FARMLAND WILDLIFE POPULATIONS

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2015 MINNESOTA AUGUST ROADSIDE SURVEY

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SUMMARY OF FINDINGS

Mild winter conditions and relatively favorable spring and summer weather led to increases in the 2015 population indices for ring-necked pheasants, gray partridge, eastern cottontails, and mourning doves; however, all indices remain below the long-term averages. The white-tailed jackrabbit index was similar to 2014 and remains at a historic low. The population index for white-tailed deer was similar to 2014 and remains well above the long-term average. The index for total sandhill cranes increased but the index for juvenile cranes was similar to 2014.

Conservation Reserve Program (CRP) enrollment declined by 153,492 acres statewide since 2014. Increases in enrollment of other farm programs and acquisition of public lands continued to only partially offset CRP losses, yielding a net loss of 127,646 acres of protected wildlife habitat statewide last year. Within the pheasant range, there was a net loss of 4,353 acres of set-aside habitat. The winter of 2014-15 was milder than normal across all regions. Spring and early summer temperatures and precipitation amounts were normal to near-normal with the exception of May, which was slightly colder than normal and had variable rainfall amounts across the farmland zone. Overall, conditions for overwinter survival were above average and nesting season conditions were favorable for nesting birds.

The 2015 range-wide pheasant index (40.7 birds/100 mi) increased 33% from 2014 but was 39% below the 10-year average and 59% below the long-term average. Minnesota's pheasant population has declined since the mid-2000s in association with the loss of CRP acres, and indices over the past 5 years are comparable to the indices calculated in the mid-1980s. The hen index (6.1 hens/100 mi) increased 32% from 2014 but was 40% below the 10-year average. The cock index (4.9 cocks/100 mi) increased 8% from 2014 but also remained 40% below the 10-year average. The hen:cock ratio (1.27) was greater than the 2014 ratio (0.99) and closer to the average ratio (1.42) for the CRP years. The pheasant brood index (6.3 broods/100 mi) increased 35% from last year but remained 38% below the 10-year average and 51% below the long-term average. Average brood size in 2015 (4.7 chicks/brood) was similar to 2014 and the 10-year average but 14% below the long-term average (5.5 chicks/brood). The median hatch date for pheasants was 9 June 2015, which is 3 days earlier than the 10-year average. The best opportunity for harvesting roosters should be in the Southwest, West Central, and East Central regions.

The gray partridge index (2.3 birds/100 miles) increased 150% from 2014 but remains well below the 10-year and long-term averages (-44% and -83%, respectively). Partridge counts were highest in the Southeast and South Central regions. The eastern cottontail rabbit index (7.1 rabbits/100 mi) was 36% greater than last year, 34% above the 10-year average, and 20% above the long-term average. The cottontail indices were highest in the Southeast, South Central, Southwest, and East Central regions. The white-tailed jackrabbit index (0.1 rabbits/100 mi) did not change from last year and is 95% below the long-term average. The jackrabbit population peaked in the 1950s but declined to low levels in the 1980s with changes in agricultural land use and has not recovered. The white-tailed deer index (21.2 deer/100 mi) was similar to 2014, 33% above the 10-year average, and 98% above the long-term average. The mourning dove index (184.2 doves/100 mi) was 14% greater than 2014 but 13% and 27% below the 10-year and long-term averages, respectively. Mourning dove counts were highest in the Southwest, West Central, and South Central regions. Rangewide, the total

sandhill crane index (14.7 total cranes/100 mi) increased 64% from 2014 and the juvenile index (1.2 juvenile cranes/100 mi) was similar to 2014.

INTRODUCTION

This report summarizes the 2015 Minnesota August Roadside Survey (ARS). The ARS is conducted annually during the first two weeks of August by Minnesota Department of Natural Resources (MNDNR) wildlife and enforcement personnel throughout Minnesota's farmland regions (Figure 1). The 2015 ARS consisted of 170 25-mile routes (1-4 routes/county); 151 routes were 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 should be interpreted cautiously.

HABITAT CONDITIONS

Undisturbed grassland habitat acres in Minnesota's farmland landscape continued to decline considerably last year. Conservation Reserve Program (CRP) enrollment declined by 153,492 acres statewide. Losses of CRP were more extensive in northwestern Minnesota's prairie chicken range (-130,540 acres) compared to the pheasant range (-23,116 acres). Acres enrolled in the Conservation Reserve Enhancement Program (CREP) held nearly steady whereas acres enrolled in Reinvest in Minnesota (RIM), Wetlands Reserve Program (WRP), and RIM-WRP increased slightly last year. Combined with acquisitions of state-owned Wildlife Management Areas (WMA) and federally-owned Waterfowl Production Areas (WPA), these gains only partially offset CRP losses, yielding a net loss of 127,646 acres statewide last year. The net loss of protected habitat in Minnesota's pheasant range was 4,353 acres. Similar to 2014, remaining protected habitat accounts for 5.9% of the landscape within the pheasant range (range: 3.1-9.6; Table 1).

Protecting grassland and wetland habitat remains one of the most critical environmental challenges facing Minnesota. Farm programs, especially CRP, make up the largest portion of protected grasslands in the pheasant range (Figure 2). Expiring CRP contracts continue to be a concern for future wildlife populations, with major losses yet to come (>495,000 acres in Minnesota scheduled to expire by fall 2018). Funding from the Legacy Amendment has helped accelerate acquisition of WMAs and WPAs throughout Minnesota's farmland zone, but not at a pace that can keep up with the loss of CRP acres. Minnesota's Prairie Conservation Plan has provided a blueprint for moving forward with conservation strategies and is being carried out through local technical teams (LTTs) using various state and federal funding sources to protect, restore, and enhance grasslands and wetlands. For more info, please visit: Minnesota Prairie Plan.

Efforts to increase public hunting opportunities on private lands, especially land enrolled in a conservation program (e.g., CRP, CREP, RIM), have continued in 2015. The 2012 Minnesota Legislature established a Walk-in Access (WIA) program to provide public access to wildlife habitat on private land for hunting. The WIA program compensates landowners for providing hunter access through an agreement with MNDNR Wildlife. In August 2015, the U.S. Department of Agriculture (USDA) awarded a 3-year, $1.67 million grant which will help continue funding of the WIA program. For the 2015-2016 hunting season, 22,800 acres of private land across 200 sites in the West Central, Central, Southwest, and South Central regions are enrolled in the WIA program. Walk-in Access sites are open for public hunting from September 1 – May 31 where boundary signs are present. Hunters must purchase a $3 WIA Validation to legally access WIA lands. For more information on the WIA program, including a printable atlas of enrolled sites by county, aerial photos of each site, interactive maps, and Global Positioning System (GPS) downloads, please visit the WIA program website at: www.mndnr.gov/walkin.

WEATHER SUMMARY

Minnesota's winter 2014-2015 was generally mild with warmer and drier than normal conditions across much of the farmland zone. November storms brought deeper snow (>6 inches) to some areas of the pheasant range, including West Central, Central, and East Central Minnesota (Minnesota Climatology Working Group [MCWG], Weekly snow depth maps), and temperatures were 8.0° F colder than normal across all regions in the farmland zone (MCWG Climate Summary). However, temperatures were 5.5° F and 3.5° F warmer than normal in December and January, respectively, and snow cover never exceeded 4 inches except in the Northwest during these months. February was 9.7° F colder than normal, on average. No region in the farmland zone had continuous deep snow cover for more than 2 weeks at a time during winter 2014-2015 except for the Northwest region which had deeper snow cover in some areas during January and February. Storms brought several inches of snow during the first and third weeks of March, but warmer than normal temperatures (average = 2.6° F above normal) melted the snow quickly.

Spring temperatures and precipitation were variable from April through June. April was slightly warmer and drier than normal (1.7° F above normal; 0.65 inches below normal). May was slightly colder than normal (-0.8° F below normal) with highly variable precipitation patterns across the farmland zone. The East Central, Southwest, South Central, and Southeast regions were only slightly wetter than normal (range: 1.05-1.23 inches above normal), whereas the Northwest, West Central, and Central regions received more precipitation (2.66, 3.30, and 2.27 inches above normal, respectively). On average across all farmland regions, June and July had near-normal temperatures and precipitation amounts.

Overall, the conditions for over-winter survival of wildlife were above average throughout the farmland zone in 2014-2015. Although conditions for nesting birds were cooler and wetter in May, June and July conditions were very beneficial for re-nesting and brood-rearing.

SURVEY CONDITIONS

The survey period was extended (30 July – 20 August) to allow routes to be completed, and observers completed 170 of 172 routes in 2015. One route in McLeod County and one route in Mower County were not completed within the survey's timeframe. Weather conditions during the survey ranged from excellent (calm winds, heavy dew, clear sky) to medium (light breeze and dew, overcast skies). Medium-to-heavy dew conditions were present at the start of 98% of the survey routes, which was better than 2014 (94%) and the 10-year average (93%). Clear skies (<30% cloud cover) were present at the start of 82% of routes and wind speeds <7 mph were recorded for 100% of the routes. Overall, survey conditions were excellent in 2015.

