for the mailback group (74%, 95% CI: 72–76%), and intermediate for the mixed-mode group (65%, 95% CI: 63–67%). Response rate by time period ranged from 7% (time period H) to 17% (time period E). Sixteen surveys were undeliverable due incorrect address in the ELS database.

Mean hunt- quality scores, interference rates, and ease of access (to hunting land) ratings were similar among treatment groups (Table 2). Therefore, we pooled data for the 3 treatment groups. The overall mean hunt-quality score was 3.3 (scale: 1 = poor to 5 = excellent) and ranged from 3.2 (PA 345) to 3.4 (PA 344). The most important factor in determining hunt quality was "seeing turkeys/calling birds in/hearing gobbling" (PAs 345, 346, 348, 349) or "spending time with family and friends" (PA 344; Table 3). Twenty-three percent of hunters responded "definitely yes" or "somewhat" that another hunter kept them from hunting where they intended (Table 4). Eighty-nine percent of hunters stated that another hunter did not interfere with their chance to harvest a turkey (Table 5). Interference rates (i.e., proportion of hunters reporting that another hunter interfered with their ability to harvest a turkey) were 10% (PAs 345, 346, 348, and 349) and 18% (PA 344). The majority (56%) of interference that was reported occurred on private land and with an average of < 1 day of interference occurring (Table 5). Of the 44% of interference reported on public land, 55% occurred in PA 344, which primarily consist of Whitewater Wildlife Management Area. Seventy-four percent of hunters reported access to hunting land as "somewhat easy" or "very easy" with 70% of hunters indicating they hunted private land, 16% public land, and 13% hunted private and public land (Table 6). Thirteen percent of private land hunters were landowners, 3% tenants, and 84% did not identify themselves as a landowner or tenant (Table 7). Thirty-four percent of hunters who hunted exclusively public land indicated they hunted public land because they could not gain access to private land. Eleven percent of hunters felt turkey numbers increased, 35% thought they decreased, 47% about the same, and 7% hunted a different PA (Table 8).

Mean respondent age ranged from 49 (PA 344) to 52 (PA 349) and was similar among treatment group; 50 (mailback), 50 (mixed-mode), and 51 (internet).
Seventy-five percent of respondents purchased a spring turkey lottery license (i.e., general lottery or landowner), 23% surplus, 2% non-resident general lottery, and < 1% non-resident surplus permits. Ninety-eight percent of respondents reported that they hunted (mean days hunted = 3) and 30% reported successfully harvesting a turkey Seventy-seven percent of respondents indicated they do not live in the PA they generally hunt, 52% applied or hunted in the same area they hunted in 2010; 18% 2 of the last 3 seasons; 18% 1 of the last 3 seasons; and 12% didn't apply or hunt in the same areas as they applied or hunted in 2010 (Table 9). Forty seven percent of respondents reported hunting each of the last 3 season (2007 – 2009), 20% 2 of the last 3 seasons, 22% 1 of the last 3 seasons, and 11% didn't hunt any of the last 3 seasons (Table 9).

Twenty-nine percent of the 492 "internet" non-respondents answered our follow-up survey about why they did not complete an internet survey. Hunters listed the following reasons for not responding to the "internet" survey (n = 142): do not own a computer or have access to the internet (41%), other (32%), did not want to participate in survey (16%), encountered technical problems trying to access the survey site (13%), concerned about privacy issues associated with using the internet (6%). Of those who indicated "other" as a reason for not responding (n = 50), 54% intended to respond but forgot to complete it, 16% did not notice survey card in the mail, 8% lost or misplaced the survey card (containing the web address and survey id), 6% state their computer was not working at the time they received the survey card, 4% did not hunt during 2010, 4% stated that they were not "good" with using computers, 2% did not want to admit they were unsuccessful in harvesting a turkey.

