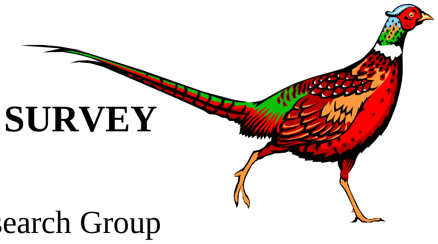
FARMLAND WILDLIFE POPULATIONS

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



2013 MINNESOTA AUGUST ROADSIDE SURVEY

Rachel Curtis, Farmland Wildlife Populations and Research Group

ABSTRACT

Population indices for ring-necked pheasants, gray partridge, and mourning doves decreased from last year, and remained below long-term averages. The population index for cottontail rabbits increased from 2012 but continued to be below the long-term average. The white-tailed jackrabbit index was similar to last year and was also below the long-term average. The population index for white-tailed deer increased from 2012 and was well above the long-term average. The sandhill crane index was similar to last year.

Conservation Reserve Program (CRP) enrollment in Minnesota declined by 171,254 acres from 2012. Increases in enrollment of other farm programs and acquisition of public lands partially offset CRP losses, yielding a net loss of 153,328 acres of protected habitat for wildlife. There was a net loss of 58,081 acres of protected habitat within the pheasant range. The winter of 2012-13 had slightly colder than normal temperatures and was followed by an extended, cold spring. Thus, conditions for overwinter survival of farmland wildlife were below average and early nesting conditions were poor in 2013.

The 2013 pheasant index (27.2 birds/100 mi) decreased 29% from 2012 and was 64% below the 10-year average, 72% below the long-term average, and 91% below the benchmark years of 1955-64. Indices over the past 3 years suggest the pheasant population has declined considerably since 2005 with comparable indices to those calculated in the mid-1980s. The 2012 hen pheasant index was 40% below last year and 70% below the 10-year average. The number of broods observed was 45% below last year, and 71% below the 10-year average. The number of chicks per brood increased from 4.4 in 2012 to 5.4 in 2013. The low hen:cock ratio might suggest that hens were undercounted in the survey, which may be due to the late nesting. Projecting from the roadside index, an estimated 246,000 roosters may be harvested this fall. The best opportunity for harvesting pheasants appears to be in the West Central, East Central, and Southwest regions.

The gray partridge index decreased 77% from last year, was 82% below the 10-year mean and 92% below the long-term average. Gray partridge counts were highest in the Southwest and South Central regions. The cottontail rabbit index was 17% higher than last year, but 22% below the 10-year average, and 23% 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 in 2013 and was 87% below the long-term average. The 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 and South Central region. The number of mourning doves observed in 2013 was 20% lower than last year, 23% below the 10-year average and 35% below the long-term average. In contrast, the white-tailed deer index was 46% higher than last year, 38% above the 10-year average and 116% higher than the long-term average. Sandhill crane indices were comparable to 2012.

INTRODUCTION

This report summarizes the 2013 Minnesota August roadside survey. The survey is conducted annually during the first half of August by Minnesota Department of Natural Resources (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 observed. 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 are used to monitor annual changes and long-term trends in regional and range-wide populations. Results are reported by agricultural region (Figure 1) and range-wide; however, population indices for species with low detection rates are imprecise and <u>should be interpreted cautiously</u>.

ACKNOWLEDGMENTS

I would like to thank the many cooperators for their efforts in completing routes in 2013; without them the survey would not be possible. Julie Luttrell provided assistance by contacting potential cooperators and mailing packages. Tonya Klinkner offered logistical assistance including entering data. 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, and John Saxhaug of U.S. Fish and Wildlife Services supplied the county by county refuge data. I also thank Kurt Haroldson and Nicole Davros for all their assistance in coordinating and compiling this report.

WEATHER SUMMARY

The winter of 2012-2013 had slightly colder than normal temperatures that extended into May for the farmland region of Minnesota. Snow cover was intermittent from December through early May in the southern regions of the state and was persistent during these months in the Central and Northwest regions. Snow depths exceeded 6 inches for 20 consecutive weeks in the Northwest region (Minnesota Climatology Working Group [MCWG], Minnesota snow map). In addition, monthly temperatures averaged 2°F below normal (range 2°F to -8°F departure from normal, MCWG, Monthly temperature summary) in all farmland regions from December through March. Cold conditions continued through April and May, and spring precipitation was normal to above normal in the month of June. The Southeast region had particularly high precipitation in April and May (2.6 and 4.9 inches above normal, respectively). Overall, the conditions for over-winter survival of wildlife were below average throughout most of the farmland region in 2013 and conditions for production of young were poor due to extended cold, wet weather in the spring and excessive rain in May.

HABITAT CONDITIONS

There have been considerable changes in habitat across Minnesota since 2012. Conservation Reserve Program (CRP) enrollment declined by 171,254 acres statewide, with losses in northwestern Minnesota's prairie chicken range (129,250 acres lost) compounded by a loss of 63,700 acres in Minnesota's pheasant range. There were also losses in Reinvest in Minnesota (RIM) and Wetlands Reserve Program (WRP). Acquisitions of Wildlife Management Areas (WMA) and Waterfowl Production Areas (WPA) only partially offset CRP, RIM, and WRP losses, yielding a net loss of 153,328 acres of protected habitat statewide. In Minnesota's pheasant range, 10,465 new acres protected as WMAs and WPAs offset losses in farm program enrollments resulting in a net loss of 58,081 acres. Within the pheasant range, protected habitats account for about 6% of the landscape (range: 3-10%; 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 a major concern for future wildlife populations, with nearly 400,000 acres in Minnesota scheduled to expire in the next 3 years. The future of farmland retirement programs remains under threat due to competing economic opportunities (e.g., high land rental rates, ethanol production).

New funding from the Legacy Amendment has accelerated acquisition of WMAs and WPAs throughout Minnesota's farmland zone. In addition, the Working Lands Initiative (DNR Working Lands Initiative) continues to protect and expand large wetland-grassland complexes in selected counties in western Minnesota.

SURVEY CONDITIONS

Observers completed all 171 routes in 2013. 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 98% of the survey routes, which was similar to 2012 (97%), and better than the 10-year average (93%). Clear skies (<30% cloud cover) were present at the start of 84% of routes, with wind speeds <7 mph recorded for 96% of routes. The survey period was extended to August 16thth to allow all routes to be completed. Overall, survey conditions were described as excellent in 2013.

RING-NECKED PHEASANT

The average number of pheasants observed (27.2/100 mi) decreased 29% from 2012, and remained 64% below the 10-year average (Figure 2A), 72% below the long-term average (Table 2) and 91% below the benchmark years of 1955-64. Indices over the past 3 years suggest the pheasant population has declined considerably since 2005 with comparable indices to those calculated in the mid-1980s (Figure 2A). Total pheasants observed per 100 miles ranged from 7.4 in the Southeast to 50.7 in the Southwest region (Table 3). The most substantial decreases in counts from last year occurred in the West Central (-43%) and East Central regions (-48%; Table 3).

The range-wide hen index (3.5 hens/100 mi) was 40% below last year and 70% below the 10-year average (Table 2). The hen index varied from 0.8 hens/100 miles in the Southeast to 5.9 hens/100 miles in the Southwest region. The hen index was higher than last year for the Southwest, South Central and Southeast regions. The range-wide cock index (5.1 cocks/100 mi) was higher than 2012 (16%) but 39% below the 10-year average (Table 2). The 2013 hen:cock ratio was 0.68, which was below average (1.44 ± 0.36 [SD]) for the CRP years (1987-2012).