RING-NECKED PHEASANT

In 2015, the average number of pheasants observed (40.7 birds/100 mi) increased 33% from 2014 but remained 39% below the 10-year average (Table 2, Figure 3A), 59% below the long-term average, and 85% below the benchmark years of 1955-64. The pheasant population has declined since the mid-2000s in conjunction with the loss of CRP acres (Figure 2), and pheasant indices over the past 5 years are comparable to the indices calculated in the mid-1980s before the CRP era began (Figure 3A). Total pheasants observed per 100 mi ranged from 26.0 birds in the Southeast region to 76.4 birds in the Southwest region (Table 3). The pheasant roadside index showed substantial increases in the Southeast (138%) and East Central (126%) regions (Table 3). The Southwest (23%), West Central (31%), and Central (44%) regions also showed increased roadside indices, whereas the South Central Region (-2%) remained similar to 2014. The best opportunity for harvesting pheasants appears to be in the Southwest, West Central, and East Central regions.

The range-wide hen index (6.1 hens/100 mi) increased 32% from 2014 but was 40% below the 10-year average (Table 2). The hen index varied from 3.8 hens/100 mi in the Southeast to 11.4 hens/100 mi in the Southwest. The 2015 hen index was similar to 2014 in the West Central (1%) and Central (8%) regions and increased in the South Central (13%), Southwest (69%), East Central (152%), and Southeast (259%) regions. The range-wide cock index (4.9 cocks/100 mi) increased 8% from 2014 but remained 40% below the 10-year average (Table 2). The cock index increased in the South Central (12%), West Central (23%), and Central

(39%) regions but decreased 16-29% in the other three regions of the pheasant range. The 2015 hen:cock ratio was 1.27, which was greater than 2014 (0.99) and closer to the average (1.42 ± 0.35) for the CRP years (1987-2014).

Across their range, the average number of pheasant broods observed (6.3 broods/100 mi) increased 35% from last year but remained 38% below the 10-year average and 51% below the long-term average (Table 2). Regional brood indices ranged from 3.9 broods/100 mi in the Central region to 13.1 broods/100 mi in the Southwest region. The brood index was similar to 2014 for the South Central and Central regions and increased in all other regions (range: 23-201%). The average brood size index in 2015 (4.7 ± 0.2 chicks/brood) was similar to 2014 and the 10-year average but 14% below the long-term average (5.5 ± 0.1 chicks/brood). The median hatch date for pheasants across their range was approximately 9 June 2015 (n = 240 broods), 3 days earlier than the 10-year average (Table 2). The distribution of estimated hatch dates was unimodal and normally distributed, which suggests that weather conditions in May and June were not disruptive to nesting overall. However, it is notable that the median hatch date for the West Central and South Central regions was delayed (15 June and 19 June, respectively).

The increase in pheasant counts can be attributed to the relatively mild winter and good nesting season conditions experienced throughout their range. Winter conditions for pheasants are considered severe when the temperature is ≤0° F and snow cover exceeds 6 inches. Lack of simultaneous extreme cold and deep snow conditions improved overwinter survival of hens. Additionally, the lack of deep snow cover made food resources (e.g., weed seeds, waste grain) more readily available, which would have allowed hens to enter the nesting season in above-average body condition. Although heavier rains in some regions in May might have forced hens to re-nest, the drier conditions in June and July were beneficial to brood-rearing and likely improved chick survival rates.

GRAY PARTRIDGE

The range-wide gray partridge index (2.3 birds/100 miles) increased 150% from 2014 but remains well below the 10-year and long-term averages (-44% and -83%, respectively; Table 2, Figure 3B). The partridge index ranged from 0.0 birds/100 mi in the Central and East Central regions to 6.5 birds/100 mi in the Southeast region (Table 3). Observations of gray partridge broods (n = 9 broods statewide) were too few for analysis by age class.

Conversion of diversified agricultural practices (e.g., hayfields, pastures, small grains, and hedgerows) to more intense land-use (e.g., corn and soybeans) has 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 years. Consequently, gray partridge are more adversely affected by heavy precipitation during the breeding season than are pheasants. The Southeast and South Central regions will offer the best opportunity for harvesting gray partridge in 2015.

COTTONTAIL RABBIT and WHITE-TAILED JACKRABBIT

The eastern cottontail rabbit index (7.1 rabbits/100 mi) increased 36% from 2014 and was 34% above the 10-year average and 20% above the long-term average (Table 2, Figure 4A). The cottontail rabbit index ranged from 1.3 rabbits/100 mi in the Northwest to 13.4 rabbits in the Southeast (Table 3). The best opportunity for harvesting cottontail rabbits should be in the Southeast, South Central, Southwest, and East Central regions.

The number of white-tailed jackrabbits observed (0.1 rabbits/100 mi) remains at a historic low (i.e., 95% below the long-term average of 1.7 rabbits/100 mi; Table 2). The range-wide jackrabbit population peaked in the late 1950s and declined to low levels in the 1980s (Figure 4B). The long-term decline in jackrabbits reflects the loss of their preferred habitats (i.e., pasture, hayfields, and small grains). The greatest potential for white-tailed jackrabbit hunting is likely in the Southwest region (Table 3).

WHITE-TAILED DEER

The index for white-tailed deer (21.2 deer/100 mi) was similar to 2014, 33% above the 10-year average, and 98% above the long-term average (Table 2, Figure 5A). Roadside indices for deer ranged from 6.1 deer/100 mi in the South Central region to 58.7 deer/100 mi in the Northwest (Table 3).

MOURNING DOVE

The mourning dove index (184.2 doves/100 mi) was 14% greater than 2014 but 13% below the 10-year average and 27% below the long-term average (Table 2, Figure 5B). The index ranged from 75.1 doves/100 mi in the East Central region to 263.8 doves/100 mi in the Southwest region (Table 3). The best opportunities for harvesting doves should be in the Southwest, West Central, and South Central regions.

SANDHILL CRANE

The 2015 range-wide index of sandhill cranes averaged 14.7 total cranes/100 mi, representing a 64% increase in total cranes compared to 2014 (Table 2). Indices ranged from 0.0 total cranes/100 miles in the Southwest region to 65.7 total cranes/100 mi in the Northwest region (Table 3). Overall, regional indices for the total number of cranes increased in the West Central (300%), Central (70%), and Northwest (120%) regions, decreased in the East Central (-8%) and South Central (-46%) regions, and remained similar in the Southeast region.

The range-wide index of juveniles was 1.2 juvenile cranes/100 mi, which was similar to 2014 (Table 2). Juvenile cranes were observed in the West Central, Central, East Central, and Northwest regions.

OTHER SPECIES

Notable incidental sightings included: belted kingfisher (Jackson and Nobles Counties), black-billed magpie (Polk and Red Lake Counties), common raven (Polk and Red Lake Counties), greater prairie-chicken (Clay and Wilkin Counties), meadowlark sp. (Redwood and Renville Counties), northern shrike (Dakota County), osprey (Wright County), pectoral sandpiper (Nobles County), purple martin (Nobles County), red-headed woodpecker (Nobles County), sharp-tailed grouse (Lac qui Parle and Red Lake Counties), trumpeter swan (Brown County), and upland sandpiper (Nobles, Redwood, and Traverse Counties). Wild turkey adults and poults were noted in 18 counties.

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LITERATURE CITED

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Table 1. Abundance (total acres) and density (acres/mi2) of undisturbed grassland habitat within Minnesota's pheasant range, 2015[a].

	Cropland Retirement									**Density**
AGREG	CRP	CREP	RIM	RIM-WRP	WRP	USFWS[c]	MNDNR[d]	Total	%	ac/mi2
WC[b]	260,174	37,688	21,641	13,783	19,992	192,000	109,553	654,832	9.6	61.7
SW	89,330	24,763	18,391	2,225	848	21,916	60,509	217,982	5.8	36.9
C	119,102	14,326	31,530	6,328	3,067	89,432	49,614	313,398	5.2	33.2
SC	81,615	27,656	12,741	10,039	8,978	9,288	34,065	184,382	4.6	29.2
SE	56,441	2,706	7,269	692	985	36,731	53,159	157,983	4.3	27.3
EC	3,430	0	1,132	0	4	4,994	91,117	100,677	3.1	20.1
Total	610,092	107,139	92,704	33,066	33,874	354,361	398,017	1,629,253	5.9	37.8

a. Unpublished data, Tabor Hoek, BWSR, 1 August 2015.

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, 1955-2015.

