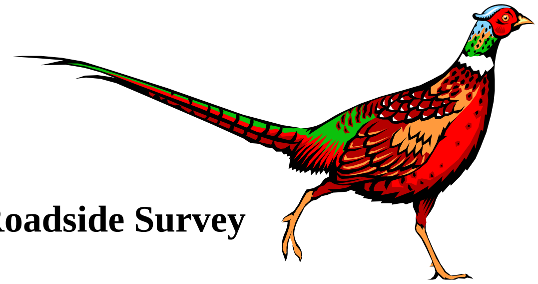
FARMLAND WILDLIFE POPULATIONS

Farmland Wildlife Populations and Research Group
35365 800th Avenue
Madelia, MN 56062-9744
(507) 642-8478



2007 Minnesota August Roadside Survey

Kurt J. Haroldson, Farmland Wildlife Populations & Research Group

ABSTRACT

Population indices for ring-necked pheasants in 2007 were similar to last year. Gray partridge, cottontail rabbit, and white-tailed jackrabbit indices were also similar to 2006, whereas deer and mourning dove indices decreased significantly. The winter of 2006-07 was average to mild throughout Minnesota's agricultural zone, and spring weather was warm and dry. Overwinter survival of farmland wildlife in 2007 was probably above average, but reproductive success varied by species.

The pheasant index remained high in 2007 (106.7 birds/100 mi), similar to the last 2 years and 48% above the 10-year average, but 63% 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). Adult pheasants indices were >50% above the 10-year average in 2007, which reflected high overwinter survival associated with mild winter weather. Although the number of broods was above the 10-year and long-term averages, mean brood size was below both averages. Overall, the size of the fall population will be close to 2005 and 2006 levels. The best opportunity for harvesting pheasants appears to be in the Southwest region, although good opportunities will likely also be available in the West Central and South Central regions.

The gray partridge index was similar to last year and the 10-year mean, but 44% below the long-term average. No significant changes were observed at the regional level. The number of adults observed was similar to last year, but the proportion of adults with broods and brood size increased in 2007. Gray partridge counts were highest in the Southwest region.

The cottontail rabbit index was similar to last year, the 10-year average, and the long-term average. Counts of cottontail rabbits were highest in the East Central and South Central regions. The jackrabbit index also held steady in 2007. The statewide index was also similar to the 10-year average, but remained 84% below the long-term average. The range-wide jackrabbit population peaked in the late 1950's and declined to its lowest level in 1993, from which populations have not recovered. Counts of white-tailed jackrabbits were highest in the Southwest region.

The number of mourning doves observed in 2007 decreased 20% from last year, but was similar to the 10-year and long-term averages. Counts decreased significantly only in the West Central region. Similarly, the white-tailed deer index declined by 35% from last year, with significant declines in the Northwest and West Central regions.

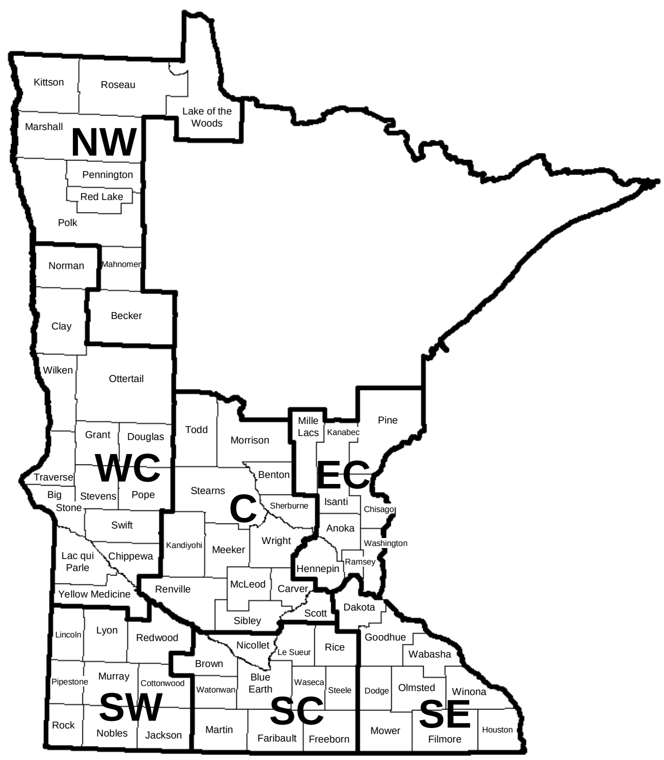


Figure 1. Survey regions for Minnesota's August Roadside Survey.

INTRODUCTION

This report is a summary of the 2007 Minnesota August roadside survey. The annual survey is conducted during the first 2 weeks in 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. The data provide an **index of relative abundance** and are used to monitor annual changes and long-term trends in regional and range-wide populations. Results were reported by agricultural region 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 2007; without their help the survey would not be possible. Angela Isackson and Tonya Klinkner provided assistance with data entry. John Giudice reviewed and provided comments on drafts 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 severity of the winter of 2006-07 was moderate to mild throughout most of the farmland region in Minnesota (the sixth consecutive mild winter). Regional temperatures were 3-29^{o}F above the long-term average for each month, December – March (MCWG, http://climate.umn.edu/cawap/monsum/ monsum.asp). In conjunction with warm weather, most regions experienced only intermittent snow cover. However, snow persisted for up to 12 continuous weeks in portions of the Northwest, South Central, and Southeast regions (MCWG, http://climate.umn.edu/doc/snowmap.htm). Although March entered like a lion with deep, heavy snow across the farmland region, snow cover persisted for only 2-3 weeks. Temperature trends reversed in April with below normal temperatures and a mid-month snowstorm. However, spring weather in May and June was warmer in all regions and drier than normal in all regions except portions of northwestern and west central Minnesota, where torrential rains in early June led to rural flooding. Conditions for overwinter survival of farmland wildlife were better than average due to breaks in snow cover except in portions of south central and southeastern Minnesota. Favorable conditions for reproduction were provided by warm, dry weather in May and June and continuing through the summer except in portions of west central and northwestern Minnesota. However, many late-summer nests, which are not counted by this survey, were likely destroyed by extreme rainfall and flooding during mid-August in parts of the Southeast and South Central regions.

HABITAT CONDITIONS

Habitat conditions in the pheasant range continue to maintain their highest levels since the mid-1990s. Over 1 million acres of habitat are currently enrolled in farm programs (e.g., CRP, CREP, RIM, WRP), and another 659,000 acres of habitat are protected as Wildlife Management Areas (WMA) and Waterfowl Protection Areas. Within the pheasant range, protected grasslands account for about 6.3% of the landscape (range: 3.0-10.7%; Table 1).

Farm programs make up the largest portion of protected grasslands in the state. Sign-up for the Minnesota CREP II began June 2005 targeting enrollment of up to 120,000 new acres of environmentally sensitive cropland in the Red River Watershed in northwestern Minnesota, the Lower Mississippi Watershed in southeastern Minnesota, and the Missouri/Des Moines River Watershed in southwestern Minnesota. Although progress continues on the CRP and CREP II, the expiration of a large proportion of existing CRP contracts (beginning in fall 2007) is still a major concern for future wildlife populations. Re-enrollment and extension opportunities may capture many of the CRP contracts that will expire during 2007-2010, but this will partly depend on commodity prices and competing economic opportunities (e.g., ethanol production).

The MNDNR continues to expand the habitat base through accelerated WMA acquisition. In addition the Working Lands Initiative will attempt to protect and expand large wetland-grassland complexes in 12 counties in western Minnesota.

SURVEY CONDITIONS

Cooperators completed 170 of the 171 routes in 2007. 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 89% of the survey routes, which was fewer than for 2006 (96%) and the 8-year average (91%). Clear skies (<30% cloud cover) were present at the start of 83% of routes, with wind speeds <4 mph recorded for 75% of routes. The survey period was extended to August 20th to allow all routes to be completed.

RING-NECKED PHEASANT

The average number of pheasants observed per 100 miles was similar to 2006 and 48% above the 10-year average (Table 2; Figure 2A). The pheasant index was similar to the long-term average (Table 2), but remained below the benchmark years of 1955-64 by 63%. Total pheasants observed per 100 miles ranged from 27.4 in the Southeast to 222.5 in the Southwest (Table 3, Figure 5). Changes from last year were not significant in any region (Table 3).

The range-wide hen index (hens/100 mi) was similar to last year, 56% (95% CI: 30-82%) above the 10-year average (Table 2), and varied from 2.9 hens/100 miles in the Southeast to 36.0 hens/100 miles in the Southwest. The cock index also was similar to 2006 and 52% (95% CI: 27-78%) above the 10-year average (Table 2). The 2007 hen:cock ratio was 1.6, which was similar to 2006 (1.6) and 2005 (2.0).

Given the above-average fall population in 2006 and likely above-average overwinter survival, the spring breeding population was expected to be higher than average. Data from spring pheasant surveys, conducted as part of a CRP/pheasant study, indicated unusually high breeding pheasant populations, with the highest hen indices in 5 years of monitoring (Kurt Haroldson, MNDNR, unpublished data). These surveys were conducted on 36 study areas located in Lincoln, Lyon, Cottonwood, and Jackson Counties in the Southwest; Pope County in the West Central; and LeSueur, and Rice Counties in the South Central region during April 20 – May 31.

The number of pheasant broods observed per 100 miles was similar to last year, 57% above the 10-year average, and 31% above the long-term average (Table 2). The brood index continues to remain below the benchmark years (1955-64). Regional brood indices ranged from 4.2 broods/100 miles in the Southeast to 38.7 broods/100 miles in the Southwest. Average brood size in 2007 (4.6 ± 0.1 [SE] chicks/brood) was similar to last year (4.8 ± 0.1 [SE] chicks/brood), but below the 10-year mean (5.0 chicks/brood) and the long-term average (5.6 chicks/brood; Table 2). The median hatch date for pheasants was June 11 (n = 659), 3 days later than last year and 4 days later than the 10-year average (Table 2). The distribution of estimated hatch dates for observed broods was unimodal and approximately normally distributed, which suggests that many early nesting attempts were successful (vs. wide-spread nest failure, which often leads to an extensive renesting effort and a bimodal peak in hatch dates). Average age of broods observed was 8.2 weeks (range: 1-16 wks).

A high range-wide pheasant index was expected given the mild winter and warm, dry weather during the reproductive season. The combination of relatively high hen and brood numbers compensated for below-average brood size, and led to a large pheasant index for 2007. In addition the above-average cock index contributed additional birds to the 2007 population. Overall, the size of the fall population will be similar to 2005 and 2006 levels. The best opportunity for harvesting pheasants appears to be in the Southwest region, although good opportunities will likely also be available in the West Central and South Central regions.

GRAY PARTRIDGE

Rangewide, the gray partridge index (8.5 partridge/100 miles) was similar to last year and the 10-year average. However, the 2007 index was 44% below the long-term average (Table 2, Figure 2B). Within regions, the partridge index ranged from 0.0/100 miles in the East Central region to 25.7/100 miles in the Southwest (Table 3, Figure 6). There were no significant regional changes from last year (Table 3).

The number of adults observed per 100 miles was similar to last year, but 36% below the 10-year mean and 49% below the long-term average (Table 2). The proportion of adult partridge observed with broods (34%) increased from 2006 (28%) and was similar to the 10-year average (34%) and long-term average (33%). Average brood size in 2007 (9.9 chicks/brood) was larger than in 2006 (7.5 chicks/brood), the 10-year average (7.6 chicks/brood), and the long-term average (8.9 chicks/brood). Total broods observed per 100 miles were similar to 2006, but 36% below the 10-year average, and 51% below the long-term average (Table 2). The median hatch date was June 20 (n = 28), which was 6 days earlier than in 2006 and the same as the 10-year average.

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. The improved reproductive success this year may be a response to the dry weather during the nesting season. Gray partridge in their native range (southeastern Europe and northern Asia) are associated with arid climates and only produce well in the Midwest during dry or drought years. Consequently, gray partridge are more strongly affected by weather conditions during nesting and brood rearing than are pheasants. The Southwest region offers the best opportunity for harvesting gray partridge in 2007.

COTTONTAIL RABBIT and WHITE-TAILED JACKRABBIT

The eastern cottontail rabbit index (7.1 rabbits/100 mi) was similar to last year, the 10-year average, and the long-term average (Table 2, Figure 3A). There continues to be high variability in counts and percent change by region (Table 3). The cottontail rabbit index ranged from 0.4 rabbits/100 miles in the Northwest to 20.3 rabbits/100 miles in the East Central region (Table 3, Figure 7). The best opportunities for harvesting cottontail rabbits are in the East Central and South Central regions.

The index of white-tailed jackrabbits held steady in 2007. The statewide index (0.3 rabbits/100 mi) was also similar to the 10-year average (0.4), but remained 84% (95% CI: 69-98%) below the long-term average (Table 2, Figure 3B). The range-wide jackrabbit population peaked in the late 1950's and declined to its lowest level (0.2 rabbits/100 mi) in 1993, from which populations have not recovered (Figure 3B). The long-term decline in jackrabbits probably 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, Figure 8). However, indices of relative abundance and annual percent change should be interpreted cautiously because estimates are based on low numbers of sightings.

WHITE-TAILED DEER

The index for white-tailed deer (9.8 deer/100 mi) declined by 35% (95% CI: 17-52%) from last year and 27% (95% CI: 9-44%) from the 10-year average, but was similar to the long-term average (Table 2, Figure 4A). Among regions, deer indices also declined significantly from 2006 in the Northwest and West Central regions (Table 3). Modeling projections based on independent data indicate similar changes from last year for deer populations in the Northwest and West Central regions.

MOURNING DOVE

The number of mourning doves observed per 100 miles in 2007 decreased 20% (95% CI: 3-38%) from last year, but was similar to the 10-year average and the long-term average (Table 2, Figure 4B). The mourning dove index ranged from 102.2 doves/100 miles in the Northwest region to 353.8 doves/100 miles in the Southwest. Regional changes in dove counts were not significant except in the West Central region (95% CI: -5 to -52%, Table 3). The number of mourning doves <u>heard</u> along U.S. Fish and Wildlife Service call-count survey (CCS) routes (n = 7) in Minnesota were similar to last year. Trend analyses indicated the number of mourning doves <u>heard</u> along the CCS routes declined 3.4% per year (90% CI: -8.6 to 1.8%) during 1998-2007 and 1.9% per year (90% CI: -3.4 to -0.3%) during 1966-2007 (Dolton et al. 2007). In fall 2004, Minnesota held its first modern dove hunting season.

OTHER SPECIES

Notable incidental sightings: 2 bald eagles (Jackson and Pope Counties), 2 coyotes (Kandiyohi, and Otter Tail Counties), 1 indigo bunting (Nicollet County), 1 lesser yellow legs (Murray County), 13 prairie chickens (Clay, Norman, and Red Lake Counties), 2 red fox (Roseau and Stevens Counties), 5 red-headed woodpeckers (Olmsted, Redwood, Rice, Rock, and Watonwan Counties), 1 ruffed grouse (Polk County), 124 sandhill cranes (16 counties), 17 sharp-tailed grouse (Lake of the Woods, Marshall, Polk, and Roseau Counties), 1 snowshoe hare (Polk County), 1 Swainsons hawk (Polk County), 1 timber wolf (Marshall County), 3 trumpeter swans (Polk and Sherburne Counties), and 2 upland sandpipers (Stearns and Yellow Medicine Counties).

LITERATURE CITED

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[MCWG] Minnesota Climatology Working Group. 17 Aug 2007. MCWG Home Page http://climate.umn.edu. Accessed 17 August 2007.

Table 1. Abundance (total acres) and density (acres/mi^2) of undisturbed grassland habitat within pheasant range, 2007[a].

	Cropland Retirement									Density
AGREG	CRP	CREP	RIM	RIM-WRP	WRP	USFWS[c]	MNDNR[d]	Total	%	(ac/mi^2)
WC[b]	380,434	37,450	17,079	822	18,683	169,791	102,336	726,595	10.7	68.4
SW	128,288	24,549	12,214	579	766	15,307	52,788	234,491	6.2	39.7
C	149,298	14,490	17,028	714	2,976	83,257	45,054	312,818	5.2	33.1
SC	99,381	27,610	11,813	3,730	8,926	7,114	29,720	188,293	4.7	29.8
SE	95,117	2,262	5,554	554	620	18,438	47,051	169,595	4.6	29.3
EC	5,011	0	1,265	0	4	4,548	83,874	94,702	3.0	18.9
Total	857,529	106,360	64,953	6,398	31,975	298,456	360,822	1,726,493	6.3	40.1

[a] Unpublished data, Tabor Hoek, BWSR, 23 August 2007.

[b] Does not include Norman County.

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

[d] MNDNR Wildlife Management Areas (WMA).

Table 2. Rangewide trends (% change) in number of wildlife observed per 100 miles driven, Minnesota August roadside survey, 1955-2007.