The number of pheasant broods observed (3.4/100 mi) was 45% below last year, 71% below the 10-year average and 74% below the long-term average (Table 2). The brood index remains well below the benchmark years of 1955-64 (34.8 broods/100 mi). Regional brood indices ranged from 1.3 broods/100 miles in the Southeast to 6.7 broods/100 miles in the Southwest region. Average brood size in 2013 (5.4 ± 0.3 [SE] chicks/brood) was higher than last year (4.4 ± 0.2 [SE] chicks/brood) and the 10-year mean (4.6 ± 0.1 [SE] chicks/brood), and was comparable to the long-term average (5.5 ± 0.1 [SE] chicks/brood; Table 2). The median hatch date for pheasants was approximately June 20 (n = 236), 11 days later than the 10-year average (Table 2). Estimated median age of broods observed was 6 weeks (range: 1-12 weeks).

The reduction in pheasant counts may be partially attributed to both colder than normal winter temperatures and snow cover that persisted into late April and early May in some regions. In addition, heavy rainfall in May likely contributed to delayed nesting effort and reduced nest success early in the breeding season. Consequently, a decline in the range-wide pheasant index due to weather was expected. However, the high cock index and low hen:cock ratio might suggest that hens were undercounted in the survey. Historically, hens that were successful nesting later in the season tend to be underrepresented in roadside data and it is possible that hens were still nesting or under cover with young chicks during the survey period. Pheasant numbers will be higher than forecasted if hens were underrepresented in these roadside surveys. Projecting from the roadside index, an estimated 246,000 roosters may be harvested this fall (Figure 2A). The best opportunity for harvesting pheasants appears to be in the West Central, East Central, and Southwest regions.

GRAY PARTRIDGE

Range-wide, the gray partridge index (1.1 partridge/100 miles) was 77% lower than last year, 82% below the 10-year average and 92% below the long-term average (Table 2, Figure 2B). The partridge index ranged from 0.0 birds/100 miles in the West Central, East Central, and Northwest regions to 3.6 birds/100 miles in the Southwest region (Table 3). Observations of gray partridge broods were too few for analysis by age class (n=3 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 and South Central regions will offer the best opportunity for harvesting gray partridge in 2013.

COTTONTAIL RABBIT and WHITE-TAILED JACKRABBIT

The eastern cottontail rabbit index (4.6 rabbits/100 mi) was 17% higher than last year, but 22% below the 10-year average and 23% below the long-term average (Table 2, Figure 3A). The cottontail rabbit index ranged from 0.6 rabbits/100 miles in the Northwest to 9.5 rabbits/100 miles in the South Central region (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 (0.2 rabbits/100 mi) did not change from 2012 or the 10-year average, but was 87% 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 and South Central regions (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 (20.7 deer/100 mi) was 46% higher than last year, 38% above the 10-year average and 116% above the long-term average (Table 2, Figure 4A). The deer index ranged from 10.6 deer/100 mi in the South Central region to 36.6 deer/100 mi in the Northwest (Table 3).

MOURNING DOVE

The number of mourning doves observed (168 doves/100 mi) in 2013 was 20% lower than last year, 23% below the 10-year average and 35% below the long-term average (Table 2, Figure 4B). The mourning dove index ranged from 76 doves/100 miles in the East Central region to 246 doves/100 miles in the Southwest region (Table 3). The number of mourning doves heard along U.S. Fish and Wildlife Service call-count survey (CCS) routes (n = 13) in Minnesota was 5.6% lower than 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 2004-2013 and declined 1.5% per year (95% CI: -2.2 to -0.7%) during 1966-2013 (Seamans et al. 2013).

SANDHILL CRANE

The sandhill crane index averaged 11.4 cranes/100 miles and 1.1 juvenile cranes/100 miles, which was comparable to the indices observed in 2012 (Table 2). Crane indices ranged from 0.0 cranes/100 miles in the Southwest region to 54.5 cranes/100 miles in the East Central region (Table 3). Regional crane indices for both the total number of cranes and juveniles increased from last year in the East Central region, and decreased in the Northwest (Table 3). Juvenile cranes were observed in the Central (2.3/100 mi), East Central (7.1/100 mi), West Central (0.4/100 mi), South Central (0.1/100 mi), and Northwest (0.2/100 mi) regions.

OTHER SPECIES

Other incidental sightings: trumpeter swan (Brown, Le Sueur, and Meeker Counties), Cooper's hawk (Lincoln County), mink (Dodge County), greater prairie chicken (Clay and Norman Counties), red-headed woodpecker (Steele County), bald eagle (Brown and Jackson Counties), and upland sandpiper (Martin, Polk, Redwood, and Wilkin Counties).

LITERATURE CITED

Seamans, M. E., R. D. Rau, and T. A. Sanders. 2013. Mourning dove population status, 2013. U.S. Department of the Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Washington, D.C.

[MCWG] Minnesota Climatology Working Group. 2013. MCWG Home Page http://climate.umn.edu/. Accessed on August 5, 2013.

Table 1. Abundance (total acres) and density (acres/mi2) of undisturbed grassland habitat within Minnesota's pheasant range, 2013[a].

	Cropland Retirement									Density
AGREG	CRP	CREP	RIM	RIM-WRP	WRP	USFWS[c]	MNDNR[d]	Total	%	ac/mi2
WC[b]	284,215	39,243	19,244	11,626	19,458	188,310	109,247	671,343	9.9	63.2
SW	94,866	25,286	12,625	1,616	471	20,624	58,454	213,942	5.7	36.2
C	127,804	15,320	20,620	5,585	2,595	88,535	47,627	308,086	5.1	32.6
SC	84,169	28,237	11,273	7,706	7,855	8,843	33,055	181,137	4.5	28.7
SE	68,832	2,733	6,971	657	774	36,597	52,847	169,410	4.6	29.3
EC	3,676	0	1,140	0	4	4,993	87,581	97,394	3.0	19.4
Total	663,561	110,819	71,873	27,190	31,156	347,902	388,811	1,641,312	6.0	38.1

a. Unpublished data, Tabor Hoek, BWSR, 1 August 2013.

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, 1955-2013.

Species	Change from 2012[a]					Change from 10-year average[b]				Change from long-term average[c]			
Subgroup	*n*	2012	2013	%	95% CI	*n*	2003-12	%	95% CI	*n*	LTA	%	95% CI
Ring-necked pheasant													
Total pheasants	150	38.0	27.2	-29	±19	148	76.3	-64	±13	150	98.8	-72	±8
Cocks	150	4.4	5.1	16	±27		8.5	-39	±13		11.2	-54	±12
Hens	150	5.8	3.5	-40	±21		11.8	-70	±14		14.3	-76	±9
Broods	150	6.3	3.4	-45	±20		11.9	-71	±13		13.0	-74	±8
Chicks per brood	236	4.4	5.4	22			4.6	17			5.5	-2	
Broods per 100 hens	129	107.8	98.5	-9			100.5	-2			101.4	-3	
Median hatch date	236	Jun 7	Jun 20				Jun 09						
Gray partridge	169	4.6	1.1	-77	±58	167	5.8	-82	±27	150	15.2	-92	±16
Eastern cottontail	169	4.0	4.6	17	±26	167	6.0	-22	±15	150	6.7	-23	±15
White-tailed jackrabbit	169	0.2	0.2	15	±141	167	0.3	-23	±83	150	1.7	-87	±21
White-tailed deer	169	14.2	20.7	46	±20	167	15.2	38	±17	169	9.6	116	±28
Mourning dove	169	210.1	168.0	-20	±14	167	216.7	-23	±11	150	271.0	-35	±12
Sandhill crane													
Total cranes	169	9.8	11.4	15	±52								
Juveniles	169	1.3	1.1	-10	±57								

[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 = 1955-2012, except for deer = 1974-2012. 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, 1955-2013.