Species / Subgroup	Change from 2014[a]					Change from 10-year average[b]				Change from long-term average[c]			
	n	2014	2015	%	95% CI	*n*	2005-14	%	95% CI	*n*	LTA	%	95% CI
Ring-necked pheasant													
Total pheasants	148	30.6	40.7	33	±26	145	65.1	-39	±13	146	96.2	-59	±10
Cocks	148	4.5	4.9	8	±24	145	7.7	-40	±12	146	10.9	-57	±11
Hens	148	4.6	6.1	32	±30	145	10.0	-40	±14	146	13.9	-57	±11
Broods	148	4.7	6.3	35	±30	145	10.1	-38	±14	146	12.7	-51	±11
Chicks per brood	240	4.6	4.7	2			4.7	0			5.5	-14	
Broods per 100 hens	148	101.7	103.0	1			100.8	2			101.3	2	
Median hatch date	240	16 June	9 June				12 June						
Gray partridge	167	0.9	2.3	150	±198	164	4.1	-44	±38	146	15.0	-83	±19
Eastern cottontail	167	5.2	7.1	36	±27	164	5.4	34	±22	146	6.6	20	±20
White-tailed jackrabbit	167	0.1	0.1	0	±119	164	0.2	-56	±52	146	1.7	-95	±14
White-tailed deer	167	21.1	21.2	0	±19	164	16.0	33	±23	165	10.6	98	±32
Mourning dove	167	161.1	184.2	14	±18	164	203.4	-13	±11	146	268.6	-27	±12
Sandhill crane													
Total cranes	167	9.0	14.7	64	±75								
Juveniles	167	1.3	1.2	-6	±47								

[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 = 1955-2014, except for deer = 1974-2014. 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, 1955-2015.

Region	**Change from 2014**[a]					**Change from 10-year average**[b]				**Change from long-term average**[c]			
Species	*n*	2014	2015	%	95% CI	*n*	2005-14	%	95% CI	*n*	LTA	%	95% CI
Northwest[d]													
Gray partridge	19	0.0	0.8			19	0.5	55	±150	19	3.3	-74	±77
Eastern cottontail	19	0.4	1.3	198	±286	19	0.5	149	±234	19	0.8	58	±148
White-tailed jackrabbit	19	0.2	0.2	0	±302	19	0.4	-41	±126	19	0.6	-67	±75
White-tailed deer	19	45.9	58.7	28	±57	19	42.8	37	±61	19	31.1	89	±73
Mourning dove	19	78.3	85.3	9	±46	19	86.8	-2	±38	19	119.4	-29	±25
Sandhill crane	19	29.9	65.7	120	±195								
West Central[e]													
Ring-necked pheasant	39	35.5	46.3	31	±60	35	72.9	-38	±30	37	97.9	-56	±23
Gray partridge	39	0.3	0.2	-33	±246	35	0.9	-73	±73	37	9.5	-98	±22
Eastern cottontail	39	3.1	2.6	-17	±54	35	2.8	-1	±45	37	3.9	-34	±32
White-tailed jackrabbit	39	0.2	0.1	-50	±229	35	0.3	-55	±107	37	2.2	-95	±21
White-tailed deer	39	24.8	17.4	-30	±31	35	15.2	18	±26	37	9.9	74	±40
Mourning dove	39	184.2	281.4	53	±40	35	239.8	10	±22	37	367.9	-22	±19
Sandhill crane	39	0.9	3.7	300	±371								
Central													
Ring-necked pheasant	27	18.5	26.7	44	±60	27	53.5	-50	±28	26	69.7	-60	±17
Gray partridge	27	0.3	0.0	-100	±206	27	1.0	-100	±90	26	9.2	-100	±49
Eastern cottontail	27	1.3	4.6	244	±186	27	5.2	-12	±48	26	6.5	-29	±33
White-tailed jackrabbit	27	0.0	0.0			27	0.0			26	1.1	-100	±24
White-tailed deer	27	14.7	20.4	40	±53	27	10.7	91	±64	26	6.0	223	±119
Mourning dove	27	88.3	123.1	40	±69	27	164.0	-25	±32	26	222.9	-44	±23
Sandhill crane	27	12.0	20.3	70	±95								
East Central													
Ring-necked pheasant	12	20.4	46.2	126	±128	13	55.4	-23	±46	13	85.8	-50	±30
Gray partridge	12	0.0	0.0			13	0.0			13	0.1	-100	±147
Eastern cottontail	12	7.0	8.9	28	±116	13	10.3	-15	±52	13	8.7	2	±46
White-tailed jackrabbit	12	0.0	0.0			13	0.0			13	0.2	-100	±64
White-tailed deer	12	22.2	23.6	6	±59	13	16.2	38	±66	13	9.6	133	±105
Mourning dove	12	78.4	75.1	-4	±50	13	100.3	-25	±30	13	117.2	-36	±38
Sandhill crane	12	43.2	39.6	-8	±50								

Table 3. Continued.

Region Species	**Change from 2014** *n*	2014	2015	%	95% CI	**Change from 10-year average** *n*	2005-14	%	95% CI	**Change from long-term average** *n*	LTA	%	95% CI
Southwest													
Ring-necked pheasant	19	62.1	76.4	23	±45	19	125.3	-39	±23	19	114.5	-33	±23
Gray partridge	19	0.8	1.9	125	±304	19	14.7	-87	±32	19	39.8	-95	±19
Eastern cottontail	19	7.6	10.7	42	±72	19	6.3	70	±66	19	8.0	35	±58
White-tailed jackrabbit	19	0.4	0.4	0.0	±153	19	0.7	-43	±106	19	3.7	-89	±24
White-tailed deer	19	23.4	18.5	-21	±41	19	16.6	11	±51	19	9.6	93	±79
Mourning dove	19	335.6	263.8	-21	±37	19	313.1	-16	±31	19	310.4	-15	±32
Sandhill crane	19	0.0	0.0										
South Central													
Ring-necked pheasant	32	31.6	31.0	-2	±48	32	64.2	-52	±23	32	126.0	-75	±13
Gray partridge	32	3.6	6.1	69	±233	32	7.3	-16	±88	32	18.3	-67	±46
Eastern cottontail	32	8.1	11.6	43	±53	32	7.8	48	±46	32	7.6	53	±48
White-tailed jackrabbit	32	0.0	0.0			32	0.1	-100	±69	32	1.7	-100	±25
White-tailed deer	32	5.5	6.1	11	±66	32	5.5	11	±47	32	3.8	62	±66
Mourning dove	32	225.8	199.9	-12	±28	32	272.5	-27	±23	32	257.4	-22	±38
Sandhill crane	32	1.6	0.9	-46	±97								
Southeast													
Ring-necked pheasant	19	10.9	26.0	138	±169	19	15.4	69	±113	19	68.0	-62	±39
Gray partridge	19	0.0	6.5			19	5.1	29	±112	19	13.6	-52	±47
Eastern cottontail	19	11.6	13.4	16	±56	19	7.1	88	±65	19	7.5	78	±69
White-tailed jackrabbit	19	0.0	0.0			19	0.1	-100	±153	19	0.6	-100	±46
White-tailed deer	19	21.0	19.1	-9	±52	19	15.4	24	±73	19	10.9	76	±102
Mourning dove	19	68.5	133.1	94	±81	19	153.0	-13	±32	19	218.7	-39	±22
Sandhill crane	19	0.0	0.4										

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

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

[c] LTA = 1955-2014, except for Northwest region (1982-2014) and white-tailed deer (1974-2014). Estimates based on routes (*n*) surveyed ≥40 years (1955-2014), 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.

[e] Two routes were added to the West Central region in 2014.

