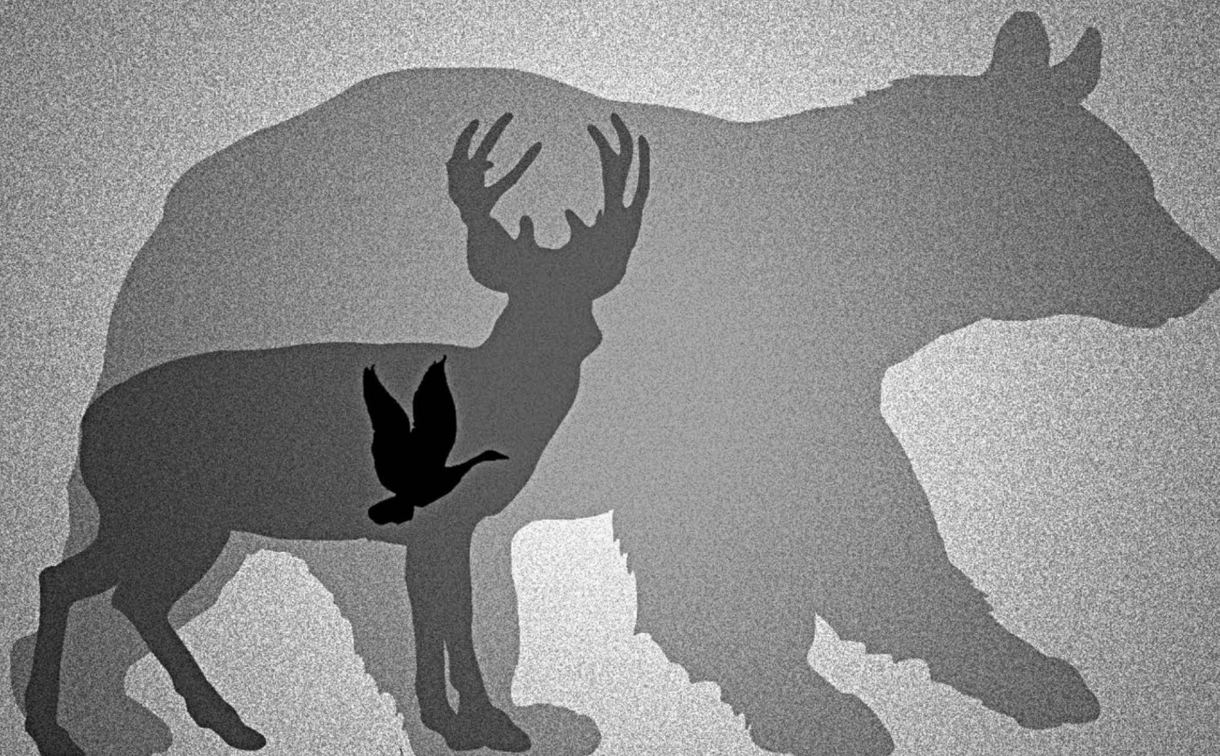

Status of Wildlife Populations

Fall 2018

Minnesota Department of Natural Resources
Division of Fish and Wildlife
St. Paul, Minnesota

DEPARTMENT OF NATURAL RESOURCES

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Status of Wildlife Populations, Fall 2018

(Including 2008-2018 Hunting and Trapping Harvest Statistics)

edited by
Margaret H. Dexter

Minnesota Department of Natural Resources
Division of Fish and Wildlife
Wildlife Research Unit
Saint Paul, Minnesota
1 (888) 646-6367
http://www.mndnr.gov

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Note: Data in this report may change as a result of future verification and more comprehensive analysis.

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Status of Wildlife Populations, Fall 2018

(Including 2008-2018 Hunting and Trapping Harvest Statistics)

This is the 42nd year that the DNR has compiled this booklet; it is primarily an administrative document intended for DNR personnel. Since 1984 we have also generated a companion volume, *Summaries of Wildlife Research Findings*, containing annual summaries of activities and findings from ongoing research projects in the Wildlife Policy and Research Unit. This publication will be posted on the DNR website and available in other formats upon request. In the on-line format links are available to the U.S. Fish and Wildlife Service Division of Migratory Bird Management to access their reports for Waterfowl Population Status; Migratory Bird Harvest Information Preliminary Estimates; American Woodcock Population Status; and Mourning Dove Population Status.

Most of the fieldwork associated with collection of census and survey data for farmland, wetland, and forest wildlife is performed by wildlife biologists and managers (conservation officers also participate in August roadside counts). The Farmland, Wetland, and Forest Wildlife Population and Research groups coordinate these activities, analyze and interpret data, and prepare recommendations for harvest regulations and season setting. Due to staffing changes and workload considerations some reports were not available at time of publication.

Most of the hunting and trapping harvest estimates are calculated and summarized by St. Paul central office personnel.

LoCompiling and publishing this report was funded in part under the Federal Aid in Wildlife Restoration Act, Minnesota project W-69-S.

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Hunting and Trapping Harvest Statistics

CONTACT INFORMATION

Farmland Wildlife Populations and Research Group
35365 800th Avenue
Madelia, MN 56062-9744
(507) 578-8910

Forest Wildlife Populations and Research Group
1201 East Highway 2
Grand Rapids, MN 55744
(218) 328-8875

Wetland Wildlife Populations and Research
102 23rd Street
Bemidji, MN 56601
(218) 308-2282

Division of Fish and Wildlife
Wildlife Policy and Research Unit
500 Lafayette Road, Box 20
Saint Paul, MN 55155 - 4020
(651) 259-5203

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FARMLAND WILDLIFE POPULATIONS

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

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2018 MINNESOTA AUGUST ROADSIDE SURVEY

Lindsey Messinger, Nicole Davros, Farmland Wildlife Populations and Research Group

SUMMARY OF FINDINGS

Despite late-season snowstorms and excessive spring and summer rainfall across some regions, the 2018 range-wide pheasant index (45.5 birds/100 mi) increased 19% from 2017 and was similar to the 10-year average of 44.7 birds/100 mi. Grassland habitat on private, state, and federally-owned lands increased by 82,519 acres statewide since 2017 and may have helped mitigate the extreme weather conditions in certain regions; however, nearly 297,000 acres of Conservation Reserve Program (CRP) are under contracts set to expire by September 2019. The range-wide indices for eastern cottontail rabbits and white-tailed deer declined slightly, whereas the indices for mourning doves and cranes were similar to 2017. Gray partridge and white-tailed jackrabbit observations continue to be historically low across our survey area.

INTRODUCTION

This report summarizes the 2018 Minnesota August Roadside Survey (ARS). Since 1955, the ARS has been conducted annually during the first two weeks of August by Minnesota Department of Natural Resources (MN DNR) wildlife and enforcement personnel throughout Minnesota's farmland regions (Figure 1). The 2018 ARS consisted of 171 25-mile routes (1-4 routes/county); 151 routes were located in the ring-necked pheasant range.

Observers drove each route during the early morning (starting at or near sunrise) at 15-20 mi/hr and recorded the number of pheasants, gray (Hungarian) partridge, eastern cottontail rabbits, white-tailed jackrabbits, white-tailed deer, mourning doves, sandhill cranes, and other wildlife they observed including information on sex and age of these species. 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** that 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 (e.g., white-tailed jackrabbits) are imprecise and *should be interpreted cautiously*.

HABITAT CONDITIONS

In Minnesota's farmland region, total undisturbed grassland habitat increased in 2018 after a slight decrease in 2017. Statewide, 82,519 habitat acres were gained; the pheasant range gained 77,876 of those acres. Undisturbed grassland acres were primarily gained on private lands with Conservation Reserve Program (CRP) enrollment (72,412 acres) accounting for a majority of these gains. Nearly all CRP gains occurred within the pheasant range (72,387 acres gained). Acres enrolled in Reinvest in Minnesota (RIM) increased by 4,306 acres in 2018 while acres enrolled in the Conservation Reserve Enhancement Program (CREP), Wetlands Reserve Program (WRP), and RIM-WRP remained relatively stable. Additionally, publically-owned grassland habitat within the farmland region also increased slightly in 2018. Federally-owned U.S. Fish and Wildlife Service (USFWS) Waterfowl Production Areas (WPA) and wildlife refuges increased by 3,664 acres and state-owned Wildlife Management Areas (WMA) increased by

6,067 acres statewide. In the pheasant range in particular, 3,015 acres of USFWS land and 3,510 acres of WMAs were added. Similar to 2017, remaining protected habitat accounts for 6.4% of the landscape within the pheasant range (range: 3.2-10.0%; Table 1).

Grassland and wetland habitat conservation remains a priority concern for Minnesota. Private-land conservation programs, including CRP, continue to make up a large portion of protected grassland habitat in the state (Figure 2). Despite the gain in private land habitat conservation programs in 2018, approximately 614,348 acres of CRP have been lost since 2007 and an additional 296,855 acres are under contracts set to expire by September 30, 2019. The 2008 and 2014 versions of the Farm Bill placed a cap of 24 million acres nationwide on CRP and this cap remains in effect at the present time. As a result, there has been a steady decline of federally-incentivized habitat acres in recent years. The Farm Bill is up for renewal by September 30, 2018 and many conservation groups are asking for the nationwide cap on CRP to be increased (up to 40 million acres). Funding from the Legacy Amendment[1] has helped partially offset habitat losses but the pace has not kept up with the rate of CRP losses in the last decade. Minnesota's Prairie Conservation Plan and Pheasant Summit Action Plan both offer a blueprint for moving forward with grassland and wetland habitat conservation strategies in the farmland regions, thereby helping partners prioritize lands acquired with Legacy Amendment funding.

Started in 2011, Minnesota's Walk-in Access (WIA) program continues to provide public hunting opportunities on private land that is already enrolled in existing conservation programs or has high quality natural habitat. The program has grown each year since inception, and in 2018 features >250 sites totaling nearly 30,000 across 47 counties in the farmland region of Minnesota. Sites are open to public hunting 1 September – 31 May where boundary signs are present. Hunters must purchase a $3 WIA Validation to which allows access to all WIA lands statewide. For more information on the WIA program, including the code of conduct for WIA lands, a printable atlas of enrolled sites by county, aerial photos of each site, interactive maps, and Global Positioning System (GPS) downloads, visit the WIA program website. The WIA program is currently funded through a grant from the Natural Resource Conservation Service of the U.S. Department of Agriculture. Other funding sources are provided through a surcharge on nonresident hunting licenses, a one-time appropriation from the Minnesota Legislature in 2012, and donations from hunters. Availability of funding sources will determine the future of this program as federal grant funding expires after 2018.

WEATHER SUMMARY

Minnesota's winter 2017-2018 (1 December 2017 – 31 March 2018) was slightly cooler across the state with average temperatures 1.3-2.4 °F below thirty-year normals (Table 2; Minnesota Climatology Working Group [MCWG] 2018, Climate Summary). Winter snow cover was variable across the farmland zone, with snow depths exceeding 6 inches for at least one 2-week period in every agricultural region except the Southwest and Southeast. Also notable were early and mid-April snowstorms which deposited several inches of snow (3-8 inches/storm) across much of the farmland zone. By April 26, 2018, snow was absent over the entire survey region.

Spring 2018 (1 April – 31 May) temperatures were 1.7-3.0 °F below thirty-year normals statewide and precipitation varied widely across the farmland regions. The West Central and Northwest regions were drier than normal whereas the South Central and Southeast regions were wetter than normal (>1 inch departure from normal). In particular, the South Central and Southeast regions had 9.1 and 9.8 inches of rain, respectively, during spring 2018.

[1] Minnesota's Legacy Amendment, passed in 2008, is a 25-year constitutional amendment that increases the state sales tax by 3/8 of 1%. A large portion of the funding generated by this amendment is dedicated to protecting drinking water sources and protecting, enhancing, and restoring wetlands, prairies, and other wildlife habitat.

Summer 2018 (1 June – 31 July) temperatures were near normal statewide with temperatures ≤1.2 °F above thirty-year normals across all regions. Rainfall across the state was at or above thirty-year normals in June and July (-0.3-2.0 inches from normal). Notably, the Southwest and South Central regions received significant rainfall amounts (15.0 and 13.1 inches of rain, respectively) during this season.

Overall, the conditions for over-winter survival of wildlife were average to below average throughout the farmland zone. Notably, some localized areas, including much of the core pheasant range, received excessive snowfall during the winter months, and snow events and measurable snow depths lingered into mid- to late April, potentially impacting nest initiation for many bird species. Rainfall during May and June (the prime period for nesting birds) was above normal in many areas. Combined with cooler-than-normal spring temperatures, nest success and chick survival were likely impacted.

SURVEY CONDITIONS

The survey period was extended (28 July – 18 August) to allow survey routes (n = 171) to be completed in 2018. Weather conditions during the survey ranged from excellent (calm winds, heavy dew, clear sky) to moderate (light dew and overcast skies). Medium to heavy dew conditions were present at the start of 89% of the survey routes, which was down from 2017 (96%) and below the 10-year average (94%). Clear skies (<30% cloud cover) were present at the start of 80% of routes which was down slightly from 2017 (85%). Wind speeds <7 mph were recorded for 92% of the routes compared to 97% in 2017. Overall, survey conditions in 2018 were slightly drier, more overcast, and windier than in 2017 but similar to conditions over the long-term and were unlikely to have adversely impacted detection rates.

SPECIES REPORTS

Ring-necked Pheasant

In 2018, the average number of pheasants observed range-wide (45.5 birds/100 mi) increased 19% from 2017 (38.2 birds/100 mi) and was similar to the 10-year average of 44.7 birds/100 mi. The index was 52% below the long-term average of 93.7 birds/100 mi (Table 3, Figure 3A). Total pheasants observed per 100 mi ranged from 23.6 birds in the Southeast region to 65.1 birds in the West Central region (Table 4). The pheasant index varied greatly statewide with significant increases in the Central (95%) and West Central (51%) regions while the Southwest region, a core area of Minnesota's pheasant range, increased only 5% from 2017. The South Central region was the only region that decreased (-36%) since 2017. The best harvest opportunities will be in the West Central, Southwest, and Central regions.

The range-wide hen index (7.6 hens/100 mi) increased 31% from 2017 (5.8 hens/100 mi) and was 10% above the 10-year average (6.9 hens/100 mi) but still 45% below the long-term average (13.6 hens/100 mi; Table 3). The hen index ranged from 4.0 hens/100 mi in the Southeast to 10.6 hens/100 mi in the West Central region. All regions showed at least an 18% increase (Central region increased 100%) in their hen index except the South Central region which decreased by 30%.

The range-wide cock index (6.5 cocks/100 mi) did not change from 2017 and the 10-year average but remained 40% below the long-term average of 10.7 cocks/100 mi (Table 3). The cock index ranged from 1.3 cocks/100 mi in the Southeast to 9.8 cocks/100 mi in the West Central region. The 2018 cock index varied greatly range-wide with increases in the Central (40%), West Central (30%), and Southwest (21%) regions and decreases in the South Central (-49%), Southeast (-25%), and East Central (-23%) regions.

The 2018 hen:cock ratio (1.16) was greater than the 2017 ratio (0.90) but still below the long-term average (1.33 ± 0.37) and the average (1.39 ± 0.35) for the CRP years (1987-2017).

The 2018 range-wide brood index (7.3 broods/100 mi) increased 28% from 2017 (5.7 broods/100 mi; Table 3). The index was similar to the 10-year average (6.9 broods/100 mi) but still 42% below the long-term average (12.4 broods/100 mi). Regional brood indices ranged from 3.7 broods/100 mi in the East Central region to 10.3 broods/100 mi in the West Central region. Brood indices increased in all regions (range: 8% to 112%) except in the East Central (-0.3%) and South Central (-28%) regions. The average brood size in 2018 (4.3 chicks/brood) was similar to 2017 but slightly below the 10-year average (4.6 chicks/brood) and below the long-term average of 5.4 chicks/brood. The median hatch date (assigned using estimated brood ages from broods observed during the survey) for pheasant broods across their range was 14 June 2018 (n = 277 broods), which was nearly a week later than 2017 (8 June) and a few days later than the 10-year average (12 June; Table 3).

Late-winter snowstorms (which extended into April) followed by locally heavy spring and summer rains likely impacted nesting cover and affected nesting and brood-rearing during the 2018 breeding season. In particular, median hatch dates in the Southwest (26 June) and South Central (23 June) regions were 20 and 8 days later, respectively, than 2017 and 1-2 weeks later than the 10-year and long-term averages. Although hatching in these regions was delayed, the Southwest region still increased in all indices measured compared to 2017. However, this was not the case for the South Central region which decreased in each index assessed compared to last year. The South Central region not only experienced late winter snowstorms, but also had poorly-timed and excessive rainfall during the typical period of peak hatch. Although weather typically drives year-to-year fluctuations in pheasant numbers, available grassland habitat on the landscape is correlated with longer-term population indices and can help mediate the impacts of annual variation in weather on local populations. Minnesota has experienced a gradual but steady loss of habitat, especially CRP, and the impact of these losses correlates well with an overall decline in the pheasant population and harvest since the mid-2000s (Figures 2 & 3A).

Gray Partridge

The 2018 range-wide gray partridge index (1.3 birds/100 mi) was similar to 2017 but remained 50% and 93% below the 10-year and long-term averages, (2.7 birds/100 mi and 14.4 birds/100 mi, respectively; Table 3, Figure 3B). Indices for partridge ranged from 0.1 birds/100 mi in the West Central region to 3.8 birds/100 mi in the Northwest region (Table 4). Intensified agricultural land use (e.g., corn and soybeans) has reduced the amount of suitable habitat for gray partridge in Minnesota. Additionally, gray partridge in their native range (southeastern Europe and northern Asia) are associated with arid climates and their reproductive success in the Midwestern United States is limited except during successive dry years. Thus, gray partridge are more adversely affected by excessive rainfall during the breeding season compared to pheasants. The Southwest, Southeast, and Northwest regions will offer the best opportunities for harvesting gray partridge in 2018.

Cottontail Rabbit and White-tailed Jackrabbit

Range-wide, the 2018 eastern cottontail rabbit index (5.8 rabbits/100 mi) decreased 23% from 2017 (7.5 rabbits/100 mi) but was 13% above the 10-year average (5.3 rabbits/100 mi) and comparable to the long-term average (6.6 rabbits/100 mi; Table 3, Figure 4A). Regionally, the cottontail rabbit index ranged from 0.6 rabbits/100 mi in the Northwest to 12.9 rabbits/100 mi in the East Central region (Table 4). Good harvest opportunities should exist in the East Central and Southeast regions.

Remaining at a historic low, the number of white-tailed jackrabbits observed range-wide (0.1 rabbits/100 mi) was 95% below the long-term average of 1.6 rabbits/100 mi (Table 3, Figure 4B). Minnesota's jackrabbit population peaked in the late 1950s, declined to low levels in the 1980s, and has remained at low levels since then. The long-term decline in jackrabbits can primarily be attributed to loss of preferred habitats (i.e., pasture, hayfields, and small grains).

White-tailed Deer

The white-tailed deer index (23.1 deer/100 mi) decreased 13% from 2017 (26.7 deer/100 mi) but was still 19% above the 10-year average and 99% above the long-term average (19.4 deer/100 mi and 11.6 deer/100 mi, respectively; Table 3, Figure 5A). Regional roadside indices for deer ranged from 7.3 deer/100 mi in the South Central region to 50.8 deer/100 mi in the Northwest region (Table 4).

Mourning Dove

The 2018 range-wide mourning dove index (129.2 doves/100 mi) was 7% lower than 2017 (139.1 doves/100 mi), 30% below the 10-year average (181.1 doves/100 mi), and 52% below the long-term average (264.2 doves/100 mi; Table 3, Figure 5B). Regional indices ranged from 61.8 doves/100 mi in the East Central region to 180.6 doves/100 mi in the Southwest region (Table 4). The best opportunities for harvesting doves should be in the Southwest, South Central, and West Central regions.

Sandhill Crane

The 2018 roadside index of sandhill cranes was 13.4 total cranes/100 mi, an 18% increase from 2017 (11.3 total cranes/100 mi; Table 3). Regional indices ranged from 0.0 total cranes/100 mi in the Southwest region to 38.0 total cranes/100 mi in the Central region (Table 4). The range-wide index of juveniles was 1.3 juvenile cranes/100 mi, which decreased 39% from 2017 (Table 3).

Other Species

Notable incidental sightings recorded by observers included: bobcat (Pope County), Eurasian collared dove (Watonwan County), ground squirrel sp. (Red Lake County), black-billed magpie (Red Lake County), purple martin (Kandiyohi County), Eastern meadowlark (Lincoln County), osprey (Todd County), river otter (Becker County), red-headed woodpecker (Kittson, Mower, and Watonwan Counties), sharp-tailed grouse (Marshall, Polk, and Red Lake Counties), striped skunk (Houston County), upland sandpiper (Murray and Norman Counties), and American woodcock (Nobles County). American kestrel, American crow, Canada goose, coyote, northern harrier, red fox, red-tailed hawk, and wild turkey were noted in multiple counties.

ACKNOWLEDGMENTS

We thank the many cooperators for their help in completing routes. This survey is simply not possible without their efforts. Tonya Klinkner and Katie Steffl were invaluable in providing logistical assistance and completing data entry. Tabor Hoek (Minnesota Board of Water and Soil Resources) provided enrollment data on cropland retirement programs in Minnesota, Jay Johnson (MN DNR) provided updated MN DNR land acquisition information, Tamra Adams (U.S. Fish and Wildlife Service) provided federal land acquisition data, and Peter Boulay (Minnesota State Climate Office) provided snow depth data. John Giudice reviewed an earlier draft of this report. This work was funded in part through the Federal Aid in Wildlife Restoration Act.