Region	Change from 2012[a]					Change from 10-year average[b]				Change from long-term average[c]			
Species	*n*	2012	2013	%	95% CI	*n*	2003-12	%	95% CI	*n*	LTA	%	95% CI
Northwest[d]													
Gray partridge	19	1.9	0.0			19	0.6	-100	±93	19	3.5	-100	±67
Eastern cottontail		0.2	0.6	200	±519		0.8	-21	±95		0.8	-22	±93
White-tailed jackrabbit		0.6	0.2	-67	±140		0.5	-56	±89		0.6	-68	±76
White-tailed deer		27.1	36.6	35	±61		44.2	-17	±28		29.5	24	±42
Mourning dove		78.4	102.4	31	±86		83.4	23	±92		121.3	-16	±66
Sandhill crane		40.4	22.7	-44	±49								
West Central													
Ring-necked pheasant	36	52.7	30.0	-43	±36	34	81.9	-61	±28	36	102.5	-71	±15
Gray partridge		0.6	0.0				1.7	-100	±66		9.6	-100	±22
Eastern cottontail		2.1	1.7	-21	±66		3.1	-43	±33		4.1	-59	±22
White-tailed jackrabbit		0.2	0.00				0.3	-100	±59		2.2	-100	±19
White-tailed deer		13.6	20.9	54	±46		13.6	61	±46		9.1	129	±76
Mourning dove		228.5	211.8	-7	±33		257.4	-18	±26		375.2	-44	±17
Sandhill crane		0.9	1.4	62	±96								
Central													
Ring-necked pheasant	30	29.7	20.7	-30	±40	29	65.2	-67	±26	29	74.3	-71	±20
Gray partridge		3.9	0.1	-97	±140		2.4	-94	±71		9.6	-99	±43
Eastern cottontail		3.2	2.9	-8	±64		6.1	-50	±23		6.3	-52	±27
White-tailed jackrabbit		0.0	0.1				0.1	41	±273		1.2	-89	±32
White-tailed deer		13.2	18.1	37	±49		8.6	114	±70		4.8	282	±135
Mourning dove		238.7	129.9	-46	±39		202.4	-35	±28		234.3	-44	±25
Sandhill crane		22.0	20.4	-7	±92								
East Central													
Ring-necked pheasant	14	55.2	28.9	-48	±43	14	56.9	-49	±31	14	84.6	-66	±27
Gray partridge		0.3	0.0				0.0				0.1	-100	±135
Eastern cottontail		12.6	7.7	-39	±64		10.5	-27	±65		8.8	-12	±74
White-tailed jackrabbit		0.0	0.0				0.0				0.2	-100	±57
White-tailed deer		17.4	24.0	37	±56		15.4	56	±68		8.6	178	±130
Mourning dove		92.5	76.1	-18	±55		103.9	-27	±35		125.9	-40	±34
Sandhill crane		11.7	54.5	365	±275								

Table 3. Continued.

Region / Species	Change from 2012					Change from 10-year average				Change from long-term average			
	n	2012	2013	%	95% CI	*n*	2003-12	%	95% CI	*n*	LTA	%	95% CI
Southwest													
Ring-necked pheasant	19	52.4	50.7	-3	±60	19	150.7	-66	±29	19	116.6	-57	±21
Gray partridge		9.9	3.6	-64	±109		20.7	-83	±37		41.1	-91	±23
Eastern cottontail		3.8	5.3	39	±84		7.3	-28	±43		8.0	-34	±34
White-tailed jackrabbit		0.2	0.2	0	±305		0.8	-75	±91		3.8	-94	±27
White-tailed deer		18.3	28.4	55	±47		14.7	94	±50		8.5	233	±85
Mourning dove		229.8	245.9	7	±32		316.8	-22	±26		311.2	-21	±28
Sandhill crane		0.0	0.0										
South Central													
Ring-necked pheasant	32	33.7	27.1	-20	±36	32	79.4	-66	±29	32	129.5	-79	±17
Gray partridge		9.5	3.3	-66	±114		10.5	-69	±51		18.8	-83	±23
Eastern cottontail		4.8	9.5	100	±49		8.7	9	±29		7.6	26	±34
White-tailed jackrabbit		0.3	0.3	0	±207		0.2	34	±181		1.7	-86	±31
White-tailed deer		6.0	10.6	77	±66		5.5	92	±67		3.5	203	±112
Mourning dove		315.5	230.2	-27	±24		277.4	-17	±20		258.5	-11	±43
Sandhill crane		1.3	1.6	30	±85								
Southeast													
Ring-necked pheasant	19	3.6	7.4	106	±156	20	21.0	-65	±37	20	72.0	-90	±32
Gray partridge		6.1	0.2	-97	±163		5.1	-96	±69		13.8	-99	±31
Eastern cottontail		4.8	5.9	22	±65		7.2	-19	±40		7.7	-25	±34
White-tailed jackrabbit		0.0	0.0				0.1	-100	±103		0.6	-100	±42
White-tailed deer		11.4	15.0	32	±42		15.5	-32	±35		10.2	54	±43
Mourning dove		150.7	96.3	-36	±27		181.4	-46	±18		220.3	-55	±15
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 = 1955-2012, except for Northwest region (1982-2012) and white-tailed deer (1974-2012). Estimates based on routes (*n*) surveyed ≥40 years (1955-2012), 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.