Species / Subgroup	Change from 2006[a]					Change from 10-year average[b]				Change from long-term average[c]			
	n	2006	2007	%	95% CI	*n*	1997-06	%	95% CI	*n*	LTA	%	95% CI
Ring-necked pheasant													
Total pheasants	150	115.4	106.7	-8	±14	147	73.2	48	±21	149	104.0	4	±17
Cocks		11.1	10.0	-10	±17		6.6	52	±26		11.6	-13	±17
Hens		17.8	16.3	-8	±14		10.7	56	±26		15.0	10	±21
Broods		18.1	17.5	-3	±14		11.4	57	±23		13.5	31	±23
Chicks per brood		4.8	4.6	-4			5.0	-8			5.6	-18	
Broods per 100 hens		101.2	107.5	6			108.3	-1			101.6	6	
Median hatch date		Jun 08	Jun 11				Jun 07						
Gray partridge													
Total partridge	169	6.3	8.5	36	±76	166	11.1	-22	±35	149	16.7	-44	±27
Adults		2.0	1.9	-4	±48		3.0	-36	±27		4.2	-49	±23
Broods		0.6	0.7	17	±65		1.0	-36	±28		1.4	-51	±22
Chicks per brood		7.5	9.9	33			7.6	30			8.9	11	
Broods per 100 adults		27.9	34.1	22			33.8	1			33.2	3	
Median hatch date		Jun 26	Jun 20				Jun 20						
Eastern cottontail	169	7.2	7.1	-2	±24	166	6.3	13	±22	149	6.8	17	±23
White-tailed jackrabbit	169	0.3	0.3	9	±60	166	0.4	-34	±38	149	1.9	-84	±14
White-tailed deer	169	15.0	9.8	-35	±17	166	13.5	-27	±18	159	7.6	6	±24
Mourning dove	169	291.3	231.8	-20	±17	166	224.5	5	±17	149	278.2	-11	±17

[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 = 1955-2006, except for deer = 1974-2006. Does not include Northwest region (8 counties in Northwest were added to survey in 1982). Estimates for all species except deer based on routes (*n*) surveyed ≥40 years; estimates for deer based on routes surveyed ≥25 years.

Table 3. Regional trends (% change) in number of wildlife observed per 100 miles driven, Minnesota August roadside survey, 1955-2007.

Region / Species	Change from 2006[a]					Change from 10-year average[b]				Change from long-term average[c]			
	n	2006	2007	%	95% CI	*n*	1997-06	%	95% CI	*n*	LTA	%	95% CI
Northwest[d]													
Gray partridge	19	0.0	1.7			19	0.0	7900	±11965	19	4.1	-59	±94
Eastern cottontail		1.7	0.4	-75	±187		1.1	-60	±61		1.0	-56	±82
White-tailed jackrabbit		0.4	0.0	-100	±144		0.5	-100	±47		0.7	-100	±45
White-tailed deer		60.4	34.4	-43	±28		40.1	-14	±50		27.2	6	±95
Mourning dove		136.5	102.2	-25	±53		88.1	16	±90		130.6	-22	±64
West Central													
Ring-necked pheasant	37	122.0	117.8	-4	±28	35	58.4	110	±59	36	106.5	14	±35
Gray partridge		0.2	1.5	614	±972		2.7	-50	±62		11.1	-86	±24
Eastern cottontail		3.8	4.1	9	±56		3.1	32	±51		4.3	-1	±42
White-tailed jackrabbit		0.3	0.3	0	±137		0.8	-70	±55		2.6	-91	±24
White-tailed deer		11.2	5.1	-55	±30		11.8	-56	±15		8.2	-38	±22
Mourning dove		316.2	225.9	-29	±23		305.6	-25	±20		394.1	-43	±14
Central													
Ring-necked pheasant	30	107.0	72.8	-32	±33	28	62.1	26	±39	29	76.7	-2	±31
Gray partridge		3.0	3.2	8	±226		5.3	-35	±92		10.6	-69	±51
Eastern cottontail		9.8	5.6	-43	±42		6.3	-19	±43		6.5	-18	±48
White-tailed jackrabbit		0.0	0.1				0.2	-38	±136		1.4	-90	±22
White-tailed deer		7.1	4.3	-40	±60		6.5	-30	±50		3.9	13	±70
Mourning dove		249.3	215.7	-14	±36		191.0	19	±38		238.0	-7	±31
East Central													
Ring-necked pheasant	13	82.3	64.3	-22	±49	14	54.3	14	±52	14	88.1	-30	±42
Gray partridge		0.0	0.0				0.1	-100	±147		0.2	-100	±133
Eastern cottontail		7.5	20.3	172	±159		9.2	116	±112		8.4	138	±124
White-tailed jackrabbit		0.0	0.0				0.0				0.3	-100	±59
White-tailed deer		10.5	11.4	8	±80		13.9	-24	±64		7.4	44	±92
Mourning dove		150.7	140.3	-7	±40		94.6	52	±63		128.6	12	±56

Table 3. Continued.

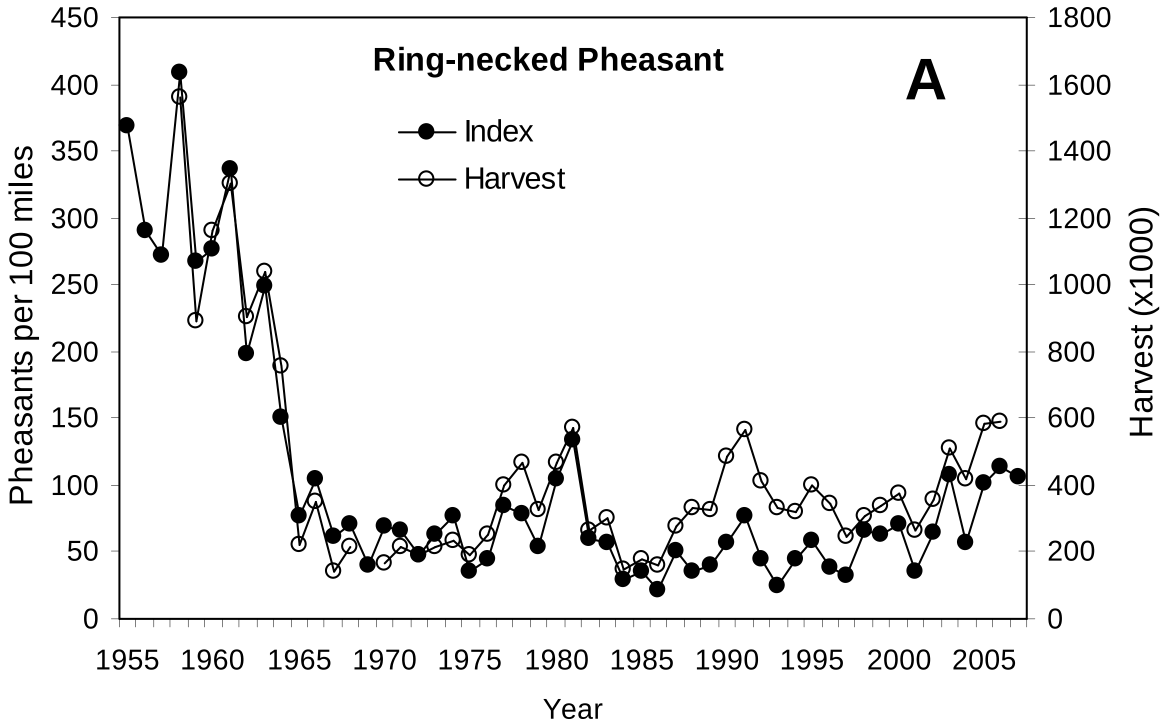
Region / Species	Change from 2006					Change from 10-year average				Change from long-term average			
	n	2006	2007	%	95% CI	*n*	1997-06	%	95% CI	*n*	LTA	%	95% CI
Southwest													
Ring-necked pheasant	19	242.2	222.5	-8	±35	19	134.1	66	±49	19	117.1	90	±67
Gray partridge		28.6	25.7	-10	±108		40.0	-36	±53		44.6	-42	±44
Eastern cottontail		10.9	5.7	-48	±46		9.1	-38	±30		8.4	-33	±31
White-tailed jackrabbit		1.5	1.3	-14	±53		0.9	46	±104		4.1	-70	±30
White-tailed deer		13.2	8.8	-33	±51		11.3	-22	±40		7.4	19	±62
Mourning dove		533.4	353.8	-34	±53		335.7	5	±38		314.7	12	±31
South Central													
Ring-necked pheasant	32	103.9	121.4	17	±26	32	89.6	36	±36	32	137.9	-12	±30
Gray partridge		11.5	13.5	18	±108		21.8	-38	±53		20.2	-33	±69
Eastern cottontail		8.5	12.6	49	±49		8.6	46	±43		7.6	66	±47
White-tailed jackrabbit		0.0	0.3				0.3	-16	±100		1.9	-87	±26
White-tailed deer		4.5	4.9	8	±62		5.1	-5	±52		3.2	40	±71
Mourning dove		290.5	310.5	7	±50		243.0	28	±64		255.9	21	±71
Southeast													
Ring-necked pheasant	19	31.1	27.4	-12	±59	19	42.3	-35	±40	19	82.3	-67	±30
Gray partridge		2.7	17.5	542	±812		7.2	141	±265		15.0	16	±129
Eastern cottontail		9.5	4.8	-49	±43		8.3	-42	±36		8.0	-39	±25
White-tailed jackrabbit		0.0	0.2				0.2	25	±295		0.7	-70	±73
White-tailed deer		12.0	11.6	-3	±28		16.7	-31	±19		9.5	22	±45
Mourning dove		319.4	206.3	-35	±58		214.6	-4	±40		231.3	-11	±33

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

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

[c] LTA = 1955-2006, except for Northwest region (1982-2006) and white-tailed deer (1974-2006). Estimates based on routes (*n*) surveyed ≥40 years (1955-2006), 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.



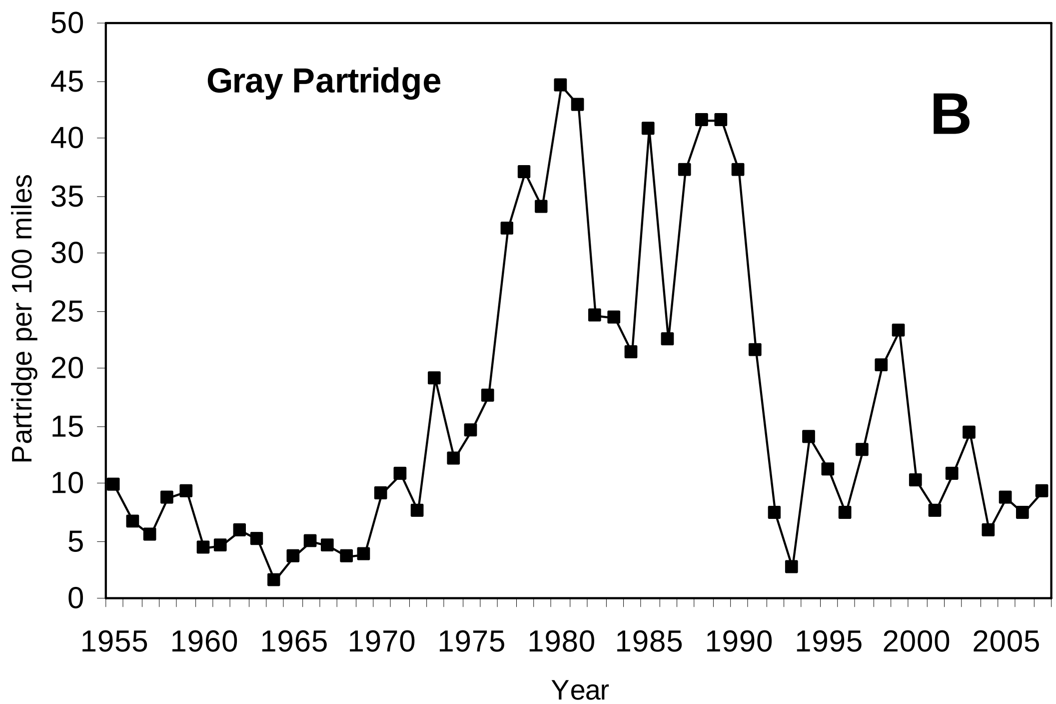


Figure 2. Rangewide index of ring-necked pheasants (**A**) and gray partridge (**B**) seen per 100 miles driven. Does not include the Northwest region. Based on all survey routes completed.

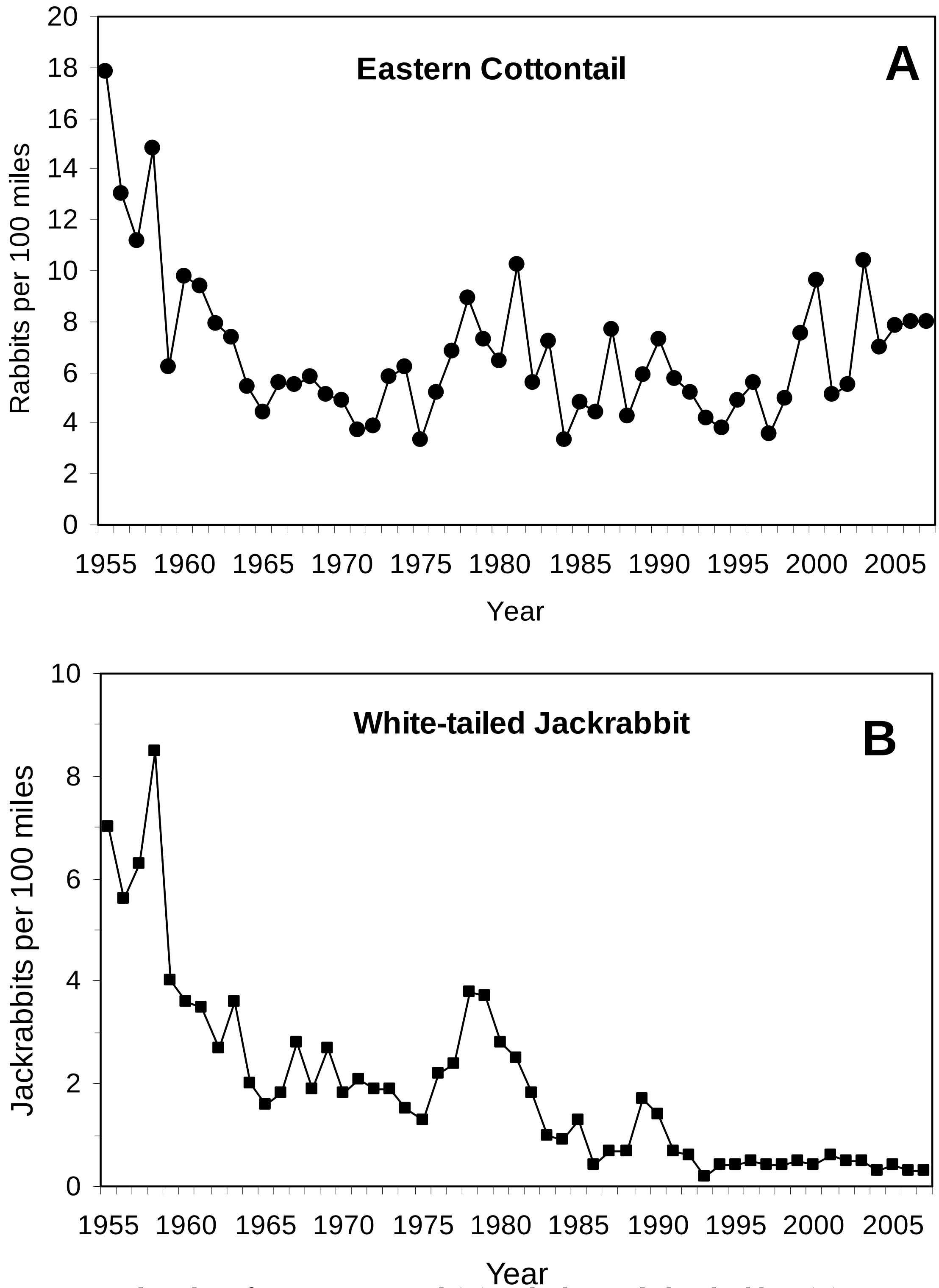


Figure 3. Rangewide index of eastern cottontail (**A**) and white-tailed jackrabbits (**B**) seen per 100 miles driven. Does not include the Northwest region. Based on all survey routes completed.