LITERATURE CITED

Minnesota Climatology Working Group (MCWG). 2018a. MCWG Climate Summary Table. Accessed 9 August 2018.

Table 1. Abundance (total acres) and density (acres/mi^2) of undisturbed grassland habitat within Minnesota's pheasant range, 2018, by agricultural region (AGREG).

	Cropland Retirement[a]					Public Lands			% of	Density
AGREG	CRP[b]	CREP	RIM	RIM-WRP	WRP	USFWS[c]	MNDNR[d]	Total	Landscape	ac/mi^2
WC[e]	273,503	37,951	22,928	14,275	20,121	201,358	111,682	681,818	10.0	64.2
SW	114,563	24,784	20,573	2,553	766	24,067	71,955	259,261	6.9	43.9
C	131,043	14,380	39,917	7,026	3,078	91,621	51,378	338,443	5.6	35.8
SC	102,436	27,633	13,585	10,775	8,943	10,875	36,811	211,058	5.2	33.4
SE	69,820	2,702	7,405	1,070	976	36,988	55,619	174,580	4.7	30.1
EC	2,949	0	1,134	0	4	4,994	92,678	101,759	3.2	20.3
Total	694,314	107,450	105,542	35,699	33,887	369,903	420,123	1,766,918	6.4	41.0

[a] Unpublished data, Tabor Hoek, BWSR, 9 August 2018.
[b] Acres reduced to account for estimated active CREP contracts reported within CREP column.
[c] Includes Waterfowl Production Areas (WPA) and USFWS refuges.
[d] MN DNR Wildlife Management Areas (WMA).
[e] Does not include Norman County.

Table 2. Average temperature, snow depth, and precipitation by season and agricultural region in Minnesota, 2018.

	Agricultural Region							
	NW	WC	C	EC	SW	SC	SE	STATE
Winter (December 1 - March 31)								
Temperature (average °F)	12.1	16.9	16.9	16.6	18.9	18.6	20.1	16.1
Departure from normal (°F)[a]	-1.6	-1.3	-1.9	-2.4	-2.1	-2.4	-1.6	-2.1
Snow Depth (average inches)	9.6[b]	2.8[b]	3.3[b]	5.9[b]	3.1	3.9[b]	3.1	4.5
Spring (April 1 - May 31)								
Temperature (average °F)	47.1	48.8	48.1	48.1	49.0	49.3	49.8	47.6
Departure from normal (°F)[a]	-1.7	-2.0	-3.0	-2.3	-2.9	-2.9	-2.0	-2.3
Precipitation (total inches)	2.2	2.6	4.0	4.0	6.4	9.1	9.8	5.5
Departure from normal (inches)[a]	-1.0	-1.3	-1.1	-1.0	0.1	1.1[c]	1.2[c]	-0.2
Summer (June 1 - July 31)								
Temperature (average °F)	54.1	57.0	56.3	55.9	58.6	58.3	58.4	55.9
Departure from normal (°F)	0.8	1.0	0.0	0.2	1.2	0.5	1.0	0.5
Precipitation (total inches)	7.6	11.5	10.3	10.4	15.0	13.1	10.4	11.0
Departure from normal (inches)[a]	-0.3	1.0	0.2	0.1	2.0[c]	0.6	-0.3	0.3

[a] Departures calculated using 30-year NOAA average (1981-2010) over respective time period.
[b] At least one two-week period with snow depth exceeding 6 inches.
[c] Precipitation >1 inch above normal.

Table 3. Range-wide trends (% change) in number of wildlife observed per 100 miles driven, Minnesota August roadside survey, 1955-2018.

Species	Change from 2017[a]					Change from 10-year average[b]				Change from long-term average (LTA)[c]			
Subgroup	*n*	2017	2018	%	95% CI	*n*	2008-2017	%	95% CI	*n*	LTA	%	95% CI
Ring-necked pheasant													
Total pheasants	151	38.2	45.5	19	±25	148	44.7	2	±16.2	149	93.7	-52	±10
Cocks	151	6.4	6.5	1	±22	148	6.4	1	±15	149	10.7	-40	±13
Hens	151	5.8	7.6	31	±30	148	6.9	10	±18	149	13.6	-45	±12
Broods	151	5.7	7.3	28	±26	148	6.9	5	±17	149	12.4	-42	±12
Chicks per brood[d]	277	4.5	4.3	-5			4.6	-7			5.4	-20	
Broods per 100 hens	151	98.6	96.5	-2			100.2	-4			101.5	-5	
Median hatch date[d]	277	8 June	14 J				12 June						
Gray partridge	170	1.3	1.3	0	±114	167	2.7	-50	±50	149	14.4	-93	±16
Eastern cottontail	170	7.5	5.8	-23	±20	167	5.3	13	±24	149	6.6	0	±23
White-tailed jackrabbit	170	0.0	0.1	100	±280	167	0.2	-37	±78	149	1.6	-95	±15
White-tailed deer	170	26.7	23.1	-13	±17	167	19.4	19	±18	168	11.6	99	±32
Mourning dove	170	139.1	129.2	-7	±20	167	181.1	-30	±12	149	264.2	-52	±8
Sandhill crane[e]													
Total cranes	170	11.3	13.4	18	±61								
Juveniles	170	2.2	1.3	-39	±51								

[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 = long-term average during years 1955-2017, except for deer (1974-2017). 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.
[d] Sample size is the total number of broods observed across all surveys rather than the number of routes run in 2018.
[e] Cranes were added to the survey in 2009; thus, 10-year and long-term averages are not calculated.

Table 4. Regional trends (% change) in number of wildlife observed per 100 miles driven, Minnesota August roadside survey, 1955-2018.

Region / Species	Change from 2017[a]					Change from 10-year average[b]				Change from long-term average (LTA)[c]			
	n	2017	2018	%	95% CI	*n*	2008-2017	%	95% CI	*n*	LTA	%	95% CI
Northwest[d]													
Gray partridge	19	0.0	3.8			19	0.5	723	±1745	19	3.0	25	±244
Eastern cottontail	19	1.3	0.6	-49	±180	19	0.7	-3	±170	19	0.9	-24	±136
White-tailed jackrabbit	19	0.2	0.2	0	±305	19	0.2	-12	±187	19	0.6	-64	±83
White-tailed deer	19	55.2	50.8	-8	±39	19	46.5	9	±43	19	33.4	52	±53
Mourning dove	19	114.7	120.0	5	±59.3	19	89.2	35	±53	19	118.2	2	±43
Sandhill crane[e]	19	35.6	24.3	-32	±45								
West Central[f]													
Ring-necked pheasant	39	43.2	65.1	51	±62	35	50.2	37	±32	37	95.0	-32	±22
Gray partridge	39	0.0	0.1			35	0.6	-100	±101	37	9.1	-99	±21
Eastern cottontail	39	4.3	2.5	-43	±50	35	2.5	-10	±49	37	3.9	-45	±32
White-tailed jackrabbit	39	0.0	0.2			35	0.1	62	±345	37	2.1	-90	±30
White-tailed deer	39	26.7	29.2	9	±45	35	20.4	50	±44	37	11.2	161	±98
Mourning dove	39	162.1	162.4	0	±31.8	35	227.8	-32	±21	37	360.2	-55	±16
Sandhill crane[e]	39	3.3	3.4	3	±72								
Central													
Ring-necked pheasant	30	24.7	48.1	95	±76	30	38.5	25	±36	29	70.4	-31	±22
Gray partridge	30	0.5	0.7	25	±187	30	1.2	-44	±79	29	8.9	-92	±44
Eastern cottontail	30	7.2	7.2	0	±57	30	4.5	59	±69	29	6.2	21	±49
White-tailed jackrabbit	30	0.0	0.0			30	0.1	-100	±113	29	1.1	-100	±22
White-tailed deer	30	33.2	13.9	-58	±29	30	15.6	-11	±37	29	6.9	100	±104
Mourning dove	30	144.0	103.5	-28	±45	30	166.9	-38	±28	29	225.9	-58	±14
Sandhill crane[e]	30	16.1	38.0	136	±221								
East Central													
Ring-necked pheasant	12	21.3	23.9	12	±58	12	45.8	-48	±34	12	84.3	-72	±24
Gray partridge	12	1.3	0.7	-50	±255	12	0.2	300	±870	12	0.2	325	±826
Eastern cottontail	12	22.3	12.9	-42	±49	12	10.8	20	±85	12	8.6	50	±88
White-tailed jackrabbit	12	0.0	0.0			12	0.0			12	0.2	-100	±65
White-tailed deer	12	24.7	26.9	9	±42	12	20.6	30	±61	12	11.0	145	±100
Mourning dove	12	56.6	61.8	9	±42	12	83.4	-26	±25	12	116.4	-47	±28
Sandhill crane[e]	12	50.0	34.6	-31	±81								

Table 4. Continued.

Region / Species	Change from 2017[a]					Change from 10-year average[b]				Change from long-term average (LTA)[c]			
	n	2017	2018	%	95% CI	*n*	2008-2017	%	95% CI	*n*	LTA	%	95% CI
Southwest													
Ring-necked pheasant	19	51.7	54.1	5	±57	19	78.7	-31	±34	19	112.5	-52	±21
Gray partridge	19	5.1	3.2	-38	±154	19	6.7	-53	±72	19	38.1	-92	±19
Eastern cottontail	19	5.1	3.8	-25	±78	19	5.6	-32	±50	19	7.9	-52	±40
White-tailed jackrabbit	19	0.2	0.2	0	±305	19	0.5	-58	±76	19	3.5	-94	±26
White-tailed deer	19	16.6	17.3	4	±55	19	19.4	-11	±33	19	10.4	67	±66
Mourning dove	19	165.9	180.6	9	±37	19	253.3	-29	±22	19	305.2	-41	±22
Sandhill crane[e]	19	0.0	0.0										
South Central													
Ring-necked pheasant	32	54.6	35.1	-36	±33	32	44.4	-21	±36	32	121.9	-71	±18
Gray partridge	32	0.9	0.3	-71	±104	32	5.3	-95	±63	32	17.6	-99	±21
Eastern cottontail	32	9.1	6.0	-34	±33	32	7.8	-23	±26	32	7.7	-22	±30
White-tailed jackrabbit	32	0.0	0.0			32	0.1	-100	±67	32	1.6	-100	±25
White-tailed deer	32	10.7	7.3	-33	±43	32	6.7	8	±42	32	4.1	77	±70
Mourning dove	32	167.1	128.6	-23	±70	32	235.1	-45	±35	32	253.0	-49	±12
Sandhill crane[e]	32	1.0	3.5	250	±339								
Southeast													
Ring-necked pheasant	19	19.2	23.6	23	±79	20	12.3	82	±115	20	67.4	-67	±37
Gray partridge	19	3.8	2.9	-22	±240	20	4.2	-34	±113	20	13.0	-79	±46
Eastern cottontail	19	11.3	12.8	14	±58	20	7.9	69	±86	20	7.9	70	±98
White-tailed jackrabbit	19	0.0	0.0			20	0.0			20	0.6	-100	±42
White-tailed deer	19	25.8	27.8	8	±58	20	17.0	55	±62	20	11.5	129	±99
Mourning dove	19	86.9	102.6	18	±28	20	112.0	-13	±22	20	210.0	-53	±22
Sandhill crane[e]	19	0.0	0.6										

[a] Based on routes (*n*) surveyed in both years.
[b] Based on routes (*n*) surveyed at least 9 of 10 years.
[c] LTA = long-term average during years 1955-2017, except for Northwest region (1982-2017) and white-tailed deer (1974-2017). Estimates based on routes (*n*) surveyed ≥40 years (1955-2017), 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] Cranes were added to the survey in 2009; thus, 10-year and long-term averages are not calculated.
[f] Two routes were added to the West Central region in 2014.

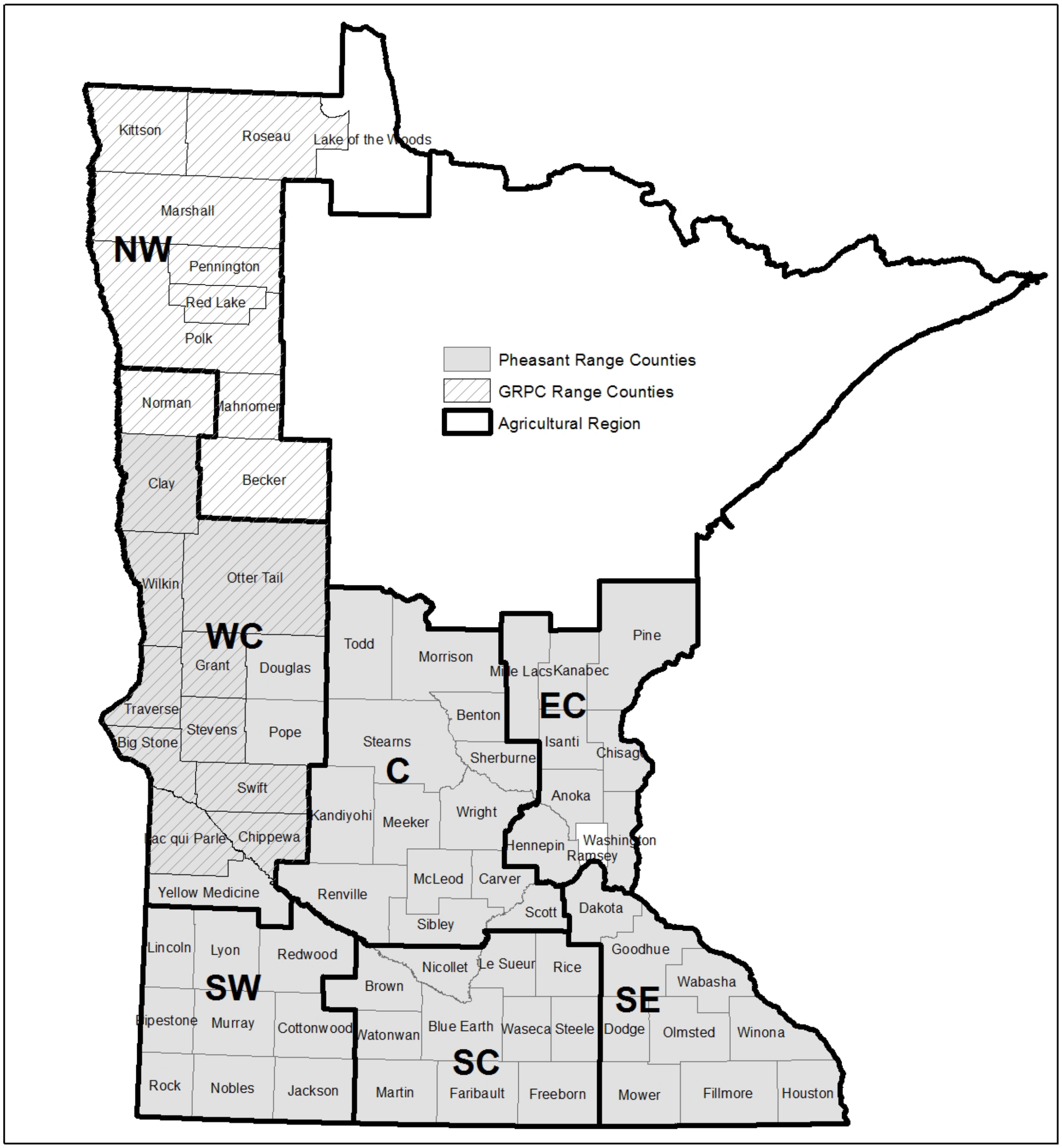


Figure 1. Survey regions and ring-necked pheasant range delineation for Minnesota's August roadside survey, 2018. The greater prairie-chicken range delineation is also shown.

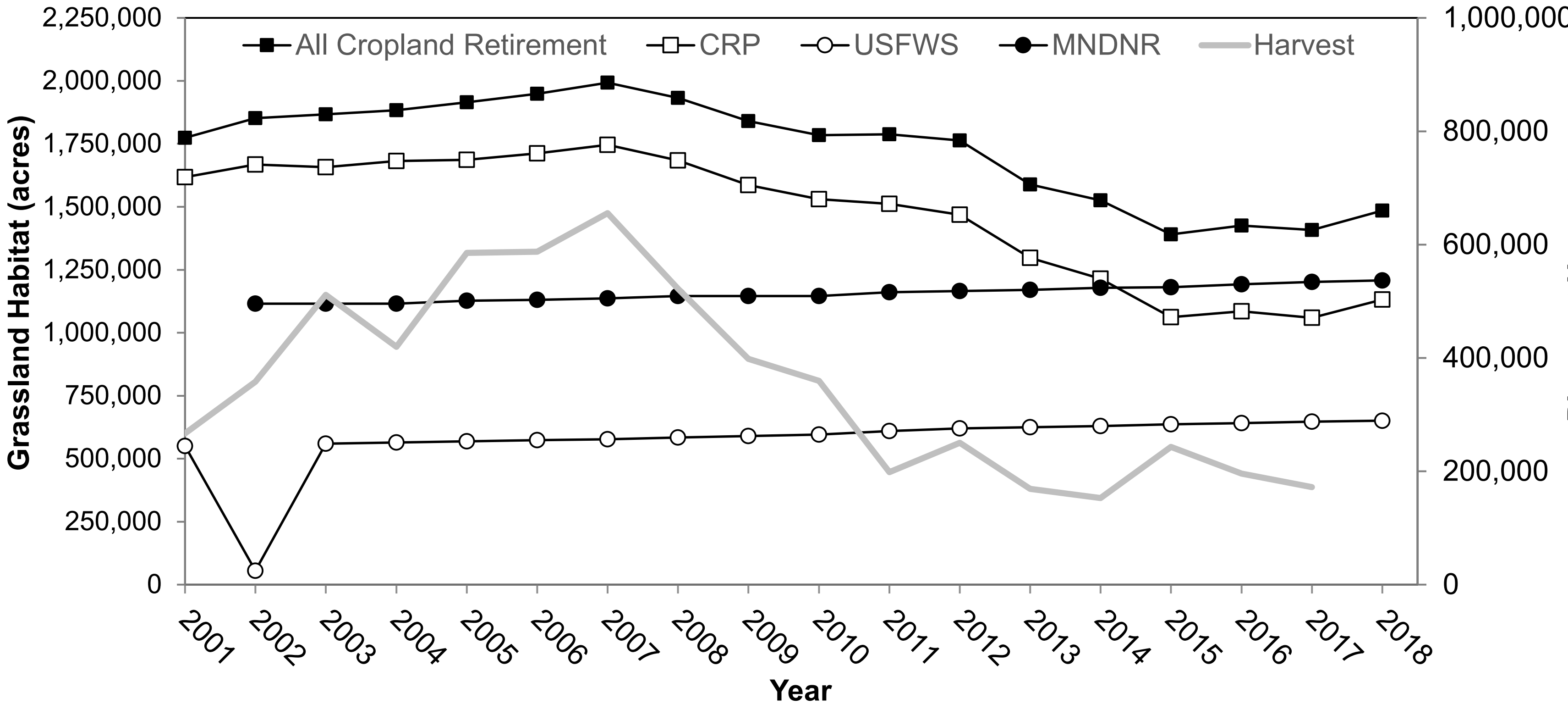


Figure 2. Acres enrolled in private (black lines with open and solid squares) and public (black lines with open and solid circles) land habitat conservation programs vs. ring-necked pheasant harvest trends (gray line with no markers) in Minnesota, 2001-2018. Acres represent STATEWIDE totals. All cropland retirement includes Conservation Reserve Program (CRP), Conservation Reserve Enhancement Program (CREP), Reinvest in Minnesota (RIM), Wetlands Reserve Program (WRP), and RIM-WRP.