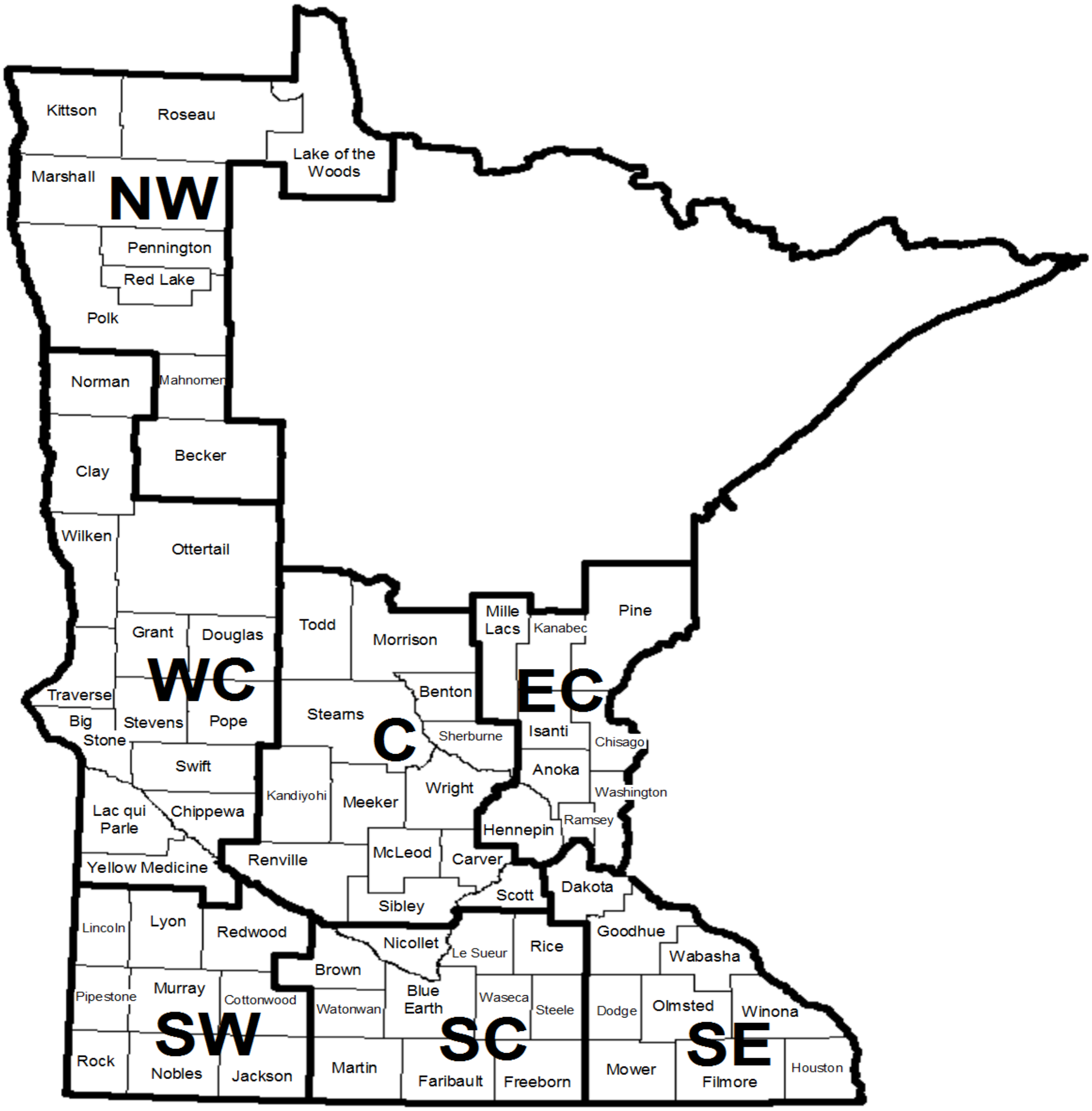


Figure 1. Survey regions for Minnesota's August roadside survey, 2015.

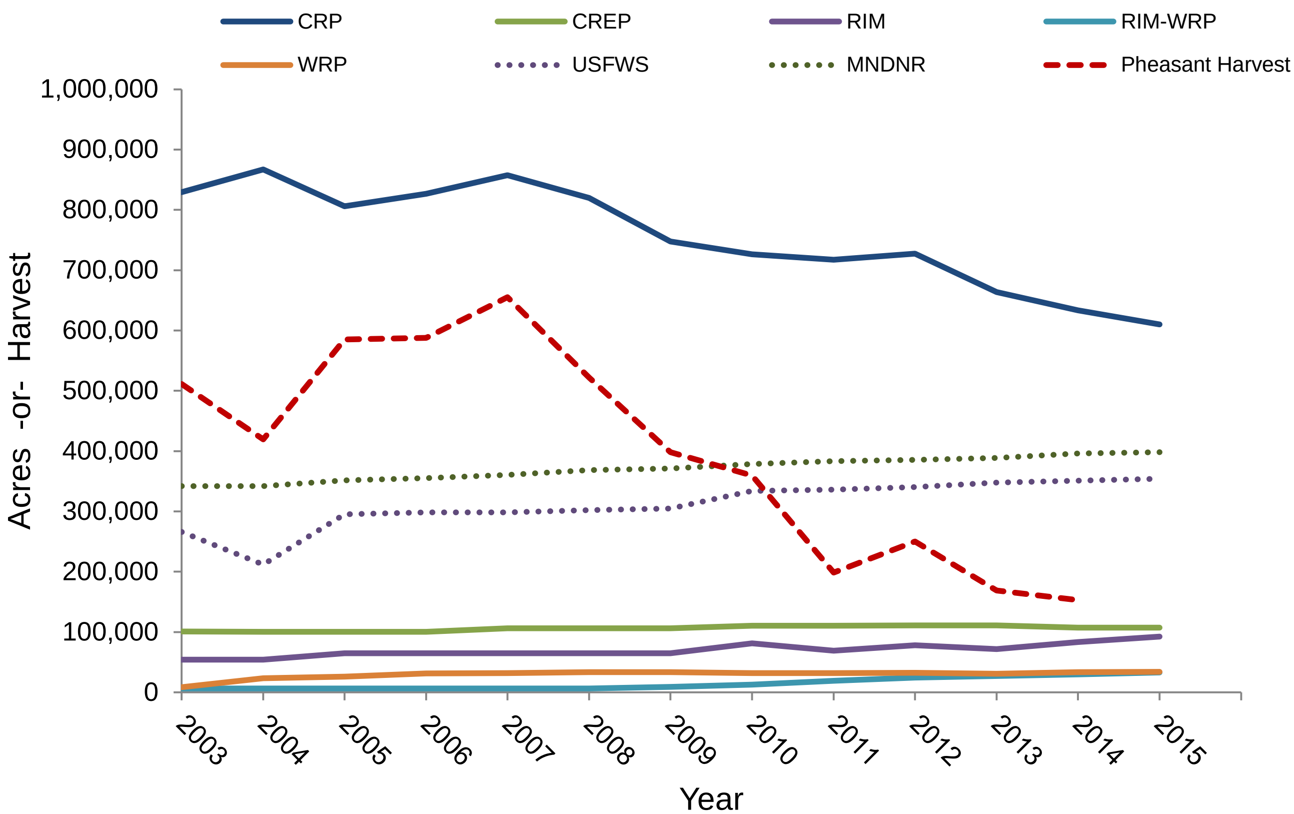


Figure 2. Acres enrolled in private and public land habitat conservation programs vs. ring-necked pheasant harvest trends in Minnesota, 2003-2015. Acres are calculated for the pheasant range only.