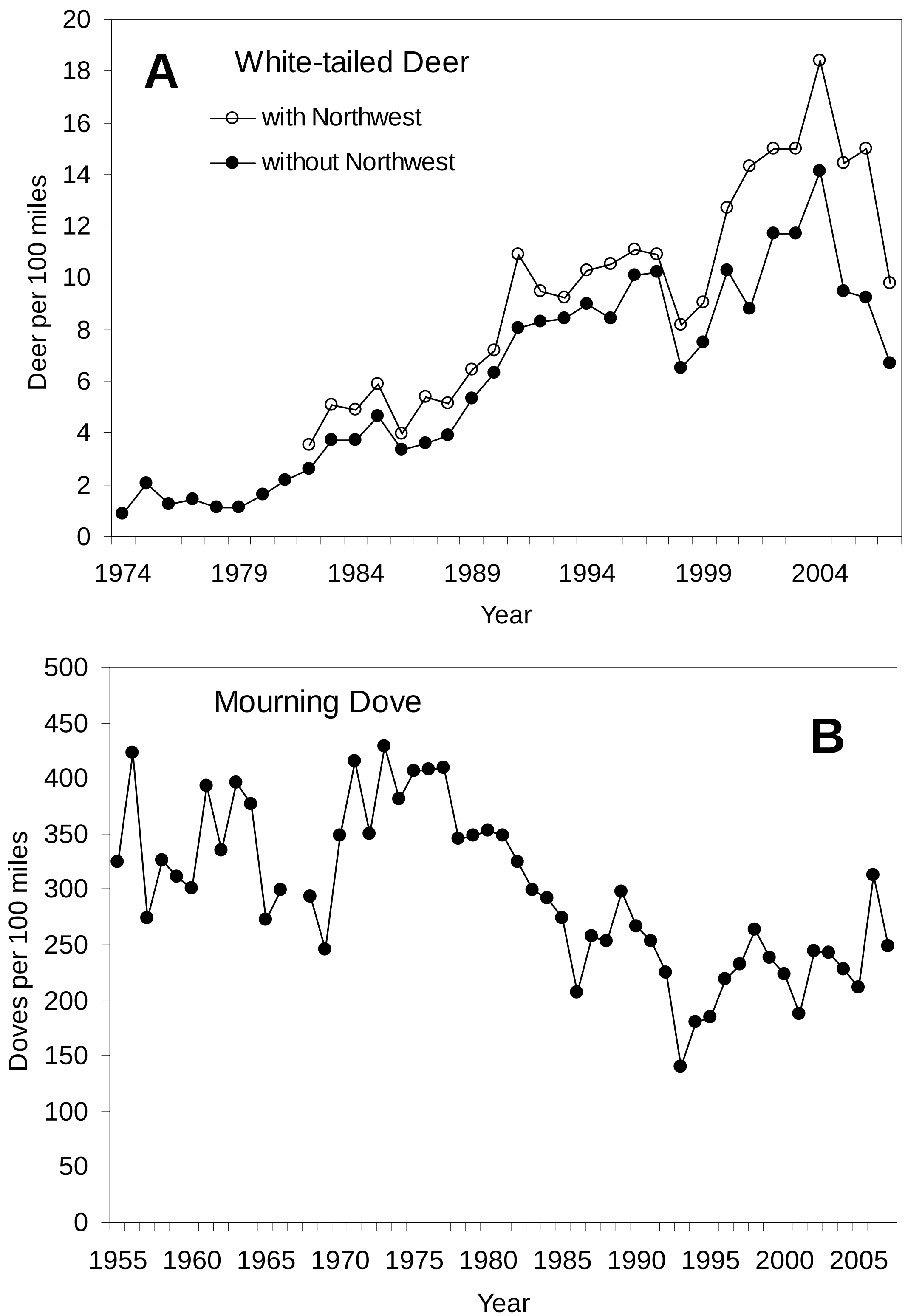


Figure 4. Rangewide index of white-tailed deer (**A**) and mourning doves (**B**) seen per 100 miles driven. Doves were not counted in 1967 and the dove index does not include the Northwest region. Based on all survey routes completed.

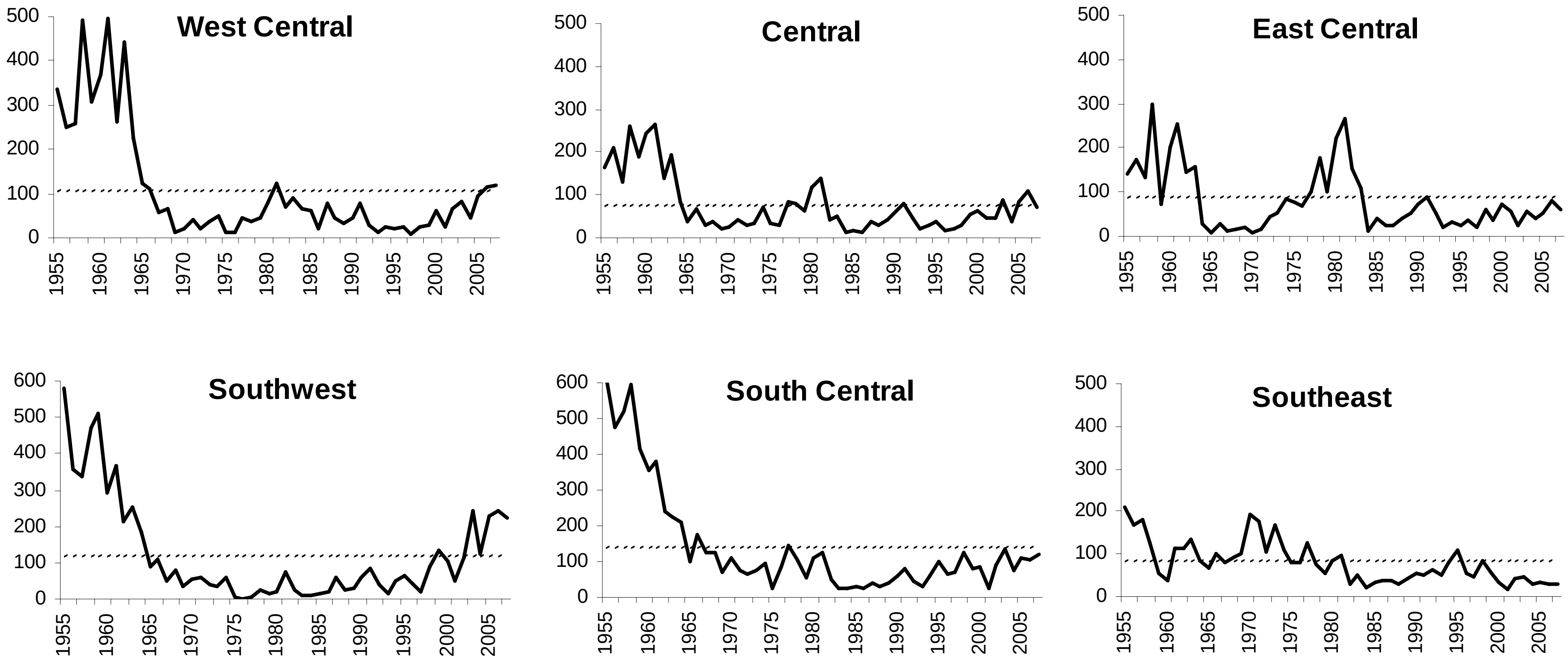


Figure 5. Regional index (——) and long-term average (......) of **ring-necked pheasants seen per 100 miles driven**, Minnesota August roadside survey (1955-present). Based on all survey routes completed. **Note:** scale of vertical axis is not the same scale among survey regions.

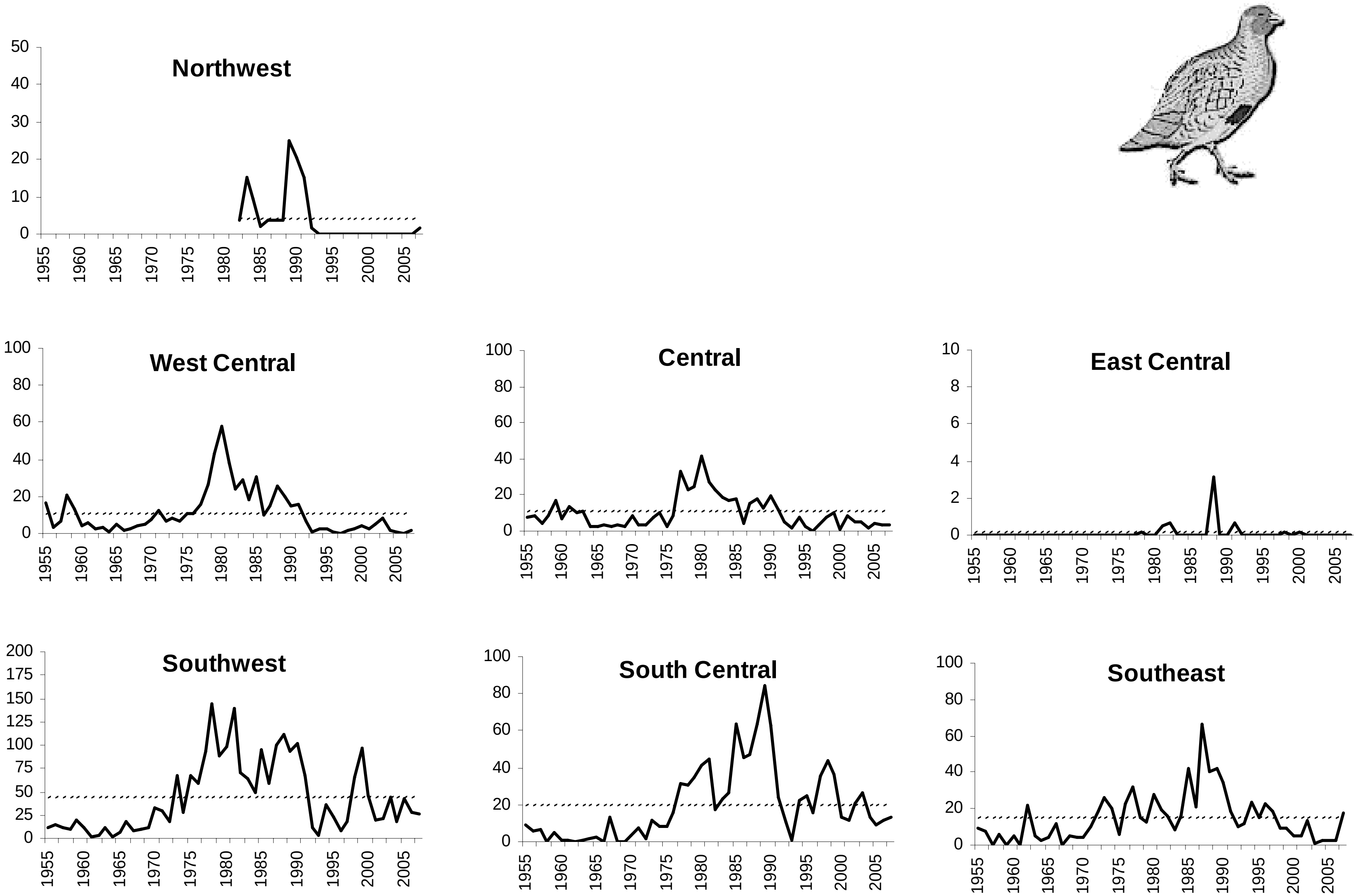


Figure 6. Regional index (——) and long-term average (·····) of **gray partridge seen per 100 miles driven**, Minnesota August roadside survey (1955-present). Based on all survey routes completed. **Note:** scale of vertical axis is not the same among survey regions.

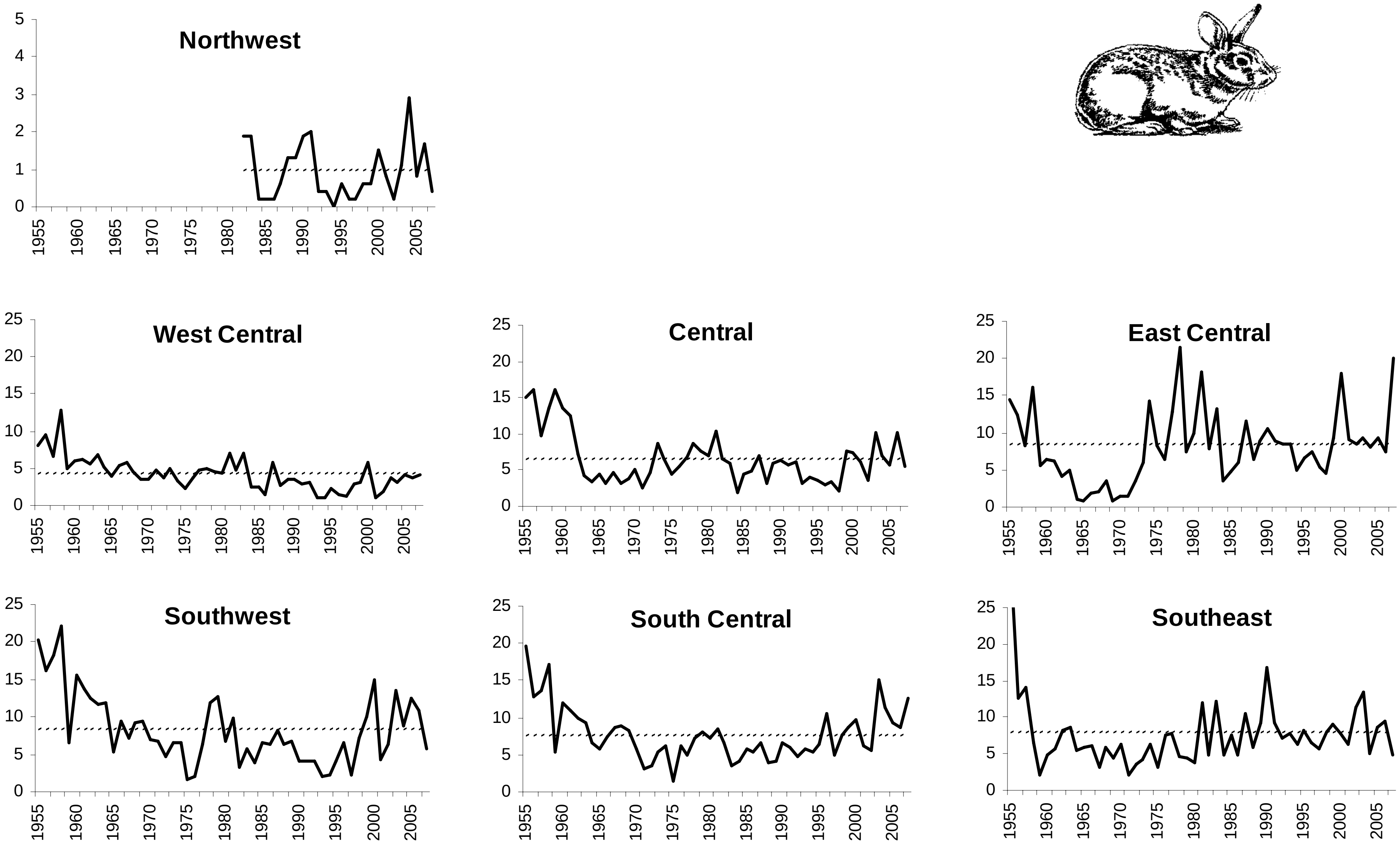


Figure 7. Regional index (——) and long-term average (······) of **cottontail rabbits seen per 100 miles driven**, Minnesota August roadside survey (1955-present). Based on all survey routes completed. **Note:** scale of vertical axis is not the same among survey regions.

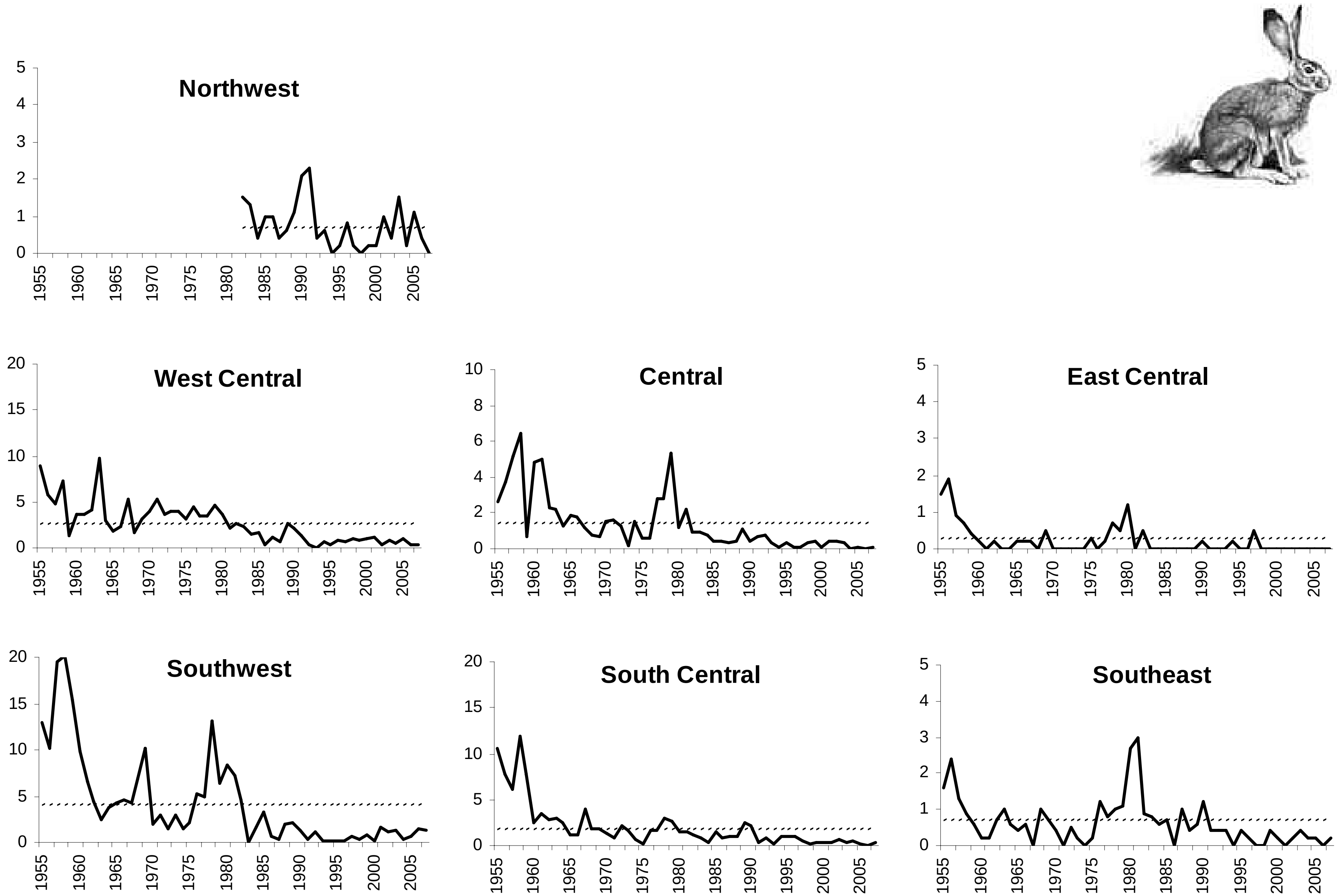


Figure 8. Regional index (——) and long-term average (.......) of **white-tailed jackrabbits seen per 100 miles driven**, Minnesota August roadside survey (1955-present). Based on all survey routes completed. **Note:** scale of vertical axis is not the same among survey regions.