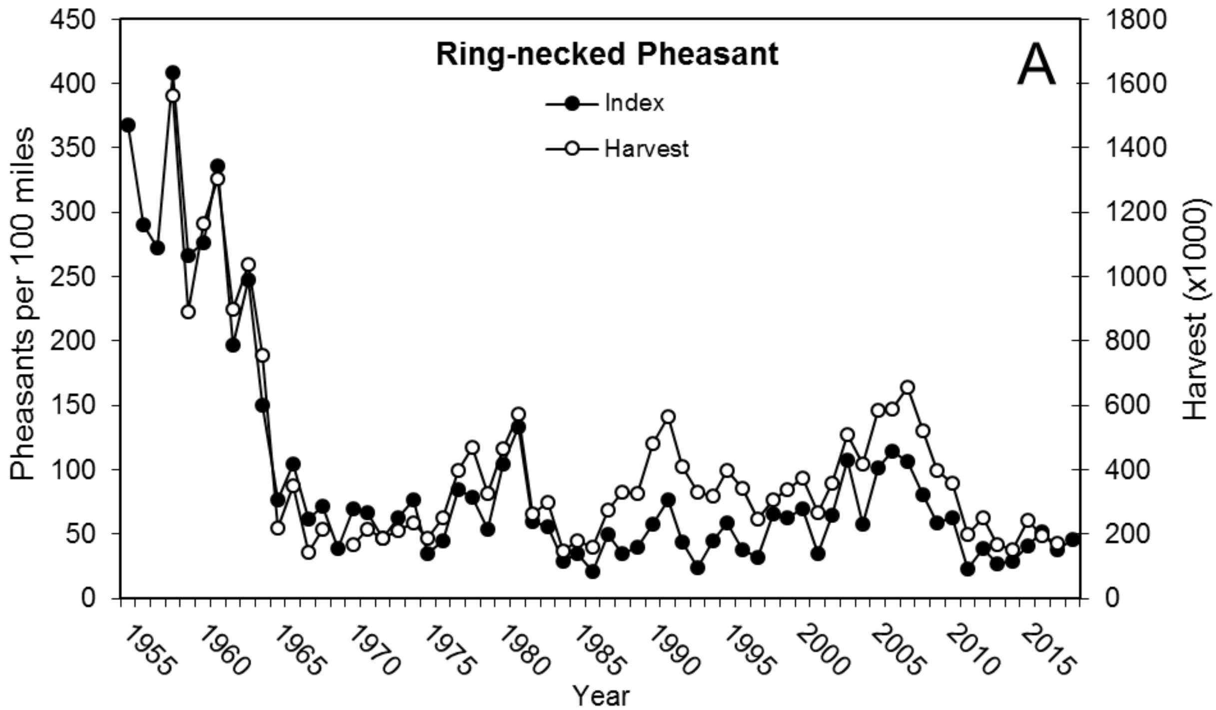
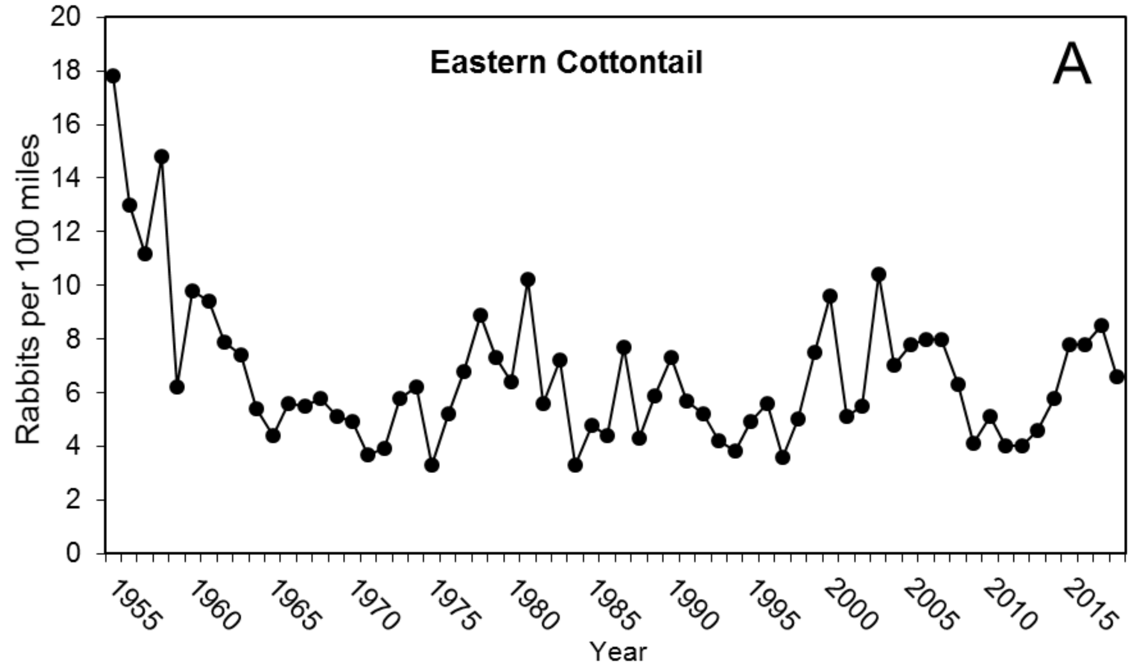


Figure 3. Range-wide index of ring-necked pheasants (A) and gray partridge (B) seen per 100 miles driven in Minnesota, 1955-2018. Does not include the Northwest region. Based on all survey routes completed.



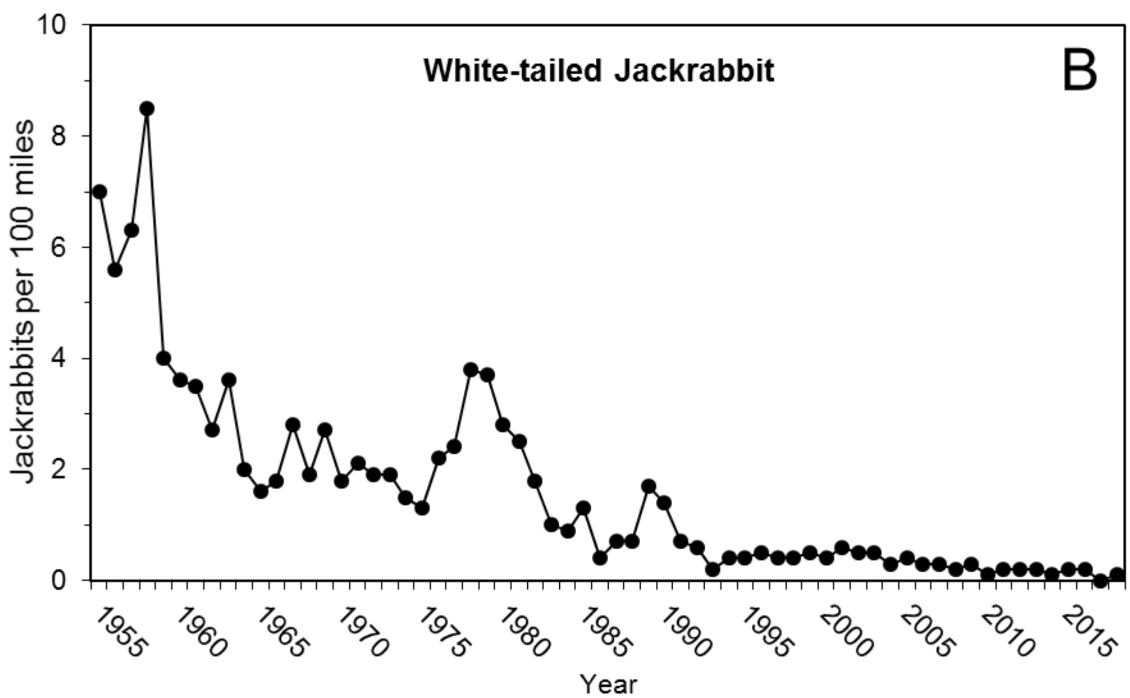
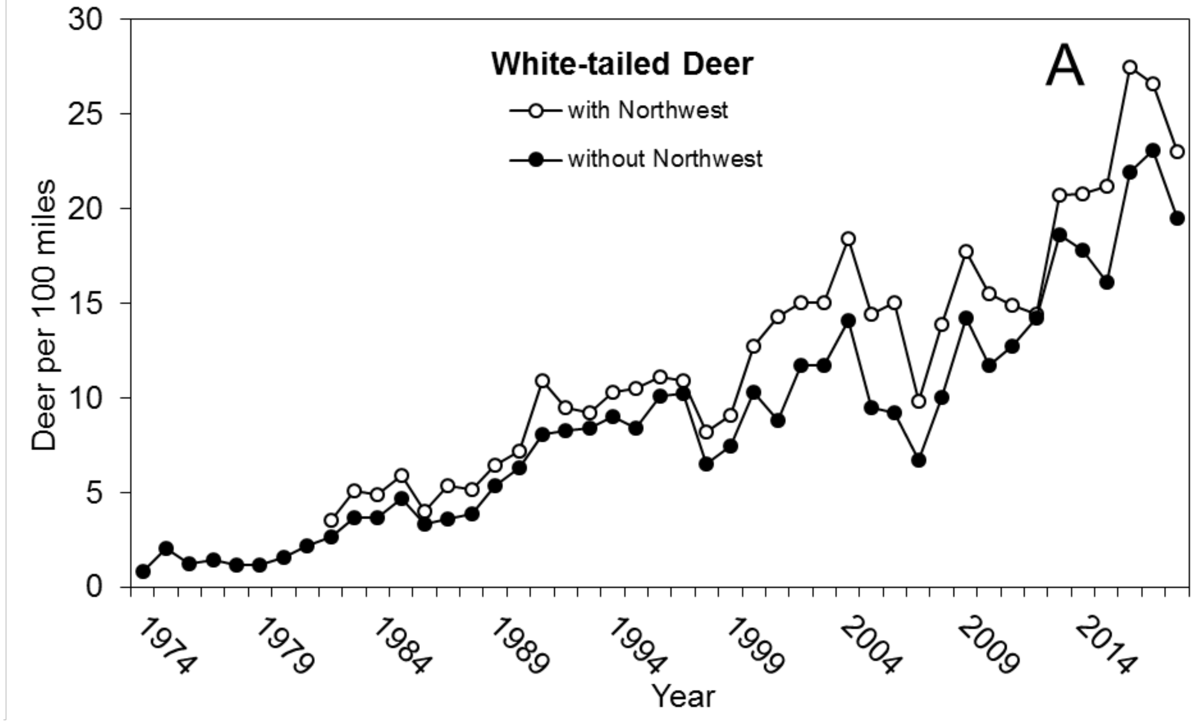


Figure 4. Range-wide index of eastern cottontail (A) and white-tailed jackrabbits (B) seen per 100 miles driven in Minnesota, 1955-2018. Does not include the Northwest region. Based on all survey routes completed.



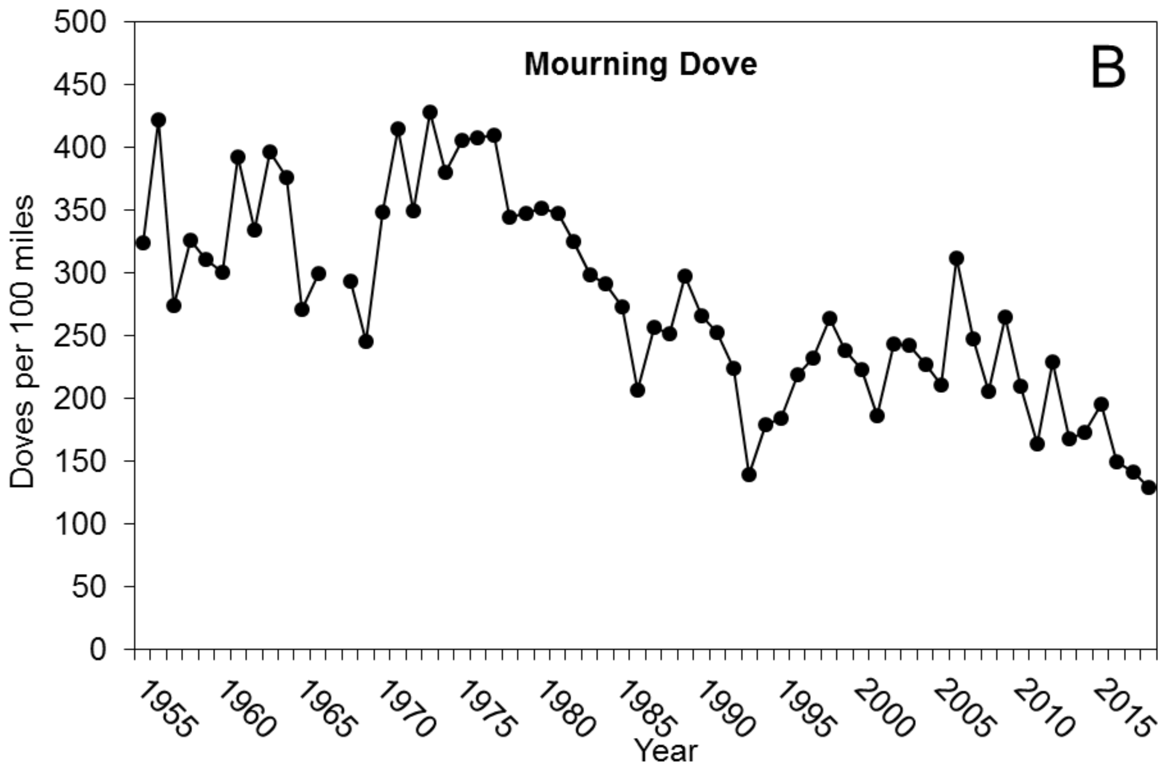


Figure 5. Range-wide index of: (A) white-tailed deer seen per 100 miles driven in Minnesota, 1974-2018, with and without the Northwest region included; and (B) mourning doves seen per 100 miles driven in Minnesota, 1955-2018. Doves were not counted in 1967 and the dove index does not include the Northwest region. Based on all survey routes completed.

DEPARTMENT OF NATURAL RESOURCES

MONITORING POPULATION TRENDS OF WHITE-TAILED DEER IN MINNESOTA - 2018

Andrew Norton, Farmland Wildlife Populations and Research Group

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. This report summarizes the structure and parameters of the simulation model, and provides a description of recent trends in deer populations.

METHODS

We used a stochastic population model to simulate annual variations in deer densities within individual DPAs. We imposed stochasticity by independently drawing random samples from the Normal or Uniform distribution (i.e., Monte Carlo method) for all parameters. We specified means and standard deviations to represent ranges of values for initial population proportions, fecundity, harvest recovery rates, and survival by sex- and age-classes of deer based on primary literature and studies within Minnesota. For all proportion or rate parameters (e.g., survival), we used the inverse logit transformation $\left(p = \frac{e^{\alpha}}{1+e^{\alpha}}\right)$ to constrain random values between 0 and 1.

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. We set 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]). The remaining proportion (0.35) was allocated equally to young-of-year (YOY) males and females.

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 that died as a result of hunting 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, from a range of values reported for Iowa, Minnesota, and Wisconsin (Iowa DNR unpublished data, Fuller 1990, McCaffery et al. 1998, DelGiudice et al. 2007, Dunbar 2007, Grund 2011, Storm 2014, Storm 2015, Dittrich 2016). Fecundity rates were partitioned by 2 age-classes of breeding females (i.e., <1 year old [YOY] when bred and $\geq$1 years old [adult] when bred) and were allowed to vary by 3 eco-geographic zones (northeast, farmland and transition areas, southeast) that reflected relative differences in climate and habitat quality. Fecundity rates were estimated to be lowest in the northeast (YOYs, mean = 0.06 [SD = 0.003]; adults, mean = 1.55 [SD = 0.078]), moderate in the farmland and transition zone (YOYs, mean = 0.08 [SD = 0.004]; adults, mean = 1.70 [SD = 0.085]), and greatest in the southeast (YOYs, mean = 0.15 [SD = 0.007]; adults, mean = 1.85 [SD = 0.092]). 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 uniformly 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.

We used estimates of spring/summer survival of fawns, from values reported in the primary literature for deer in Minnesota and populations in similar habitats (Wisconsin DNR unpublished data, Huegel et al. 1985, Nelson and Mech 1986a, Nelson and Woolf 1987, Kunkel and Mech 1994, Brinkman et al. 2004, Vreeland et al. 2004, Rohm et al. 2007, Hiller et al. 2008, Carstensen et al. 2009, Warbington et al. 2017). 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 0.70 (SD = 0.031), 0.55 (SD = 0.037), and 0.45 (SD = 0.037) when WSI<100, 100≤WSI<180, and 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 = 0.004], male = 0.98 [SD = 0.003]). 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 Recovery Rates

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, special hunts, and harvest reported by Native American Tribes within DPAs.

We recognized that some deer died during the hunting season because they were harvested illegally or not registered (Dusek et al. 1992, Rupp et al. 2000), wounded and not recovered (Nixon et al. 2001), or died from other non-hunting causes (e.g., deer-vehicle-collision, Norton 2015). We applied a mean multiplier of 1.05 (SD = 0.002) to the numerical harvest to account for non-registered deer that died during the hunting season. Because we expect the true multiplier to be greater than 1.05, density estimates are conservative, but resulting population trends will likely be similar when different multipliers are used based on the modeling procedures.

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, Norton 2015). 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, Norton 2015).

For adult deer, we set mean winter survival at 0.95 when WSI≤25. When WSI>25, we used a linear equation to calculate survival as a function of winter severity (mean winter survival = 1 − [0.011 + 0.0015 x WSI]) based on previous research in Minnesota. For fawns, we set the mean winter survival rate at 0.85 when WSI≤60.When WSI was above 60 and less than 100, the linear equation to calculate adult survival was used. However, an additional mortality rate of 0.05 was subtracted to simulate parallel but lower survival of fawns versus adults (mean winter survival = (1 − [0.011 + 0.0015 x WSI]) − 0.05). For more severe winters (100≤WSI≤240), the equation was adjusted to simulate increased mortality reported for fawns in field studies (mean winter survival = 1 − [0.0054 x WSI − 0.33]). When WSI exceeded 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 ≈ 0.012. Winter survival relationships were parameterized based on previous Minnesota research studies of radiocollared deer.

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 success. 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 other vital rates in conjunction with varying initial population densities.

Because the initial population density is the primary parameter adjusted, similar population trends can be fit when the mean for parameters that are constant (with only random variation) among years (e.g., recovery rates, adult summer survival) is changed. However, the absolute density will shift similarly among years (e.g., all density estimates may be 20% greater if recovery rates are increased), because the modeler can adjust the initial density to fit the same trend. Importantly, the resulting density estimates are only unbiased when all input parameters are unbiased, but accurate trends can still be estimated even when mean values for parameters are biased.

We ran most model simulations for 7 years (2012-2018) with the final population estimate occurring pre-fawning for the spring following the most recent deer hunting season (i.e., spring 2018). All simulations were performed with the R programming language (ver. 3.3.2, R Core Team 2017). We used 500 Monte Carlo simulations 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). Because 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

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 104 of 130 DPAs in Minnesota to estimate deer densities before reproduction during spring 2018 (Table 1, Figure 2).

Following 3 deer seasons with relatively conservative management designations and 3 winters with mild conditions across most of the state, deer populations in nearly all DPAs increased through 2017. Management designations in 2017 were liberalized in most DPAs compared to prior years in attempts to stabilize or reduce densities that had exceeded goals. However, some DPAs in the southwestern farmland and northeastern forest remained below goal, even with conservative hunting regulations, likely due to resource limitations. Because firearm hunting season conditions across some areas in the state were below average in 2018, antlerless harvest goals were not achieved, resulting in more deer after the hunting season than intended with hunting season regulations. Liberal antlerless seasons in 2018 will be required again to effectively manage deer populations in DPAs with average and above average productivity.

With the exception of northeastern Minnesota, the extended 2017-2018 winter had little effect on deer mortality and deer densities continued to increase across much of the state despite more liberal antlerless regulations in 2017. In terms of management intensity, the 2018 designations afford more antlerless deer harvest opportunities to hunters in approximately one third of the DPAs versus the 2017 season. For most of the remaining DPAs, designations in 2018 were the same as 2017, and only a few DPA designations afforded less antlerless harvest opportunity.

Farmland Zone

Of the 36 farmland zone DPAs, 10 were within 10% of goal, 12 were at least 10% below goal, and 14 were at least 10% above goal based on modeling or buck harvest trends. Modeling deer densities in the farmland with harvest data continues to be a challenge, and relatively stable buck harvests the past 20 years suggests a stable population with limited potential for growth, likely a result of habitat constraints. We selected management designations to stabilize deer numbers with consistent regulations across years whenever possible. Most farmland DPAs (n = 25) were under a Lottery designation. Five of the DPAs required Hunter Choice and 6 were under Managed designations to stabilize or reduce deer numbers at appropriate levels.

Farmland-Forest Transition Zone

Deer populations in the farmland-forest transition zone are highly productive due to excellent habitat and generally milder winters as compared to the forest zone. Historical harvests and modeled population trends suggested that Lottery designations were not sufficient to stabilize deer numbers in most transition zone DPAs as evidenced by few DPAs with Lottery recommendations. Of the 45 transition zone DPAs with goals, 8 were within 10% of goal, 2 were at least 10% below goal, and 35 were at least 10% above goal based on modeling or buck harvest trends. For the 2018 season designations, Lottery will be used for 5 of the DPAs, Hunter Choice for 10 DPAs, and Managed for 16 DPAs. In 17 DPAs, Intensive designations will be necessary to continue reducing deer densities toward goal level, 3 of which (DPA 346, 348 and 349) have additional antlerless seasons. In the metro area (DPA 601) and the chronic wasting disease management zone (DPA 603), Unlimited Antlerless opportunity will be available during the legal hunting seasons.

Forest Zone

Many deer populations in the forest zone with adequate habitat have recovered from the severe winter of 2013-14. Of the 44 forest zone DPAs, 16 were within 10% of goal, 9 were at least 10% below goal, and 19 were at least 10% above goal based on modeling or buck harvest trends. For 2018 season designations, Bucks-only will be used in 1 DPA, Lottery in 9 DPAs, Hunter Choice in 21 DPAs, Managed in 9 DPAs, and Intensive in 4 DPAs.

ABRIDGED DESCRIPTIONS OF DEER HUNTING SEASON DESIGNATIONS (MNDNR 2017)

Bucks-only Deer Areas – The bag limit is one legal buck total per year. Except residents of Minnesota State Veterans' Homes and hunters who are 84 or older, no antlerless deer may be harvested.

Lottery Deer Areas – The bag limit is one deer total per year. An either-sex permit is required to take an antlerless deer unless you have a youth deer license, are 84 or older or are a resident of a Minnesota State Veterans' Home.

Hunter Choice Deer Areas – The bag limit is one either-sex deer total per year.

Managed Deer Areas – The bag limit is two deer total per year, only one of which can be antlered.

Intensive Deer Areas – The bag limit is three deer total per year, only one of which can be antlered.

Unlimited Antlerless Deer Areas – There is no limit to the number of antlerless deer that may be taken.