Of those respondents that indicated they experienced technical problems accessing the survey site,13 respondents stated they could not find the survey site, 1 respondent could not complete the survey, and 1 reported their survey ID did not work. Of the respondents who attempted to respond but failed, 8 respondents tried to access the survey site using an internet based search engine (i.e., Google, Yahoo, Aol, Bing, etc), 6 used the browser address bar, 1 respondent had the DNR website saved in their internet favorites and tried to find the survey site on the DNR homepage.

Respondents were also given the opportunity to provide comments or suggestions on how to make an internet-based survey easier to use. Seventeen hunters stated they simply prefer mailback surveys, 2 stated the DNR should ask for e-mail addresses from hunters and conduct e-mail based surveys, 1 suggested making it similar to the Harvest Information Program (HIP) used for migratory bird data collection (i.e., ask survey questions when the buy a license the following year), 1 reported survey fatigue (i.e., asked to complete too many surveys), and 1 suggested making the survey phone-based rather than internet- based.

DISCUSSION

Minnesota's harvest-management strategy is to maximize the amount of turkey hunting across each permit area while providing a safe, quality hunting experience. The factors most often cited as contributing to a quality hunt include ease of access to hunting lands, a feeling of safety, proper distribution of hunters (i.e., lack of interference from other hunters), observing turkeys while hunting, having the opportunity to get a shot, and success in harvesting a turkey (Smith et al. 1992, Dingman 2003). Success is the most often cited factor influencing a quality hunting experience (Stankey et al. 1973, Hende 1974, Dingman 2003). Based on the results from this survey, hunters in the surveyed permit areas generally are experiencing a quality hunt (mean score = 3.3), which is characterized by relatively high success (mean = 30%), low interference rates (mean = 11%), relatively easy access to hunting land (74% of hunters reported finding a place to hunt as "somewhat easy" or "very easy"), and the majority of hunters (70%) hunted private land, indicating that access to hunting land does not appear to be an issue for most hunters.

The survey area covered southeastern Minnesota, which is where wild turkeys were initially reintroduced and where the first spring season was held in 1978. This area has the highest hunter density (mean = 0.7 permits/mi^2 of PA; Time Periods A-F) in the State, which is one factor that can contribute to increased interactions among hunters. Although hunter density is relatively high (compared to other PAs in the state), 89% of respondents reported that another hunter did not interfere with their chance to harvest a turkey. Furthermore, 84% of hunters reported that interference did not occur and over half of the interference that was reported occurred mostly on private land. Interference occurring on privately owned land would seem to be a hunter-landowner issue (i.e., landowner allowing multiple hunters on their land at the same time or hunters choosing to hunt land that they know other hunters are hunting). In PA 344, which contains a large tract of publicly owned land (i.e., Whitewater Wildlife Management Area), 77% of hunters reported that interference did not occur and only 7% indicated that interference was the most important factor in determining a quality hunting experience for them. Overall, respondents indicated that the most important factor in determining a quality turkey hunting experience was "seeing turkeys/calling birds in/hearing gobbling." Hunters reported quality as slightly above average (mean score = 3.3) across all PAs and treatment groups, and hunters that successfully harvested a turkey rated quality slightly higher (mean score = 4.0), which is consistent with previous surveys that found success to be the most important factor in determining a quality turkey-hunting experience (Dingman 2003).

We also found a high level of turkey-hunter retention (i.e., 87% of respondents hunted in 2 of the last 3 years) and high fidelity to a turkey permit area (e.g., 70% of respondents applied or hunted 2 of the last 3 years in the same area they hunted in 2010). The southeast region also appears to be drawing hunters from other areas of the state (e.g., 77% of respondents indicated they did not live in the area they hunt).