Monitoring Population Trends of White-tailed Deer in Minnesota's Farmland/Transition Zone – 2007

Marrett D. 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, 3) discusses general trends of deer density and current abundance, and 4) describes trends of harvest patterns in the farmland/transition zone.

METHODS

Minnesota Farmland/Transition Zone

There were 4 deer management units (DMUs) in Minnesota's farmland/transition zone (Figure 1). Permit areas (PAs) delineated within DMUs served as the basis for population modeling and managing antlerless harvests (Figure 2). There were 86 PAs in Minnesota's farmland zone in 2006. However, the 2 PAs encompassing the Twin Cities metro region were not modeled.

Population Modeling

The population model used to analyze past 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.

The 3 most important parameters within the model reflect the aforementioned biological events, which include reproduction, harvest, and non-hunting mortality. Embryo rates were typically estimated at the DMU level via fetal surveys conducted each spring (for details, see Dunbar 2005). Embryo rates were then used to estimate population reproductive rates for each deer herd within a particular DMU. 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, virtually all mortality occurring during the 12-month 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. 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.

Model Recalibration Efforts

Previous research demonstrated that this model provides reliable population estimates if the model is recalibrated every 4-5 years using field surveys (Grund and Woolf 2004). Thus, in an effort to recalibrate the model, population estimates using aerial (Haroldson et a. 2005) and ground surveys (Grund et al. 2005) were begun in 2004. Population densities have been estimated in 22 farmland PAs over the past 3 years (Table 1). Several PAs have been surveyed using both techniques due to concurrent studies. Preliminary estimates from both techniques have been useful to recalibrate models. However, additional research needs to be conducted to refine field protocols and produce more precise population estimates.

Population Trends and Densities

Deer densities continue to increase throughout most of the transition zone. Deer densities were highest in the Big Woods DMU, lowest in the Prairie DMU, and at intermediate levels in the Northwest (Agassiz & Red River DMUs). Detailed long-term trends in deer densities are presented in Table 2.

In the Northwest DMUs, simulated deer densities indicated a slight downward trend over the last couple of years. Efforts to reduce deer in this area may be having an impact. However, current deer densities remain well above goal in most northwestern permit areas.

In the Big Woods DMU, which incorporates most of the transition zone, simulated deer densities continue to increase. The rate of increase is most rapid in the Southeast and Metro PAs, despite efforts to reduce deer populations in these areas.

In the Prairie DMU, the farmland model suggests that deer densities have increased slowly over the last couple of years. Rate of increase is fastest in the North and Southwest permit areas. This trend reflects objectives and management strategies of most wildlife managers in southwestern Minnesota who wish to either maintain or slightly increase deer herds in their respective work areas.

Harvest Trends and Model Performance

In northwestern Minnesota, registered harvest densities have steadily increased over the past 5-6 years. Harvest densities are higher and have increased at a faster rate in the Agassiz DMU than in the Red River DMU. I use antlered and antlerless harvest trends as an ancillary index to measure population dynamics over time. In most situations, the trend in harvests agreed with what I would expect from simulated population densities. The efforts the DNR have made to recalibrate the farmland model in the northwest have improved model performance thereby making the ancillary population indices logical. Consequently, the farmland model has become a more useful management tool in these Northwest DMU permit areas.

Harvest densities fluctuated substantially across the Big Woods DMU and across years. Trends in harvest densities have been most stable in the Metro and most variable in the Southeast permit areas of the Big Woods DMU. Harvest densities have generally increased in the central and northern portions of the Big Woods DMU over the past 4-6 years. In the southeastern and metro portions of the Big Woods DMU, trends in harvest densities agreed with output generated by the farmland model. The DNR has recalibrated the farmland model in most southeastern and metro PAs thereby improving model performance. In almost all PAs located in the northern and central areas of the Big Woods DMU, trends in harvest densities did not agree with simulated estimates. In most of these areas, the farmland model is performing so poor that it cannot be used to make science-based management recommendations. Thus, I highly recommend recalibrating the farmland model in these permit areas.

In the Prairie DMU, harvest densities have substantially declined over the past decade. However, the farmland model indicated that populations have increased in most Prairie DMU permit areas. Based on my interpretation of these trends, the farmland model is performing very poorly in most Prairie PAs and I highly recommend recalibrating the farmland model in these areas. Based on the marked declines in harvests over the past 10-15 years and the fact that current densities are 25-50% below newly established goals, antlerless harvest quotas have generally been reduced by 50-75% from 2006 in most Prairie DMU permit areas.

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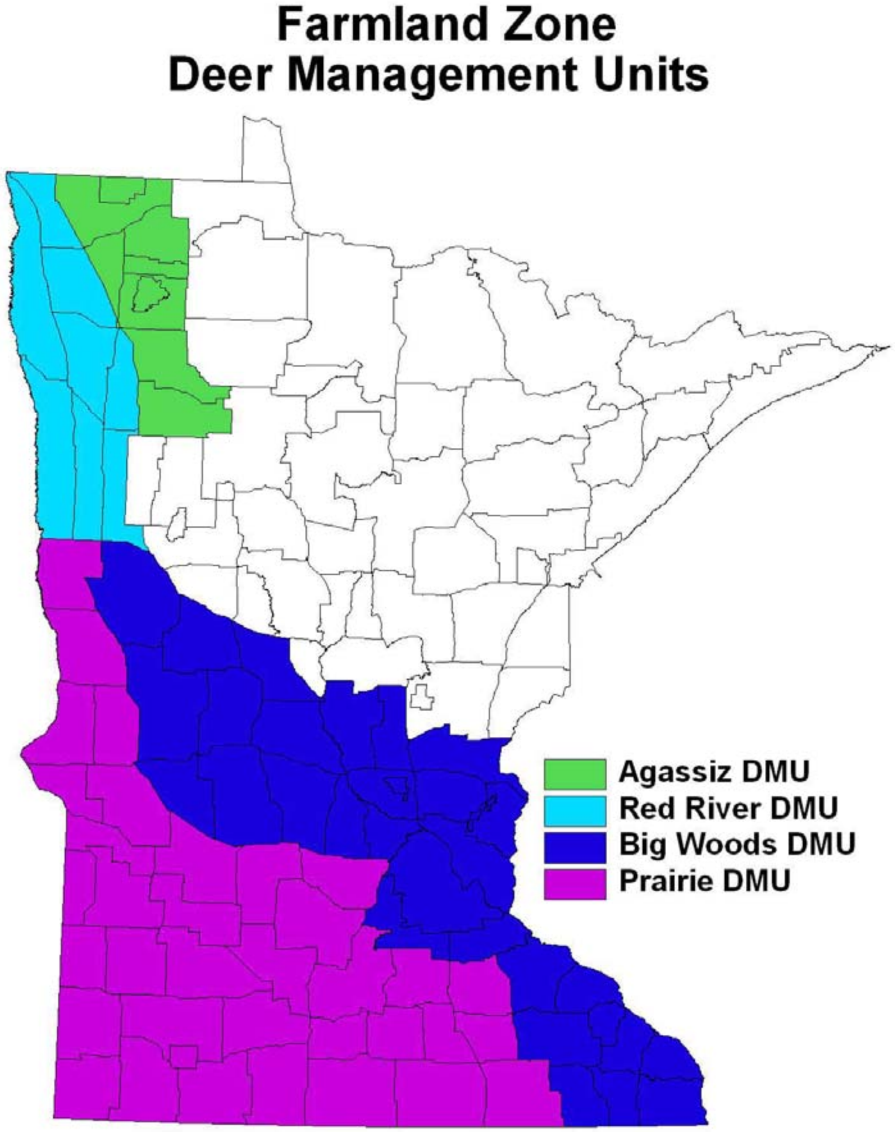


Figure 1. Deer management units in the farmland zone of Minnesota, 2005.

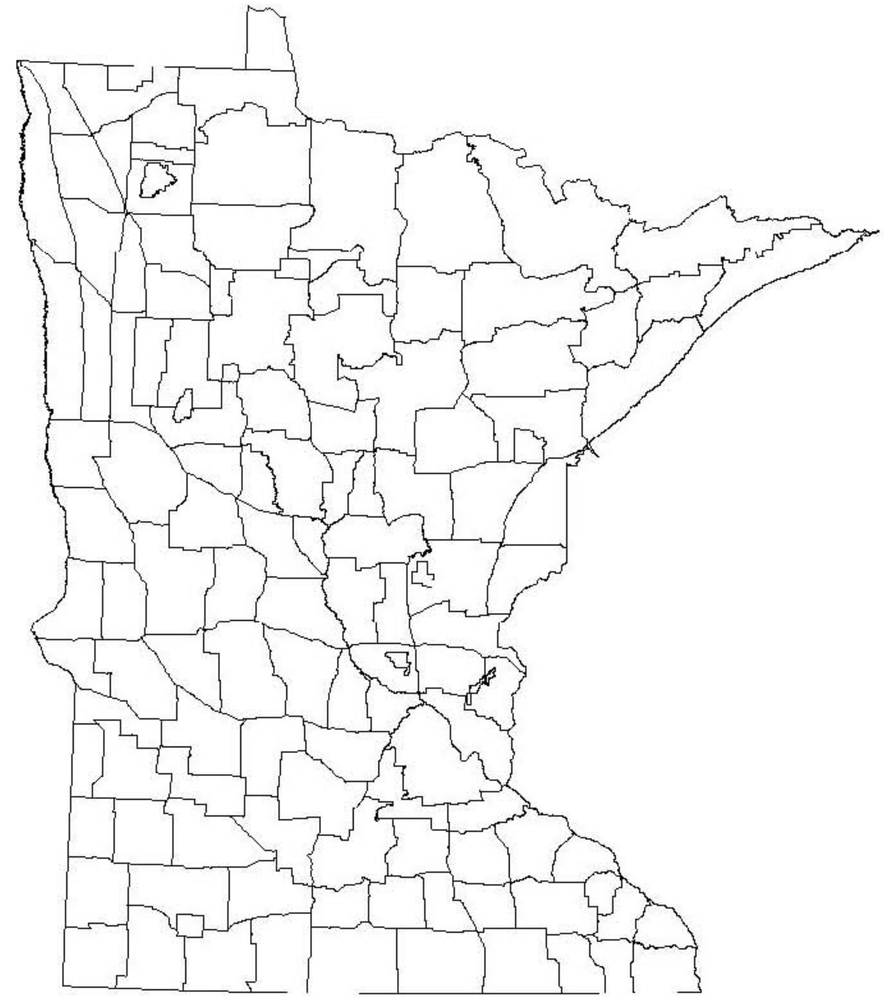
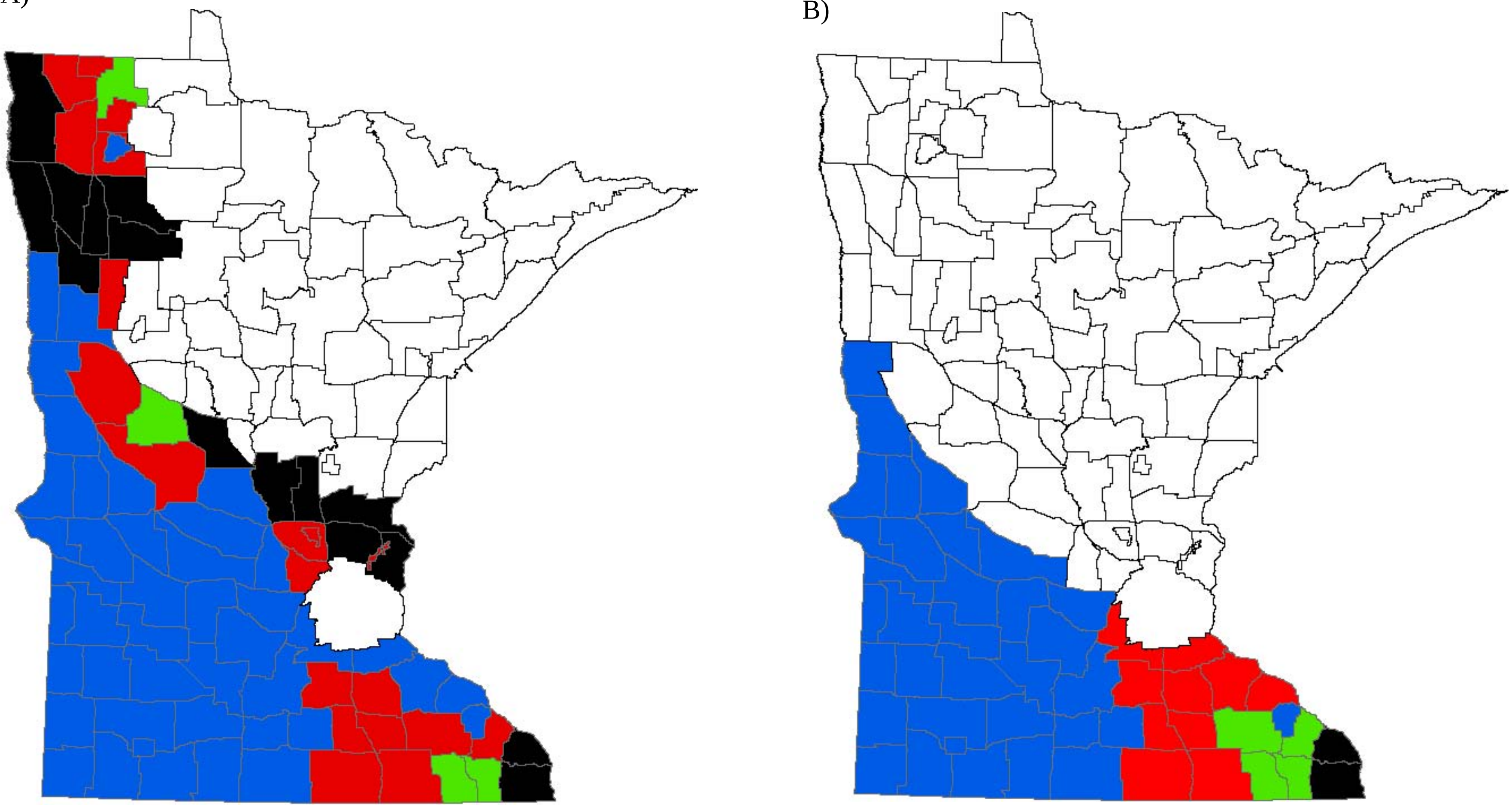


Figure 2. Deer permit areas in Minnesota, 2006.

A)

B)



Figures 3A and B. Management strategies in Zones 2, 3A, and 4A (top figure), and in Zones 3B and 4B (bottom figure) during 2007. Permit areas shaded in blue, red, green, and black represent lottery, managed, intensive, and intensive plus early antlerless- only strategies, respectively.

Table 1. Deer density (deer/mi^2) estimates for permit areas in Minnesota's Farmland/Transition Zone where field surveys have been conducted, 2005-2007.