Early or Late Antlerless Season – The bag limit is 5 additional antlerless deer during each season.

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Table 1. Estimated mean pre-fawn deer densities (deer/mi^2) derived from population model simulations in Minnesota deer permit areas, 2012-2018.

Deer Permit Area	Land area (mi^2)	Pre-fawn deer density[a]						
		2012	2013	2014	2015	2016	2017	2018
101	496	7	7	6	7	8	9	10
103	1,820	4	4	3	3	4	4	5
105	740	12	12	9	9	11	12	13
108	1,651	7	7	5	5	6	7	8
110	529	18	16	11	11	14	15	17
111	1,438	3	3	2	3	3	4	4
114	116	-	-	-	-	-	-	-
117	927	-	-	-	-	-	-	-
118	1,220	6	6	4	4	4	5	5
119	770	8	7	4	4	5	6	7
126	942	5	5	3	3	3	3	3
130	746	5	5	3	3	4	4	4
131	899	-	-	-	-	-	-	-
132	482	8	8	5	5	6	6	7
133	352	14	13	7	7	9	10	10
152	61	-	-	-	-	-	-	-
155	593	17	16	13	14	17	19	20
156	825	16	16	10	11	13	15	16
157	673	21	21	21	21	24	27	28
159	571	18	19	14	15	18	21	24
169	1,124	13	13	8	9	11	13	14
171	701	11	11	9	10	12	13	14
172	687	20	20	16	19	21	24	25
173	584	11	11	8	7	9	10	12
176	921	13	12	8	8	10	12	13
177	480	18	17	11	11	14	15	16
178	1,195	13	12	8	8	10	12	13
179	862	21	21	13	13	16	18	18
181	629	14	14	8	9	11	13	15
182	267	-	-	-	-	-	-	-
183	663	14	15	9	10	13	15	17
184	1,229	22	20	15	16	18	20	22
197	955	14	13	9	10	12	14	16
199	148	-	-	-	-	-	-	-
201	161	9	9	7	8	9	9	10
203	118	-	-	-	-	-	-	-
208	379	5	5	4	5	6	7	7

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

Deer Permit Area	Land area (mi^2)	Pre-fawn deer density[a]						
		2012	2013	2014	2015	2016	2017	2018
209	640	8	9	7	7	8	9	9
210	615	12	11	8	9	10	11	12
213	1,057	14	15	15	15	17	19	21
214	554	24	25	23	23	24	26	26
215	701	17	18	17	17	19	20	22
218	884	9	10	10	10	11	13	14
219	391	11	12	12	12	13	15	17
221	642	14	15	13	13	15	17	19
222	413	18	18	15	15	17	20	22
223	376	13	15	14	14	16	17	19
224	47	-	-	-	-	-	-	-
225	618	19	20	17	17	20	22	24
227	472	18	19	17	17	19	20	22
229	284	8	9	9	10	11	13	14
230	452	-	-	-	-	-	-	-
232	377	4	5	5	5	6	7	7
233	385	4	4	4	5	5	6	6
234	636	2	2	2	2	3	3	3
235	34	-	-	-	-	-	-	-
236	370	16	17	15	16	17	19	21
237	728	-	-	-	-	-	-	-
238	95	-	-	-	-	-	-	-
239	919	13	12	11	11	12	12	13
240	643	20	21	20	19	22	23	25
241	996	29	30	25	25	26	27	27
242	214	26	26	22	23	27	30	31
246	840	18	17	14	16	18	20	21
247	228	22	22	19	20	22	24	25
248	214	21	21	18	17	19	21	22
249	502	18	19	17	16	18	21	23
250	713	-	-	-	-	-	-	-
251	55	-	-	-	-	-	-	-
252	715	-	-	-	-	-	-	-
253	974	-	-	-	-	-	-	-
254	929	4	4	4	4	4	4	5
255	774	4	4	4	5	5	6	7
256	654	7	7	6	7	8	8	9
257	412	8	9	8	8	9	10	11
258	343	21	20	17	18	20	22	24
259	490	23	20	16	17	20	22	22

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

Deer Permit Area	Land area (mi^2)	Pre-fawn deer density[a]						
		2012	2013	2014	2015	2016	2017	2018
260	1,249	3	3	3	4	4	5	6
261	795	2	2	2	3	3	4	4
262	677	2	3	3	3	3	4	5
263	512	7	8	6	7	9	9	10
264	669	10	10	9	10	10	11	12
265	494	8	9	8	9	10	11	11
266	617	5	5	5	5	6	7	8
267	472	5	5	4	5	6	6	7
268	228	10	10	9	10	11	11	11
269	650	2	3	3	3	3	4	5
270	748	-	-	-	-	-	-	-
271	632	-	2	2	3	3	3	4
272	531	-	-	-	-	-	-	-
273	571	5	6	6	6	7	8	9
274	354	5	5	5	5	5	6	7
275	764	3	3	3	3	3	4	4
276	542	7	8	8	9	10	12	13
277	812	11	12	12	13	14	15	17
278	402	6	6	6	6	7	8	9
279	344	4	4	4	4	4	4	4
280	675	3	2	2	2	3	3	3
281	575	5	5	6	7	8	9	10
282	778	-	-	-	-	-	-	-
283	613	-	-	-	-	-	-	-
284	838	-	-	-	-	-	-	-
285	549	5	5	6	6	7	8	10
286	446	5	5	5	5	5	6	7
287	46	-	-	-	-	-	-	-
288	625	5	5	5	5	5	5	6
289	815	2	2	2	2	2	3	3
290	662	4	5	5	5	6	7	7
291	800	6	6	6	7	7	8	9
292	479	8	9	9	10	12	13	15
293	511	8	9	8	9	10	11	12
294	686	4	4	4	4	4	4	5
295	839	4	4	4	4	4	5	6
296	667	3	3	3	3	4	4	5
297	438	3	3	3	3	3	4	5
298	618	10	9	9	10	12	14	16
299	386	5	5	5	5	6	6	7

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

Deer Permit Area	Land area (mi^2)	Pre-fawn deer density[a]						
		2012	2013	2014	2015	2016	2017	2018
338	454	5	5	6	6	7	8	10
339	394	6	6	6	7	7	8	10
341	612	13	13	13	14	14	15	16
342	349	14	14	14	15	15	16	17
343	663	13	13	13	13	13	13	14
344	190	19	19	18	17	16	16	17
345	323	12	13	13	14	14	15	16
346	318	27	29	30	29	28	28	29
347	434	-	-	-	-	-	-	-
348	332	-	-	-	-	-	-	-
349	490	23	25	26	27	26	27	28
601	1,625	-	-	-	-	-	-	-
603	364	-	-	-	-	-	-	-

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

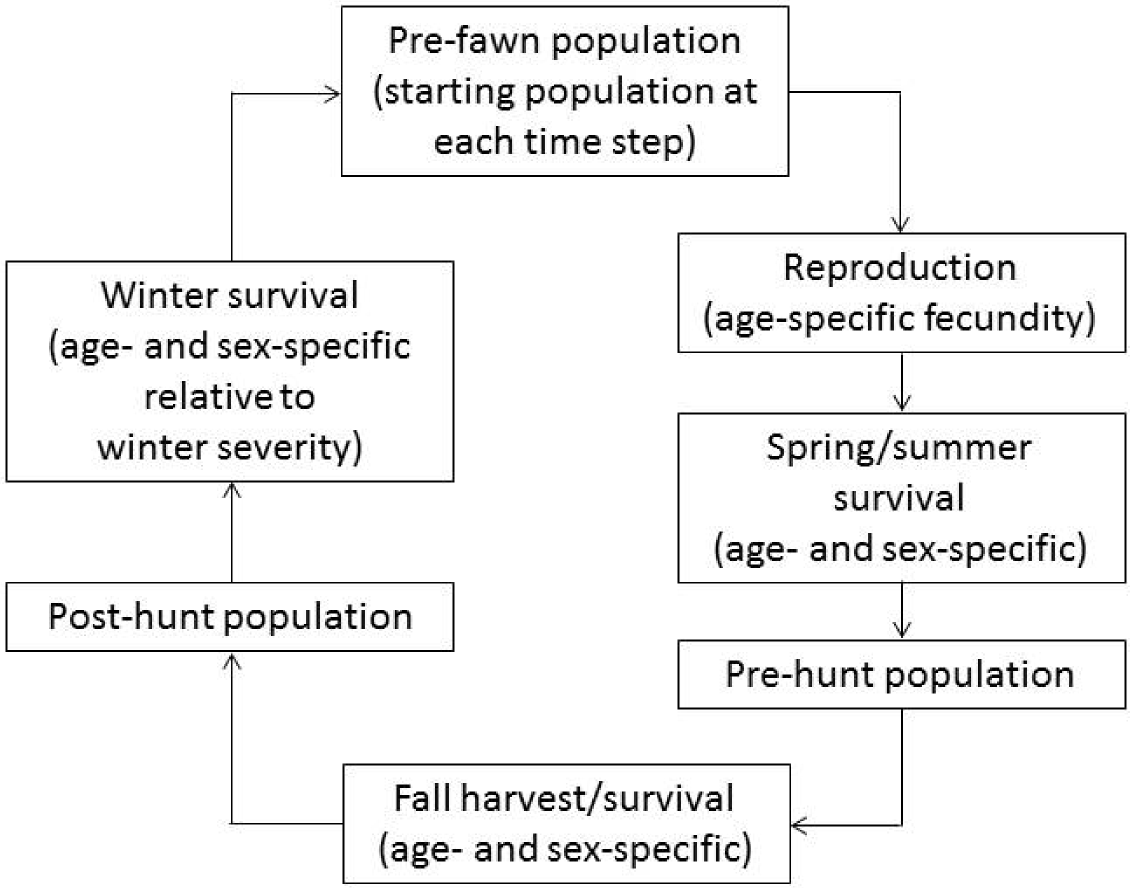

Figure 1. Model structure for simulations of white-tailed deer populations in Minnesota.

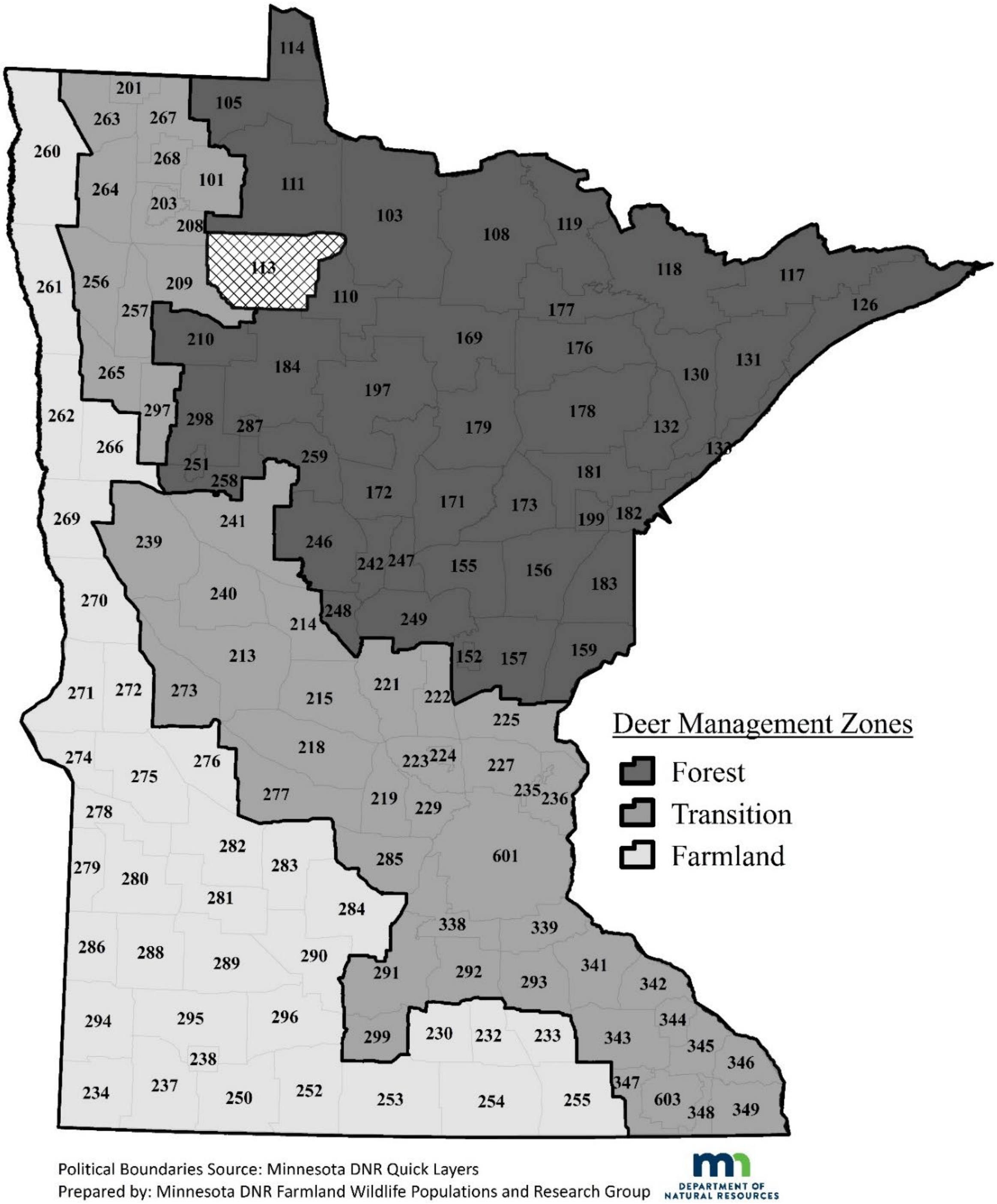

Figure 2. Deer permit areas (DPAs) in Minnesota and deer management zones used to describe deer population and harvest trends, 2018. DPAs were assigned to forest, transition, or farmland zones based on historical land cover and current woody cover. Generally, forested DPAs were composed of ≥60% woody cover, transition DPAs were composed of 6%-50% woody cover, and farmland DPAs were composed of ≤5% woody cover.

2018 WHITE-TAILED DEER AERIAL 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 111 permit areas (PA) to estimate and track changes in white-tailed deer (*Odocoileus virginianus*) abundance and, subsequently, to aid in developing harvest recommendations to manage deer populations toward goal levels (Norton and Giudice 2018). In general, model inputs include estimates of initial population size, reported harvest, 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 recommended that managers collect additional data to develop ancillary indices of changes in deer populations or periodically recalibrate models with independent deer population estimates (Grund and Woolf 2004).

Our objective was to use aerial surveys by helicopter to provide independent estimates of deer abundance in select deer PAs, where the 90% confidence interval bound on each estimate was within 20% of the estimate (Lancia et al. 1994). Estimates within these bounds were 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. hemionus*; Bartmann et al. 1986) in a variety of habitat types. Within each area, quadrats were delineated by Public Land Survey (PLS) section (640 ac) boundaries. In PAs with woody cover distributed uniformly across the landscape, we used a simple random sampling frame. 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 2017), and R package 'stratification' (Baillargeon and Rivest 2017) 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). We used optimal allocation, R package 'spsurvey' (Kincaid and Olsen 2017), and a generalized random tessellation stratified procedure (GRTS; Stevens and Olsen 2004) to draw spatially balanced simple or stratified random samples within each PA.

During all surveys, we used Bell OH-58 and MD-500E helicopters and attempted to maintain flight altitude at 200 ft (60 m) above ground level and airspeed at 50-60 mi/hr (80-97 km/hr). A pilot and 2 observers searched for deer along transects spaced at 0.17-mi (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; Haroldson et al. 2015), 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 maximize sightability, we completed surveys during winter when snow cover measured at least 6 in (15 cm) and we varied survey intensity as a function of cover and deer numbers (Gasaway et al. 1986).

We implemented double sampling (Eberhardt and Simmons 1987, Thompson 2002) on a subsample of quadrats within each PA to estimate sightability of deer from the helicopter. We sorted the sample of survey quadrats by woody cover abundance, excluded quadrats likely to contain no deer (e.g., quadrats where woody cover < 40 ac [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 (40-50 mi/hr [64-80 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 (Haroldson et al. 2015) 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. We used the R package ‘spsurvey’ (Kincaid and Olsen 2017) to compute deer abundance and density (mean count per quadrat) indices within each stratum, where indices were expanded for sampling but not sightability. We used the local mean variance estimator (Kincaid and Olsen 2017) with a finite population correction to compute stratum-specific estimates of sampling variance. We summed stratum-specific estimates by management unit (Cochran 1977:34) to compute deer abundance and density indices for each PA. We used a Horvitz-Thompson estimator (Thompson 2002:53, Fieberg and Giudice 2008) to convert population indices to population estimates (adjusted for sightability), and the Delta method (Seber 1982:9) to compute the variance. 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).

RESULTS AND DISCUSSION

We completed 5 surveys during 2017 (Figure 1). We utilized a simple random sample in PA 241, whereas PAs 214, 221, 223, and 224 were stratified using the relationship between woody cover abundance per quadrat and historic deer density. Mean deer density estimates ranged from 13-26 deer/quadrat throughout all PAs and, except for PA 224, all estimates met precision goals (relative error ≤ 20%; Table 1). Deer were observed in 64-86% of sample quadrats in the 5 surveyed areas, with greater occupancy occurring in PAs with more woody cover (Table 2). In addition, mean group size and mean number of groups per “occupied” quadrat was similar across all areas.

Estimates of sightability ranged from 0.646 (SE = 0.023) in PA 221 to 0.807 (SE = 0.017) in PA 214 and averaged 0.714 (SE = 0.076), which were similar to sightability estimates during 2010-2017 (range = 0.633-0.909; mean = 0.743). Correcting for sightability increased relative variance (CV [%]) of population estimates by 2.8-9.8%, 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. In the event when animals are unavailable, resulting population estimates would be underestimated. 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 logistical and statistical problems for distance sampling and double-observer methods (Nichols et al 2000, Bart et al 2004). Therefore, our double-sampling approach is a reasonable alternative to using unadjusted counts or applying more complicated methods whose assumptions are difficult to attain in practice. Nevertheless, our population estimates must still be viewed as approximations to the truth.

ACKNOWLEDGMENTS

We thank R. Tebo, T. Obermoller, and field staff throughout the survey areas for logistical assistance and conducting the surveys. J. Heineman and B. Maas piloted the helicopters during all surveys. A. Norton and N. Davros reviewed an earlier draft of this report. Deer surveys were funded in part under the Federal Aid in Wildlife Restoration Act.

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Table 1. Deer population and density (deer/quadrat) estimates derived from aerial surveys in Minnesota, 2018.

Permit area	Sampling rate (%)	Sightability rate	Population estimate		CV (%)	Relative error (%)[a]	Density estimate	
			N	90% CI			Mean	90% CI
214	19	0.807	12,636	11,371 – 13,901	6.1	10.0	23	21 – 25
221	20	0.646	8,094	6,902 – 9,286	9.0	14.8	13	11 – 15
223	20	0.669	6,486	5,386 – 7,586	10.3	16.9	16	13 – 19
224	20	0.669[b]	1,468	1,027 – 1,909	18.3	30.1	14	10 – 19
241	20	0.735	26,832	24,500 – 29,164	5.3	8.7	26	24 – 28

[a]Relative precision of population estimate. Calculated as 90% CI bound/*N*.
[b]Estimate derived from permit area 223.

Table 2. Sampling metrics from aerial deer surveys in Minnesota, 2018.

Permit area	Quadrats in permit area	Quadrats sampled	Quadrats occupied[a]	Deer observed	Deer groups observed	Groups / occupied quadrat		Group size / occupied quadrat		Max. quadrat count
						Mean	Range	Mean	Range	
214	548	106	91	2,135	456	5	1 – 14	5	1 – 34	84
221	620	124	79	1,465	358	5	1 – 12	4	1 – 30	68
223	405	81	55	1,061	232	4	1 – 15	5	1 – 28	74
224	103	21	17	200	53	3	1 – 8	4	1 – 13	41
241	1,024	205	177	3,947	972	5	1 – 24	4	1 – 51	107

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

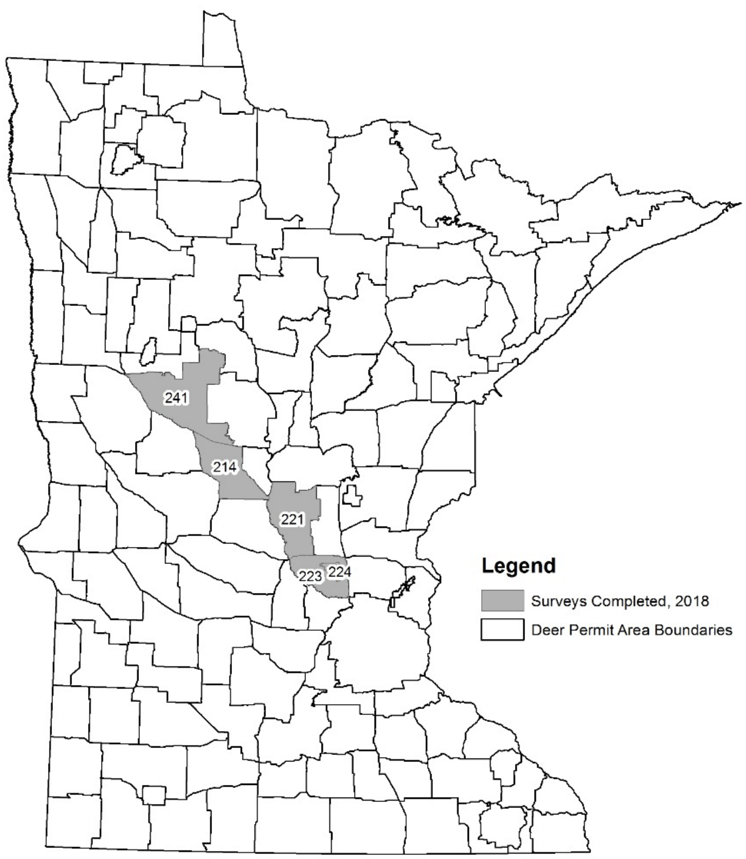

Figure 1. Aerial deer survey areas flown during winter 2018 in central Minnesota.