There was a notable difference in the overall response rate among the 3 treatment groups (74% mail-back, 65% mixed-mode, and 44% internet only), but there was an inverse relationship in terms of the cost of conducting each survey. The estimated cost per useable return was $1.96 for the internet-only survey, $2.24 for the mixed-mode survey, and $2.75 for the mail-back survey. We included costs for printing services, postage, envelopes, and data entry services, but we did not include programming cost ($420) for

the internet database because we used the same database to store returns from all 3 treatment groups. Although the cost per useable return was lowest for the internet-only survey, we caution that cost is only one of several factors that should be considered when choosing a survey design. For example, the low response rate in the internet-only survey and information from the follow-up survey (security concerns, technical difficulties, no computer) raises concerns about the potential for non-response bias in the internet-only survey. Likewise, the low response rate in the internet-only survey means that more effort would be needed to obtain a similar sample size and level of precision as in the mail-back survey, and whether such additional costs would be linear with respect to estimated cost/useable return is not clear. For example, you would likely need to mail out more surveys initially and conduct >1 follow-up survey, both of which would increase mailing and non-respondent costs.

Within the internet treatment there were some hunters that reported an inability to access the survey site. In follow-up phone conversations with hunters who called looking for assistance in locating the website, it was discovered that the problem was due to hunters using an internet search engine (i.e., Google, Bing, Yahoo, etc) to type the web address provided on the survey card rather than using browser address bar. The survey website was not indexed on search engines and consequently hunters were unable to find the site. A link to the survey website was placed on the MNDNR Farmland Wildlife Populations and Research Group and the MNDNR Wild Turkey web pages (the 2 most common sites visited by hunters looking for the survey website), which re-directed respondents to the correct URL. Undoubtedly this contributed to the lower response rate in the internet treatment group (e.g., additional hunters tried to access the internet survey, could not, and disposed of survey postcard). We also asked hunters that received a mailback survey if they would respond to the survey if they received a postcard directing them to a computer website; 77% indicated "yes" they would respond, 22% "no", and 1% did not answer the question. This suggests that most hunters are willing to respond to an internet-based survey, but technical problems must be resolved and tradeoffs involving non-response bias, precision, and costs should be more carefully evaluated before committing to an internet-only survey design.

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Table 1. Spring wild turkey hunter's surveyed (*n*) and response rate (%) by permit area, mailing, and treatment group for the 2010 spring wild turkey season, Minnesota.

	Mailback[a]		Mixed-mode[b]		Internet[c]	
Permit area	*n*	%	*n*	%	*n*	%
1st mailing						
344	151	58	154	23	154	30
345	163	51	161	27	161	21
346	156	51	155	23	157	22
348	160	61	161	25	161	29
349	177	60	175	34	175	24
Total	807	56	806	27	808	25
2nd mailing						
344	62	39	119	50	108	28
345	79	41	117	53	125	20
346	75	39	119	48	119	24
348	60	48	121	64	113	24
349	69	39	114	48	133	28
Total	345	41	590	53	598	25
Overall						
344	151	74	154	62	154	49
345	163	71	161	66	161	37
346	156	70	155	60	157	41
348	160	79	161	73	161	46
349	177	76	175	66	175	45
Total	807	74	806	65	808	44

[a] Hunters received a postage-paid paper mailback survey for both mailings.
[b] Hunters received a postcard with a website address and unique survey identification number on the first mailing. Non-respondents received a postage-paid mailback survey for the second mailing.
[c] Hunters received a postcard with a website address and a unique survey identification number and were asked to go to the website to complete the survey.

Table 2. Mean hunt-quality scores, interference rates, and ease of access (to hunting land) by treatment group for the 2010 spring wild turkey season, Minnesota.

Treatment group	Mean hunt quality score	Interference rates (%)	Ease of access to hunting land (%)				
			Very difficult	Somewhat difficult	Somewhat easy	Very easy	Total(*n)*
Mailback	3.2	11	4	22	31	43	592
Mixed-Mode	3.4	13	4	23	33	40	518
Internet	3.4	10	4	20	30	46	352

Table 3. The most important factors hunters selected in determining a quality spring turkey hunt by permit area during the 2010 spring wild turkey season, Minnesota.