Permit Area	Winter	Survey Type	Density Estimate (CIs)	Simulated Winter Estimate Prior to Field Survey
201	2006	AerialSurvey	2(1-3)	6
204	2006	AerialSurvey	5(3-6)	5
206	2005	AerialSurvey	5(4-7)	5
209	2006	Aerial Survey	10 (8-12)	5
209	2006	GroundSurvey	6(4-8)	5
210	2006	AerialSurvey	6(5-8)	12
210	2006	GroundSurvey	11 (7-17)	12
225	2007	AerialSurvey	8(6-10)	25
227	2007	Aerial Survey	10 (8-12)	27
236	2006	Aerial Survey	18 (14-22)	35
236	2006	GroundSurvey	13 (8-21)	35
252	2005	AerialSurvey	3(2-4)	2
252	2006	GroundSurvey	1(1-2)	2
256	2006	AerialSurvey	7(5-9)	5
256	2006	GroundSurvey	3(2-5)	5
257	2005	AerialSurvey	6(4-8)	6
257	2006	GroundSurvey	6(4-9)	6
342	2005	AerialSurvey	9(8-11)	19
343	2007	Aerial Survey	10 (9-12)	29
344	2007	Aerial Survey	20 (16-23)	49
346	2007	Aerial Survey	23 (17-29)	31
347	2007	Aerial Survey	13 (10-15)	13
349	2007	Aerial Survey	20 (17-24)	35
420	2006	AerialSurvey	3(2-4)	3
421	2005	AerialSurvey	1(0-1)	5
423	2006	AerialSurvey	1(0-1)	5

Table 2. Pre-fawning deer density estimates[a] (deer/mi^2) by Deer Management Unit (DMU), sub-unit (DMSU), and permit area (PA) in Minnesota's Farmland/Transition Zone, 1994-2006.

DMU	DMSU	PA	Area mi^2	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
RED RIVER	*West*	252	1039	3	2	2	2	2	2	2	2	2	2	2	2	2
		253	1021	4	4	3	3	3	3	3	3	3	2	3	3	2
		Total	2060													
	East	254	396	7	6	6	6	7	7	8	8	8	8	7	7	6
		255	631	8	7	7	7	8	8	8	8	9	9	8	7	6
		256	654	7	6	6	6	7	7	8	8	8	7	7	7	6
		257	413	13	11	10	10	11	11	11	10	10	8	8	7	5
		258	618	9	8	8	8	8	9	9	9	9	9	8	6	4
		259	494	8	7	7	7	7	8	8	9	9	9	8	8	7
		Total	3206													
Red River Total			5266													
AGASSIZ		201	155	4	2	2	3	3	4	5	5	5	5	5	6	6
		202	156	10	7	6	8	9	10	11	11	11	9	9	8	7
		203	108	7	3	2	2	3	4	5	6	7	7	7	8	11
		204	718	7	6	5	5	6	6	6	6	6	5	5	5	4
		205	642													
		206	471	9	7	6	7	7	8	9	9	9	8	7	5	3
		207	300	8	6	6	6	7	8	8	8	9	8	7	6	4
		208	448	4	3	2	3	3	4	4	4	5	4	4	4	4
		209	576	6	5	5	6	6	6	7	7	7	7	7	5	4
		210	485	12	11	10	10	11	11	11	11	12	11	11	11	10
Agassiz Total			4059													

DMU	DMSU	PA	Area mi ^{2}	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
BIG WOODS	*North*	239	924	14	14	13	13	15	16	16	17	18	19	20	22	25
		240	642	21	21	20	21	23	25	26	27	29	31	33	37	42
		412[c]	575	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	7
		213[c]	644	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	13
		214	557	17	17	17	17	18	19	19	19	20	19	18	18	16
		215	702	9	9	9	9	9	9	9	10	10	9	8	7	5
		416	544	10	10	9	9	9	8	8	8	8	7	7	8	9
		417[c]	939	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	8
		218[c]	760	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	6
		219	393	10	10	9	8	8	9	9	9	10	11	12	14	17
		229	288	5	5	5	5	5	6	6	6	7	7	8	9	10
		Total	7799													
	Central	221	642	9	9	9	10	11	12	11	12	13	12	13	13	13
		222	412	13	13	13	13	14	14	14	15	15	14	14	14	13
		223	376	13	13	13	13	13	13	13	14	15	15	16	18	20
		224	48	15	15	16	18	18	20	22	25	27	28	31	26	42
		225	619	19	18	18	18	18	19	19	19	20	20	22	24	25
		Total	2097													
	Metro	227	472	13	13	13	13	13	14	15	15	18	20	23	13	13
		235	33	18	22	16	19	21	23	22	26	24	17	18	18	18
		236	374	17	16	16	16	17	17	19	20	23	26	31	18	19
		338	452	5	4	4	4	4	4	5	6	7	9	11	15	21
		339	395	6	6	5	4	5	5	5	6	8	10	12	16	23
		Total	1726													

DMU	DMSU	PA	Area mi ^{2}	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
	Southeast	341	611	12	13	14	15	16	17	17	18	21	24	28	31	21
		342	352	11	10	10	11	11	12	11	13	15	17	13	13	13
		343	663	8	8	8	8	8	9	9	11	13	16	19	23	11
		344	189	17	17	16	15	14	14	15	17	20	24	28	37	20
		345	326	11	10	11	11	11	11	10	10	11	12	14	17	19
		346	319	17	17	18	18	18	19	19	20	23	25	27	29	23
		347	434	9	10	10	9	9	9	9	10	11	12	13	13	13
		348	332	16	17	17	17	17	16	15	15	16	17	17	16	13
		349	492	12	13	14	15	16	17	17	18	21	24	28	31	21
		Total	3718													
Big Wood Total			15340													
PRAIRIE	*North*	420	651	4	4	3	3	3	4	4	4	4	4	4	3	3
		421	749	3	3	3	3	3	3	3	3	4	4	5	6	7
		422	634	3	2	2	2	2	2	2	2	3	3	3	4	5
		423	531	4	4	4	3	3	3	3	3	4	4	4	5	7
		424	766	6	7	5	4	4	4	3	3	3	4	4	5	6
		425	779	2	2	1	1	1	1	1	1	1	2	2	2	3
		426	614	4	3	3	3	3	3	3	3	4	4	5	6	8
		427	837	2	2	2	1	1	2	2	2	2	2	3	4	5
		428	550	4	4	4	3	4	4	4	4	5	6	6	7	9
		Total	6111													
	River	431	360	7	8	7	6	6	5	4	4	4	4	4	5	5
		433	397	10	10	9	9	8	8	8	8	9	9	10	11	13
		435	575	6	6	5	5	5	5	5	4	5	5	6	8	10
		440	662	5	5	4	4	4	4	4	4	4	4	4	4	5
		442	806	5	5	4	4	4	4	4	4	5	6	6	8	9
		443	386	7	7	6	6	5	5	5	5	5	5	5	6	6
		Total	3186													

DMU	DMSU	PA	Area mi [2]	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
	Southwest	446	345	7	7	7	6	6	6	6	5	5	5	5	6	6
		447	675	3	3	2	2	2	2	2	2	2	3	3	4	5
		448	447	3	3	3	2	2	3	4	4	4	5	6	7	8
		449	625	4	3	3	3	2	3	4	4	5	6	7	8	10
		450	816	2	2	2	1	2	1	1	1	2	2	2	2	3
		451	687	3	3	3	3	3	3	3	3	3	4	5	6	7
		452	637	3	3	3	3	3	4	4	4	4	5	5	6	7
		453	729	2	2	2	2	2	2	2	2	3	4	5	6	8
		454	840	4	4	3	3	3	3	3	3	4	4	5	6	7
		455	95	5	5	4	4	4	4	4	4	4	4	5	5	6
		456	712	4	4	3	3	3	3	4	4	4	5	6	7	8
		457	666	3	3	2	2	3	3	3	3	3	3	3	4	5
		458	715	3	3	3	2	2	2	2	2	3	3	3	4	5
		459	974	3	3	3	3	3	3	3	3	3	4	4	5	6
		Total	8963													
	Southeast	461	481	9	9	9	8	8	8	7	7	8	7	7	7	6
		462	506	8	8	9	8	8	8	8	7	8	8	8	9	9
		463	453	4	3	3	3	3	3	3	3	4	4	4	5	6
		464	377	5	5	4	4	4	4	4	4	5	6	7	8	9
		465	385	5	5	5	4	4	4	4	4	5	5	5	6	6
		466	931	4	4	4	4	4	4	4	4	4	4	5	6	7
		467	774	4	4	4	3	4	4	4	4	4	4	4	4	3
		Total	3907													
Prairie Total			22167													
Farmland Zone Total			46832													

[a] Density estimates are subject to change as new data are incorporated or the model is revised.

[b] Excluding permit areas 228 & 337, which were not modeled.

[c] New permit area so no historical information is available

Fetus Survey Data Results Of White-Tailed Deer
In The Farmland/Transition Zone Of Minnesota – 2007

Emily Dunbar, Farmland Populations and Research Group

INTRODUCTION

Fetus surveys are used to gather information on productivity (number of fetuses per doe) of juvenile (≤12 months of age) and adult (>12 months of age) female white-tailed deer (*Odocoileus virginianus*) in the farmland/transition zone of Minnesota (Figure 1). These data, along with other biological information, are incorporated into the farmland deer population model. The farmland deer population model is used to simulate herd dynamics, predict changes in population size, and determine deer management strategies for 85 permit areas.

A simple and effective method for estimating productivity rates is through direct examination of the reproductive tracts of female deer killed by motor vehicles. The objectives of this survey were to estimate 1) pregnancy rates of juvenile and adult white-tailed deer in the farmland/transition zone of Minnesota and 2) fetal rates of adult and juvenile white-tailed deer in the farmland/transition zone of Minnesota.

METHODS

Reproductive data required for the farmland deer population model include age class of the female, pregnancy status, number of fetuses present, and gender of the fetuses. These data were collected from road-killed females from 1 February to 31 May. Personnel participating in the survey included all wildlife staff in the farmland/transition zone. Area Wildlife Managers were encouraged to contact local Department of Transportation staff and law enforcement officials to facilitate locating dead deer in a timely fashion. Where possible, the use of volunteers was also encouraged.

Equipment for data collection included a sharp knife or scalpel, vinyl gloves, and self-addressed, postage-paid postcards. When examining deer, staff located and opened the uterus to check for fetuses. Staff recorded pregnancy/lactation status, age class of the female, number and gender of all fetuses present, and the location of the road-killed animal (Figure 2). Notes on body condition or any other unusual observations were also recorded.

Data were also collected from a special hunt conducted from late February to mid April in the bovine tuberculosis (TB) zone in the Northwest DMU. These data were summarized separately from the road-killed deer.

RESULTS & DISCUSSION

A total of 79 road-killed deer were examined in 2007. Three (4%) of these deer came from the Northwest Deer Management Unit (DMU; Table 1), 59 (75%) from the Big Woods DMU (Table 2), and 17 (22%) from the Prairie DMU (Table 3).

Pregnancy rates for fawns ranged from 0% in the Northwest DMU to 17% in the Prairie DMU. Throughout the farmland/transition zone, 9% of fawns were pregnant. Pregnancy rates for adults ranged from 55% in the Prairie DMU to 100% in the Northwest DMU and averaged 67% across the farmland/transition zone.

Fetal rates for fawns ranged from no fetuses/fawn in the Northwest DMU to 0.3 fetuses/fawn in the Prairie DMU, and averaged 0.18 fetuses/fawn across the farmland/transition zone. Fetal rates for adults ranged from 2.0 fetuses/adult in the Northwest to 0.9 fetuses/adult in the Prairie DMU. Fetal rates averaged 1.24 fetuses/adult throughout the farmland/transition zone.

A total of 290 deer from the special TB hunt were examined. The pregnancy rate for fawn and adults was 3% and 93%, respectively. Fetal rate for fawns was 1.0 fetuses/fawn and for adult does was 1.5 fetuses/adult. The sex ratio of fetuses was 50:50 for both fawns and adult does.

Table 1. Reproductive performance of white-tailed deer in Minnesota for the Northwest[a] Deer Management Unit, 1980 – 2007.

	Fawns			Adults		
Year	N	Percent Pregnant	Fetuses per doe	N	Percent Pregnant	Fetuses per doe
1980	8	50	0.6	12	92	1.7
1981	4	0	0.0	11	100	1.7
1982	6	67	0.7	18	94	1.8
1983	15	27	0.3	26	85	1.6
1984	10	40	0.6	23	87	1.7
1985	6	17	0.2	11	91	1.7
1986	3	0	0.0	6	83	1.3
1987	3	0	0.0	5	100	1.6
1988	3	33	0.3	4	50	0.8
1989	14	21	0.3	27	93	1.7
1990	18	22	0.2	29	93	1.7
1991	11	9	0.1	15	87	1.6
1992	13	8	0.1	24	96	1.6
1993	7	0	0.0	11	100	1.6
1994	7	14	0.1	13	92	1.4
1995	4	25	0.3	6	100	2.0
1996	5	0	0.0	21	81	1.3
1997	4	0	0.0	12	100	1.5
1998	3	0	0.0	7	86	1.6
1999	5	0	0.0	14	100	1.6
2000	7	14	0.1	11	100	2.0
2001	4	0	0.0	8	100	1.8
2002	7	14	0.1	13	100	1.8
2003	0	0	0.0	3	100	1.7
2004	2	50	0.5	2	100	2.0
2005	6	33	0.3	9	89	1.9
2006	4	25	0.5	9	100	2.0
2007	1	0	0.0	2	100	2.0
Mean (1980's)		26	0.3		88	1.6
Mean (1990's)		8	0.1		94	1.6
Mean (2000's)		17	0.2		99	1.9

[a]Red River (East and West) and Agassiz Deer Management Units were combined into the Northwest Deer Management Unit due to small sample sizes.

Table 2. Reproductive performance of white-tailed deer in Minnesota for the Big Woods Deer Management Unit[a], 1978 – 2007.

	Fawns			Adults		
Year	N	Percent Pregnant	Fetuses per doe	N	Percent Pregnant	Fetuses per doe
1978	74	47	0.5	113	96	1.8
1979	87	30	0.3	119	92	1.7
1980	87	61	0.7	107	97	1.8
1981	78	58	0.6	132	92	1.7
1982	95	43	0.5	197	95	1.8
1983	83	55	0.7	167	95	1.8
1984	77	22	0.3	123	95	1.8
1985	60	50	0.6	105	96	1.8
1986	79	37	0.4	116	88	1.6
1987	45	44	0.5	146	94	1.8
1988	14	64	0.8	31	97	1.8
1989	51	31	0.3	85	96	1.8
1990	96	32	0.3	125	95	1.8
1991	50	20	0.2	71	96	1.8
1992	67	24	0.3	100	95	1.8
1993	47	38	0.4	95	93	1.7
1994	46	15	0.2	99	94	1.7
1995	21	19	0.2	54	91	1.8
1996	59	15	0.2	112	96	1.8
1997	40	33	0.4	96	88	1.6
1998	53	23	0.3	109	91	1.7
1999	49	37	0.4	95	91	1.6
2000	62	23	0.3	76	91	1.6
2001	36	14	0.1	65	94	1.7
2002	70	23	0.3	97	95	1.8
2003	66	20	0.2	90	95	1.6
2004	65	20	0.2	60	88	1.6
2005	93	29	0.4	99	91	1.7
2006	22	41	0.5	63	97	1.8
2007	27	7	0.1	32	69	1.3
Mean (1980's)		47	0.5		95	1.8
Mean (1990's)		26	0.3		93	1.7
Mean (2000's)		22	0.3		90	1.6

[a]The majority of samples (approximately 68%) from this Deer Management Unit were obtained from the Big Woods Metro sub-unit. Consequently, the data reported in this table may not reflect reproductive performances throughout the remainder of the Big Woods Management Unit.

Table 3. Reproductive performance of white-tailed deer in Minnesota for the Prairie Deer Management Unit, 1978 – 2007.