CARNIVORE SCENT STATION SURVEY

AND

WINTER TRACK INDICES

NOTE: This survey is organized and coordinated by the Forest Wildlife Populations and Research Group, 1201 E. Hwy 2, Grand Rapids, MN 55744. Results are presented at this location in the book because of the statewide nature of the data.

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CARNIVORE SCENT STATION SURVEY SUMMARY, 2017

John Erb, Minnesota Department of Natural Resources, Forest Wildlife Research Group

INTRODUCTION

Monitoring the distribution and abundance of carnivores can be important for understanding the effects of harvest, habitat change, and environmental variability on these populations. However, many carnivores are highly secretive, difficult to repeatedly capture, and naturally occur at low to moderate densities, making it difficult to annually estimate abundance over large areas using traditional methods (e.g., mark-recapture, distance sampling, etc.). Hence, indices of relative abundance are often used to monitor such populations over time (Sargeant et al. 1998, 2003, Hochachka et al. 2000, Wilson and Delahay 2001, Conn et al. 2004, Levi and Wilmers 2012).

In the early 1970's, the U.S. Fish and Wildlife Service initiated a carnivore survey designed primarily to monitor trends in coyote populations in the western U.S. (Linhart and Knowlton 1975). In 1975, the Minnesota DNR began to utilize similar survey methodology to monitor population trends for numerous terrestrial carnivores within the state. This year marks the 42nd year of the carnivore scent station survey.

METHODS

Scent station survey routes are composed of tracking stations (0.9 m diameter circle) of sifted soil with a fatty-acid scent tablet placed in the middle. Scent stations are spaced at 0.5 km intervals on alternating sides of a road or trail. During the initial years (1975-82), survey routes were 23.7 km long, with 50 stations per route. Stations were checked for presence/absence of tracks on 4 consecutive nights (old tracks removed each night), and the mean number of station visits per night was the basis for subsequent analysis. Starting in 1983, following suggestions by Roughton and Sweeny (1982), design changes were made whereby routes were shortened to 4.3 km, 10 stations/route (still with 0.5 km spacing between stations), and routes were surveyed only once on the day following route placement. The shorter routes and fewer checks allowed for an increase in the number and geographic distribution of survey routes. In either case, the design can be considered two-stage cluster sampling.

Survey routes were selected non-randomly, but with the intent of maintaining a minimum 5 km separation between routes, and encompassing the variety of habitat conditions within the work area of each survey participant. Most survey routes are placed on secondary (unpaved) roads/trails, and are completed from September through October. Survey results are currently stratified based on 3 habitat zones within the state (forest (FO), transition (TR), and farmland (FA); Figure 1).

Track presence/absence is recorded at each station and track indices are computed as the percentage of scent stations visited by each species. Confidence intervals (95%) are computed using bootstrap methods (percentile method; Thompson et al. 1998). For each of 1000 replicates, survey routes are randomly re-sampled according to observed zone-specific route sample sizes, and station visitation rates are computed for each replicate sample of routes.

Replicates are ranked according to the magnitude of the calculated index, and the 25th and 975th values constitute the lower and upper bounds of the confidence interval.

RESULTS AND DISCUSSION

A total of 203 routes and 1,879 stations were surveyed this year, the fewest since the survey became fully operational in the early 1980's. Route density varied from 1 route per 761 km^2 in the Forest Zone to 1 route per 1,891 km^2 in the Farmland Zone (Figure 1). The decline in survey effort was likely a result of staffing shortages and competing workload demands.

Statewide, route visitation rates (% of routes with detection), in order of increasing magnitude, were opossum (5%), wolves (12%), bobcats (13%), domestic dogs (15%), domestic cats (26%), coyotes (28%), skunks (32%), raccoons (33%), and red foxes (35%). Regionally, route visitation rates were as follows: red fox – TR 17%, FA 31%; FO 47%; coyote – FO 13%, TR 36%, FA 58%; skunk – FO 25%, TR 28%, FA 58%; raccoon – FO 16%, TR 34%, FA 86%; domestic cat – FO 11%, TR 33%, FA 58%; domestic dog – FO 6%, FA 25%, TR 26%; opossum - FO 0%, TR 10%, FA 14%; wolf - FA 0%, TR 2%, FO 21%; and bobcat - FA 0%, TR 9%, FO 19%.

Figures 2-5 show station visitation indices (% of stations visited) from the survey's inception through the current year. Although the survey is largely intended to document long-term trends in populations, confidence intervals improve interpretation of the significance of annual changes. Based strictly on the degree of confidence interval overlap, significant changes this year include 1) increases in red fox, skunk, and raccoon indices in the Farmland Zone (Figure 2), 2) declines in red fox, skunk, and domestic cat indices in the Transition Zone (Figure 3), 3) decreases in coyote, skunk, and raccoon indices in the Forest Zone (Figure 4), and 4) increases in wolf and bobcat indices in the Forest Zone (Figure 5).

In the Farmland Zone (Figure 2), the red fox index increased significantly from last year, but the index remains below the long-term average and has fluctuated around a stable trend since the mid-2000s. Although the farmland coyote index was the highest on record, it was not significantly different from last year. It is however, suggestive of a continuing increase in coyotes that began in the late 1990's. Raccoon and skunk indices both exhibited significant increases from last year, and both were the highest since the survey began. However, neither has exhibited any consistent trend over the last decade, with recent indices for both generally remaining above the long-term average.

In contrast to the Farmland Zone where numerous indices increased, red fox, skunk, domestic cat, and wolf indices all declined in the Transition Zone (Figure 3). However, over the last decade there has been no consistent trend for these species, with most fluctuating at or below long-term averages. There was no significant change in the Transition Zone coyote index from last year; coyote indices here have generally declined over the past 4 years but remain well above the long-term average. Raccoon indices in the Transition Zone remain near their long-term average.

In the Forest Zone (Figures 4 and 5), significant declines were observed in coyote, skunk and raccoon indices. However, there has been no consistent trend for these species over the past decade, all fluctuating at or below their long-term average. Conversely, wolf and bobcat indices significantly increased from last year and are well above their long-term averages. Although these surveys cannot ascertain cause and effect, published research would suggest an increase in wolves would negatively affect coyotes, which in turn could positively affect bobcats; observed changes in the Forest Zone indices from last year are consistent with this scenario.

ACKNOWLEDGMENTS

I wish to thank all of the cooperators who participated in the 2017 survey: DNR Division of Wildlife staff; Superior National Forest Aurora District; Agassiz, Rice Lake, Rydell, Sherburne and Tamarac National Wildlife Refuges; 1854 Treaty Authority, White Earth, Red Lake, and Leech Lake Tribal Natural Resource Departments; Lori Schmidt and Vermillion Community College; Peter Jacobson and Faribault High School; Josh Tharaldson and Central High School (Marshall County); and Steven Hogg and the Three Rivers Park District. This project was funded in part by the Wildlife Restoration Program (Pittman-Robertson).

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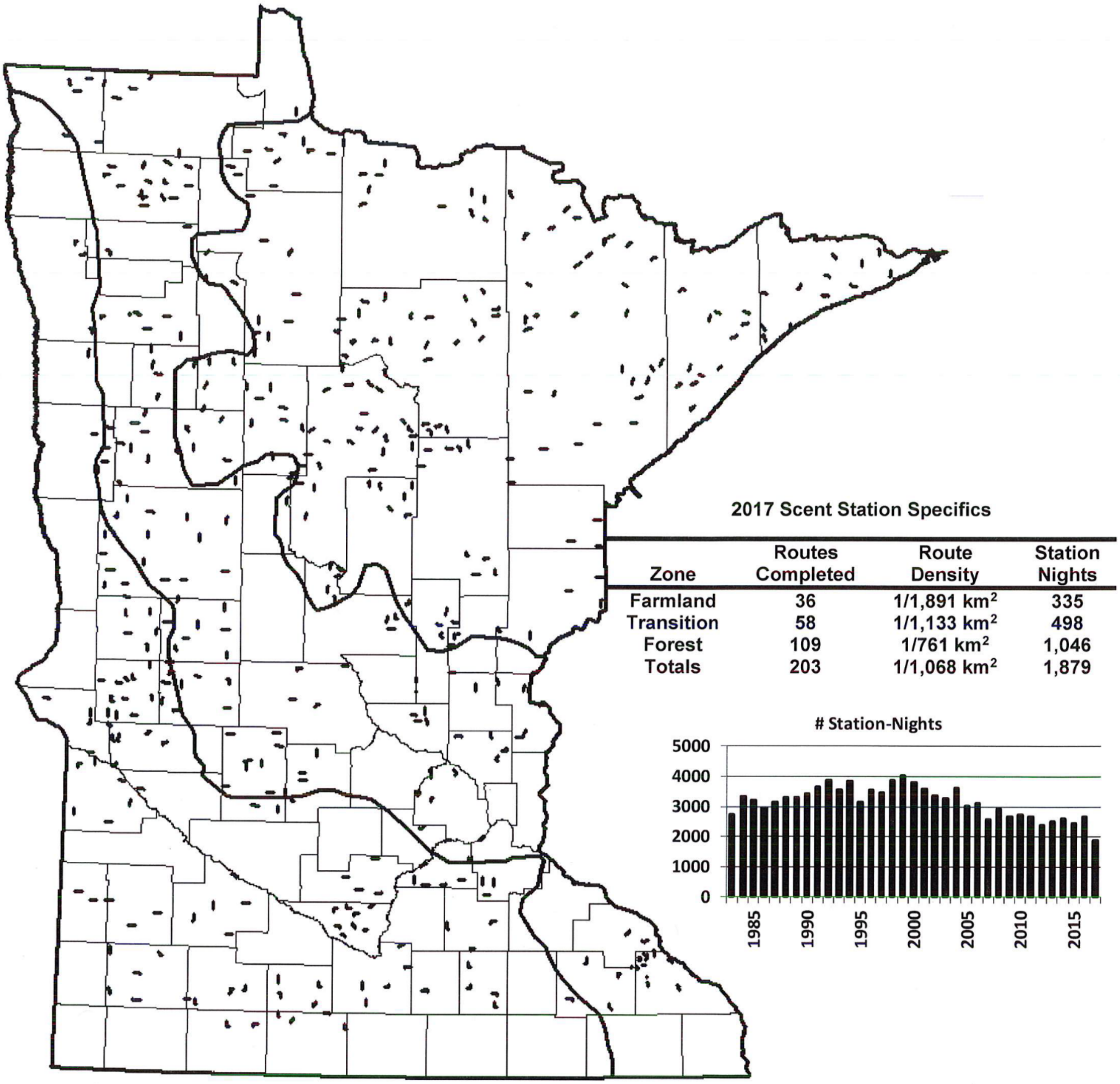

2017 Scent Station Specifics

Zone	Routes Completed	Route Density	Station Nights
Farmland	36	1/1,891 km^2	335
Transition	58	1/1,133 km^2	498
Forest	109	1/761 km^2	1,046
Totals	203	1/1,068 km^2	1,879

Figure 1. Locations of existing scent station routes (not all completed every year). Insets show 2017 route specifics and the number of station-nights per year since 1983.

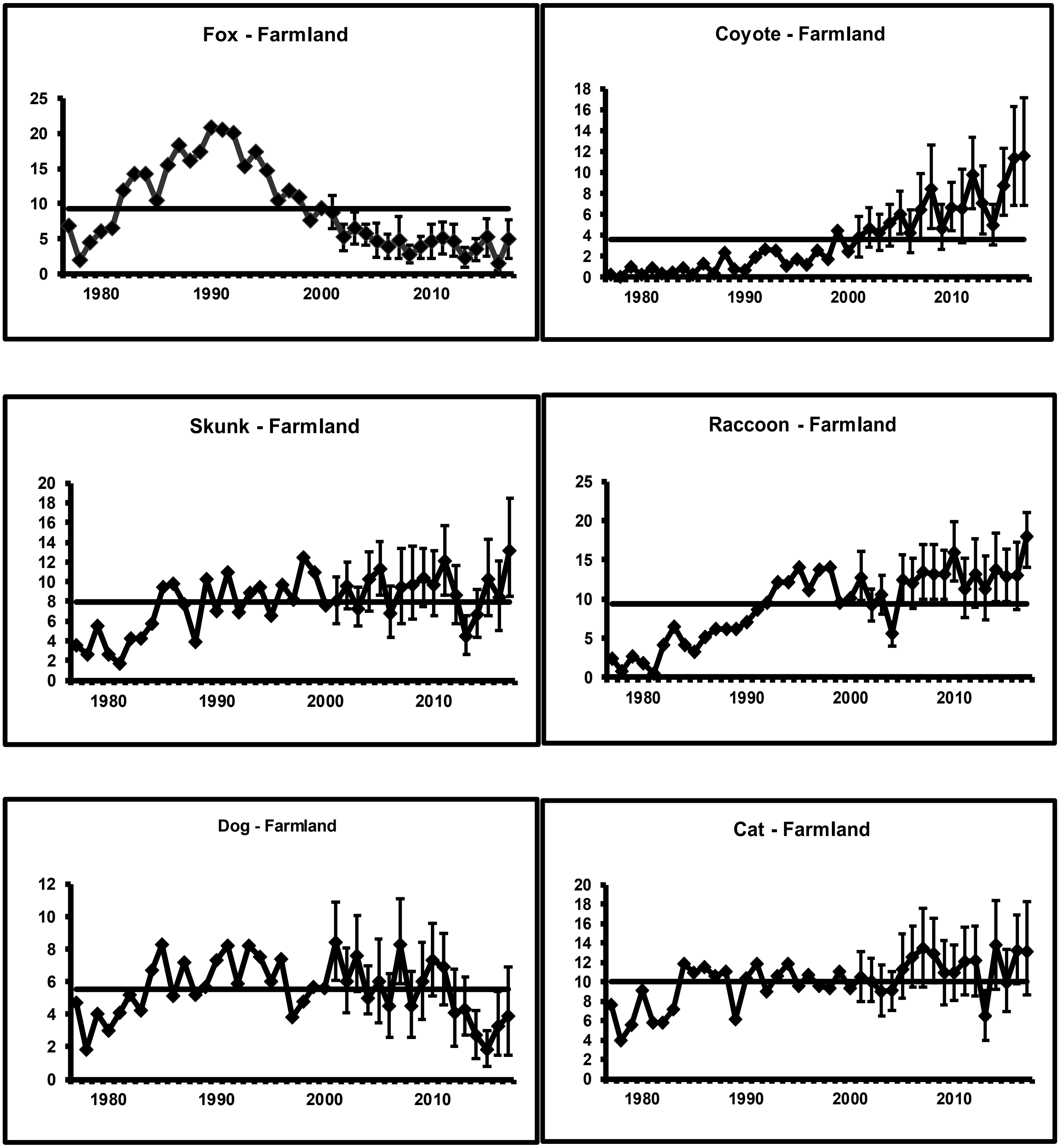

Figure 2. Percentage of scent stations visited by selected species in the Farmland Zone of Minnesota, 1977-2017. Horizontal line represents long-term mean.

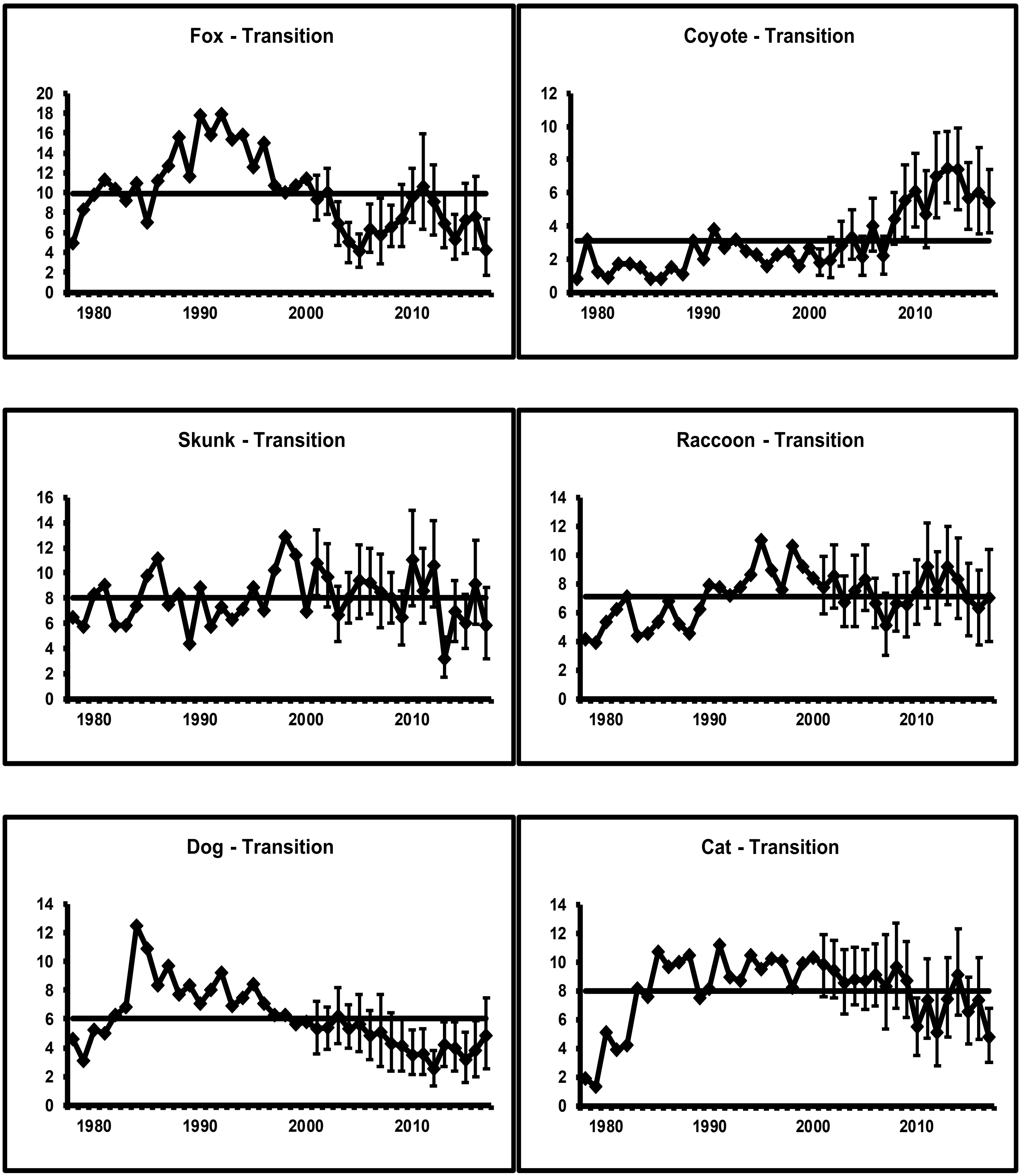

Figure 3. Percentage of scent stations visited by selected species in the Transition Zone of Minnesota, 1978-2017. Horizontal line represents long-term mean.