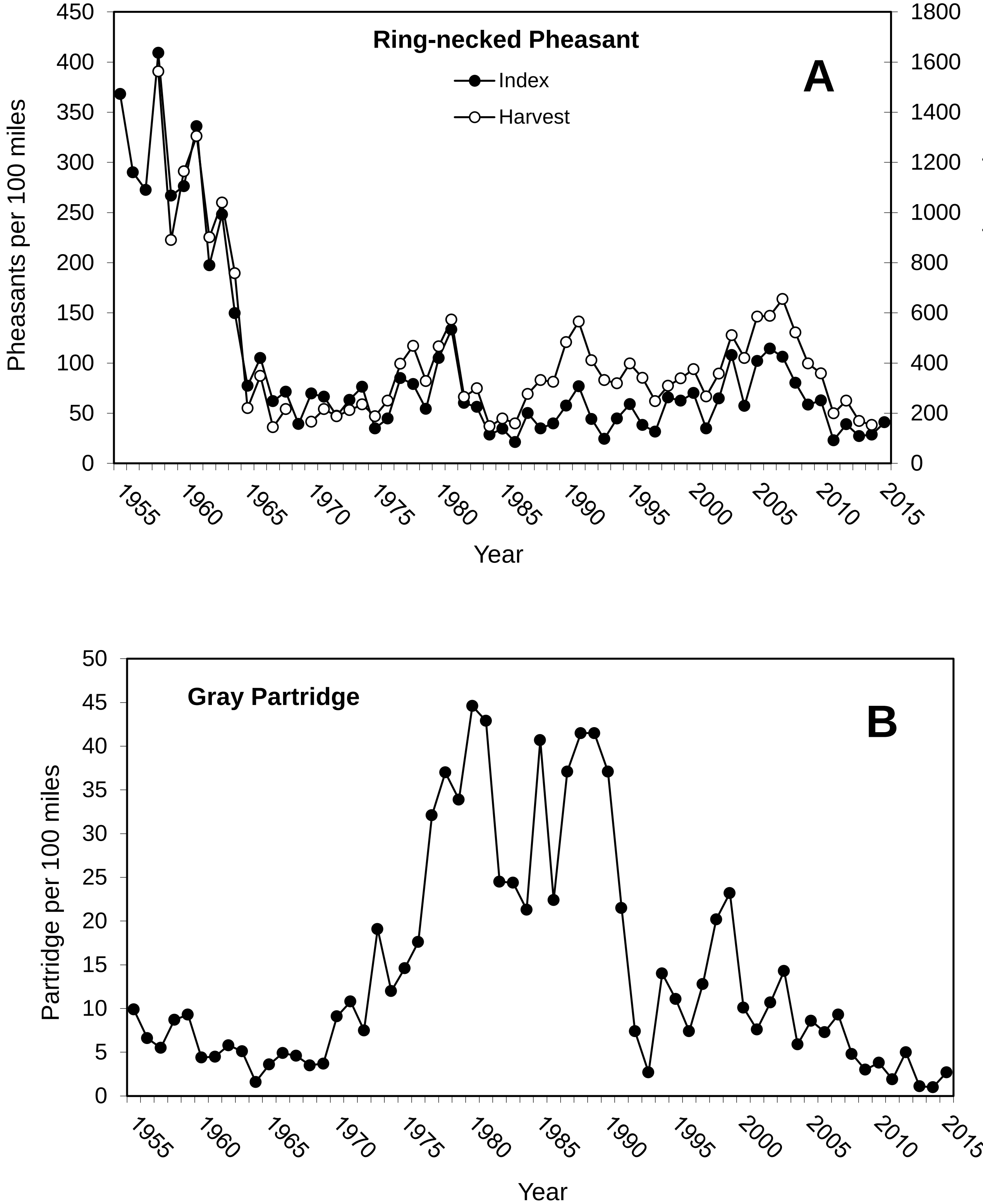
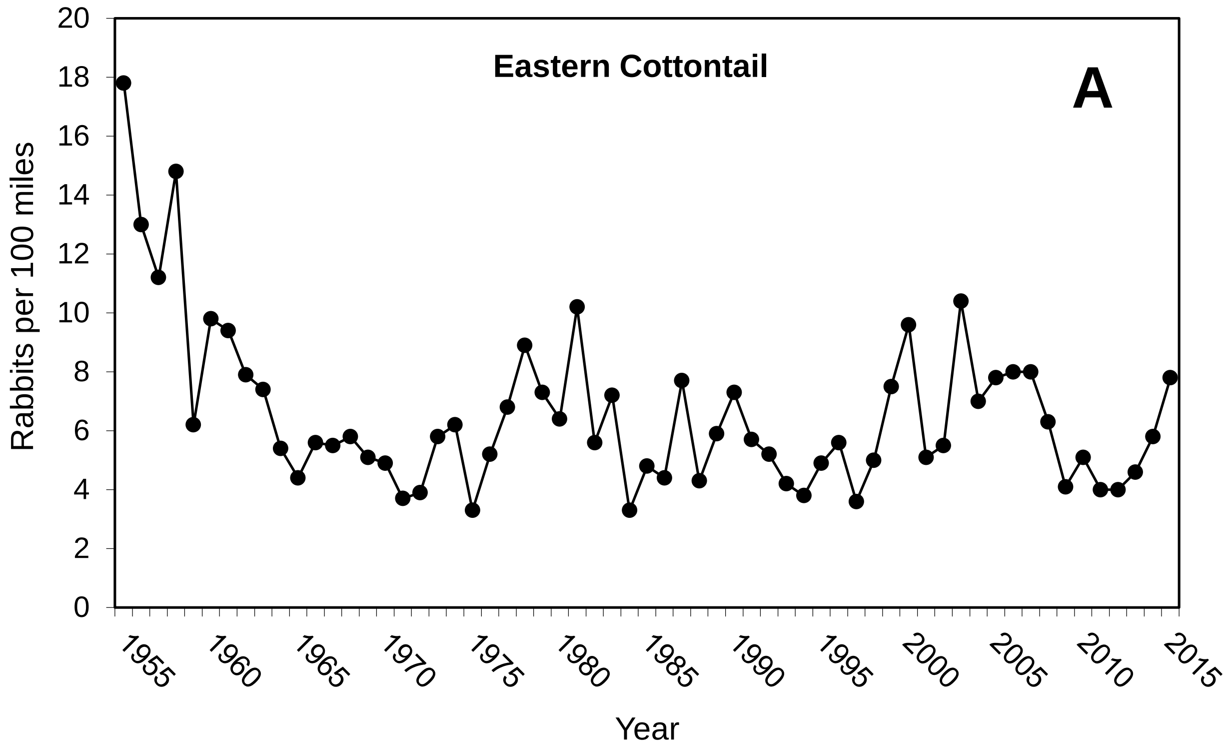


Figure 3. Range-wide index of ring-necked pheasants (**A**) and gray partridge (**B**) seen per 100 miles driven in Minnesota, 1955-2015. Does not include the Northwest region. Based on all survey routes completed.



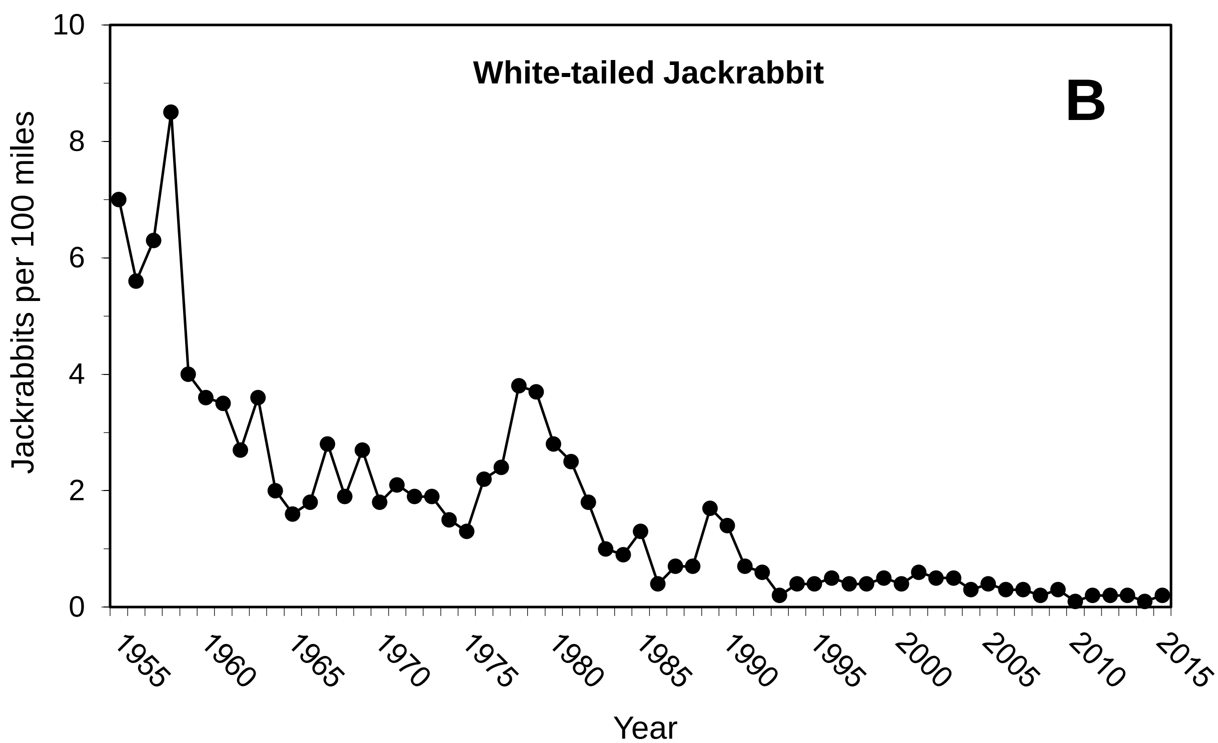
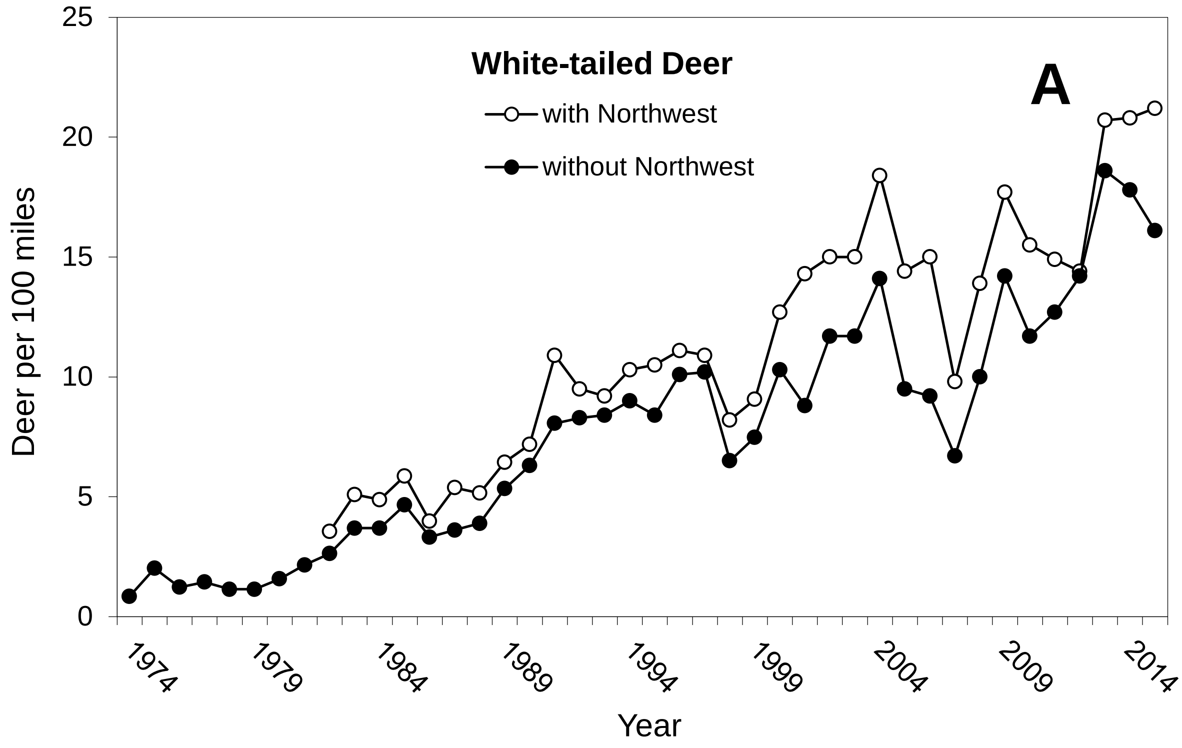