	Fawns			Adults		
Year	N	Percent Pregnant	Fetuses per doe	N	Percent Pregnant	Fetuses per doe
1978	25	44	0.6	69	100	1.9
1979	83	34	0.4	92	90	1.8
1980	51	63	0.7	55	91	1.7
1981	57	44	0.5	65	92	1.8
1982	50	46	0.6	85	94	1.9
1983	42	62	0.9	51	96	1.9
1984	30	23	0.3	69	84	1.6
1985	21	38	0.4	49	94	1.9
1986	25	64	0.8	56	93	1.7
1987	27	52	0.6	47	94	0.9
1988	20	40	0.5	16	100	1.9
1989	37	38	0.4	54	89	1.7
1990	43	42	0.4	62	97	1.8
1991	30	20	0.2	67	94	1.8
1992	37	19	0.2	51	94	1.9
1993	39	38	0.4	75	93	1.8
1994	32	16	0.2	46	98	1.9
1995	39	21	0.3	50	92	1.7
1996	28	14	0.1	30	90	1.6
1997	26	4	0.0	49	92	1.7
1998	18	17	0.2	38	97	1.7
1999	26	19	0.2	47	96	1.7
2000	13	23	0.4	23	87	1.6
2001	18	6	0.1	39	87	1.5
2002	19	32	0.4	26	92	1.7
2003	18	22	0.2	123	93	1.7
2004	10	10	0.1	9	89	1.7
2005	16	13	0.1	39	90	1.7
2006	2	0	0	16	94	1.9
2007	6	17	0.2	11	55	0.9
Mean (1980's)		47	0.5		93	1.7
Mean (1990's)		21	0.2		94	1.8
Mean (2000's)		15	0.2		90	1.7

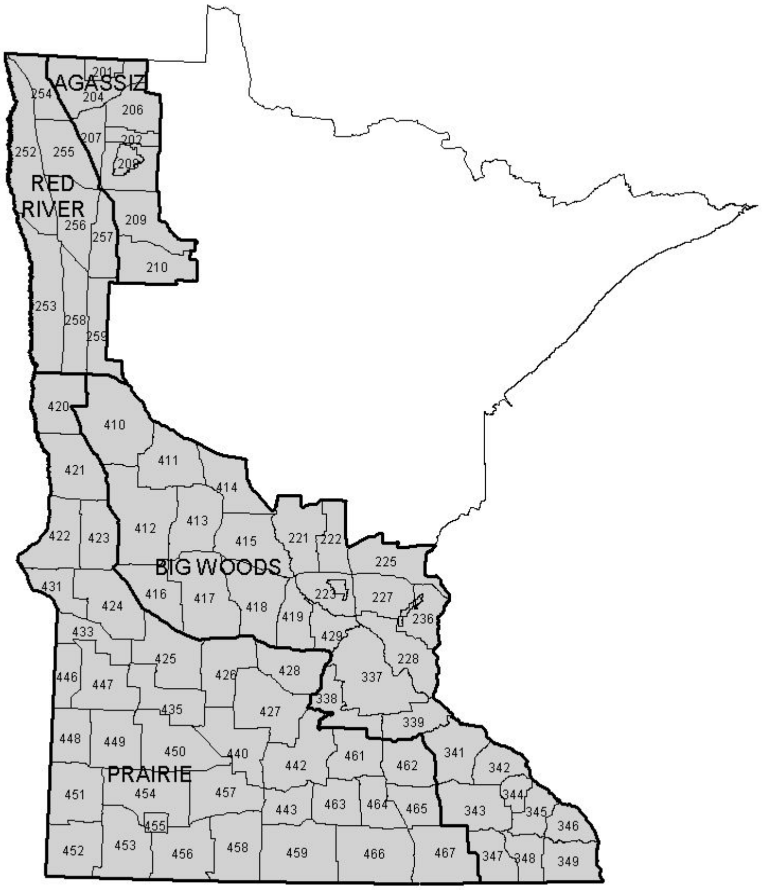
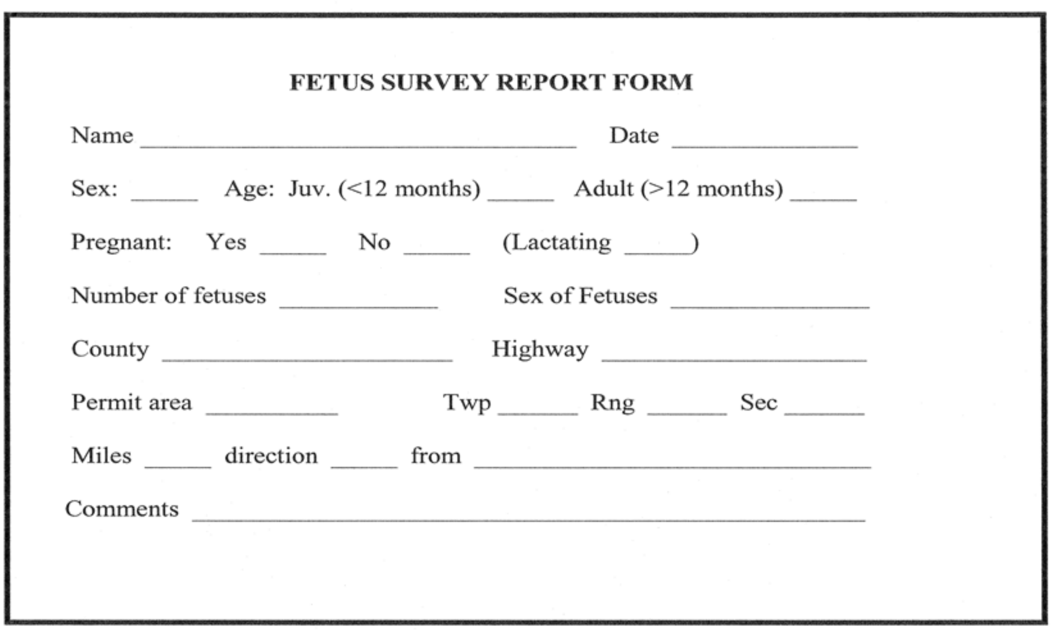


Figure 1. Permit areas within the Farmland Zone of Minnesota



FETUS SURVEY REPORT FORM

Name ______________________________ Date ____________

Sex: _____ Age: Juv. (<12 months) _____ Adult (>12 months) _____

Pregnant: Yes _____ No _____ (Lactating _____)

Number of fetuses ___________ Sex of Fetuses _____________

County ____________________ Highway __________________

Permit area _________ Twp ______ Rng ______ Sec ______

Miles _____ direction _____ from ___________________________

Comments ____

Figure 2. Postcard for reporting fetus survey data

2006 Minnesota Fall Wild Turkey Population Survey

Angela Isackson, Tonya Klinkner, Dan Smedberg, and Richard Kimmel
Farmland Wildlife Populations and Research Group

INTRODUCTION

The fall wild turkey population survey is a mail survey of deer hunters (regular firearm) in Minnesota's wild turkey range and potential range. The survey is scheduled once every 2 years and consists of asking randomly selected deer hunters where they hunted (permit area [PA]), if they saw wild turkeys while hunting, and the approximate location (miles and direction from nearest town) of turkey sightings. The purpose of the survey is to estimate a wild turkey population index (the proportion of deer hunters observing wild turkeys [HOWT]) in 16 turkey management units (TMU) and their subset PAs.

METHODS

For the 2006 fall wild turkey population survey, 18,247 hunters were randomly selected from regular firearm deer permit holders in 16 TMUs, which included 108 PA's (Figures 1 and 2). The area surveyed was selected by the Minnesota Department of Natural Resources (MNDNR) Turkey Committee to include Minnesota's current and potential wild turkey range. Prior to 2006, the survey consisted of a stratified sample of antlerless deer hunters (lottery winners), where the PA of each hunter was known prior to drawing the sample (i.e., hunters mostly hunted in the PA for which they had an antlerless permit). Beginning in 2006, the sampling frame was modified because of regulation changes (antlerless permits are no longer required for managed or intensive areas) to all regular firearm deer hunters (excluding muzzleloader, all-season, and multi-zone licenses). Hunters can hunt anywhere within their selected hunting period and zone, but most hunters pursue deer within relatively small, traditional areas (Welsh and Kimmel 1990). Therefore, PAs listed in the Electronic Licensing System (ELS) database were used as a stratification variable and a random sample of regular firearm deer hunters was selected from each PA.

The 2006 survey included 1 new TMU, and there were several boundary and PA-name changes since 2002. It should be noted that turkey PAs equal deer PAs in most cases, except where turkey PAs consist of >1 deer PA (combined PAs). A new TMU "P" was created from 9 PAs in northern Minnesota (previously part of the non-survey area). Within TMU "K" old PA-417 (was in TMU "L") and PA-418 (was in TMU "K") were modified; new PA's are numbered 417 and 218, and both are now part of TMU "K." A new customized TMU "L" includes the change of old PA-413 (was in TMU "N") now being part of a new PA-213 in TMU "L." The boundary between old PA-412 and PA-413 was modified and now designated PA-412 (smaller) and PA-213. Also within TMU "L" old PA-410 was renamed PA-239. Modifications within TMU "N" included name changes of old PA-411 to PA-240, old PA-414 to PA-214, and old PA-409 to PA-241.

TMU "O" had a minor boundary change (ignored) involving eastern edge of PA-209 and PA-210. Also within TMU "O" several name changes occurred with old PA-402 to PA-253, old PA-407 to PA-258, old PA-408 to PA-259, old PA-406 to PA-257, old PA-405 to PA-256, old PA-401 to PA-252, old PA-403 to PA-254, and old PA-404 to PA-255. No changes were made to TMU's "A-J" or "M." Survey data collected from TMUs or PAs with boundary changes are not directly comparable to 2002.

Sample size was estimated for each TMU based on a family-wise Type I error rate of 0.15 (α_c = 0.15/15 = 0.01), a desired margin of error = 0.07 (half-width of CI for HOWT change), mean HOWT = 0.5, a finite population correction factor, and a response rate of 60%. A per-contrast alpha (α_c) of 0.01 was used as a tradeoff between controlling the Type I error rate (probability of rejecting a true null) and having reasonable power to detect a change of $\geq$7% at the TMU scale. Each estimated TMU sample size was then divided among PAs based on the proportion of hunters in each PA (ELS database).

Selected hunters were mailed a postcard questionnaire requesting information on PA hunted, number of turkeys observed while hunting, and location of turkey observations (miles and direction from nearest town). The first mailing occurred 24 November 2006. A second mailing was sent on 12 January 2007 to all non-respondents. A third mailing was sent on 14 March 2007 to all remaining non-respondents.

We estimated HOWT for each TMU and PA and compared estimates to those of the previous survey (Kruger and Dingman 2002). We also used log-linear models (Eberhardt and Simmons 1992) to estimate the mean annual rate of change (λ) in HOWT during 1999-2006. We constructed an 85% family of confidence intervals (CI) for parameter estimates at the TMU scale. These are equivalent to 99% CIs where the per-family Type I error rate is 0.15 (see above). We did not attempt to control the Type I error rate at the PA scale because sample sizes were small. Thus, we constructed 95% confidence intervals at the PA scale. Estimated changes in HOWT (compared to 2002) were considered meaningful if the CI did not include zero, and precision was deemed acceptable if the CI was less than ±7% (desired margin of error). Likewise, we interpreted estimated finite rates of change (λ) as meaningful if the CI did not include 1, and we deemed precision as acceptable if the CI was less than ±0.07. Finally, we generated maps of turkey observations to monitor potential range changes. We excluded questionable observations (where distance between the turkey observation and the center of the hunter-listed PA was >3x the diameter of the PA) and locations that were outside the state boundary.

RESULTS

The overall response rate was 44.1%, which was lower than the expected response rate (60%) used in sample-size calculations. The response rate per mailing ranged from 28.2% in mailing 1 to 8.5% in mailing 3. The percentage of hunters that reported seeing turkeys was independent of mailing (χ^2_2 = 1.35, P = 0.51), which indicated that non-response bias was negligible (at least at the range-wide scale).

Compared to 2002, the HOWT index increased in 9 TMUs and was unchanged (CI included zero) in 6 TMUs (Table 1). The desired level of precision (±7%) was achieved in 6 of the 9 TMUs with an increase, but none of the TMUs with "no change" (Figure 1). Thus, conclusions about "no change" at the TMU scale should be viewed cautiously. Ninety-five PAs (88%) had comparable data for estimating change in HOWT from the 2002 survey (Table 2). The HOWT index decreased in 1 PA (345) and increased in 26 PAs (227, 228, 156, 157, 159, 183, 464, 466, 449, 458, 431, 154, 221, 247, 249, 215, 219, 239,421, 424, 214, 240, 241, 243, 246, 248); the remaining 68 CIs included zero (indicating no meaningful change or the change was undetectable due to poor precision). Most estimates at the PA scale were imprecise, e.g., only one PA (154) achieved the desired margin of error (Figure 2). This lack of precision primarily reflected small sample sizes.

One TMU (E) exhibited a positive annual rate of change during 1999-2006 and the associated CI achieved the desired margin of error. No negative trends were detected, but 14 TMUs had CI's that included $\lambda = 1$ with margins of error that exceeded 0.07. Thus, estimates of λ were imprecise and conclusions about "no change" at the TMU scale should be interpreted cautiously. Eighty-nine PAs had comparable data for estimating λ. Based on the 95% CI of λ, 1 PAs exhibited a negative rate of change, 11 PAs had positive rates of change, and 77 PAs had CIs that included $\lambda = 1$ (no change) (Table 2). However, only 6 of the 12 PAs with significant rates of changes had CIs that achieved the desired margin of error (i.e., estimates of change were imprecise). Likewise, only 5 of the 77 CIs that included $\lambda = 1$ achieved the desired bound. Thus, estimates of "no change" should be viewed cautiously at both the TMU and PA scale.

Wild turkey range in Minnesota has continued to expand as evidenced by the distribution of turkeys sighted by deer hunters during fall 2006 (Figure 3). Although some wild turkey observations were assumed to be game farm turkeys, turkey-distribution information is comparable to past surveys. Maps of turkey locations and number of turkeys observed by county and PA (Figure 4) are available upon request.

INTERPRETATIONS

Wild turkey population indices increased significantly in the northern third of their range (TMUs E, J, K, M, N, and O), possibly in response to consecutive mild winters. The survey lacked power to detect relatively small changes in HOWT (e.g., < ±14%) in the southern 2/3 of Minnesota's turkey range. The lack of a significant change should not be interpreted as population stability, but rather inability of the survey to detect small changes. Thus, the non-significant decrease in TMU A (Δ HOWT = -7.0) and all 4 subset PAs (Δ HOWT = -2.9 to –14.4) may have reflected a true population decline that the survey failed to detect or estimate precisely. Turkey populations are well established in TMU A, and the observed decline may represent normal fluctuation around a stable mean. For future surveys, we are considering analysis of population trends over >3 surveys to help reveal true population trends.

Population indices from this survey have been used to predict future population levels and allocate turkey-hunting permits to meet management objectives (Kimmel 2000). This report improved measures of uncertainty for population indices and estimated rates of change (previously assumed to be measured without error). These measures of uncertainty can be incorporated into turkey population models to realistically account for precision in management decisions. Options for dealing with uncertainty at the PA scale include managing at a broader scale (e.g., TMU) or looking for alternate techniques to interpret data at the PA scale.

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Table 1. Percent of deer hunters that observed wild turkeys (HOWT) by turkey management unit (TMU) in Minnesota, 1991-2006.

	2006			Average (1991-2002)			Absolute change from 2002			Mean rate of change (1999-2006)		
TMU	*n*	HOWT	SE	*n*	HOWT	SE	*n*	Δ HOWT	99% CI[a]	*n*	λ	99% CI[a]
A	469	64.1	2.2	7	65.7	1.7	980	-7.0	(-14.7, 0.7)	3	0.98	(0.73, 1.33)
B	350	60.7	2.7	7	62.4	3.3	664	-2.0	(-11.8, 7.8)	3	0.97	(0.33, 2.81)
C	524	68.8	2.1	7	60.9	3.3	1,049	3.4	(-4.1, 10.9)	3	0.99	(0.35, 2.83)
D	468	59.0	2.4	7	25.1	4.5	1,006	12.3	(4.1, 20.5)	3	1.06	(0.96, 1.16)
E	581	34.9	2.0	7	6.8	1.7	1,113	16.1*	(9.4, 22.8)	3	1.16*	(1.09, 1.23)
F	491	54.0	2.3	7	26.6	5.2	1,042	5.7	(-2.3, 13.7)	3	1.02	(0.82, 1.27)
G	538	34.9	2.1	7	7.0	2.3	1,082	8.1	(0.9, 15.3)	3	1.07	(0.86, 1.34)
H	629	51.2	2.1	7	23.3	5.0	1,183	2.5	(-5.2, 10.2)	3	1.02	(0.80, 1.30)
I	401	34.0	2.5	7	5.7	2.1	846	7.3	(-1.2, 15.8)	3	1.09	(0.36, 3.29)
J	540	30.4	2.0	7	3.9	1.8	1,083	13.8*	(7.1, 20.5)	3	1.11	(0.17, 7.18)
K[b]	613	50.4	2.0	7	8.9	3.0	1,321	19.5*	(12.5, 26.5)	3	1.10	(0.34, 3.50)
L[b]	430	42.8	2.5	7	3.6	1.7	891	13.8	(5.3, 22.3)	3	1.17	(0.07, 18.46)
M	468	23.3	2.2	7	4.4	0.9	969	10.5*	(3.5, 17.5)	3	1.20	(0.20, 7.09)
N[b]	581	29.9	2.0	7	3.0	1.0	1,113	17.4*	(11.0, 23.8)	3	1.16	(0.11, 12.86)
O	490	14.6	1.7	7	2.7	0.7	1,060	5.8*	(0.6, 11.0)	3	1.19	(0.09, 15.41)
P[c]	466	3.9	0.9									

[a] 85% family of confidence intervals (type I error rate controlled at $\alpha = 0.15$).

[b] Estimates of change should be interpreted cautiously because boundary changes occurred in 2006.

[c] New turkey management unit created in 2006.

* Desired level of precision was achieved.

Table 2. Percent of deer hunters that observed wild turkeys (HOWT) by turkey permit area (PA) in Minnesota, 1991-2006.