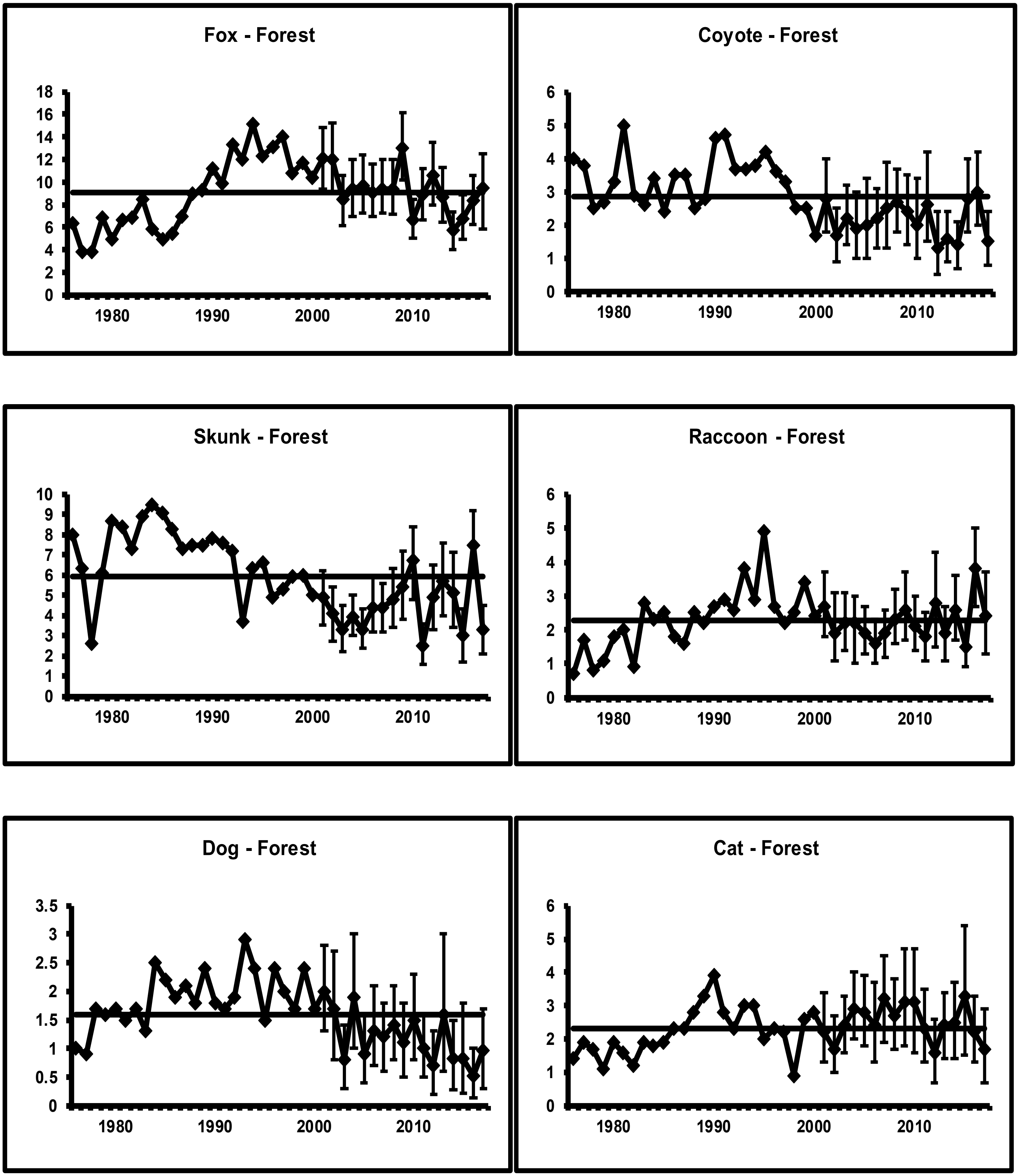

Figure 4. Percentage of scent stations visited by selected species in the Forest Zone of Minnesota, 1976-2017. Horizontal line represents long-term mean.

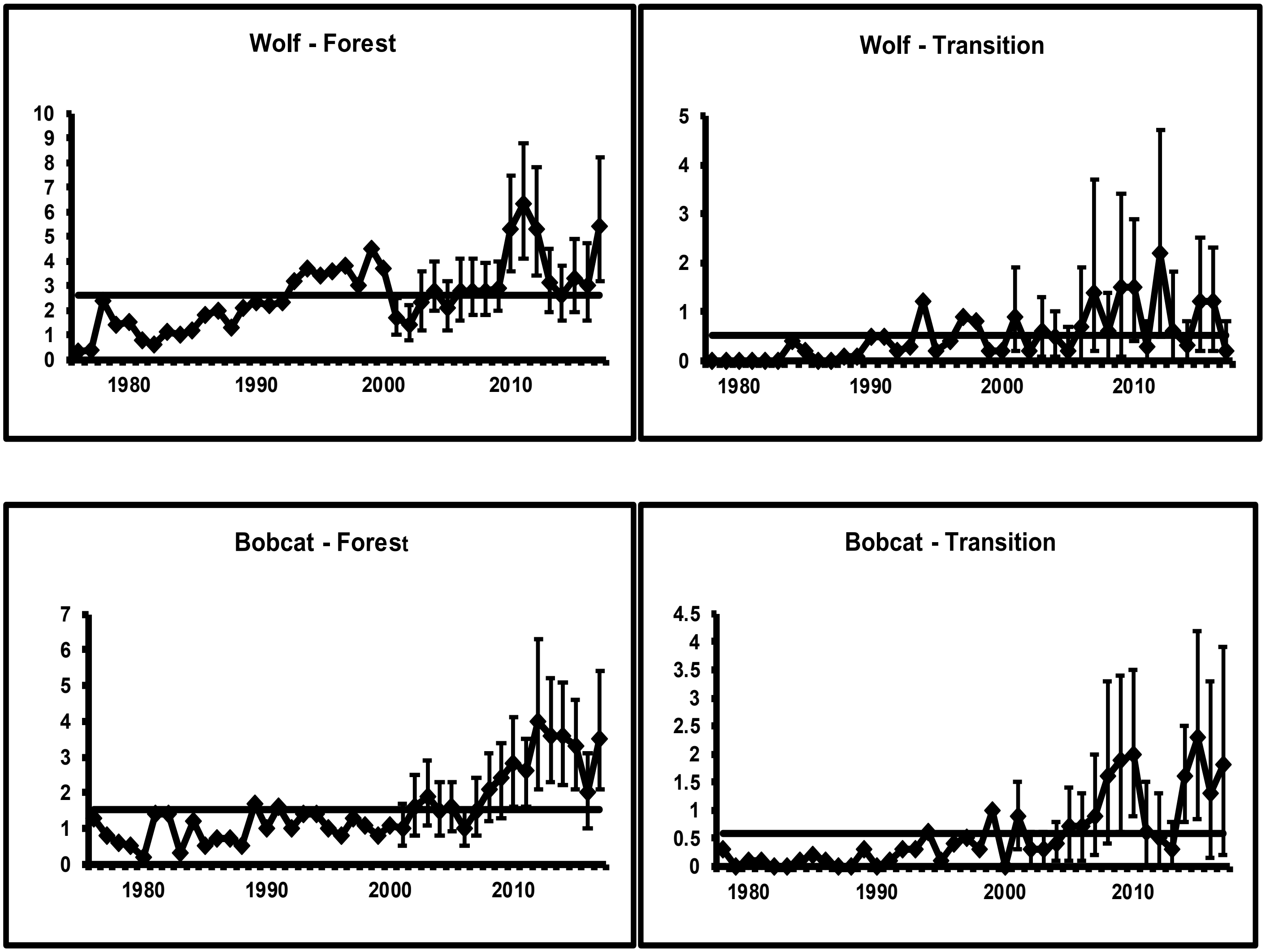

Figure 5. Percentage of scent stations visited by wolves and bobcat in the Forest and Transition Zones of Minnesota, 1976-2017. Horizontal lines represents long-term mean.

FURBEARER WINTER TRACK SURVEY SUMMARY, 2017

John Erb, Minnesota Department of Natural Resources, Forest Wildlife Research Group

INTRODUCTION

Monitoring the distribution and abundance of carnivores can be important for documenting the effects of harvest, habitat change, and environmental variability on these populations. However, many carnivores are highly secretive, difficult to repeatedly capture, and naturally occur at low to moderate densities, making it difficult to estimate abundance over large areas using traditional methods (e.g., mark-recapture, distance sampling, etc.). Hence, indices presumed to reflect relative abundance are often used to monitor such populations over time (Hochachka et al. 2000, Wilson and Delahay 2001, Conn et al. 2004).

In winter, tracks of carnivores are readily observable following snowfall. Starting in 1991, Minnesota initiated a carnivore snow-track survey in the northern portion of the State. The survey's primary objective is to use a harvest-independent method to monitor distribution and population trends of fisher (*Martes pennanti*) and marten (*Martes americana*), two species for which no other survey data is available. Because sign of other carnivores is readily detectable in snow, participants also record tracks for other selected species. After three years of evaluating survey logistics, the survey became operational in 1994. Formal recording of gray fox detections did not commence until 2008.

METHODS

Presently, 57 track survey routes are operational across the northern portion of the state (Figure 1). Each route is a total of 10 miles long and follows secondary roads or trails. A majority of routes are continuous 10-mile stretches of road/trail but a few are composed of multiple discontinuous segments. Route locations were subjectively determined based on availability of suitable roads/trails but were chosen where possible to represent the varying forest habitat conditions in northern Minnesota. For data recording, each 10-mile route is divided into 20 0.5-mile segments.

Each route is surveyed once following a fresh snow typically from December through mid-February, and track counts are recorded for each 0.5-mile segment. When it is obvious the same animal crossed the road multiple times *within* a 0.5-mile segment, the animal is only recorded once. If it is obvious that an animal ran along the road and entered multiple 0.5 mile segments, which often occurs with canids, its tracks are recorded in all segments but circled to denote it was the same animal. Though duplicate tracks are not included in calculation of track indices (see below), recording data in this manner allows for future analysis of animal activity in relation to survey 'plot' size and habitat. Snowshoe hares (*Lepus americanus*) are recorded only as present or absent in the first 0.1 miles of each 0.5-mile segment. Although most routes are surveyed one day after the conclusion of a snowfall (ending by ~ 6:00 pm), thereby allowing one night for tracks to be left, a few routes are usually completed two nights following snowfall. In such cases, track counts on those routes are divided by the number of days post-snowfall.

Because most targeted species occur throughout the area where survey routes are located, calculated indices for all species prior to 2015 utilize data from all surveyed routes. Starting with the 2015 report, all past marten indices were re-calculated using only those routes that fall within a liberal delineation of marten range. However, in general there were minimal differences in temporal patterns observed in this subset versus the full sample of routes.

Currently, three summary statistics are presented for each species. First, I compute the percentage of 0.5-mile segments with species presence after removing any duplicates (e.g., if the same fox clearly traverses two adjacent 0.5-mile segments along the road, and it was the only 'new' red fox (*Vulpes vulpes*) in the second segment, only one of the two segments is considered independently occupied). In addition to this metric, but on the same graph, the average number of tracks per 10-mile route is presented after removing any obvious duplicate tracks across segments. For wolves (*Canis lupus*) traveling through adjacent segments, the maximum number of pack members recorded in any one of those segments is used as the track total for that particular group, though this is likely an underestimate of true pack size. Because individuals from many of the species surveyed tend to be solitary, these two indices (% segments occupied and # tracks per route) will often yield mathematically equivalent results; on average, one tends to differ from the other by a constant factor. In the case of wolf packs, and to a lesser extent red fox and coyotes (*Canis latrans*) which may still associate with previous offspring or start traveling as breeding pairs in winter, the approximate equivalence of these two indices will still be true if average (detected) group sizes are similar across years. However, the solitary tendencies in some species are not absolute, potential abundance (in relation to survey plot size) varies across species, and for wolves, pack size may vary annually. For these reasons, as well as to provide an intuitive count metric, both indices are currently presented. Because snowshoe hares are tallied only as present/absent, the 2 indices are by definition equivalent. Dating back to 1974, hare survey data has also been obtained via counts of hares observed on ruffed grouse drumming count surveys conducted in spring. Post-1993 data for both the spring and winter hare indices are presented for comparison in this report.

In the second graph for each species, I illustrate the percentage of *routes* where each species was detected (hereafter, the 'distribution index'). This measure is computed to help assess whether any notable changes in the above-described track indices are a result of larger-scale changes in distribution (more/less routes with presence) or finer-scale changes in density along routes.

Using bootstrap methods, I compute confidence intervals (90%) for the percent of segments with species presence and the percent of routes with species presence. For each of 1000 replicates, survey routes are randomly re-sampled with replacement according to the observed route sample size. Replicates are ranked according to the magnitude of the calculated index, and the 50th and 950th values constitute the lower and upper bounds of the confidence interval.

RESULTS

This winter, 44 of the 57 routes were completed, the third most since the survey began (Figure 2). Survey routes took an average of 1.9 hours to complete. Total snow depths averaged 10.5" along completed routes, similar to the long-term average (Figure 3). Mean overnight low temperature the night preceding the surveys was -1°F, below the long-term average (Figure 3). Survey routes were completed between December 12th and February 28th, with a mean survey date of January 9th (Figure 3).

Based on degree of confidence interval overlap, significant changes from last winter include an increase in wolves and a decrease in coyotes (Figure 4). Red fox and bobcat indices also increased, though less significantly (Figure 4). These changes mirror similar results on the fall scent station survey, and are consistent with expectations based on known inter-specific interactions among these species.

Fishers were detected on approximately 4% of the route segments and along 50% of the routes (Figure 4). Numerous sources of information indicate that over the past decade fishers have expanded in distribution and abundance along the southern and western edge of their Minnesota range, an area currently with few or no track survey routes. Hence, fisher indices in this report are presumed indicative of population trends only in the previous ‘core’ of fisher range. In the core area, data indicates a longer-term decline, with low but stable numbers since 2012; at their peak (2003/2004), fishers were detected on 14% of the segments and 78% of the survey routes.

Within the ‘marten zone’, martens were detected on approximately 6% of the route segments and 56% of the survey routes (Figure 4), similar to last year. Similar to results for fishers, marten indices remain below their long-term average and have not exhibited any unidirectional trends over the last 11 years. However, recent marten fluctuations show indications of 3-5 year cycles consistent in timing with cyclic fluctuations of some of their rodent prey species in Minnesota (e.g., Oestricher 2018, Berg et al. 2017).

Bobcat indices had increased for approximately 15 years through 2014, and then declined to their long-term average the past two years. Data from this winter suggests a moderate increase, now slightly above the long-term average. Bobcats were detected on 3.4% of the segments and 45% of the routes.

Wolf indices increased significantly to their second-highest level since the survey began. Wolves were detected on approximately 10% of the route segments and 82% of the survey routes (Figure 4). The average number of wolves detected per route was 3.5. Coyotes were detected on 2.3% of the route segments and 27% of the routes. As with martens and weasels (see below), coyote indices appear to exhibit 4 to 5 year cycles consistent in timing with data for some rodent species in MN. Although red fox indices have been comparatively stable in recent years, indices have remained below the long-term average since 2006. Red foxes were detected on approximately 12% of the segments and 80% of the routes (Figure 4), both slight increases from the previous winter. Gray fox detections have only been formally recorded since 2008. Although it may be premature to characterize longer patterns in gray fox detections, data from the past 9 years suggests a possible 4-5 year cyclic fluctuation. However, gray fox fluctuations appear inversely correlated with those in rodent and coyote indices, suggesting, as found in various studies, a potential negative influence of coyotes on gray foxes. There was a marginally significant increase in gray fox indices from last winter, with gray foxes being detected on 2% of the segments and 18% of the routes.

Weasel (*Mustela erminea* and *Mustela frenata*) indices did not change significantly from last year and their long-term fluctuations have been characterized by 4 to 5 year cycles or ‘irruptions’ superimposed on a declining trend (Figure 4). No significant change was observed in winter snowshoe hare indices from last winter. Since the winter track survey began in 1994, hare indices had steadily increased, leveled off some around 2010, and declined in recent years (Figure 4). Both the spring and winter indices were near (slightly above in spring, slightly below in winter) their long-term averages (Figure 4). Historic data (pre-1994; not presented here) for the spring index of snowshoe hares clearly exhibited 10-year cycles. Since then, only subtle ‘hints’ of a cycle are apparent in both surveys during the first few years of each decade.

DISCUSSION

Reliable interpretation of changes in these track survey results is dependent on the assumption that the probability of detecting animals remains relatively constant across years (Gibbs 2000, MacKenzie et al. 2004). Because this remains an untested assumption, caution is warranted when interpreting changes, particularly annual changes of low to moderate magnitude or short-term trends. The only significant changes detected this winter were an increase in wolves and a decrease in coyotes, potentially explained by increasing deer numbers facilitating a wolf increase, which in turn may have a negative impact on coyotes. Overall, the timing and average ambient conditions during this winter's survey suggest conditions slightly more 'extreme' than their long-term averages (later in winter, with slightly more snow and colder temperatures than average). While this could negatively bias indices for some species as a result of reduced animal activity, average conditions during route completion were not 'severe' and other unknown factors can influence animal movement and detection rates. Hence, there is no clear indication that results were biased in either direction, and as always, inferences should largely be restricted to multi-year trends.

ACKNOWLEDGMENTS

I wish to thank all those who participated in this year's survey, including staff with the Minnesota DNR, Superior National Forest (Cook, Ely, and Grand Marais offices), Leech Lake, Fond-du-Lac, Grand Portage, and Red Lake Bands of Ojibwe, and the 1854 Treaty Authority. This project was funded in part by the Wildlife Restoration Program (Pittman-Robertson).

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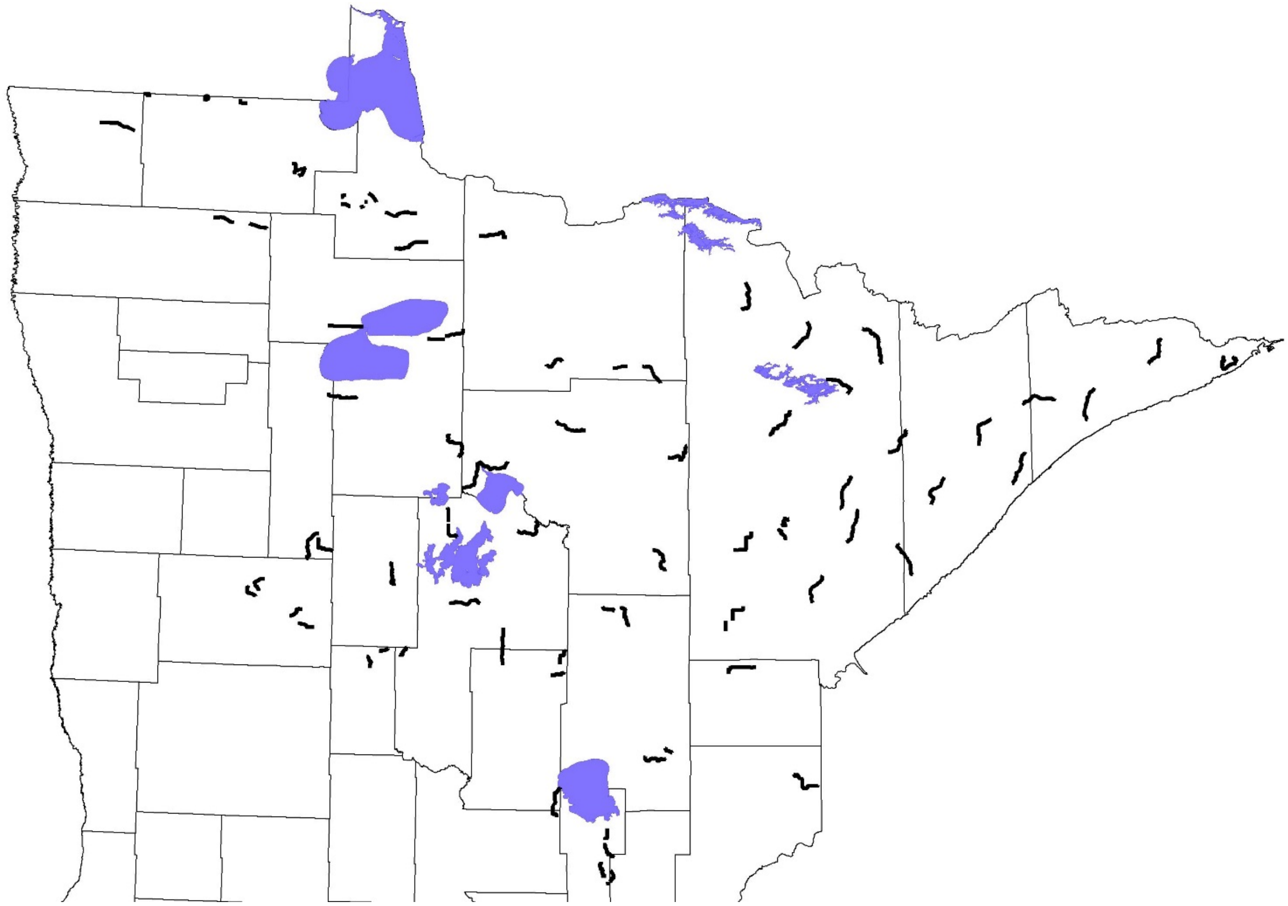

Figure 1. Locations of furbearer winter track survey routes in northern Minnesota.

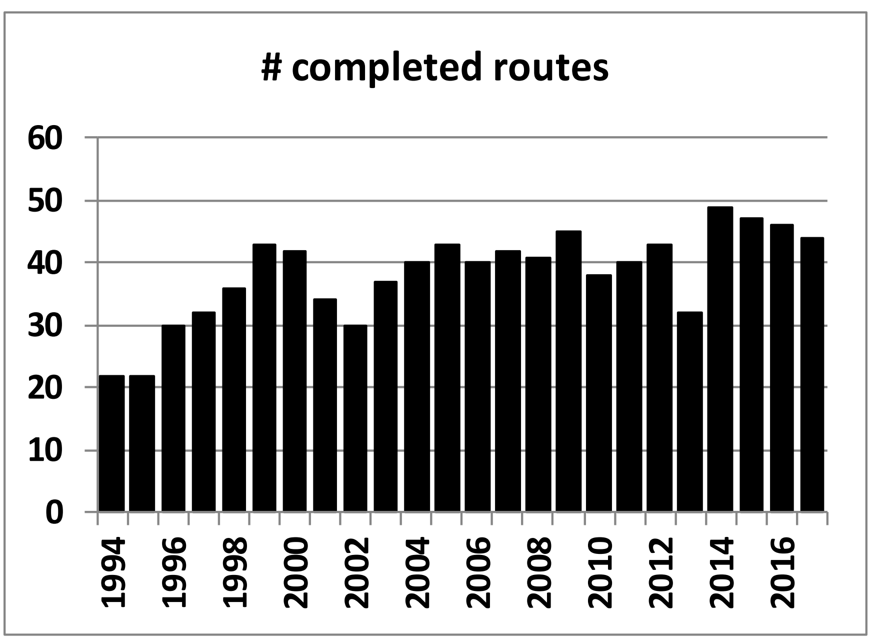

Figure 2. Number of snow track routes surveyed in Minnesota, 1994-2017.