Figure 4. Range-wide index of eastern cottontail (A) and white-tailed jackrabbits (B) seen per 100 miles driven in Minnesota, 1955-2015. Does not include the Northwest region. Based on all survey routes completed.



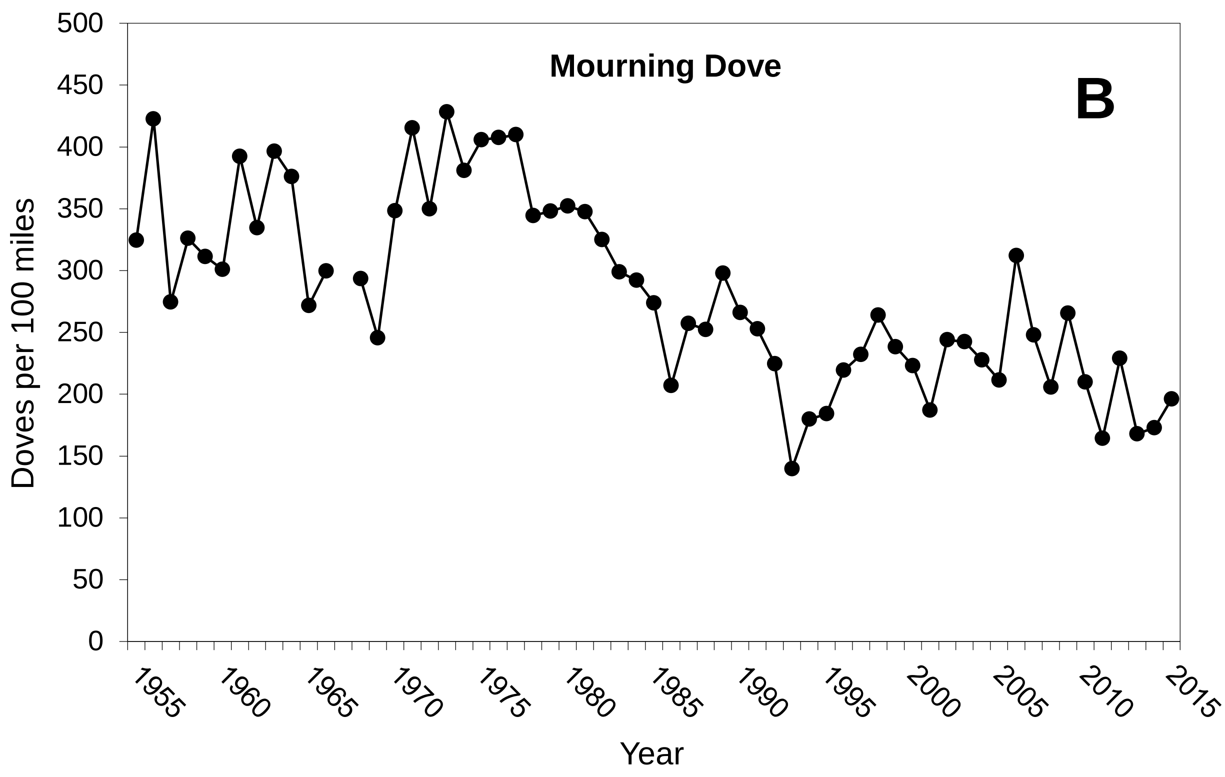


Figure 5. Range-wide index of white-tailed deer (**A**) and mourning doves (**B**) seen per 100 miles driven in Minnesota, 2015. Doves were not counted in 1967 and the dove index does not include the Northwest region. Based on all survey routes completed.

MONITORING POPULATION TRENDS OF WHITE-TAILED DEER IN MINNESOTA - 2015

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INTRODUCTION

Hunting is the primary method used to manage white-tailed deer (*Odocoileus virginianus*) populations in Minnesota. Minnesota Department of Natural Resources (MNDNR) sets hunting regulations annually to adjust deer harvest to meet management goals. MNDNR wildlife researchers conduct simulation modeling of deer populations within deer permit areas (DPAs) to understand historical deer herd dynamics, predict population sizes, and to explore the impacts of various hunting regulations on populations. To aid in decision-making, the output from population modeling is considered along with deer harvest metrics, hunter success rates, surveys of hunter and landowner satisfaction with deer populations, and deer population goals set through a public process.

We utilized a stochastic population model to simulate annual variations in deer densities within individual DPAs. We defined ranges of values for fecundity and survival by sex- and age-classes of deer based on values from the primary literature and data from studies within Minnesota. This report summarizes the structure and parameters of the simulation model, and provides a description of recent trends in deer populations.

METHODS

Model Structure

We started each multi-year simulation in spring of the initial year before reproduction occurred (Figure 1). We specified an initial population density (see more about selection of initial population densities in Modeling Procedures section), and the model converted the initial population density into a total population size by multiplying the density by the total land area of the DPA. Based on harvest data from previous years (McInenly 2014), we estimated the proportion of adult deer by age- and sex-class in the initial population (adult females mean = 0.40 [SD = 0.02], adult males mean = 0.25 [SD = 0.02]).

Within each annual cycle, we applied age-specific fecundity rates to females to estimate reproduction. All age- and sex-classes were subjected to spring/summer mortality, and the result was the pre-hunt fall population. Deer harvested were subtracted from the pre-hunt population. Winter mortality rates were estimated by age-class relative to the severity of winter, and were applied to the post-hunt population. The remaining population represented the starting population size for the next stage of the simulation. We assumed that the effects of immigration and emigration on a population within a DPA were equal. In the following, we provide more detailed information about the selection of model parameters.

Reproduction

We used fecundity rates, which were within a range of values reported for Minnesota and Wisconsin (MNDNR unpublished data, Fuller 1990, McCaffery et al. 1998, DelGiudice et al. 2007, Dunbar 2007, Grund 2011, Wisconsin Department of Natural Resources 2014). Fecundity rates were partitioned by 2 age-classes of breeding females (i.e., yearlings <1.0 years old when bred and adults ≥ 1.0 years old when bred) and were allowed to vary by 3 eco-geographic zones (northeast, farmland-forest transition areas, southeast) that reflected relative differences in habitat quality. Fecundity rates were estimated to be lowest in the northeast (yearlings, mean = 0.06 [SD = 0.01]; adults, mean = 1.55 [SD = 0.03]), moderate in the farmland-forest transition zone (yearlings, mean = 0.10 [SD = 0.01]; adults, mean = 1.75 [SD = 0.03]), and greatest in the southeast (yearlings, mean = 0.15 [SD = 0.01]; adults, mean = 1.85 [SD = 0.03]). The sex ratio of fawns at birth in most deer populations is approximately 50:50, but may vary annually (Ditchkoff 2011). We allowed the proportion of male fawns at birth to vary between 0.48-0.52.

Spring/Summer Survival

Survival rates of deer during winter are dependent on the severity of winter conditions (Fuller 1990, DelGiudice et al. 2002). Likewise, the condition of breeding females following winter may directly influence survival of their newborn fawns (Verme 1977, Nixon et al. 1991, Carstensen et al. 2009). MNDNR calculates a winter severity index (WSI) in each DPA annually based on snow depth and minimum daily temperatures. WSI was calculated weekly by staff from Minnesota Information Technology Services at MNDNR. From 1 November through 31 May, 1 point was added to the WSI for each day with snow depths $\geq$ 15 in (38.1 cm). One point was also added to the WSI for each day when temperatures were $\leq 0^{0}$ F (-17.8^{0} C). Therefore, the WSI accumulated 0, 1, or 2 points each day in a DPA. Winters were considered mild when the WSI was <100 and severe winters had a WSI $\geq$180.