Most important factor in determining quality	Permit area				
	344	345	346	348	349
An opportunity to kill a turkey	18%	10%	10%	9%	14%
Seeing turkeys/calling birds in/hearing gobbling	1%	53%	63%	56%	56%
Killing a turkey (Tom, Jake, Bearded hen)	1%	1%	2%	1%	1%
Killing a mature Tom	4%	4%	2%	3%	3%
Weather	3%	6%	3%	5%	4%
Not seeing other hunters	3%	1%	1%	2%	2%
Not being interfered with by other hunters	7%	5%	3%	3%	2%
Spending time with family and friends	54%	10%	9%	12%	10%
Access to private hunting land	1%	3%	3%	2%	3%
Being successfully drawn to hunt an early time period	9%	6%	4%	7%	5%
Total (*n*)	253	277	258	313	325

Table 4. Number of hunters that indicated another hunter kept them from hunting where they wanted by permit area during the 2010 spring wild turkey season, Minnesota.

Permit area	Definitely Yes	Somewhat	Not Much	Not at All
344	29	63	72	116
345	20	37	59	161
346	17	39	53	150
348	23	39	61	191
349	19	48	61	197
Total (*n*)	108	226	306	815

Table 5. Hunters who indicated another hunter interfered with their chance to harvest a turkey, type of land where interference occurred, and number of days interference occurred by permit area during the 2010 spring wild turkey season, Minnesota.

Permit area	Another hunter interfered with chance to harvest a turkey		Type of land interference occurred on			Number of days interference occurred		
	Yes	No	Public	Private	Interference didn't occur	Mean	Range	# reporting zero days
344	49	231	58	7	215	0.65	0 - 7	172
345	28	249	11	33	233	0.38	0 - 4	202
346	27	232	7	31	221	0.33	0 - 7	206
348	30	285	16	33	264	0.39	0 - 5	235
349	32	294	13	29	284	0.34	0 - 4	256
Total (*n*)	166	1291	105	133	1217			1051

Table 6. Ease of access to hunting land and type of land hunted by permit area during the 2010 spring wild turkey season, Minnesota.

Permit area	Ease of access to hunting land				Type of land hunted		
	Very difficult	Somewhat difficult	Somewhat easy	Very easy	Private	Public	Both
344	7	61	102	111	59	165	57
345	15	66	83	114	244	10	24
346	8	54	84	115	233	5	23
348	11	70	94	141	232	35	50
349	15	70	99	142	264	26	37
Total (*n*)	56	321	462	623	1032	241	191

Table 7. Number of private land hunters who indicated they were the landowner or tenant of the land they hunted, and number of public land hunters who indicated they hunted public land exclusively because they could not gain access to private land during the 2010 spring wild turkey season, Minnesota.

	Private land hunters			Public land hunters[a]	
Permit area	Landowner	Tenant	Neither	Yes	No
344	6	4	106	83	134
345	35	5	228	10	35
346	39	8	210	9	23
348	37	11	233	30	58
349	39	9	253	23	52
Total (*n*)	156	37	1030	155	302

[a] Respondents were asked "yes" or "no" if they hunted public land exclusively because they could not access private land

Table 8. Hunters perception of changes in turkey numbers by permit area over the last 3 spring wild turkey seasons, Minnesota.

Permit area	Increased	Decreased	About the same	Didn't hunt the Same PA
344	31	64	151	34
345	32	95	129	20
346	24	100	126	10
348	46	96	150	23
349	20	154	134	18
Total (*n*)	153	509	690	105

Table 9. Respondents that live in the permit area they hunted in 2010, number of seasons respondents applied or hunted in the area they hunted in 2010, and total number of spring wild turkey seasons hunted by permit area during the previous 3 (2007-2009) seasons.

Permit area	Live in PA they hunted		# of seasons (2007-2009) applied or hunted in PA they hunted in 2010				# of seasons hunted in last 3 spring seasons (2007- 2009)			
	Yes	No	0	1	2	3	0	1	2	3
344	45	236	43	65	49	120	46	87	40	102
345	107	171	42	35	54	143	35	33	58	149
346	65	196	21	36	40	159	18	36	46	156
348	52	265	39	82	61	135	34	102	70	108
349	65	262	32	45	53	191	29	63	66	161
Total (*n*)	334	1130	177	263	257	748	162	321	280	676

Appendix A.