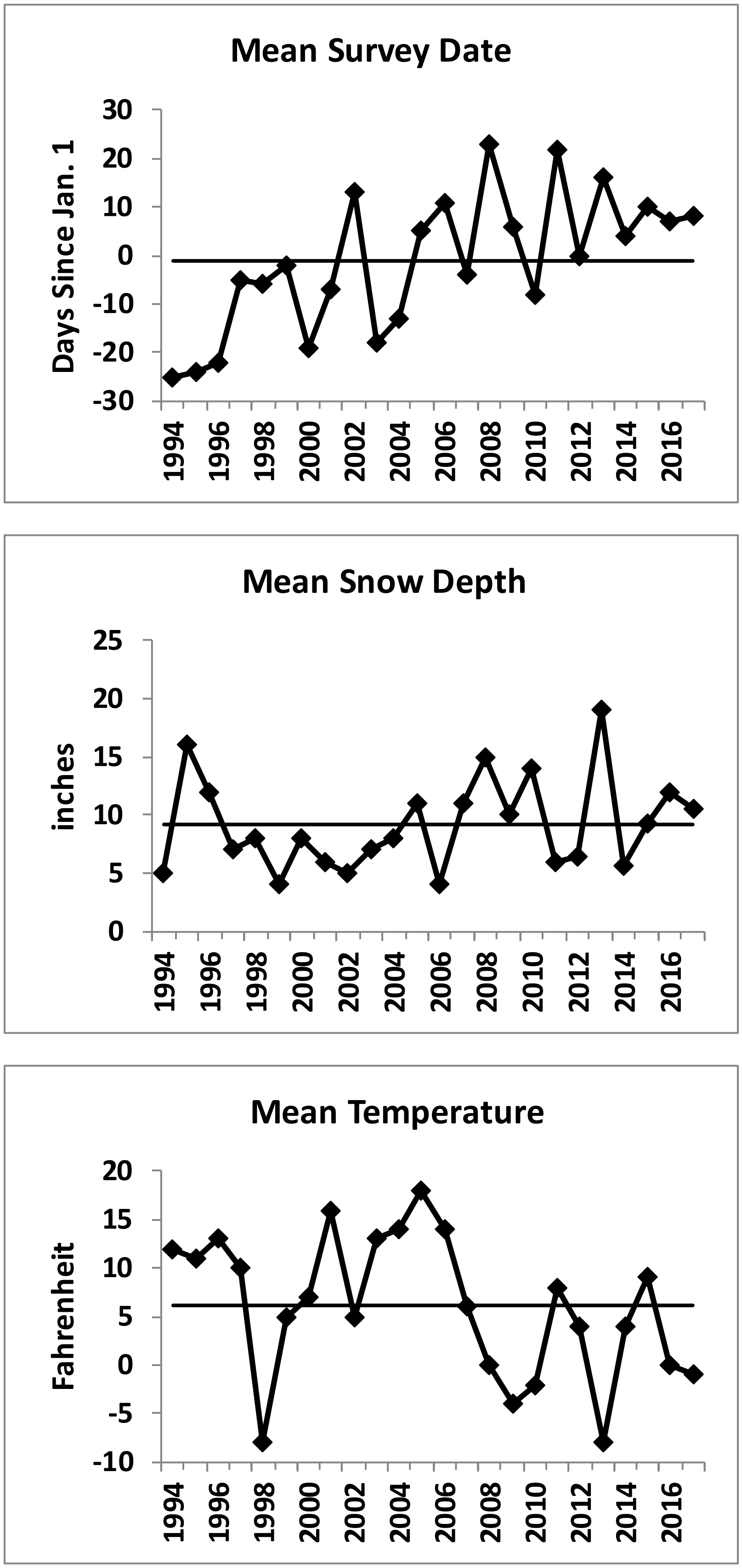

Figure 3. Average survey date, snow depth, and temperature for snow track routes completed in Minnesota, 1994-2017. Horizontal line represents long-term mean.

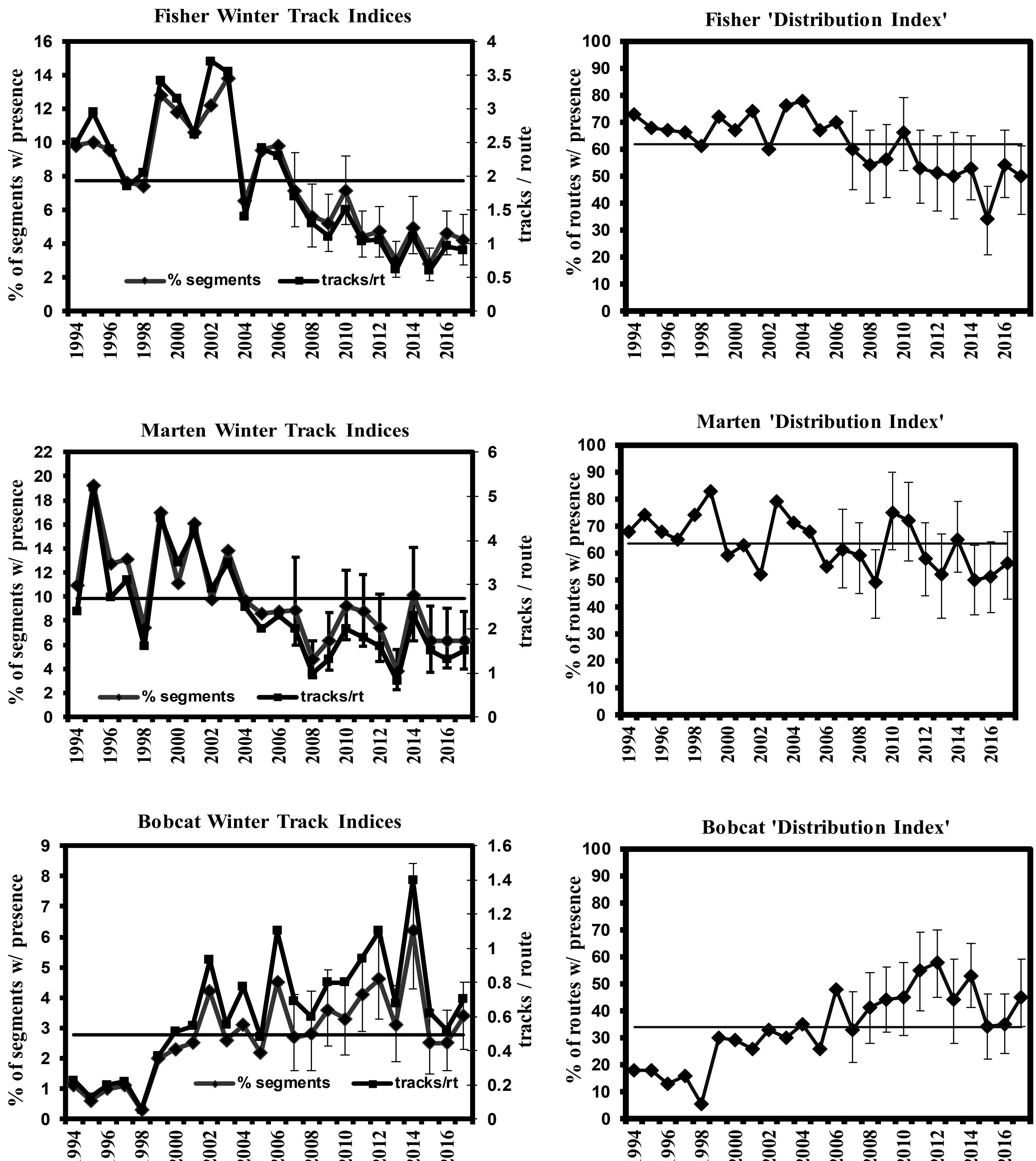

Figure 4. Winter track indices for selected species in Minnesota, 1994-2017. Confidence intervals are presented only for % segments and % routes with track presence; horizontal lines represent their long-term averages.

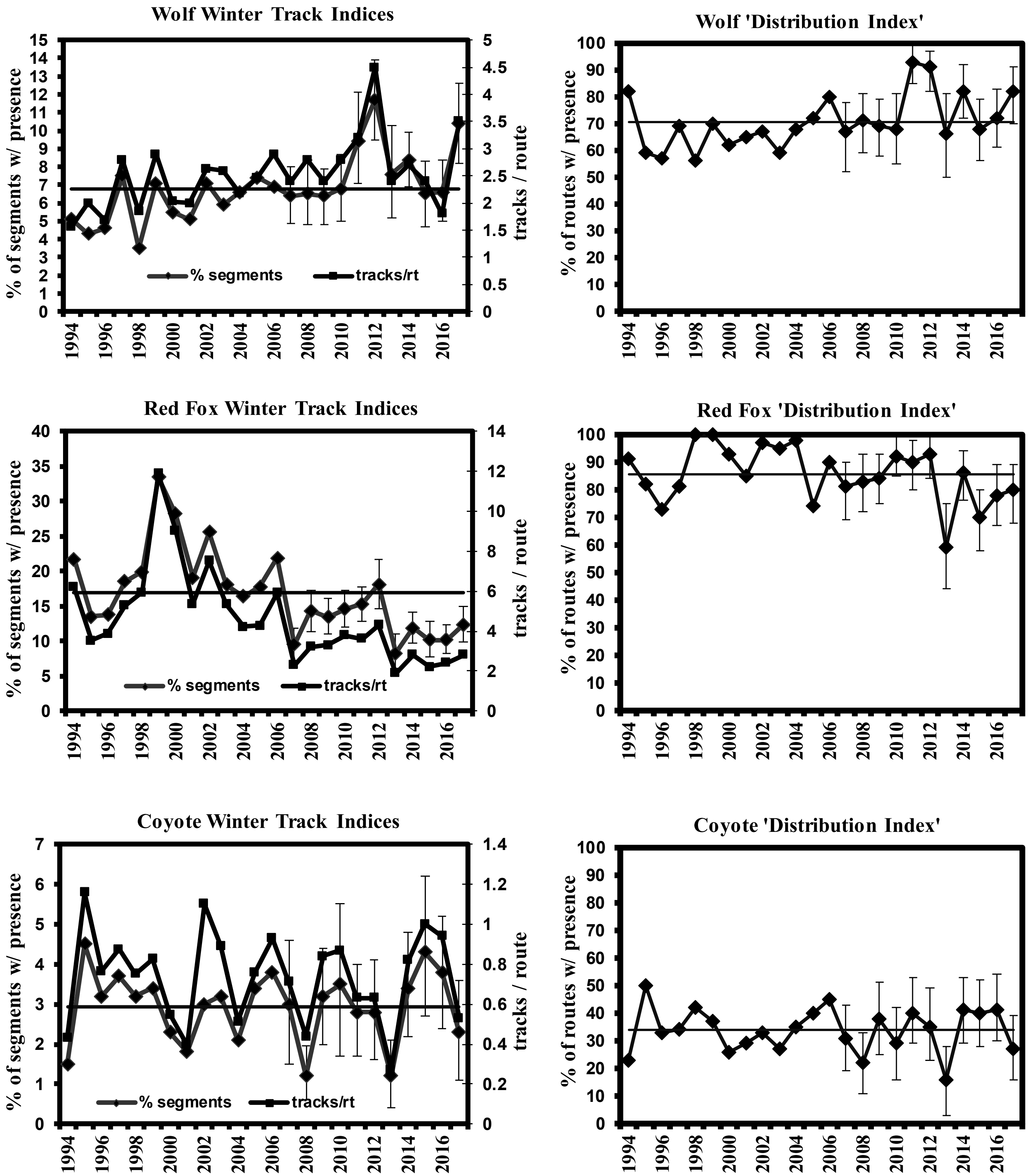

Figure 4 (continued). Winter track indices for selected species in Minnesota, 1994-2017.

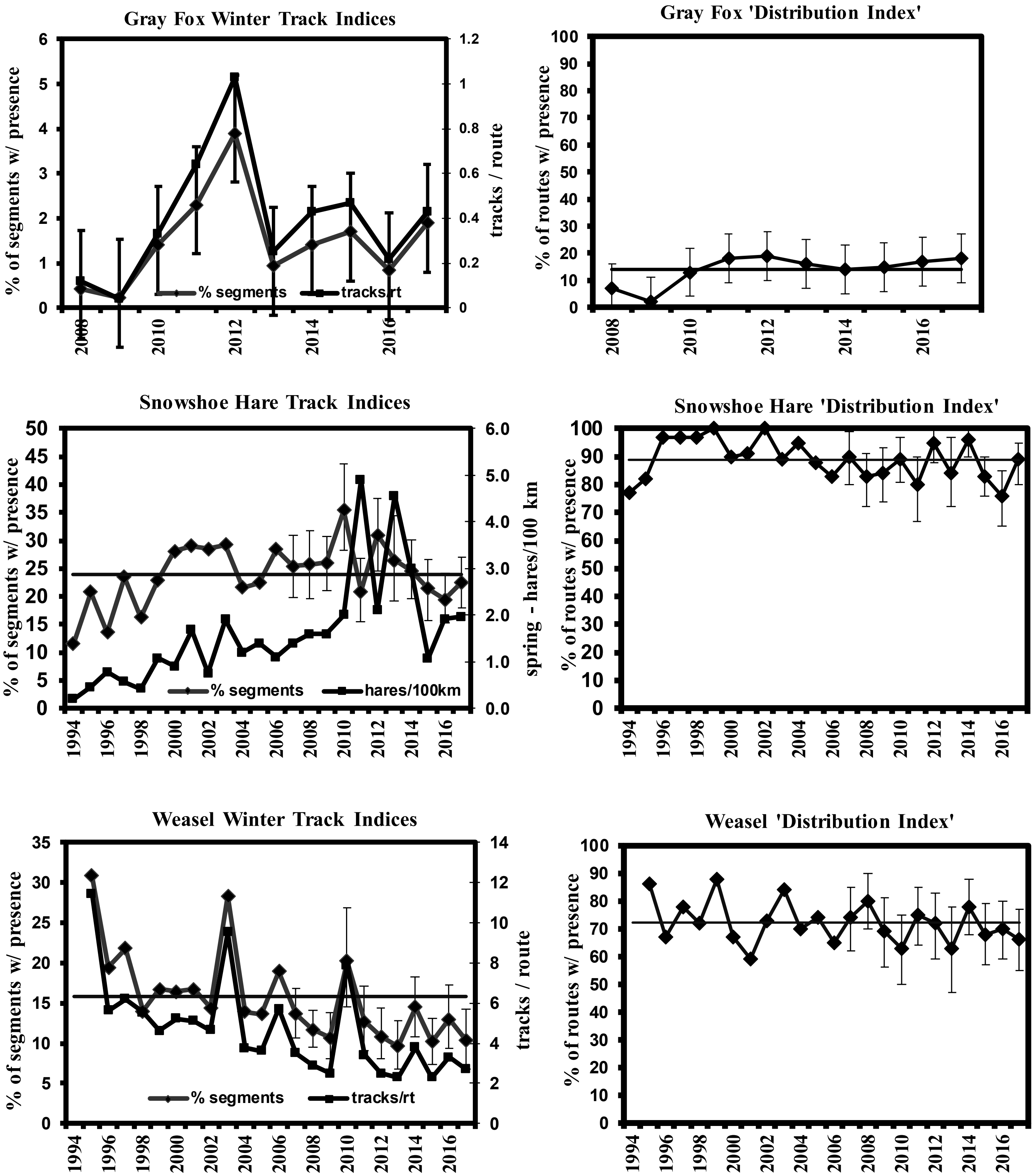

Figure 4 (continued). Winter track indices for selected species in Minnesota, 1994-2017.

FOREST WILDLIFE POPULATIONS

Forest Wildlife Populations and Research Group
1201 East Highway 2
Grand Rapids, MN 55744
(218) 327-4432

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STATUS OF MINNESOTA BLACK BEARS, 2017

Dave Garshelis and Andy Tri, Forest Wildlife Research Group

INTRODUCTION

The size of the Minnesota bear population has been estimated in the past using a biomarker (tetracycline) and mark–recapture based on hunter-submitted samples (Garshelis and Visser 1997, Garshelis and Noyce (2006). The last estimate was produced in 2008, and the use of that biomarker may no longer be permitted. Since then, trends in the population have been assessed using various modelling approaches, based on composition (sex-age) of harvest data. Additionally, population information may be inferred by examination of nuisance bear complaints and the seasonal abundance of natural bear foods.

METHODS

Successful hunters must register their bears and submit a tooth sample, which is used to estimate age, and thus harvest age structure. Hunters also report the sex of their harvested bear; we adjust this for a known bias in hunter-reported sex (11% of female bears reported as males). Ages and sexes of harvested bears were used to reconstruct a minimum statewide population through time. Each sex was estimated separately, and then summed. Age groups were collapsed to 1, 2, and 3+ years in order to estimate population size 3 years in the past (no more recent estimates can be obtained using this technique). This technique only estimates the size of the population that eventually dies due to hunting; to account for bears that die of other causes, the trend lines are scaled upward to attempt to match tetracycline-based estimates.

A second, independent assessment of population trend is obtained by investigating harvest rates (% of living bears harvested each year). A relatively low harvest rate would signify a population with more potential growth. Harvest rate is estimated from the inverse of the age at which the number of males and females in the harvest is equal, based on methodology of Fraser (1984).

RESULTS

Population trend

Ages of harvested bears accumulated since 1980 were used to reconstruct minimum statewide population sizes through time (i.e., the size of the population that eventually died due to hunting) using a technique formulated by Downing (Figure 1). This was scaled upwards (to include bears that died of other causes), using 4 statewide tetracycline mark–recapture estimates as a guide (Figure 2). Whereas both the tetracycline-based and reconstructed populations showed a “humped” trajectory, with an increase during the 1990s, followed by a decline during the 2000s, the shapes of the 2 trajectories differed somewhat (the reconstructed population curves were less steep). Therefore, it was not possible to exactly match the curve from the reconstruction to all 4 tet- based estimates.

Downing population reconstruction assumes equal harvest pressure through time: as harvest pressure is diminished, and fewer bears are killed (as has been the trend since 2003), ensuing population estimates will be biased low, so it is possible that the curve for the most recent years should be higher.

Harvests were intentionally reduced in the quota zone when it was surmised (in the mid-2000s) that the population was declining. Since 2013, quotas were maintained at a low and fairly consistent level (Table 1), although harvests varied with food.

Population reconstruction does not provide reliable estimates for the 2 most recent years, so the most recent estimate is pre-hunt 2015. This estimate shows an increase of about 10%, following the very low harvest of 2014. Both quota and no- quota zones increased by about the same percent. However, the unexpectedly high harvest of 2016 (in both quota and no-quota zones) is not yet reflected in the model estimates.

Trends in harvest rates

The sex ratio of harvested bears varies by age in accordance with the relative vulnerability of the sexes (Figure 3). Male bears are more vulnerable to harvest than females, so males always predominate among harvested 1-year-olds (67–75%). Males also predominate, but less strongly among 2 and 3-year-old harvested bears. However, older-aged harvested bears (≥7 years) are nearly always dominated by females, because, although old females continue to be less vulnerable, there are far more of them than old males in the living population. The age at which the line fitted to these proportions crosses the 50:50 sex ratio is approximately the inverse of the harvest rate. Segregating the data into time blocks showed harvest rates increasing from 1980–1999, then declining with reductions in hunter numbers (Figure 4). Harvest rates since 2014 have been significantly less than what they were in the early 1980s, when the bear population was increasing (Figure 2).

Nuisance complaints and kills

The total number of recorded bear complaints slowly increased over the past decade, reaching a peak in 2015 and 2016 (Table 2, Figure 5). Number of complaints declined in 2017, despite a higher number of DNR personnel recording complaints. A new recording system was instituted in 2017 whereby Wildlife Managers recorded all bear complaints online as they were received, instead of submitting reports at the end of each month (thus, unlike previous years, Managers who had no complaints were not counted in the number of personnel participating). Conservation Officers continued to use the monthly reporting system (and recorded zero when they had no complaints). Six Wildlife Managers and 2 Conservation Officers received 20 or more (up to 40) nuisance bear reports in 2017. The number of nuisance bears killed in 2017 was less than half that of 2015 and 2016. Conservation Officers recorded 4x the number of bears killed than Wildlife Managers. A new effort to target nuisance bears through an “area 88” quota hunting license resulted in only 1 bear being killed. No bears were killed by permittees.

Food abundance

The composite range-wide, all-season abundance of natural bear foods (fruits and nuts) in 2017 was similar to 2016; this was lower than 2013 and 2014 (both good food years) and above 2015 (a poor food year). Regionally in 2017 (Figure 6), more summer foods were below than above the long-term (33-year) average (Figures 4, 5, 6). The statewide fall food index (productivity of dogwood+oak+hazel), which helps predict annual harvest after accounting for hunter effort (Figure 7), was equivalent to 2013 and 2014, and considerably higher than 2015 and 2016. Dogwood and hazelnut production were low in the north-central and northeast, but high in east-central. Oak was above average in the northwest and north-central, and average elsewhere.

Predictions of harvest from food abundance

The 2017 statewide harvest was close to what was expected, based on regression of harvest as a function of hunter numbers and the fall food productivity index (Figure 7). This regression is particularly strong (and has accurately predicted previous harvests) when only the past 15 years are considered. However, for the quota zone, the actual harvest in 2017 was higher than predicted by this regression.

All data contained herein are subject to revision, due to updated information, improved analysis techniques, and/or regrouping of data for analysis.