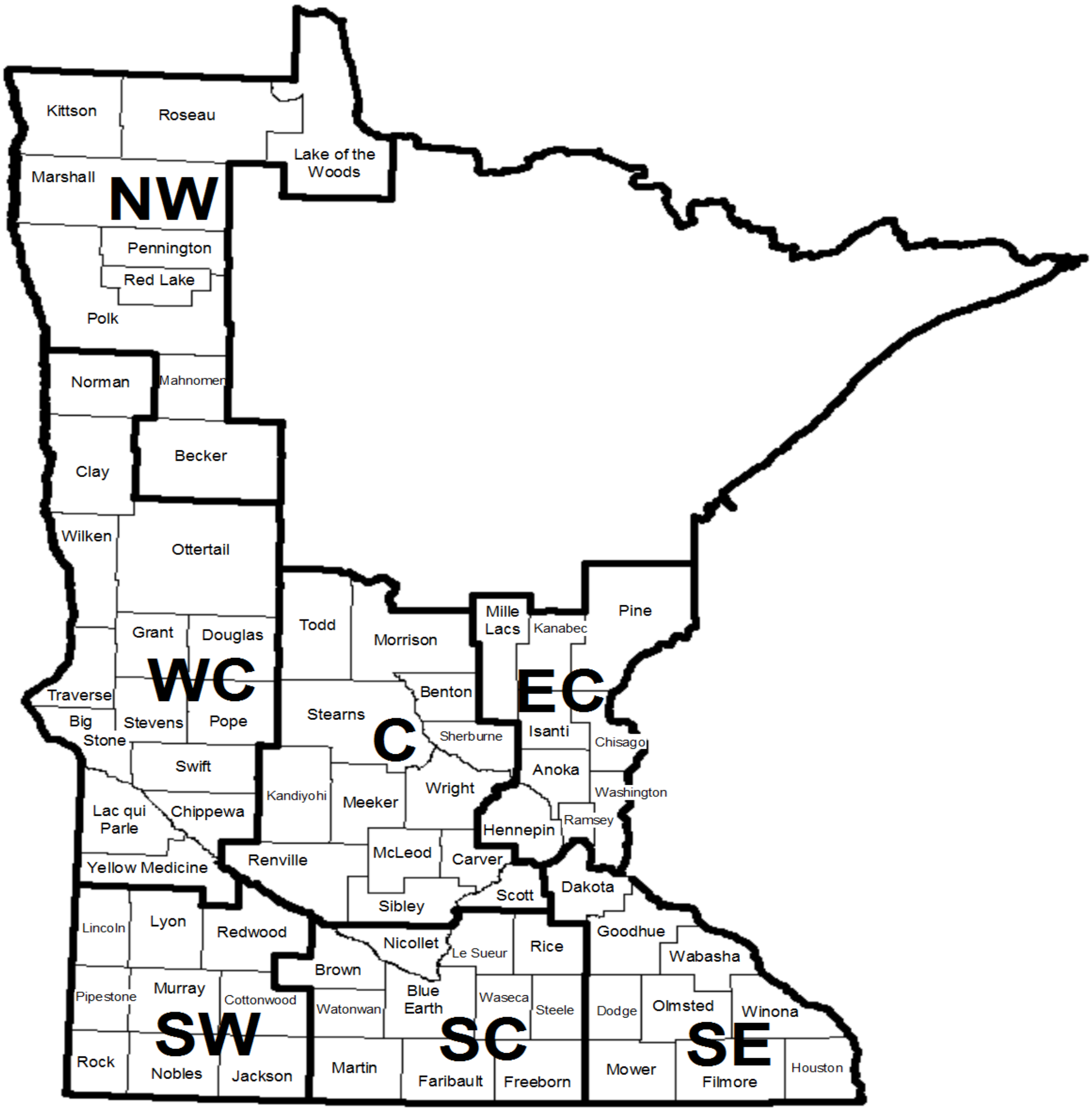


Figure 1. Survey regions for Minnesota's August roadside survey, 2013.

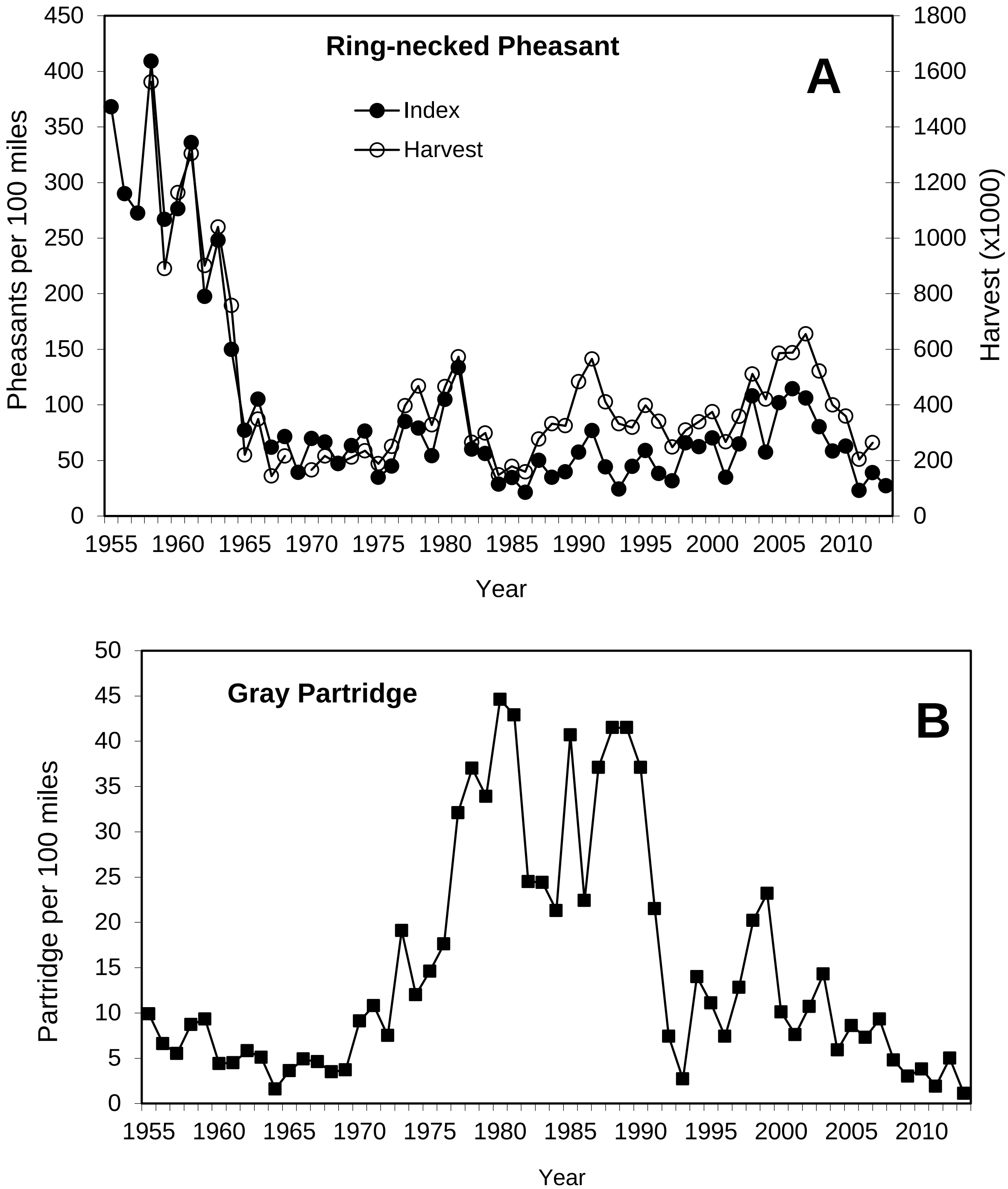


Figure 2. Range-wide index of ring-necked pheasants (**A**) and gray partridge (**B**) seen per 100 miles driven in Minnesota, 1955-2013. Does not include the Northwest region. Based on all survey routes completed.