Minnesota Spring Turkey Hunter Survey

Please respond to all the questions based on the spring 2010 turkey season

1. Did you hunt turkeys in Minnesota during the spring 2010 season?
   Yes____ No*____

   * If you did not hunt during the 2010 spring turkey season please do not continue

2. Did you successfully harvest a turkey during the 2010 spring wild turkey season?
   Yes____ No____

3. How many days did you hunt during the 2010 spring wild turkey season (check only one)?
   1____ 2____ 3____ 4____ 5____ 6____ 7____

4. In which of the past 3 spring turkey hunting seasons did you hunt in Minnesota (check all that apply)?
   2007____ 2008____ 2009____

5. During which of the 3 past spring turkey seasons (2007-2009) did you apply and/or hunt in the permit area where you hunted in 2010 (check all that apply)?
   2007____ 2008____ 2009____

6. Do you live in the permit area in which you generally apply and hunt?
   Yes____ No____

7. How difficult was it to find a place to hunt during the 2010 spring turkey season (check only one)?
   Very difficult____ Somewhat difficult____ Somewhat easy____ Very easy____

8. What type of land did you hunt during the 2010 spring season (check only one)?
   Private land____ Public land____ Both____

9. If you hunted private land, were you the landowner or the tenant of the land (check only one)?
   Landowner____ Tenant____ Neither____ I did not hunt on private land____

10. If you hunted public land exclusively was it because you could not gain access to private land (check only one)?
    Yes____ No____ I did not hunt on public land____

11. Over the last 3 spring turkey seasons do you feel turkey numbers have changed in the permit area you hunt (check only one)?
    Increased____ Decreased____ About the same____ Did not hunt same PA____

12. During the 2010 spring turkey season, did other hunters keep you from hunting where you wanted to hunt (check only one)?
    Definitely Yes____ Somewhat____ Not Much____ Not at All____

13. Did another hunter interfere with your chance to harvest a turkey?
    Yes____ No____

14. If yes, what type of land were you hunting when another hunter interfered with your chance to bag a turkey (check only one)?
    Public____ Private____ Interference did not occur____

15. How many days did you experience interference from another turkey hunter while hunting during the 2010 spring turkey season (check only one)?
    0____ 1____ 2____ 3____ 4____ 5____ 6____ 7____

16. Rate the quality of your turkey hunting experience during spring 2010 on a scale of 1- 5 (check only one number):

    Poor Quality Average Quality Excellent Quality

    1____ 2____ 3____ 4____ 5____

17. What is the most important factor in determining a quality spring turkey hunting experience in Minnesota for you (check only one)?
    An opportunity to kill a turkey____
    Seeing turkeys/calling birds in/hearing gobbling____
    Killing a turkey (Tom, Jake, Bearded hen)____
    Killing a mature Tom____
    Weather____
    Not seeing other hunters____
    Not being interfered with by other hunters____
    Spending time with family and friends____
    Access to private hunting land____
    Being successfully drawn to hunt an early time period____

18. In the future, would you respond to this survey if you received a postcard directing you to a computer website to fill out the survey?
    Yes____ No____

Appendix B.

Minnesota Spring Wild Turkey Hunter Follow-Up Survey

1. What were your reasons for not responding to the initial survey? (*check all that apply*)

    a. Did not want to participate in the survey_____

    b. Do not own a computer or have access to the internet_____

    c. Concerned about privacy issues associated with using the internet_____

    d. Encountered technical problems trying to access the survey site_____

    e. Other (please state)_____

2. If you checked item *d* above, please describe the problems you encountered.

    _____
    _____
    _____

3. If you attempted to access the survey web site through the internet, which of the methods listed below did you use? (*check only one*)

    a. Typed web address provided on postcard into the browser address bar_____

    b. Typed web address on the postcard into a search engine (e.g., Google, Yahoo, Bing, etc)_____

    c. Other (please state)_____

    d. Did not try to complete the survey_____

4. Do you have comments or suggestions on how to make the internet–based survey easier to use?