We used estimates of spring/summer survival of fawns, which spanned values reported in the primary literature for deer in Minnesota and populations in similar habitats (Huegel et al. 1985, Nelson and Mech 1986a, Nelson and Woolf 1987, Kunkel and Mech 1994, Van Deelen et al. 1997, Brinkman et al. 2004, Vreeland et al. 2004, Rohm et al. 2007, Hiller et al. 2008, Carstensen et al. 2009). Fawn survival rates were adjusted to approximate the effects of winter severity on the condition of adult females during the previous winter. Mean spring/summer survival values for fawns were 0.80 (SD = 0.03), 0.65 (SD = 0.03), and 0.45 (SD = 0.03) following mild (WSI <100), moderate (WSI $\geq$100 and <180), and severe winters (WSI $\geq$180), respectively.

Spring/summer survival rates reported in the primary literature for adult deer $\geq$1 year old were relatively high and similar for both sexes (DeYoung 2011). We used default values for summer survival of adult deer from the population model previously used in Minnesota (Grund and Woolf 2004, Grund 2014) and allowed the values to vary stochastically (female = 0.97 [SD = 0.01, male = 0.98 [SD = 0.01]). These estimates overlapped values reported in the literature for Minnesota and populations in similar habitats (Nelson and Mech 1986a, Fuller 1990, Van Deelen et al. 1997, Whitlaw et al. 1998, Brinkman et al. 2004, Grund and Woolf 2004, Grund 2011, Grovenburg et al. 2011).

Fall Harvest and Survival

In most DPAs in Minnesota, hunter harvest represents the greatest source of mortality for deer populations in the fall (Fuller 1990, DelGiudice et al. 2006, Grovenburg et al. 2011).

We obtained harvest data from the MNDNR Electronic Licensing System. Hunters were required to register deer within 48 hours after harvest, indicate in which DPA the deer was harvested, and classify the deer as adult male, adult female, fawn male, or fawn female. We pooled harvest data for the archery, firearms, and muzzleloader seasons within DPAs.

We recognized that some deer were killed but not registered because hunters did not complete the registration process (Rupp et al. 2000), wounding loss occurred (i.e., deer was not recovered by the hunter and thus was not reported; Nixon et al. 2001), and deer were harvested illegally (Dusek et al. 1992). We first applied a mean multiplier of 1.05 (SD = 0.002) to the numerical harvest to account for non-registered deer. We then applied a mean multiplier of 1.05 (SD = 0.002) for wounding loss and 1.05 (SD = 0.002) for illegal harvest. The mean multiplier for combined harvest reporting errors was 1.13 (SD = 0.003).

Winter Survival

Winter severity, particularly snow depth, increases risk of deer mortality via starvation and predation and fawns are more susceptible than adults (Nelson and Mech 1986b, DelGiudice et al. 2002). We estimated winter survival rates relative to winter severity based on studies conducted in Minnesota (Nelson and Mech 1986a, DelGiudice et al. 2002, Brinkman 2004, Grund and Woolf 2004, DelGiudice 2006, Grovenburg et al. 2011, Grund 2011). These studies reported survival rates similar to those observed in other deer populations in northern latitudes (Van Deelen et al. 1997, Whitlaw et al. 1998, DePerno et al. 2000, Dumont et al. 2000).

For adult deer, we set mean winter survival at 0.95 during mild winters. For moderate to severe winters, the model used a linear equation to calculate survival as a function of winter severity (mean winter survival = 1 − [0.011 + 0.0015 WSI]). For fawns, we set the mean winter survival rate at 0.85 during mild winters. For fawn survival in moderate winters, the linear equation to calculate adult survival was used, however, an additional mortality rate of 0.05 was subtracted to simulate the parallel but lower survival of fawns versus adults (mean winter survival = (1 − [0.011 + 0.0015 WSI]) − 0.05). For severe winters, the equation was adjusted to simulate increased mortality reported for fawns in field studies (mean winter survival = 1 − [0.0054 WSI − 0.33]). For extremely severe winters (WSI >240), we set fawn survival at 0.033. We then allowed winter survival (for both fawns and adults) in any given model iteration to vary stochastically about the predicted mean using SD ≈ 0.02.

Modeling Procedures

To model each DPA, we tested several initial population densities including: 1) population estimates from field surveys when available for the starting year of the simulation (Haroldson 2014), 2) previous estimates from modeling (Grund 2014), or 3) a crude population estimate reconstructed from the reported harvest of adult males in the most recent deer season and given assumptions about the harvest rate of adult males, the proportion of adult males in the pre-hunt population, and the proportion of adults in the pre-hunt population.

To determine the most appropriate initial population density, we examined the modeled population trends relative to: 1) population estimates from field surveys when available within the years modeled, 2) the trend in reported deer harvest, and 3) the relationship between estimated population densities and adult male harvest. To further refine the initial population density, we incrementally increased and decreased the density and re-examined the modeled trend relative to the aforementioned indices. In some cases, we also adjusted spring/summer survival of adult females ≤0.10 in conjunction with varying initial population densities.

We ran each model simulation for 6 years (2010-2015) with the final population estimate occurring pre-fawning for the spring following the most recent deer hunting season (i.e., spring 2015). All simulations were performed with the R programming language (ver. 3.1.2, R Core Team 2014). We used 1,000 Monte Carlo simulations (simulated draws from the stochastic distributions) until the most reasonable set of starting parameters was determined, and then used 5,000 simulations for the final run.

It is not logistically or financially feasible to conduct field studies on deer populations across all DPAs with regularity to estimate model input parameters. Population modeling requires researchers to make assumptions about these data based on prior studies (Hansen 2011). Since model input data rely on broad generalizations about herd demographics and survival rates, models simulating deer populations in small geographic areas would not be realistic. Grund and Woolf (2004) demonstrated that modeling small deer herds increased variability in model estimates, thus decreasing the ability to consider model outputs in making management decisions. Therefore, we did not model populations in DPAs that were small in area or where harvest data were limited.

RESULTS

Deer Population Trends and Management Recommendations

Deer population goal-setting was conducted during 2015 in 40 deer permit areas through a public process. Of the 40 deer permit areas with new goals, 26 will be managed for deer densities higher than those established by the previous goals; 8 will be managed at similar densities to former goals; and 6 will be managed for densities below former goals. Management designations throughout the state for the 2014 deer season were conservative to intentionally reduce harvest of antlerless deer to offset deer mortality due to the harsh winter of 2013-14. The statewide deer harvest of approximately 139,442 deer was the lowest observed since the mid-1980s with antlerless harvest 34% below the average for the previous 5 years. With more antlerless deer left on the landscape and mild winter conditions throughout much of the state, deer populations in most DPAs likely increased above 2014 levels following reproduction in 2015.

Although the parameters included in the model were derived from studies of deer in Minnesota or from studies in similar habitats and environmental conditions, uncertainty is inherent in modeling the dynamics of free-ranging deer populations. Our modeling allowed input parameters to vary stochastically to simulate uncertainty, and model outputs also included measures of uncertainty reflecting variation among model simulations. However, for ease of interpretation, we present mean pre-fawn deer densities in this document.

We conducted simulation modeling in 112 of 128 DPAs (Table 1, Figure 2). Recommendations from MNDNR research for the 2015 deer season were similar to 2014 to provide continuity in management designations wherever possible. Changes in management strategies were recommended to: 1) bring stabilization to deer populations that had reached appropriate levels by spring of 2015, or 2) to increase or decrease populations toward goals where necessary.

Farmland Zone

For the 2015 deer season, most DPAs throughout the farmland region were recommended for Lottery designations with a low to moderate number of either-sex permits. Most deer populations have been stable for several years, and these DPAs generally have consistent hunter numbers with less hunting pressure than the farmland-forest transition zone and forest region. Antlerless harvest in the farmland is closely tied to the number of either-sex permits and a similar number of permits across years will maintain deer densities.

Farmland-Forest Transition Zone

Deer populations along the transition zone are highly productive. Most 2015 season recommendations for the DPAs in the transition zone were for the Hunter Choice designation or Lottery with permit levels allowing ≥20% of hunters to receive an either-sex permit. Several areas were recommended for Managed where deer abundance is higher and agricultural depredation is a concern. Deer populations in DPAs 346 and 349 in extreme southeast Minnesota have been above goal levels for several years and agricultural complaints are common. These DPAs should be managed with an Intensive designation and an early season antlerless hunt to maximize the harvest of antlerless deer and to reduce deer densities in a reasonable timeframe.