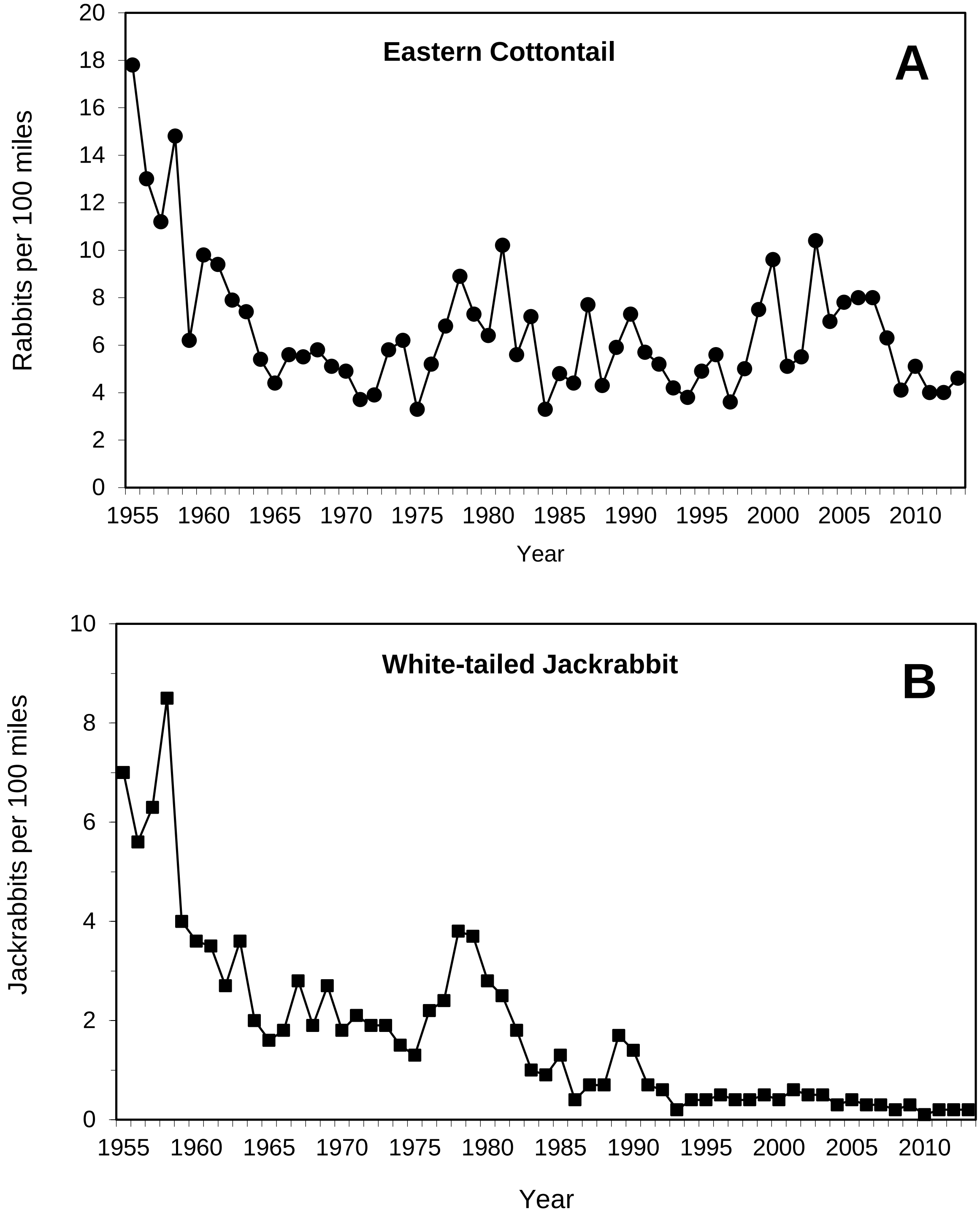


Figure 3. Range-wide index of eastern cottontail (**A**) and white-tailed jackrabbits (**B**) seen per 100 miles driven in Minnesota, 1955-2013. Does not include the Northwest region. Based on all survey routes completed.

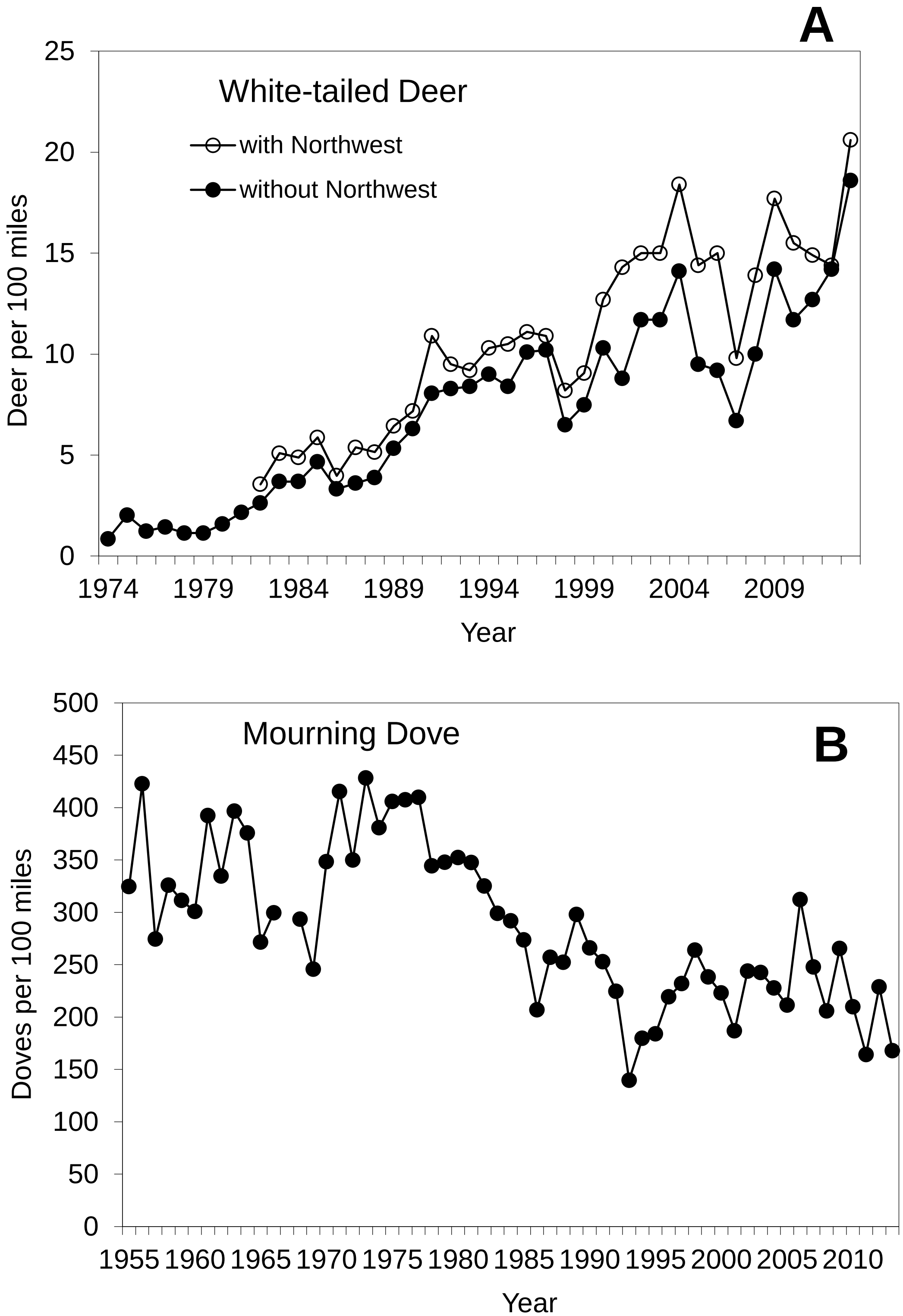


Figure 4. Range-wide index of white-tailed deer (**A**) and mourning doves (**B**) seen per 100 miles driven in Minnesota, 2013. Doves were not counted in 1967 and the dove index does not include the Northwest region. Based on all survey routes completed.

MONITORING POPULATION TRENDS OF WHITE-TAILED DEER IN MINNESOTA - 2013

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) describes the structure of and data inputs for the population model used on white-tailed deer in Minnesota, and 2) discusses general trends of deer density and current abundance.

METHODS

I arbitrarily pooled permit areas (PAs) into 12 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 where hunters could hunt either-sex, 3) managed, 4) intensive, and 5) no limit antlerless (Figure 2). The strategy employed during a given year depended upon where the population density was in relation to the population density goal. The Twin Cities metro region (PA 601) and PA 182 were not modeled due to limited hunting opportunities and light harvest pressure, and PAs 199, 203, 224, 235, 238, 251, 287, and 344 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 was partitioned into 4 sex-age classes (fawns, adults, males, and females). The 12-month annual cycle was divided into 4 periods representing important biological events in the deer's life (hunting season, winter, reproduction, and summer). The primary purposes of the population model were to 1) organize and synthesize data on deer populations, 2) advance the understanding of Minnesota's deer population through population analysis, 3) provide population estimates and simulate vital rates for 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 and forested regions. Although summer mortality rates were low, they did represent a reduction in the annual deer population. 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. Because these deer herds are heavily exploited by deer hunters, 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 Midwest 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 Population Management

Northwest Management Units

Karlstad Unit – Deer numbers have generally declined in this unit and most populations are at or slightly below the goal density (Table 1). Thus, management strategies applied during the 2013 hunting season were relatively conservative compared to those used 5-8 years ago. Deer populations immediately to the west of PA 101 were well below goal due to prior TB management efforts but management strategies are more conservative in 2013 to allow populations to increase.

Crookston/TRF Unit – With the exception of PA 261, modeling suggests deer numbers are increasing throughout the unit. Therefore, management strategies were more aggressive in 2013 than in the PAs to the north. Deer numbers are still within goal, but it is likely that more aggressive management strategies will be employed in 2014 to address higher deer densities.

Mahnomen Unit – Deer densities have been relatively stable in this unit and remain slightly below goal. Consequently, most permit areas were designated as lottery to allow populations to increase. Deer densities are lower in this unit than in other more eastern units due to less woody cover being available.