	2006			Average (1991-2002)			Absolute change from 2002			Mean annual rate of change			
PA	*n*	HOWT	SE	*n*	HOWT	SE	*n*	Δ HOWT	95% CI[a]	Period	*n*	λ	95% CI[a]
A-345	83	64.2	5.4	11	55.4	3.8	172	-14.4	(-28.1, -0.7)	1999-2006	3	0.98	(0.73, 1.32)
A-346	128	57.7	4.5	11	57.4	2.9	257	-5.1	(-17.3, 7.1)	1999-2006	3	0.98*	(0.97, 0.99)
A-348	88	64.0	5.4	11	73.2	2.2	218	-9.0	(-22.1, 4.1)	1999-2006	3	0.97*	(0.94, 1.01)
A-349	168	68.9	3.6	12	66.1	1.9	331	-2.9	(-12.7, 6.9)	1999-2006	3	0.99*	(0.98, 1.00)
B-344	350	60.7	2.7	11	60.4	3.0	664	-2.0	(-9.4, 5.4)	1999-2006	3	0.97	(0.78, 1.20)
C-341	184	62.4	3.6	11	47.4	5.3	365	8.2	(-2.0, 18.4)	1999-2006	3	0.97	(0.53, 1.77)
C-342	115	68.2	4.6	11	50.7	5.3	241	3.9	(-8.3, 16.1)	1999-2006	3	0.99	(0.84, 1.18)
C-343	133	74.0	3.8	11	48.1	5.9	260	-3.1	(-13.5, 7.3)	1999-2006	3	1.00	(0.90, 1.11)
C-347	90	74.9	4.9	11	63.2	2.2	181	2.4	(-10.9, 15.7)	1999-2006	3	1.01*	(0.98, 1.05)
D-227	173	57.8	3.8	9	16.9	3.8	382	22.4	(12.4, 32.4)	1999-2006	3	1.12*	(1.06, 1.18)
D-228	38	83.3	6.3	5	32.0	6.6	75	45.5	(25.5, 65.5)	1999-2006	3	1.08	(0.40, 2.93)
D-235	22	40.0	11.5	11	17.5	2.6	37	0.0	(-33.5, 33.5)	1999-2006	3	1.09	(0.49, 2.43)
D-236	115	59.3	4.7	10	28.5	5.9	312	4.0	(-7.6, 15.6)	1999-2006	3	1.04	(0.88, 1.22)
D-337	47	54.4	7.4	11	13.1	2.9	61	18.7	(-10.3, 47.7)	1999-2006	3	0.99	(0.38, 2.58)
D-338	68	57.4	6.5	11	28.5	5.0	134	-7.7	(-24.8, 9.4)	1999-2006	3	0.99	(0.85, 1.14)
E-152	15	12.5	11.1	2	33.3	17.8	22	-30.3	(-75.8, 15.2)	1999-2006	3	1.40	(0.01, 360.29)
E-156	115	19.7	3.7	2	5.8	3.9	210	11.3	(2.1, 20.5)	1999-2006	3	1.52	(0.21, 10.82)
E-157	179	39.7	3.7	7	4.2	2.3	342	23.1	(13.9, 32.3)	1999-2006	3	1.29	(0.86, 1.93)
E-159	92	45.0	5.5	7	4.9	2.4	195	24.6	(11.3, 37.9)	1999-2006	3	1.25	(0.92, 1.71)
E-183	99	23.3	4.3	2	8.6	0.6	184	15.1	(4.7, 25.5)	1999-2006	3	1.13	(0.40, 3.22)
E-225	83	52.2	5.8	9	12.3	3.5	162	9.1	(-6.6, 24.8)	1999-2006	3	1.11	(0.67, 1.84)
F-339	89	57.6	5.4	11	31.7	3.7	144	10.3	(-6.6, 27.2)	1999-2006	3	0.99	(0.58, 1.68)
F-461	81	48.8	5.6	11	20.9	4.8	202	-5.8	(-19.9, 8.3)	1999-2006	3	1.04	(0.58, 1.87)
F-462	84	50.0	5.8	11	37.2	4.9	179	-10.0	(-24.9, 4.9)	1999-2006	3	0.98	(0.82, 1.17)

Table 2. Continued.

	2006			Average (1991-2002)			Absolute change from 2002			Mean annual rate of change			
PA	*n*	HOWT	SE	*n*	HOWT	SE	*n*	Δ HOWT	95% CI[a]	Period	*n*	λ	95% CI[a]
F-463	42	45.7	8.1	11	13.6	3.2	91	17.2	(-3.2, 37.6)	1999-2006	3	1.04	(0.56, 1.96)
F-464	37	61.0	9.4	11	11.7	3.9	77	26.0	(2.5, 49.5)	1999-2006	3	1.09	(0.69, 1.71)
F-465	28	43.8	10.2	11	13.8	4.5	66	-3.5	(-29.0, 22.0)	1999-2006	3	1.01	(0.80, 1.27)
F-466	75	51.7	6.2	11	21.5	4.5	168	16.2	(0.7, 31.7)	1999-2006	3	1.01	(0.47, 2.13)
F-467	51	73.5	6.2	11	19.2	5.9	111	10.1	(-7.1, 27.3)	1999-2006	3	1.06	(0.86, 1.32)
G-446	38	41.4	8.3	8	10.0	5.0	78	8.9	(-12.9, 30.7)	1999-2006	3	1.02	(0.71, 1.46)
G-447	39	24.9	7.4	8	4.5	3.0	68	-2.7	(-24.5, 19.1)	1999-2006	3	1.05	(0.54, 2.03)
G-448	43	48.2	7.9	6	18.6	7.5	102	-2.6	(-22.6, 17.4)	2002-2006	2	0.99	NA
G-449	46	61.3	7.4	7	12.1	4.9	104	25.1	(5.9, 44.3)	2002-2006	2	1.14	NA
G-450	20	32.9	10.8	8	10.8	4.4	50	-7.1	(-34.5, 20.3)	1999-2006	3	0.99	(0.70, 1.39)
G-451	86	27.0	5.0	7	8.2	2.8	158	11.7	(-1.0, 24.4)	1999-2006	3	1.02	(0.38, 2.77)
G-454	80	19.2	4.6	7	8.7	3.1	154	-2.4	(-15.3, 10.5)	1999-2006	3	0.99	(0.87, 1.11)
G-456	36	23.9	7.9	10	6.2	1.3	88	16.2	(-0.9, 33.3)	1999-2006	3	1.16	(0.41, 3.28)
G-457	45	38.8	7.7	7	9.7	2.5	75	18.8	(-2.0, 39.6)	1999-2006	3	1.18*	(1.14, 1.21)
G-458	43	29.9	7.1	7	4.2	1.2	77	24.0	(7.9, 40.1)	1999-2006	3	1.21	(0.23, 6.30)
G-459	59	47.9	6.8	11	13.8	3.6	125	13.1	(-4.5, 30.7)	1999-2006	3	1.05	(0.80, 1.37)
H-431	41	57.3	7.9	11	7.2	2.1	94	29.0	(9.4, 48.6)	1999-2006	3	1.16	(0.92, 1.45)
H-433	78	32.1	5.7	7	10.7	3.5	161	4.4	(-10.3, 19.1)	1999-2006	3	1.09	(0.70, 1.71)
H-440	108	53.1	4.9	7	29.6	6.4	198	0.9	(-13.2, 15.0)	1999-2006	3	1.01*	(0.97, 1.04)
H-442	156	52.2	4.1	11	31.8	4.4	283	-2.9	(-14.7, 8.9)	1999-2006	3	0.97	(0.87, 1.09)
H-443	79	59.1	5.8	9	25.4	7.0	145	1.5	(-15.0, 18.0)	1999-2006	3	1.00*	(0.93, 1.07)
I-425	165	52.9	4.2	7	21.0	5.8	345	7.4	(-3.6, 18.4)	1999-2006	3	1.02	(0.91, 1.15)
I-426	115	19.2	3.7	8	9.1	3.0	294	-0.9	(-10.3, 8.5)	1999-2006	3	1.00	(0.92, 1.09)
I-427	116	33.8	4.5	9	9.1	3.2	175	-3.5	(-18.6, 11.6)	1999-2006	3	1.07	(0.46, 2.49)

Table 2. Continued.

PA	2006 *n*	2006 HOWT	2006 SE	Average (1991-2002) *n*	Average (1991-2002) HOWT	Average (1991-2002) SE	Absolute change from 2002 *n*	Absolute change from 2002 Δ HOWT	Absolute change from 2002 95% CI[a]	Mean annual rate of change Period	Mean annual rate of change *n*	Mean annual rate of change λ	Mean annual rate of change 95% CI[a]
I-428	168	44.3	4.0	9	11.0	3.6	330	9.7	(-1.1, 20.5)	1999-2006	3	1.13	(0.65, 1.98)
J-154	143	10.8	2.7	2	1.9	0.3	264	9.1*	(3.4, 14.8)	1999-2006	3	1.21	(0.25, 5.92)
J-221	69	51.4	6.2	8	6.1	2.7	141	26.4	(10.7, 42.1)	1999-2006	3	1.15	(0.86, 1.55)
J-222	77	39.4	5.8	8	4.5	1.9	138	14.8	(-0.9, 30.5)	1999-2006	3	1.26	(0.45, 3.56)
J-223	50	75.1	6.3	8	15.0	6.1	97	17.7	(-1.1, 36.5)	1999-2006	3	1.09	(0.95, 1.24)
J-224	16	50.9	13.9	5	16.4	9.8	27	-21.9	(-61.6, 17.8)	1999-2006	3	1.12	(0.18, 6.85)
J-242	46	5.7	3.7	1	5.6	NA	118	0.1	(-8.9, 9.1)	2002-2006	2	1.00	NA
J-247	62	15.7	5.1	2	3.6	1.3	117	13.9	(3.1, 24.7)	1999-2006	3	1.19	(0.11, 13.07)
J-249	77	32.3	5.3	2	13.0	2.0	181	17.9	(5.6, 30.2)	1999-2006	3	1.17	(0.85, 1.61)
K-215	184	55.7	3.8	8	14.9	5.2	429	19.8	(10.2, 29.4)	1999-2006	3	1.09	(0.94, 1.28)
K-218[b]	117	61.5	4.6										
K-219	88	41.9	5.6	11	10.1	0.8	161	24.1	(10.0, 38.2)	1999-2006	3	1.19	(0.87, 1.61)
K-229	39	36.7	8.1	5	14.2	5.1	76	4.2	(-17.8, 26.2)	1999-2006	3	1.08	(0.72, 1.63)
K-417[b]	118	37.8	4.5										
L-213[b]	38	47.7	8.3										
L-239	151	52.6	4.4	7	6.6	3.0	332	28.2	(17.6, 38.8)	1999-2006	3	1.22	(1.09, 1.37)
L-412[b]	117	31.0	4.3										
L-416	94	38.6	5.2	7	9.5	4.0	156	9.6	(-5.7, 24.9)	1999-2006	3	1.07*	(1.05, 1.10)
M-420	89	25.5	4.8	7	7.8	2.0	193	8.2	(-3.8, 20.2)	1999-2006	3	1.41	(0.16, 12.57)
M-421	66	23.6	5.5	7	1.6	0.4	170	22.7	(11.9, 33.5)	1999-2006	3	1.35	(0.08, 23.85)
M-422	55	48.7	7.1	7	12.4	3.9	123	17.8	(-0.0, 35.6)	1999-2006	3	1.12*	(1.07, 1.18)
M-423	93	11.4	3.4	7	3.9	1.4	203	-0.4	(-9.4, 8.6)	1999-2006	3	1.17	(0.27, 5.12)
M-424	163	20.1	3.3	7	4.2	1.0	278	10.6	(2.2, 19.0)	1999-2006	3	1.20*	(1.12, 1.27)
N-214	63	56.8	6.5	7	4.5	1.7	128	39.9	(24.2, 55.6)	1999-2006	3	1.32	(1.20, 1.47)

Table 2. Continued.

PA	2006			Average (1991-2002)			Absolute change from 2002			Mean annual rate of change			
	n	HOWT	SE	*n*	HOWT	SE	*n*	Δ HOWT	95% CI[a]	Period	*n*	λ	95% CI[a]
N-240	42	44.2	8.0	7	6.1	2.3	91	21.7	(2.1, 41.3)	1999-2006	3	1.17	(1.06, 1.29)
N-241	59	35.0	6.4	6	2.1	0.6	85	27.3	(11.2, 43.4)	2002-2006	2	1.43	NA
N-243	50	34.7	7.0	2	6.2	2.2	101	26.8	(11.1, 42.5)	1999-2006	3	1.36	(0.91, 2.02)
N-244	109	29.8	4.5	7	4.4	2.4	201	10.2	(-1.8, 22.2)	1999-2006	3	1.14	(0.89, 1.45)
N-245	94	8.5	3.3	2	5.6	1.7	201	2.0	(-6.0, 10.0)	1999-2006	3	1.14	(0.61, 2.14)
N-246	134	20.4	3.8	2	5.7	0.2	242	14.9	(6.3, 23.5)	1999-2006	3	1.18	(0.39, 3.57)
N-248	26	49.1	10.7	2	19.6	5.5	60	25.5	(0.2, 50.8)	1999-2006	3	1.21	(1.06, 1.39)
O-201	10	7.1	10.6	1	0.0	NA	18	7.1	NA	2002-2006	2	1.69	NA
O-202	20	3.0	6.2	2	1.7	0.8	69	1.0	(-11.9, 13.9)	1999-2006	3	1.21	(0.42, 3.46)
O-203	8	15.4	12.9	1	20.0	NA	13	-4.6	(-53.2, 44.0)	2002-2006	2	0.94	NA
O-204	36	9.0	6.9	2	4.6	4.0	85	0.9	(-14.8, 16.6)	1999-2006	3	1.37	(0.11, 17.78)
O-206	26	3.0	4.8	2	4.3	0.6	77	-0.9	(-11.7, 9.9)	1999-2006	3	0.94	(0.83, 1.06)
O-207	25	22.1	10.9	2	7.3	2.7	56	12.5	(-11.2, 36.2)	1999-2006	3	1.24	(1.04, 1.47)
O-208	17	18.5	10.7	2	0.0	0.0	39	18.5	NA	1999-2006	3	1.56	(0.11, 22.02)
O-209	32	13.5	6.5	2	3.0	1.9	62	13.5	NA	1999-2006	3	1.19	(0.02, 92.01)
O-210	67	8.4	3.9	2	1.5	0.6	108	5.9	(-3.1, 14.9)	1999-2006	3	1.24	(0.89, 1.73)
O-251	14	34.5	14.7	2	5.4	4.5	36	25.4	(-6.0, 56.8)	1999-2006	3	1.65	(0.32, 8.41)
O-252	12	39.0	17.4	2	29.2	2.9	20	14.0	(-34.7, 62.7)	1999-2006	3	1.04	(0.54, 1.97)
O-253	20	41.5	11.8	7	6.0	4.2	80	8.2	(-17.9, 34.3)	1999-2006	3	1.26	(0.27, 5.96)
O-254	12	0.0	0.0	2	15.6	6.7	23	-27.3	NA	1999-2006	3	0.68	(0.01, 34.35)
O-255	26	7.1	6.1	2	2.2	0.4	64	4.5	(-8.6, 17.6)	1999-2006	3	1.16	(0.73, 1.85)
O-256	29	13.8	7.2	7	2.9	0.6	57	10.3	(-5.4, 26.0)	1999-2006	3	1.17	(0.35, 3.92)
O-257	20	1.9	4.1	7	1.8	0.4	46	-1.9	(-12.9, 9.1)	1999-2006	3	0.98	(0.39, 2.49)
O-258	26	18.7	10.0	7	4.4	1.2	52	11.0	(-11.1, 33.1)	1999-2006	3	1.26	(1.00, 1.58)

Table 2. Continued.

PA	2006 *n*	2006 HOWT	2006 SE	Average (1991-2002) *n*	Average (1991-2002) HOWT	Average (1991-2002) SE	Absolute change from 2002 *n*	Absolute change from 2002 Δ HOWT	Absolute change from 2002 95% CI[a]	Mean annual rate of change Period	Mean annual rate of change *n*	Mean annual rate of change λ	Mean annual rate of change 95% CI[a]
O-259	18	29.5	12.4	7	2.6	1.4	41	12.1	(-16.7, 40.9)	1999-2006	3	1.60	(0.08, 32.54)
O-297	24	21.9	8.9	6	2.8	1.3	33	21.9	NA	1999-2006	3	1.59	(0.10, 26.03)
O-298	46	13.2	5.2	2	3.2	3.0	79	7.1	(-6.0, 20.2)	1999-2006	3	1.44	(0.26, 8.01)
P-170[c]	96	3.1	1.8										
P-172[c]	90	3.3	1.9										
P-174[c]	52	1.9	1.9										
P-181[c]	55	3.6	2.5										
P-182[c]	10	22.3	13.7										
P-184[c]	101	4.8	2.2										
P-197[c]	39	0.0	0.0										
P-199[c]	8	13.4	12.8										
P-287[c]	12	6.2	9.6										

[a] Confidence intervals are not adjusted for multiple comparisons, i.e., $\alpha \geq 0.25$.

[b] HOWT estimates are not comparable among survey years because of boundary changes.

[c] New turkey management unit and permit areas in 2006.

* Desired level of precision was achieved.