Forest Zone

Deer herds in the forest zone were most impacted by the severe winter of 2013-14. In some DPAs, winter mortality of fawns would have exceeded 90% with substantial losses of adult deer. Several years of conservative management will allow deer numbers to rebound if winters continue to be mild. Recommendations for the majority of forest DPAs were for a low number of Lottery permits or Bucks-only designations during the 2015 deer season. DPAs in the moose range have relatively low population goals to minimize the effects of deer abundance on moose. Also, with Bucks-only designations during 2014 in these areas, populations likely began to rebound. Given these factors, DPAs in the northeastern-most portion of the arrowhead were recommended for less conservative designations to maintain current deer densities.

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Table 1. Mean pre-fawn deer densities (deer/mi^2) derived from 5,000 population model simulations in Minnesota deer permit areas, 2010-2015.

		Pre-fawn deer density[a]					
Deer Permit Area	Land area (mi^2)	2010	2011	2012	2013	2014	2015
101	496	-	-	-	-	-	-
103	1820	4	4	4	4	3	3
105	740	13	12	13	13	10	10
108	1651	6	6	7	7	5	5
110	529	19	16	18	16	12	12
111	1438	3	3	3	3	2	3
114	116	-	-	-	-	-	-
117	927	-	-	-	-	-	-
118	1220	5	4	5	5	3	4
119	770	8	7	8	8	5	6
122	603	6	5	5	6	4	4
126	942	4	4	4	5	3	3
127	564	-	-	-	-	-	-
152	61	-	-	-	-	-	-
155	593	18	18	19	19	16	19
156	825	16	16	15	14	9	9
157	673	21	20	20	19	19	19
159	571	18	16	16	17	12	14
169	1124	13	12	13	12	8	9
171	701	12	12	13	13	10	11
172	687	21	21	22	23	18	21
173	584	10	10	10	10	7	8
176	1113	13	12	13	14	9	10
177	480	23	19	20	20	13	14
178	1280	16	13	12	12	7	8
179	862	20	18	18	17	11	10
180	977	10	9	8	8	5	5
181	708	18	15	13	14	8	9
182	267	-	-	-	-	-	-
183	663	14	15	16	18	12	13
184	1229	22	21	22	21	16	18
197	955	13	12	12	12	9	10
199	148	-	-	-	-	-	-
201	161	-	-	-	-	-	-
203	83	-	-	-	-	-	-
208	414	6	6	6	6	6	7
209	640	8	8	8	7	5	6

[a] "-" indicates deer permit area was not modeled.

Deer Permit Area	Land area (mi^2)	Pre-fawn deer density[a]					
		2010	2011	2012	2013	2014	2015
210	615	14	12	11	10	7	7
213	1057	15	14	15	16	18	21
214	554	23	24	26	28	26	27
215	701	15	16	17	19	18	18
218	884	9	10	10	11	11	13
219	391	12	13	13	15	15	17
221	642	14	14	15	16	14	14
222	413	17	17	17	17	14	15
223	376	12	13	14	16	16	17
224	47	-	-	-	-	-	-
225	618	17	16	17	18	14	14
227	472	17	17	17	18	15	16
229	284	7	8	8	10	10	12
230	452	4	4	4	4	4	4
232	377	6	5	5	6	5	6
233	385	5	5	5	5	5	5
234	636	2	3	3	3	3	3
235	34	-	-	-	-	-	-
236	370	17	16	17	17	16	17
237	728	2	2	3	2	2	3
238	95	-	-	-	-	-	-
239	919	13	12	12	12	11	13
240	643	20	19	20	21	20	20
241	996	28	28	28	30	24	25
242	214	24	23	22	20	15	14
246	840	16	16	17	17	15	17
247	228	20	20	21	22	19	20
248	214	20	20	20	20	17	16
249	502	18	16	17	18	16	16
250	713	4	4	4	5	6	7
251	55	-	-	-	-	-	-
252	715	4	4	4	5	6	7
253	974	3	3	4	4	4	5
254	929	4	4	5	5	5	5
255	774	4	4	4	5	5	5
256	654	6	6	6	6	6	6
257	412	8	7	8	8	7	8
258	343	21	20	22	22	19	22
259	490	25	24	24	23	18	21
260	1249	2	2	2	3	2	3

[a] “-“ indicates deer permit area was not modeled.

		Pre-fawn deer density[a]					
Deer Permit Area	Land area (mi^2)	2010	2011	2012	2013	2014	2015
261	795	2	2	3	3	4	4
262	677	2	2	2	3	3	3
263	512	8	7	8	9	8	9
264	669	10	10	11	13	12	14
265	494	8	8	8	9	9	10
266	617	5	4	4	5	5	6
267	472	4	4	4	4	3	4
268	228	11	10	11	12	11	13
269	650	3	3	3	3	3	4
270	748	2	2	2	2	2	3
271	632	3	3	3	3	4	5
272	531	3	3	3	4	4	6
273	571	6	6	6	7	8	10
274	354	5	5	5	6	8	9
275	764	4	3	3	4	4	5
276	542	8	8	8	9	9	11
277	812	12	12	13	16	18	22
278	402	6	6	6	7	8	11
279	344	4	4	4	5	6	7
280	675	2	2	2	3	3	4
281	575	6	6	6	7	8	9
282	778	2	2	2	2	3	4
283	613	4	4	4	5	6	7
284	838	3	3	3	4	4	5
285	549	5	5	5	6	6	6
286	446	5	5	5	5	5	5
287	46	-	-	-	-	-	-
288	625	6	6	6	6	6	6
289	815	2	2	2	3	3	3
290	662	6	5	5	6	6	7
291	800	6	6	7	7	8	9
292	479	8	8	9	11	12	15
293	511	8	8	8	8	7	7
294	686	3	3	4	4	4	5
295	839	4	4	4	5	5	6
296	667	4	4	4	5	6	7
297	438	3	3	3	3	3	3
298	618	10	9	10	10	9	12
299	386	5	5	5	6	6	6
338	454	5	6	6	6	6	6

[a] “-“ indicates deer permit area was not modeled.

Deer Permit Area	Land area (mi^2)	Pre-fawn deer density[a]					
		2010	2011	2012	2013	2014	2015
339	394	6	6	6	7	7	7
341	612	13	13	12	12	11	12
342	349	16	16	15	14	12	11
343	663	12	12	12	12	12	11
344	190	-	-	-	-	-	-
345	323	11	11	12	12	12	12
346	318	26	28	28	28	26	22
347	434	8	9	10	10	9	9
348	332	16	16	16	15	14	14
349	490	22	24	23	23	22	20
601	1625	-	-	-	-	-	-

[a] "-" indicates deer permit area was not modeled.

Figure **1.** Model structure for simulations of white-tailed deer populations in Minnesota, 2015.

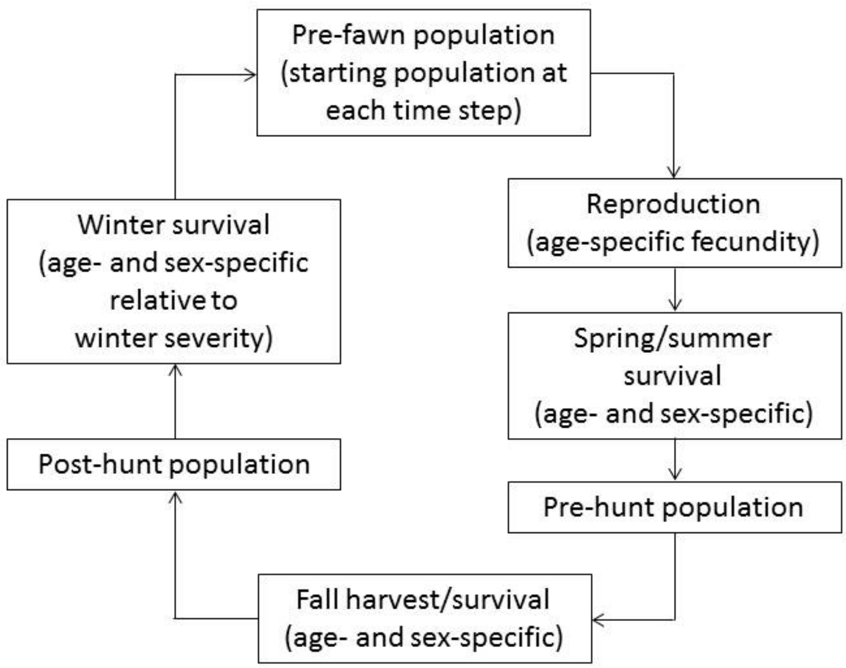

Figure 2. Deer permit areas (DPAs) in Minnesota and deer management zones used to describe deer population and harvest trends, 2015. DPAs were assigned to forest, farmland-forest transition, or farmland zones based on historical land cover and current woody cover. Generally, forested DPAs were composed of ≥60% woody cover, farmland-forest transition DPAs were composed of 6%-50% woody cover, and farmland DPAs were composed of ≤5% woody cover.