Central Management Units

Morris Unit – Conservative management strategies used over the past few years have allowed deer populations to increase. However, deer densities remain below goal in 4 PAs. Lottery management strategies are being used throughout the unit but more antlerless permits are being issued in 2013. Although more permits are being issued, modeling projections suggest deer densities will continue to increase over the year provided a severe winter does not occur.

Osakis Unit – Deer densities have been stable to slightly increasing over the past few years in this unit. More conservative management strategies have been used in the past 2 years to reduce the antlerless harvest. Management strategies used in 2013 are more aggressive and the intent is to stabilize deer numbers throughout the unit. Due to more woody cover than PAs toward the west, deer densities are considerably higher ranging from 9-29 deer per square mile.

Cambridge Unit – Deer densities in this unit are stable to slightly increasing despite remaining aggressive with harvest management strategies over the past few years. Deer densities remain above goal in the north metro PAs where PAs have been designated as Intensive for the past 10 years and early antlerless seasons have been used for 5 of the past 10 years. More aggressive management strategies are likely warranted in the near future if deer density goals remain lower than current deer densities.

Hutchinson Unit – Deer densities have been increasing in this unit over the past 5-7 years and are near goal levels. More aggressive management strategies were used in 2013 in attempt to increase the antlerless harvest and stabilize deer numbers. Deer densities vary from 4-11 deer per square mile.

Southern Management Units

Minnesota River Unit – Modeling suggests these deer herds are all increasing. Harvest trends in the eastern PAs around New Ulm and Mankato to Jordan support the increasing modeling trends. However, the population statistics in the western PAs do not support the increasing trends shown by the population models. It is conceivable that the severe winters that occurred in 2010 and 2011 had a greater impact in the western areas than in the eastern areas and deer densities are not growing as fast as the models are suggesting in the western areas.

Slayton Unit – Conservative management strategies used over the past 5 years have significantly reduced the antlerless harvests to allow populations to increase. Numeric buck harvests substantially increased throughout the unit which is indicative of higher deer densities. All population statistics support the increasing trends shown by the population models and most PAs have been recalibrated through distance sampling techniques. Hunter and landowner surveys suggest deer densities should be stabilized so more aggressive management strategies were used this year in attempt to stop population growth rates and stabilize deer numbers.

Waseca Unit – Deer densities have been very stable throughout this unit over the past 5-10 years. All deer populations are at or near population goals and deer densities range from 3-7 deer per square mile. In general, management strategies are more aggressive in 2013 but expected harvests should keep deer numbers relatively stable through 2014.

Rochester Unit – Deer densities are at or are approaching desired goal densities throughout the unit. Management strategies being used in 2013 are comparable to those used in 2012 with the intent to keep deer numbers relatively stable. The 4-points-to-a-side antler-point restriction implemented in 2010 was effective at reducing the kill of young bucks and had substantial support by hunters. Consequently, the antler restriction will continue to be used in 2013 and the effectiveness of the regulation will be monitored in the future.

Forest Unit – Winter severity indices (WSIs) were relatively high in extreme northern Minnesota. Some wildlife managers were concerned about the impact winter had on the deer herd, particularly in the most northern PAs towards the east. The winter was unique in that it was relatively mild through February but then deep snow was on the ground through most of April. Modeling suggests deer numbers are stable to slightly increasing throughout most of the forest zone, and most population statistics agree with those trends. For the most part, management strategies used in 2013 are comparable to those used in 2012. In general, management strategies are more aggressive in the southern portion of the forest zone where WSIs were lower and more conservative in the northern permit areas.

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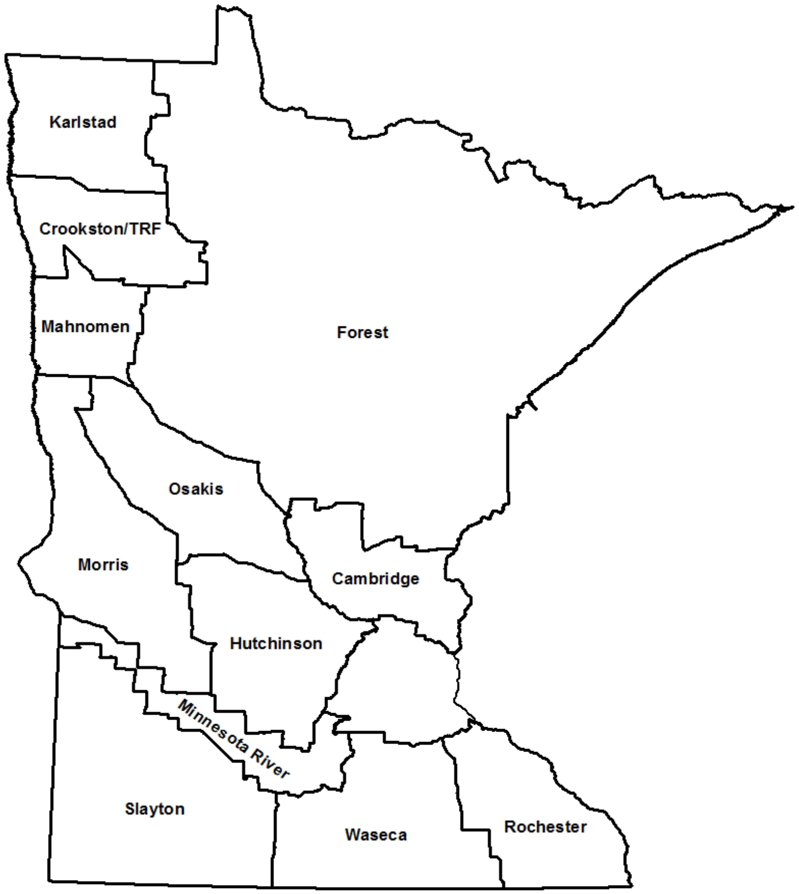

Figure 1. Deer management units in Minnesota, 2012.

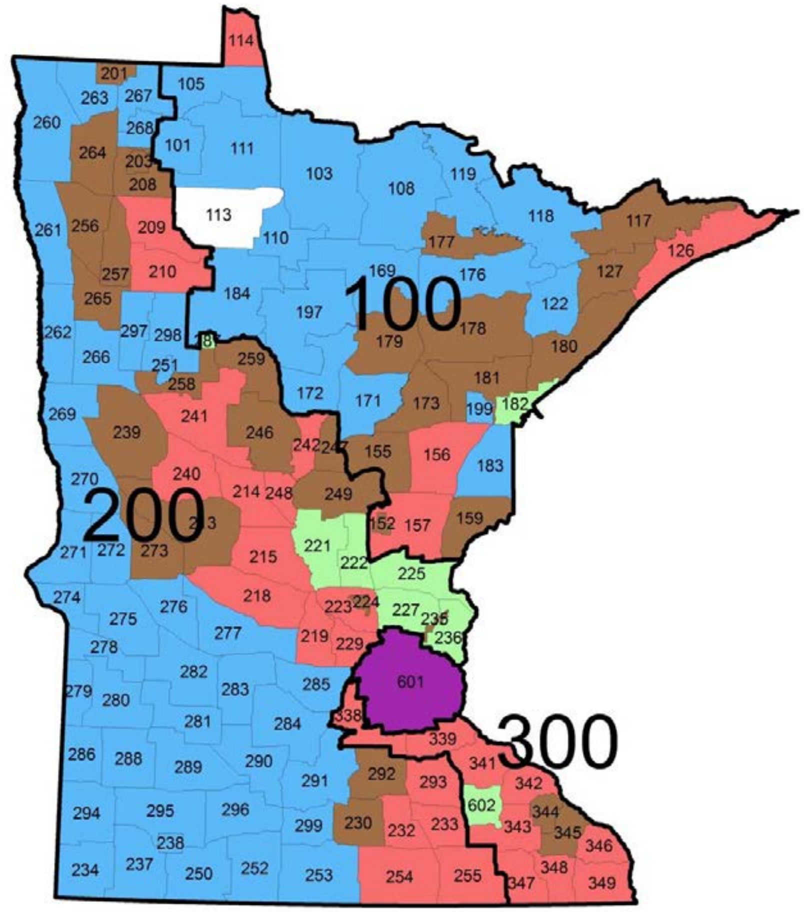

Figure 2. Deer management strategies used in permit areas throughout Minnesota, 2013. Permit areas are numbered and management strategies are color-coded. Permit areas are designated as: 1) lottery if colored blue, 2) hunter's choice if colored brown, 3) managed if colored red, 4) intensive if colored green, and 5) unlimited antlerless if colored purple.