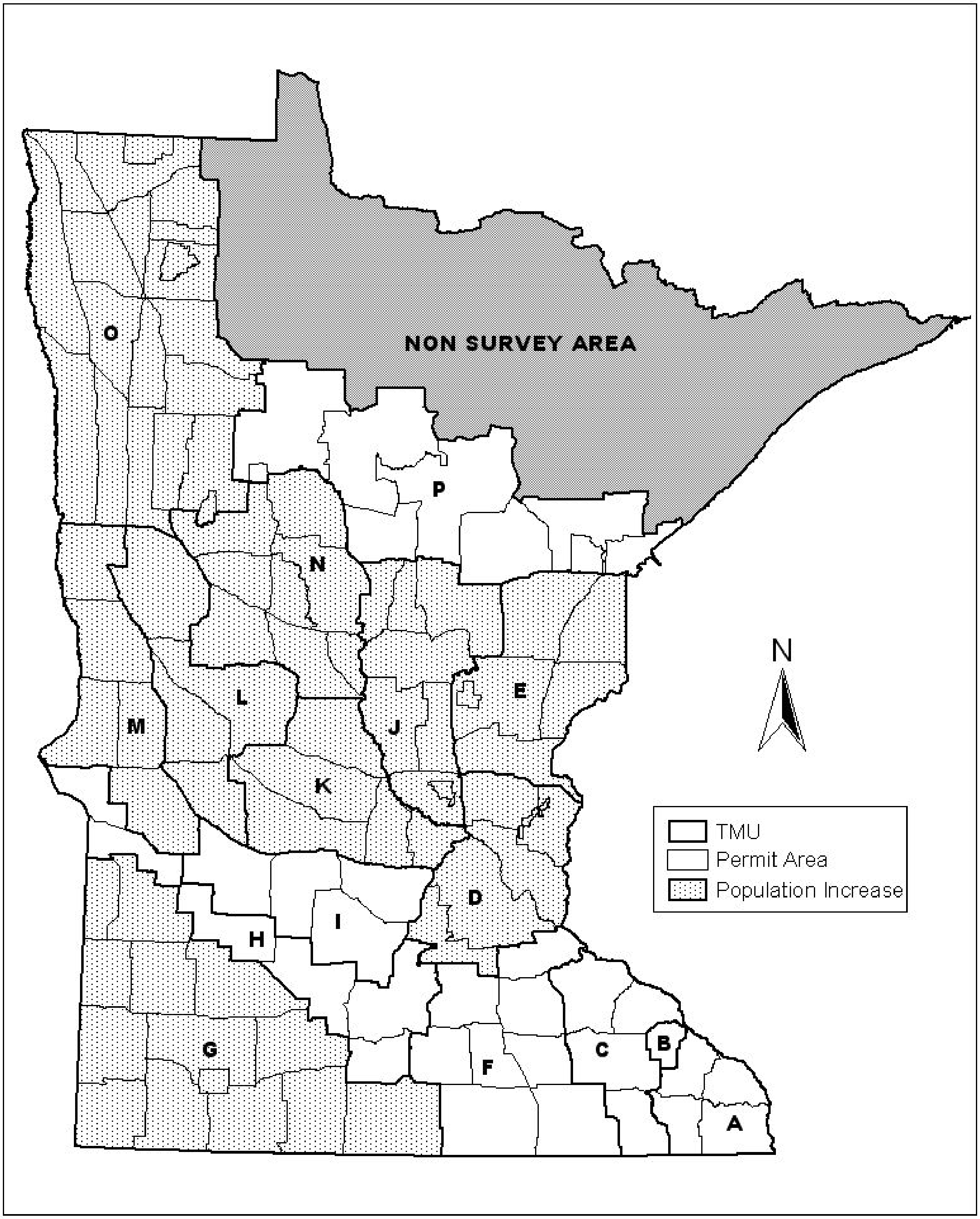


Figure 1. Location of turkey management units (TMUs) used for the wild turkey survey in Minnesota, fall 2006. Shaded TMUs had a significant increase in HOWT (population index) from the 2002 survey.

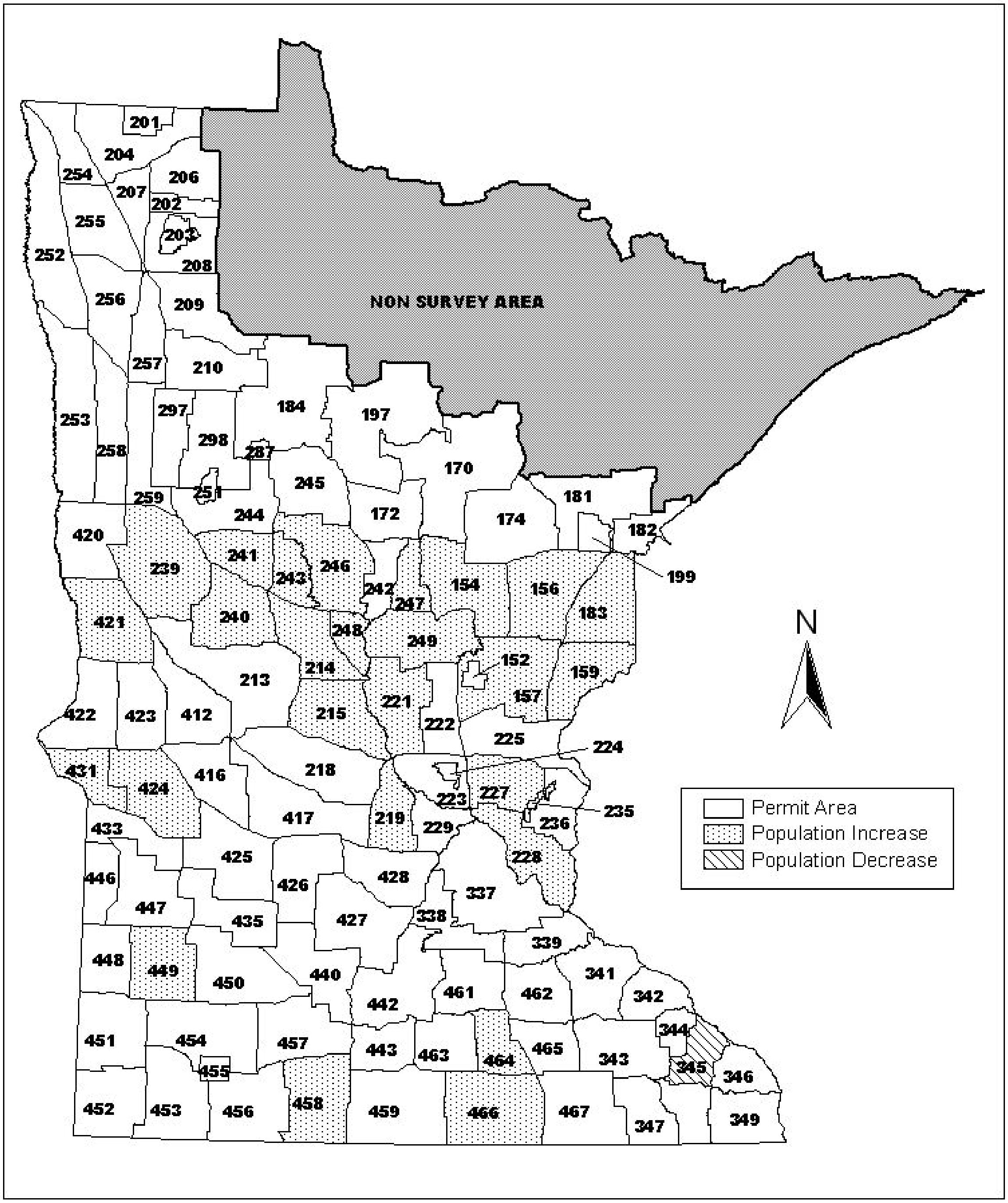


Figure 2. Location of deer hunting permit areas (PAs) used for the wild turkey survey in Minnesota, fall 2006. Shaded PAs had a significant increase in HOWT (population index) and barred PAs had a significant decrease in HOWT from the 2002 survey.

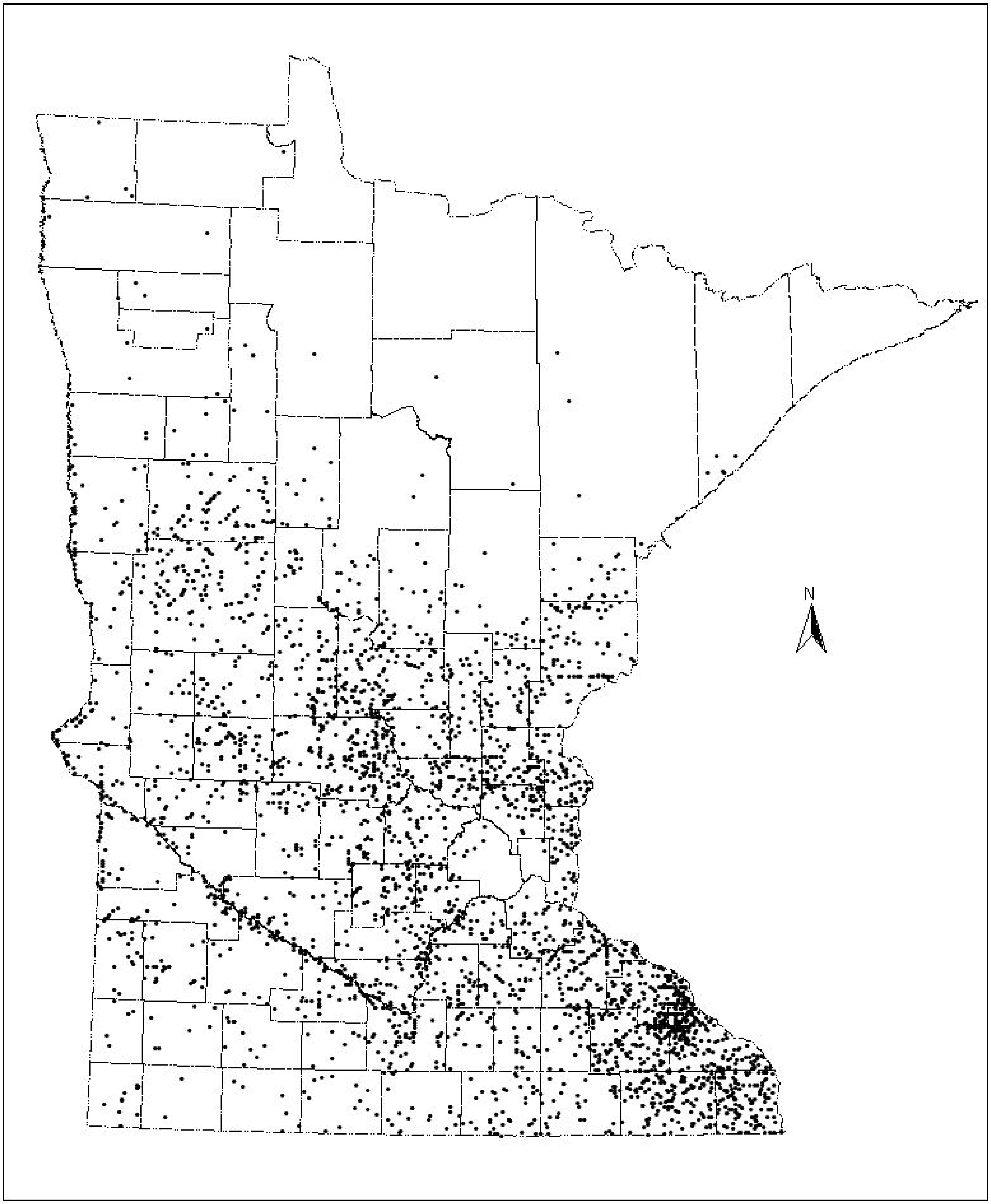
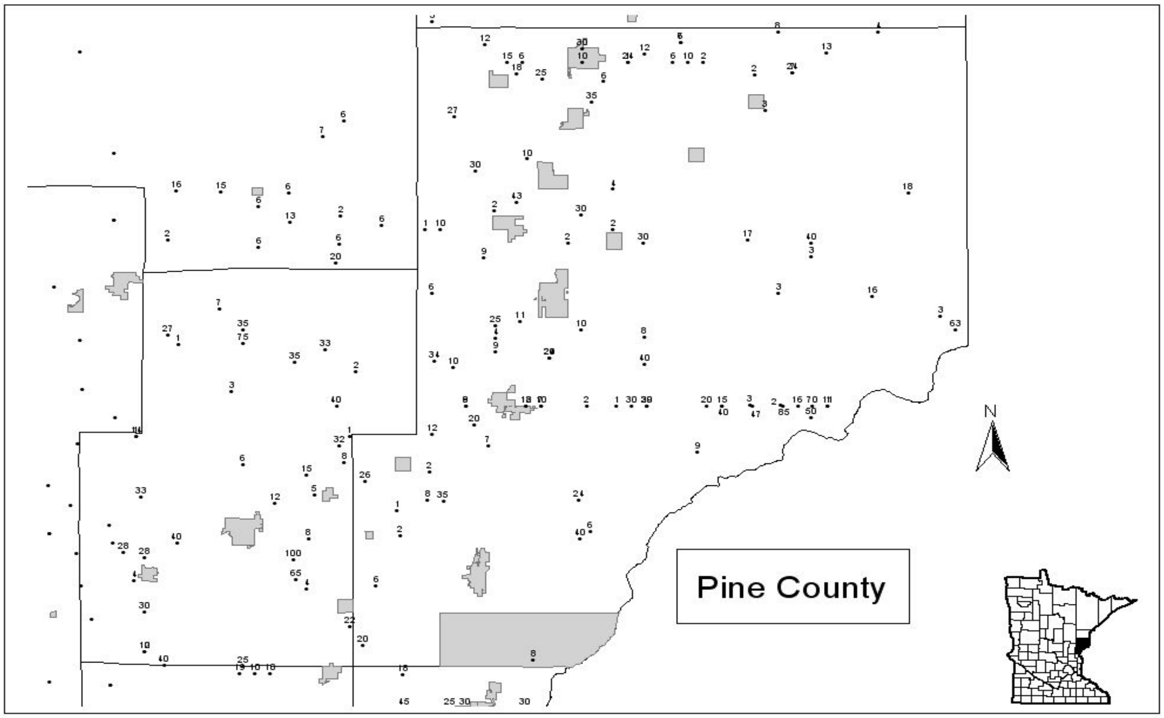
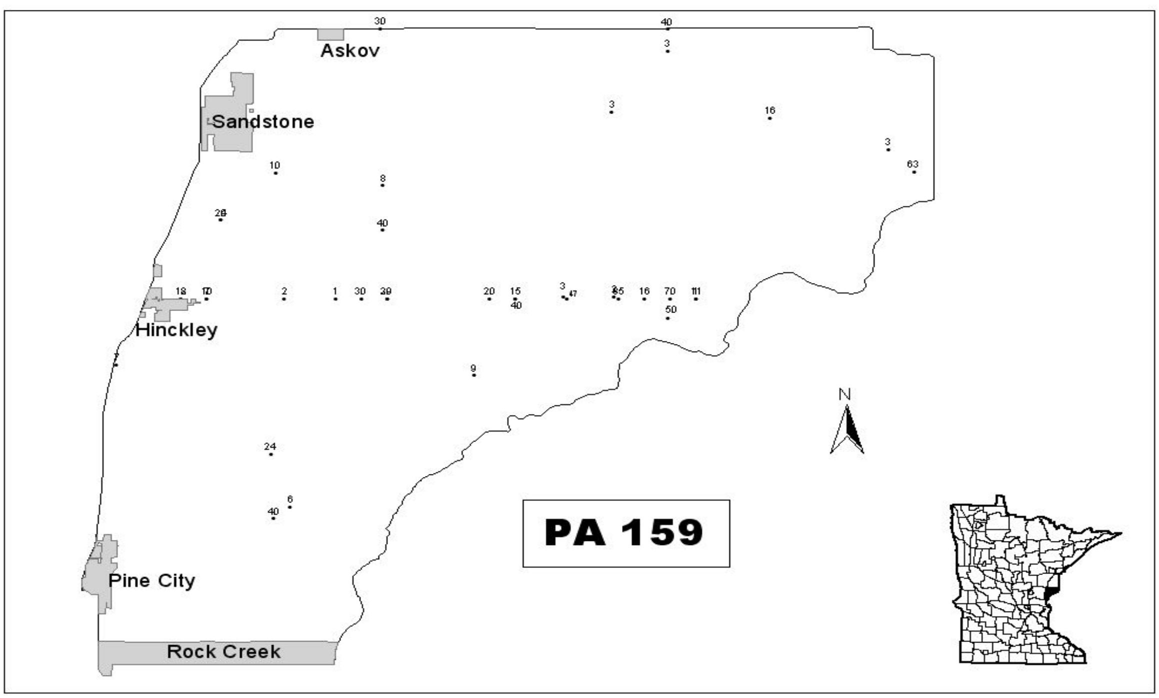


Figure 3. Distribution of wild turkey sightings based on a survey of regular firearm deer permit holders in Minnesota, fall 2006.



Pine County turkey sightings from a survey of regular firearm deer permit holders. Minnesota, November 2006.

Wild Turkey Sightings
Fall 2006



Permit Area 159 turkey sightings from a survey of regular firearm deer permit holders. Minnesota, November 2006.

Wild Turkey Sightings
Fall 2006

Figure 4. Example maps of distribution and number of wild turkey sightings by county (top) and by permit area (bottom) based on a survey of regular firearm deer permit holders in Minnesota, fall 2006.