Table 1. Pre-fawn deer density (deer/mi^2) as simulated from population modeling in each permit area in Minnesota, 2008-2013.

Region		**Pre-fawning Density**					
Permit Area	**Area (mi^2)**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Karlstad							
201	155	6	6	6	5	5	5
208	443	4	4	4	4	3	2
260	1249	4	4	3	3	3	3
263	512	5	5	5	4	3	2
264	669	7	7	6	5	6	6
267	472	3	3	3	2	2	2
268	230	9	9	8	7	7	6
Total	3,838	6	6	5	5	4	4
Crookston							
209	576	9	9	9	7	7	9
210	485	12	12	11	11	10	13
256	654	5	5	5	5	5	7
257	413	8	7	6	6	6	9
261	795	2	2	2	2	2	2
Total	3,053	7	7	7	6	6	8
Mahnomen							
262	677	2	2	2	2	2	2
265	494	9	10	10	9	8	8
266	617	5	6	6	5	4	4
297	438	3	2	3	2	3	3
Total	2,226	5	5	5	5	4	4
Morris							
269	651	2	2	2	2	2	3
270	749	1	2	2	1	2	2
271	634	2	2	3	3	2	3
272	531	1	2	2	2	2	2

Region		Pre-fawning Density					
Permit Area	Area (mi^2)	2008	2009	2010	2011	2012	2013
273	575	4	5	4	4	4	5
274	360	3	3	4	3	3	5
275	766	3	3	5	5	5	6
276	544	4	4	4	4	5	6
282	779	1	1	1	1	1	2
Total	5,589	2	2	3	3	3	3
Osakis							
213	1058	11	12	13	10	11	12
214	557	19	19	19	19	20	20
215	702	9	10	10	10	10	10
239	924	10	9	10	8	9	9
240	642	18	18	18	15	16	18
Total	3,879	13	14	14	12	13	14
Cambridge							
221	642	13	13	13	12	12	12
222	412	15	15	15	15	15	14
223	376	9	9	9	10	10	12
225	619	16	16	16	14	14	14
227	472	12	13	14	13	13	14
229	287	6	6	7	6	6	7
236	374	16	16	16	16	16	17
Total	2,895	12	13	13	12	12	13
Hutchinson							
218	813	6	7	7	7	7	8
219	393	7	8	9	9	10	11
229	288	6	6	7	6	6	7
277	885	4	5	6	5	4	6
283	614	2	3	3	3	3	4

Region		Pre-fawning Density					
Permit Area	Area (mi^2)	2008	2009	2010	2011	2012	2013
284	837	2	2	3	3	3	4
285	550	3	4	4	4	4	5
Total	4,380	4	5	6	5	5	6
Minnesota River							
278	397	6	6	7	6	6	7
281	575	3	3	4	4	4	5
290	662	3	3	4	4	4	5
291	806	4	4	5	4	4	5
Total	2,440	4	4	5	5	5	6
Slayton							
234	637	2	2	2	3	3	3
237	729	2	2	2	2	2	3
250	712	2	2	2	2	3	3
279	345	3	4	3	3	4	5
280	675	2	2	2	2	3	3
286	447	3	3	3	3	3	4
288	625	2	2	2	2	3	3
289	816	2	1	1	1	2	2
294	687	2	2	2	2	2	3
295	839	2	2	2	2	3	3
296	666	2	2	2	2	3	3
Total	7,178	2	2	2	2	3	3
Waseca							
230	453	3	3	3	4	3	4
232	377	5	4	4	4	5	5
233	390	4	4	4	4	5	5
252	715	2	2	2	2	3	3
253	974	2	2	2	2	2	3

Region		Pre-fawning Density					
Permit Area	Area (mi^2)	2008	2009	2010	2011	2012	2013
254	931	3	3	3	3	3	3
255	774	3	3	3	3	3	4
292	481	8	7	7	6	6	6
293	506	7	7	7	7	7	7
299	386	4	4	5	4	4	5
Total	5,987	4	4	4	4	4	5
Rochester							
338	452	4	5	5	5	5	6
339	409	5	5	6	5	5	5
341	596	10	10	10	10	11	12
342	352	13	13	14	14	14	14
343	663	11	11	10	10	10	11
345	326	10	9	8	8	9	10
346	319	21	20	19	19	17	16
347	434	9	8	7	8	8	8
348	332	18	15	14	14	14	14
349	492	22	21	20	19	19	18
Total	4,564	12	12	12	11	11	11
Forest							
103	1824	6	6	5	5	4	5
105	932	14	13	11	10	8	8
108	1701	9	9	6	6	7	7
110	530	26	23	22	19	20	21
111	1440	4	3	2	2	2	3
117	1129	2	2	2	3	3	3
118	1445	5	4	4	4	4	5
119	946	7	5	5	4	5	5
122	622	5	5	5	5	5	6
126	979	4	4	4	3	3	4
127	587	3	3	3	3	3	3

Region		Pre-fawning Density					
Permit Area	Area (mi^2)	2008	2009	2010	2011	2012	2013
155	639	12	12	13	14	14	14
156	834	15	14	14	14	14	13
157	904	22	21	21	20	20	20
159	575	18	17	16	15	14	15
169	1202	10	9	9	9	9	9
171	729	10	9	9	10	10	10
172	786	15	13	13	13	13	13
173	617	9	9	9	9	10	10
176	1150	9	8	9	8	9	9
177	553	21	16	17	14	15	16
178	1325	18	16	16	14	13	13
179	939	15	15	15	14	14	13
180	999	9	8	8	8	8	8
181	746	18	17	17	14	13	15
183	675	12	11	11	11	11	12
184	1318	18	16	16	16	16	17
197	1343	8	7	7	5	5	6
241	1047	36	34	33	30	30	32
242	307	22	22	22	22	21	20
246	860	14	14	15	15	15	14
247	263	17	17	18	18	18	18
248	229	24	24	25	25	25	24
249	729	10	11	12	11	11	11
258	381	23	19	19	18	18	19
259	546	25	23	24	23	21	21
298	677	17	15	13	11	12	13
Total	32,907	13	11	11	11	11	11

2013 WHITE-TAILED DEER SURVEYS

Brian S. Haroldson, Farmland Wildlife Populations and Research Group
John H. Giudice, Wildlife Biometrics Unit

INTRODUCTION

Management goals for animal populations are frequently expressed in terms of population size (Lancia et al. 1994). Accurate estimates of animal abundance allow for documentation of population trends, provide the basis for setting harvest quotas (Miller et al. 1997), and permit assessment of population and habitat management programs (Storm et al. 1992).

The Minnesota Department of Natural Resources (MNDNR) uses simulation modeling within 125 permit areas (PA) to estimate and track changes in white-tailed deer (*Odocoileus virginianus*) abundance and, subsequently, to develop harvest recommendations to keep deer populations within goal levels. In general, model inputs include estimates of initial population size, and spatial and temporal estimates of survival and reproduction for various age and sex cohorts. Because simulated population estimates are subject to drift as model input errors accumulate over time, it is imperative to periodically recalibrate the starting population within these models with independent deer population estimates (Grund and Woolf 2004).

Our objective was to provide independent estimates of deer abundance in select deer PAs that are within 20% of the true population size with 90% confidence (Lancia et al. 1994). Abundance data are used to recalibrate population models to improve population management.

METHODS

We estimated deer populations in selected PAs using a quadrat-based, aerial survey design. Quadrat surveys have been used to estimate populations of caribou (*Rangifer tarandus*; Siniff and Skoog 1964), moose (*Alces alces*; Evans et al. 1966), and mule deer (*O. heimonus*; Bartmann et al. 1986) in a variety of habitat types. Within each PA, quadrats were delineated by Public Land Survey section boundaries. In PAs with marginal deer habitat (i.e., limited woody cover, predominance of row-crop agriculture) and no survey history, we stratified the sampling frame into 2 or 3 density categories (low, high; low, medium, high) using the local wildlife manager’s knowledge of deer abundance and distribution. In PAs with abundant woody cover and past survey data, we used regression trees (Fabrizi and Trivisano 2007, Fieberg and Lenarz 2012), the R programming language (R Core Team 2013), and R package ’stratification’ (Baillargeon and Rivest 2012) to stratify the sampling frame into 2 categories (low, high) based upon past helicopter counts of deer and abundance of woody cover within each quadrat. Woody cover data were derived from the 2006 National Land Cover database (Fry et al. 2011). In some PAs, an additional stratum was constructed to encompass State Park boundaries where applicable. We used optimal allocation, R package ‘spsurvey’ (Kincaid and Olsen 2012), and a generalized random tessellation stratified procedure (GRTS; Stevens and Olsen 2004) procedure to draw spatially balanced samples within each PA.

During all surveys, we used Bell OH-58 helicopters and attempted to maintain flight altitude at 60 m above ground level and airspeed at 64-80 km/hr. A pilot and 2 observers searched for deer along transects spaced at 270-m intervals until they were confident all “available” deer were observed. When animals fled the helicopter, direction of movement was noted to avoid double counting. We used a real-time, moving-map software program (DNRSurvey; Wright et al. 2011), coupled to a global positioning system receiver and a convertible tablet computer, to guide transect navigation and record deer locations, direction of movement, and aircraft flight paths directly to ArcGIS (Environmental Systems Research Institute, Redlands, CA) shapefiles. To minimize visibility bias, we completed surveys during winter (December-March) when snow cover measured at least 15 cm and we varied survey intensity as a function of cover and deer numbers (Gasaway et al. 1986). We estimated deer abundance using R package ‘spsurvey’ (Kincaid and Olsen 2012). We evaluated precision using coefficient of variation (CV), defined as standard deviation of the population estimate divided by the population estimate, and relative error, defined as the 90% confidence interval bound divided by the population estimate (Krebs 1999).

We implemented double sampling (Eberhardt and Simmons 1987, Thompson 2002) on a subsample of quadrats in each PA to estimate sightability of deer from the helicopter. For each PA, we sorted the sample of survey quadrats by woody cover abundance, excluded quadrats likely to contain no deer (e.g., low stratum quadrats or quadrats where woody cover < 0.17 km^2), and selected a 4% systematic subsample of sightability quadrats. Immediately after completing the operational survey on each sightability quadrat, a second more intensive survey was flown at reduced speed (48-64 km/hr) to identify animals that were missed (but assumed available) on the first survey (Gasaway et al. 1986). We used geo-referenced deer locations, group size, and movement information from DNRSurvey (Wright et al. 2011) to “mark” deer (groups) observed in the operational survey and help estimate the number of “new” (missed) animals detected in the sightability survey. We used a binary logistic model to estimate average detection probabilities (i.e., the conditional probability of detection given animals are present in the sampling unit and available for detection) for each PA. We computed population estimates adjusted for both sampling and sightability.

RESULTS AND DISCUSSION

We completed 4 surveys during 2013 (Table 1). PAs 260 and 270 were stratified by expected deer density based upon input from local wildlife managers. PAs 264 and 344 were stratified using the relationship between woody cover abundance per quadrat and historic deer density. In PA 344, sampling rate exceeded 20% to incorporate additional quadrats within Whitewater State Park. With the exception of PA 270, population estimates were precise and met precision goals (relative error $\leq$ 20%; Table 1). Deer were observed in 36%, 75%, and 83% of survey quadrats within PAs 260, 264, and 344, respectively, but only 21% of quadrats in PA 270 (Table 2). In addition, the number of deer groups observed and mean number observed per “occupied” quadrat was less in PA 270 compared to other PAs. Conversely, mean group size in PA 270 was nearly 3-fold higher than in other areas (Table 2). Finally, the majority of deer (58%) within PA 270 were observed in only 4 plots and 27% were observed within a single plot. Deep snow cover caused deer to group together in large clusters within this PA, decreasing precision of the population estimate. Kufeld et al. (1980) described similar challenges with precision due to nonuniformity of mule deer distribution within strata in Colorado.

Estimates of sightability ranged from 0.755 (SE = 0.020) in PA 264 to 0.864 (SE = 0.013) in PA 260 and averaged 0.800 (SE = 0.025; Table 1), which are similar to sightability estimates during 2009-2011 (range = 0.655-0.909). Correcting for sightability increased relative variance (CV [%]) of population estimates by 1.3-5.7%, which was a reasonable tradeoff between decreased bias and increased variance, although costs associated with the sightability surveys are also important. However, we caution that our sightability estimates are conditional on animals being available for detection (Johnson 2008, Nichols et al. 2009). Unfortunately, like many other wildlife surveys, we have no estimates of availability or how it varies over space and time. Our approach also assumes that sightability is constant across animals and quadrats. Heterogeneity in detection probabilities can lead to biased estimates of abundance. Common methods for correcting for heterogeneous detection probabilities include distance sampling, mark-recapture methods, and logistic-regression sightability models (based on radio-marked animals). We did not have marked animals in our populations, and relatively high densities of deer in our survey areas would present serious logistical and statistical problems for distance-sampling and double-observer methods. Therefore, our double-sampling approach is a reasonable alternative to using unadjusted counts or applying more complicated methods whose assumptions are tenuous. Nevertheless, our "adjusted" population estimates must still be viewed as approximations to the truth.

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Table 1. Deer population and density (deer/mi^2) estimates derived from aerial surveys in Minnesota, 2013.

Permit area	Sampling rate	Detection rate	Population estimate		CV (%)	Relative error (%)[a]	Density estimate	
			N	90% CI			Mean	90% CI
260	0.20	0.864	4,710	4,100 – 5,320	7.8	12.8	3.7	3.2 – 4.1
264	0.20	0.755	9,190	7,910 – 10,470	8.5	14.0	14.2	12.2 – 16.2
270	0.20	0.817	2,760	1,960 – 3,560	17.7	29.1	3.6	2.6 – 4.7
344[b]	0.27	0.763	4,800	4,070 – 5,530	9.2	15.1	24.5	20.8 – 28.2

[a]Relative precision of population estimate. Calculate as 90% CI bound/*N*.
[b]Includes Whitewater State Park.

Table 2. Sampling metrics from aerial deer surveys in Minnesota, 2013.

Permit area	Total quadrats	Sample quadrats	Occupied[a] quadrats	Deer observed	Deer groups observed	Groups / occupied quadrat			Group size / occupied quadrat			Maximum quadrat count
						min	mean	max	min	mean	max	
260	1,286	258	92	2,085	341	1	4	13	1	6	65	132
264	647	130	98	1,893	504	1	5	17	1	4	32	92
270	758	152	32	1,460	84	1	3	6	1	17	155	395
344	196	53	44	1,169	194	1	4	11	1	6	38	89

[a]Number of quadrats with >1 deer observed.