Table 1. Number of bear hunting quota area permits available, 2012–2017. Highlighted values show a change from the previous year. BMUs 26 and 44 were divided into 27/28 and 46/47, respectively, in 2016.

BMU	2012	2013	2014	2015	2016		2017
					Before BMU split [a]	After BMU split	
12	300	200	200	150	150	150	125
13	400	250	250	250	250	250	225
22	100	50	50	50	50	50	50
24	300	200	200	200	200	200	175
25	850	500	500	500	500	500	400
26	550	350	350	350	325		
27						250	225
28						75	60
31	900	550	550	550	550	550	500
41	250	150	150	150	125	125	125
44	700	450	450	450	450		
46						400	350
47						50	40
45	200	150	150	150	250	250	175
51	1450	900	900	900	1000	1000	900
Total	**1650**	**3750**	**3750**	**3700**	3850	**3850**	**1465**

[a] In 2016, the Leech Lake Reservation was split from BMUs 26 and 44 to form BMUs 28 (north) and 47 (south), with the remaining area of BMU 26 renamed BMU 28 and remaining area of BMU 44 renamed BMU 46. The column shows permit allocation before the split in order to compare with previous years.

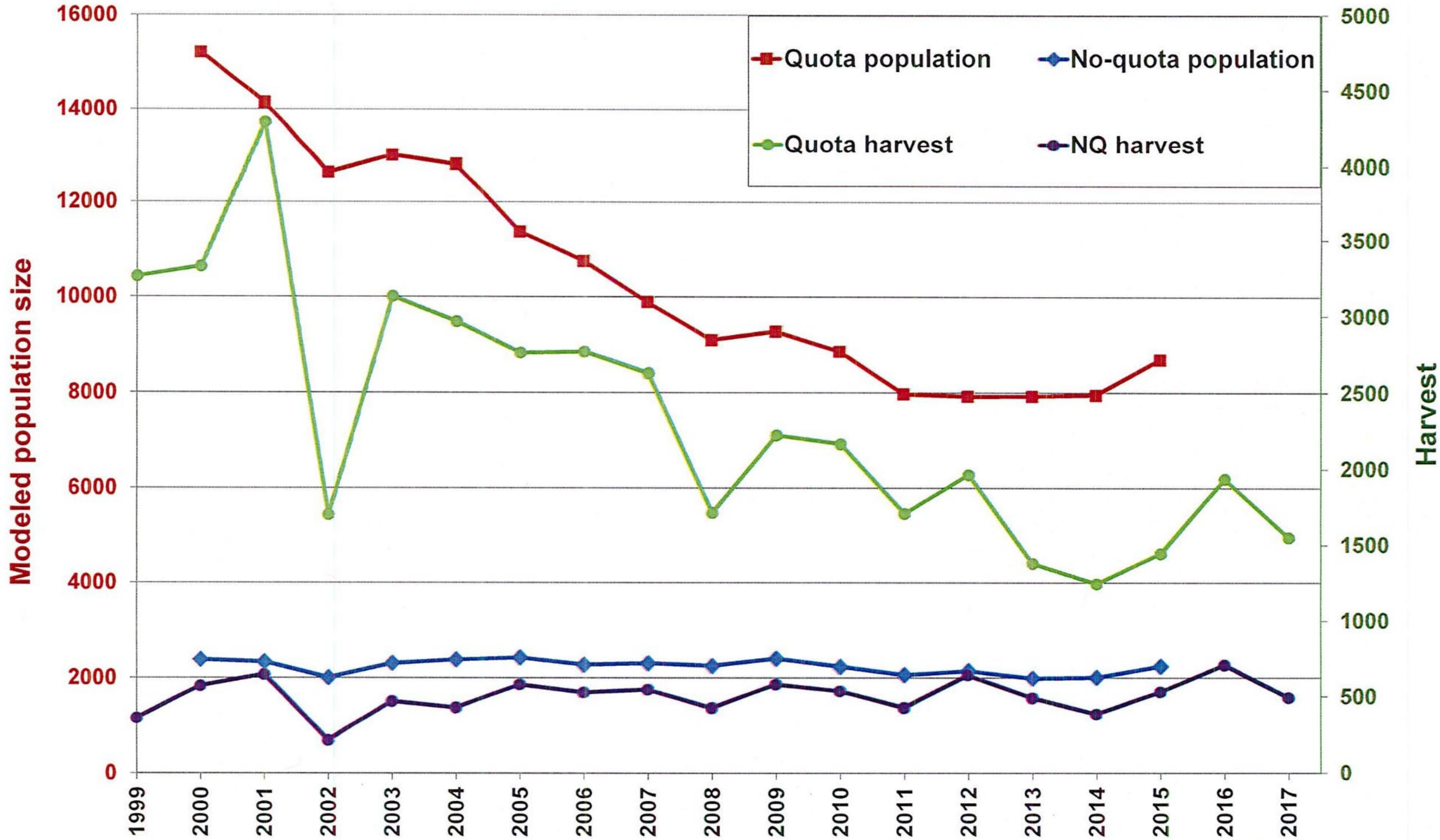

Figure 1. Population trends during 2000s derived from Downing reconstruction for quota and no-quota zones compared to respective harvests. Reconstruction-based estimates <2 years from the most recent harvest age data are unreliable (hence curves terminate in pre-hunt 2015). Population curves were scaled (elevated to account for non-harvest mortality) to match the lower curve in Figure 1 (i.e., the actual scale of the population estimates is not empirically-based).

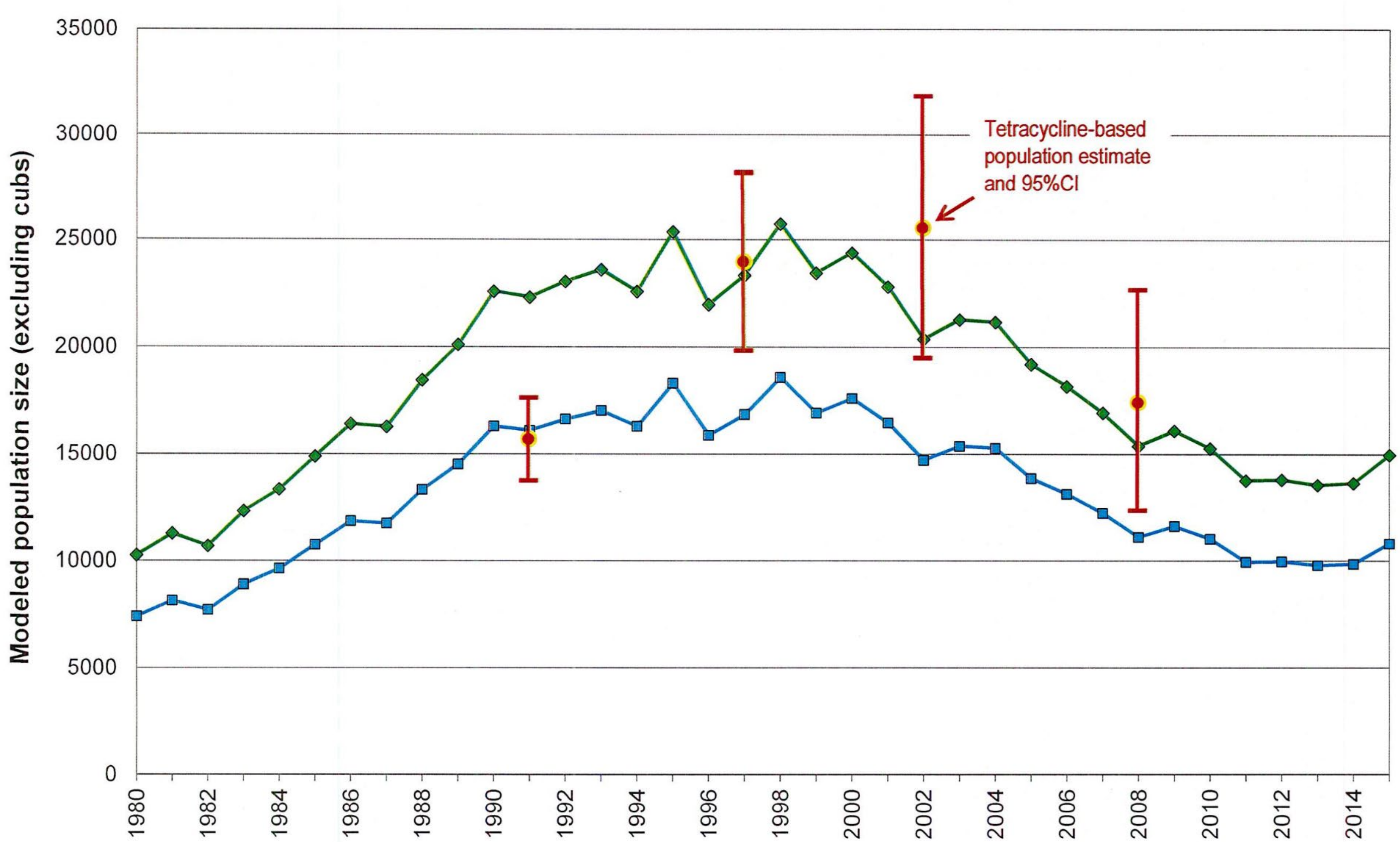

Figure 2. Statewide bear population trend (pre-hunt) derived from Downing reconstruction using harvest age structures, 1980–2017. Curves were scaled (elevated to account for non-harvest mortality) to various degrees to attempt to match the tetracycline-based mark–recapture estimates (2 such curves shown here). Estimates beyond 2015 are unreliable.

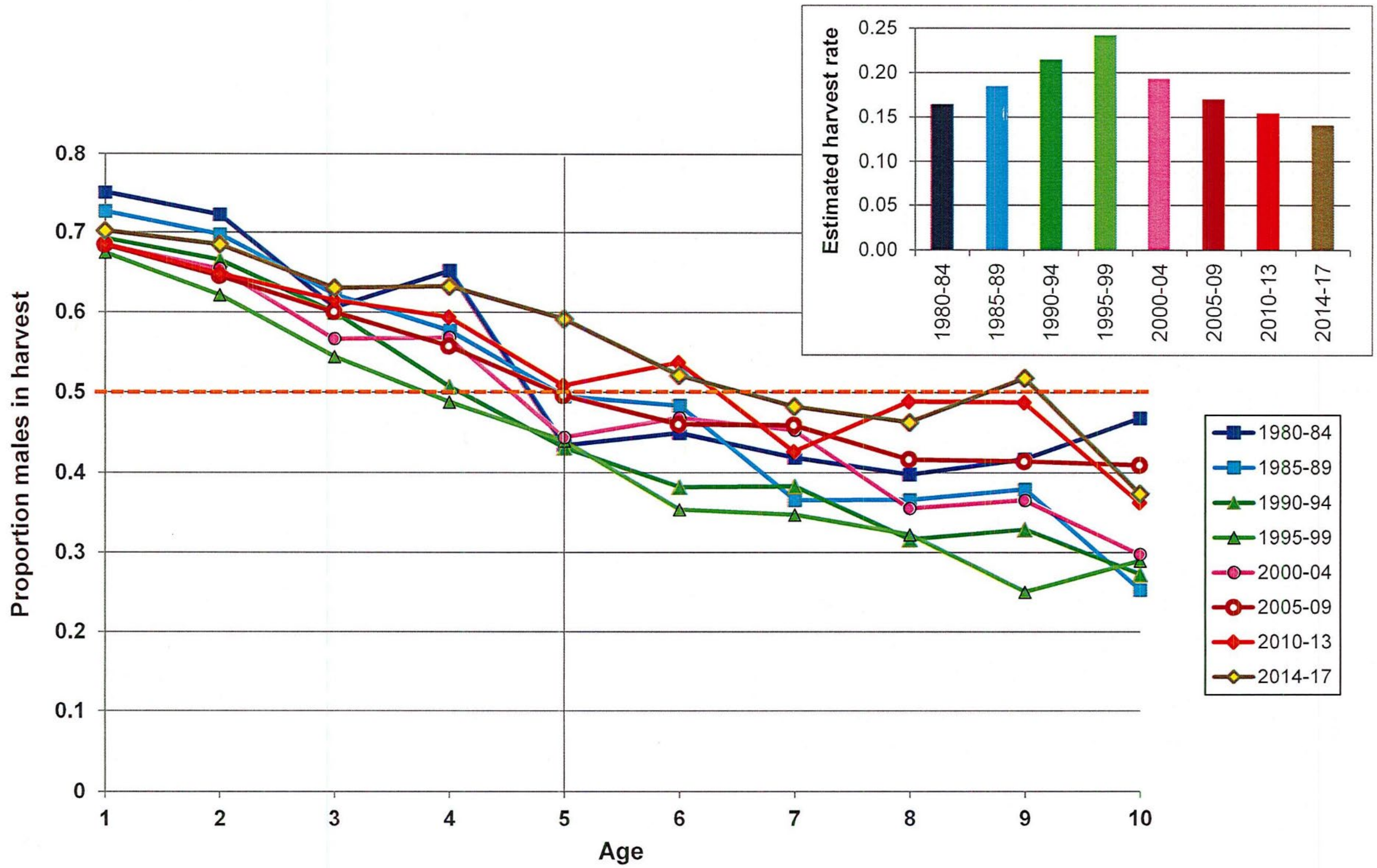

Figure 3. Trends in proportion of male bears in statewide harvest at each age, 1–10 years, grouped in 5-year time blocks, 1980–2017 (last 2 intervals are 4 years). Higher harvest rates result in steeper curves because males are reduced faster than females. Fitting a line to the data for each time block and predicting the age at which 50% of the harvest is male (dashed tan line) yields approximately the inverse of the harvest rate (derived rates are shown in inset).

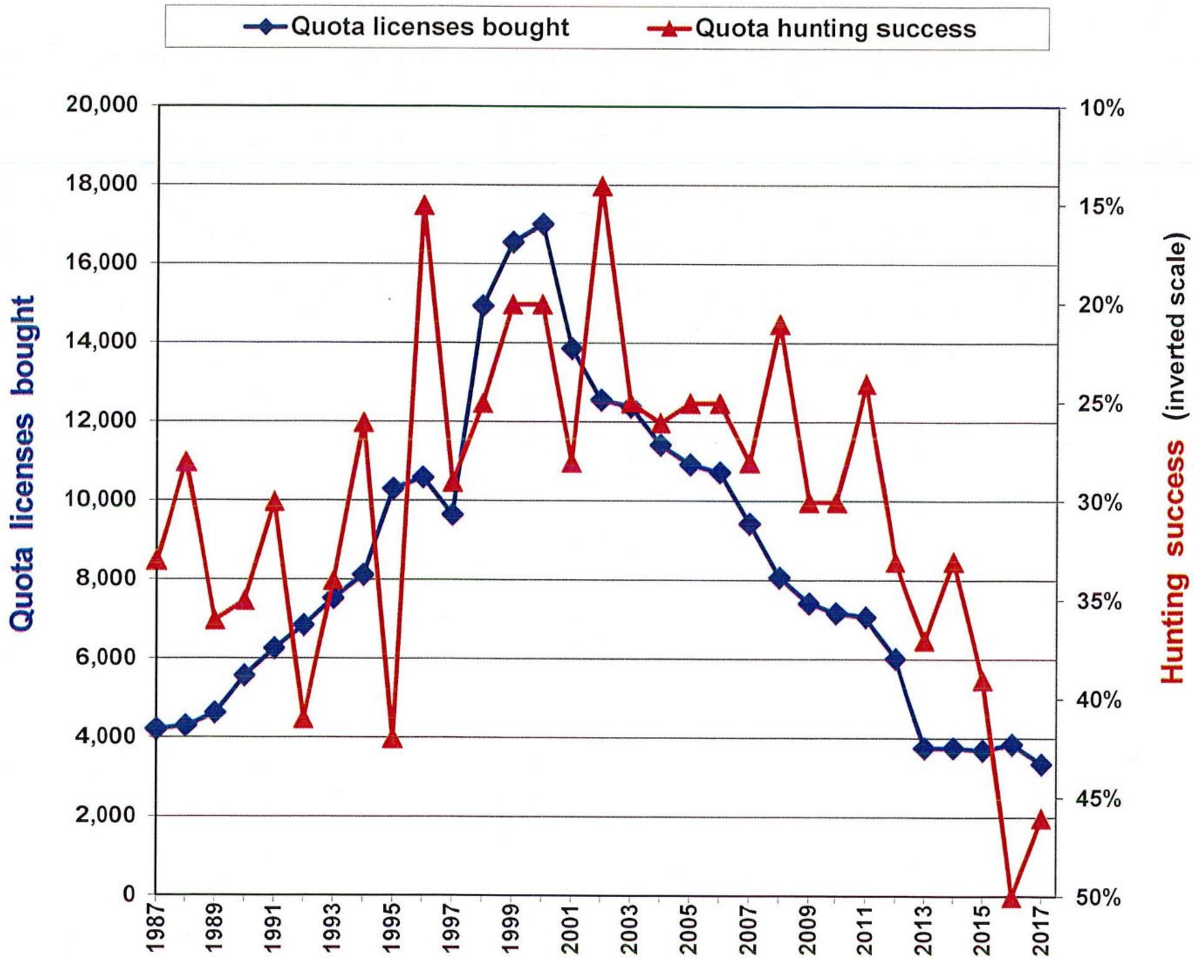

Figure 4. Relationship between licenses sold and hunting success (*note inverted scale*) in quota zone, 1987–2017 (no-quota zone first partitioned out in 1987). Number of licenses explains 48% of variation in hunting success during this period. Large variation in hunting success is also attributable to food conditions.

Table 2. Number of nuisance bear complaints registered by Conservation Officers and Wildlife Managers during 1997–2017, including number of nuisance bears killed and translocated, and bears killed in vehicular collisions.

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017 [i]
Number of personnel participating in survey [a]	69	71	52	60	54	50	39	34	42	46	46	37	51	40	34	56	63	64	61	55	86 (51,35)
Complaints examined on site	661	226	189	105	122	75	81	75	61	57	63	59	65	70	37	113	69	79	97	118	71 (22,49)
Complaints handled by phone [b]	2196	743	987	618	660	550	424	507	451	426	380	452	535	514	396	722	623	570	840	780	644 (450,194)
Total complaints received	2857	969	1176	723	782	625	505	582	512	483	443	511	600	584	433	835	692	649	937	898	715
• % Handled by phone	77%	77%	84%	85%	84%	88%	84%	87%	88%	88%	86%	88%	89%	88%	91%	86%	90%	88%	90%	87%	90%
Bears killed by: • Private party or DNR	93	31	25	25	22	12	13	25	28	11	21	22	23	22	9	16	24	26	45	53	22 (4, 18)
• Hunter before season [c]																					
– from nuisance survey	32	23	5	7	4	0	3	3	6	2	18	3	4	3	3	11	0	0	1	13	1
– from registration file	35	31	24	43	20	11	8	4	13	6	25	5	15	10	5	12	0	1	4	6	3
• Hunter during/after season [d]	4	3	0	1	1	0	0	0	1	0	0	0	0	0	0	0	1	0	1	1	1
• Hunter by Area 88 license [e]																					1
• Permittee [f]	7	11	7	2	6	4	6	1	5	4	5	1	3	5	0	0	1	0	3	0	0
Bears translocated	115	24	29	1	6	3	1	3	3	3	1	3	2	2	2	0	3	2	0	0	0
• % bears translocated [g]	17	11	15	1	5	4	1	4	5	5	2	5	3	3	5	0	4	3	0	0	0
Bears killed by cars [h]	52	61	60	39	43	26	25	16	22	18	20	27	18	28	15	33	32	28	47 h	27	9 h

Table 8. (continued)

[a] Maximum number of people turning in a nuisance bear report each month. Monthly reports were required beginning in 1984, and included cases of zero complaints. In 2017, the recording system was changed, where it was no longer possible to differentiate Wildlife Managers who participated month by month. Instead, the number reflects the total number of people receiving and recording at least 1 complaint during that year. For consistency, the records from Conservation Officers were handled the same way.

[b] If a complaint was handled by phone, it means a site visit was not made.

[c] The discrepancy between the number recorded on the nuisance survey and the number registered before the opening of the season indicates incomplete data. Similarity between the two values does not necessarily mean the same bears were reported.

[d] Data only from nuisance survey because registration data do not indicate whether bear was a nuisance.

[e] Beginning in 2017, hunters could choose Area 88 in the quota lottery, and if drawn, could hunt for a nuisance bear, if authorized. In 2017, 11 hunters were authorized, but only 1 killed a bear.

[f] A permit for non-landowners to take a nuisance bear before the bear season was officially implemented in 1992, but some COs individually implemented this program in 1991. Data are based on records from the nuisance survey, not directly from permit receipts. Only 4 bears have been killed by permittees since 2011.

[g] Percent of on-site investigations resulting in a bear being captured and translocated.

[h] Car kill data were reported on the monthly nuisance form for the first time in 2005. In all previous years, car kill data were from Enforcement's confiscation records. In 2015, confiscation records had more car-kills than the nuisance survey (47 vs 33), so the higher number is shown here. In 2017, only 1 car-kill was in the confiscation records. The number of reported car-kills in 2017 was the lowest since record-keeping began in 1981.

[i] Beginning in 2017, Wildlife Managers recorded nuisance bear complaints on an all-species wildlife damage app, whereas Conservation Officers continued to submit monthly nuisance bear survey forms (April–Oct). The 2 survey tools are not exactly the same, so data are presented separately for each in parenthesis (Wildlife Managers, COs). For consistency, only April–October data are included (in 2017 10 calls were received in other months).

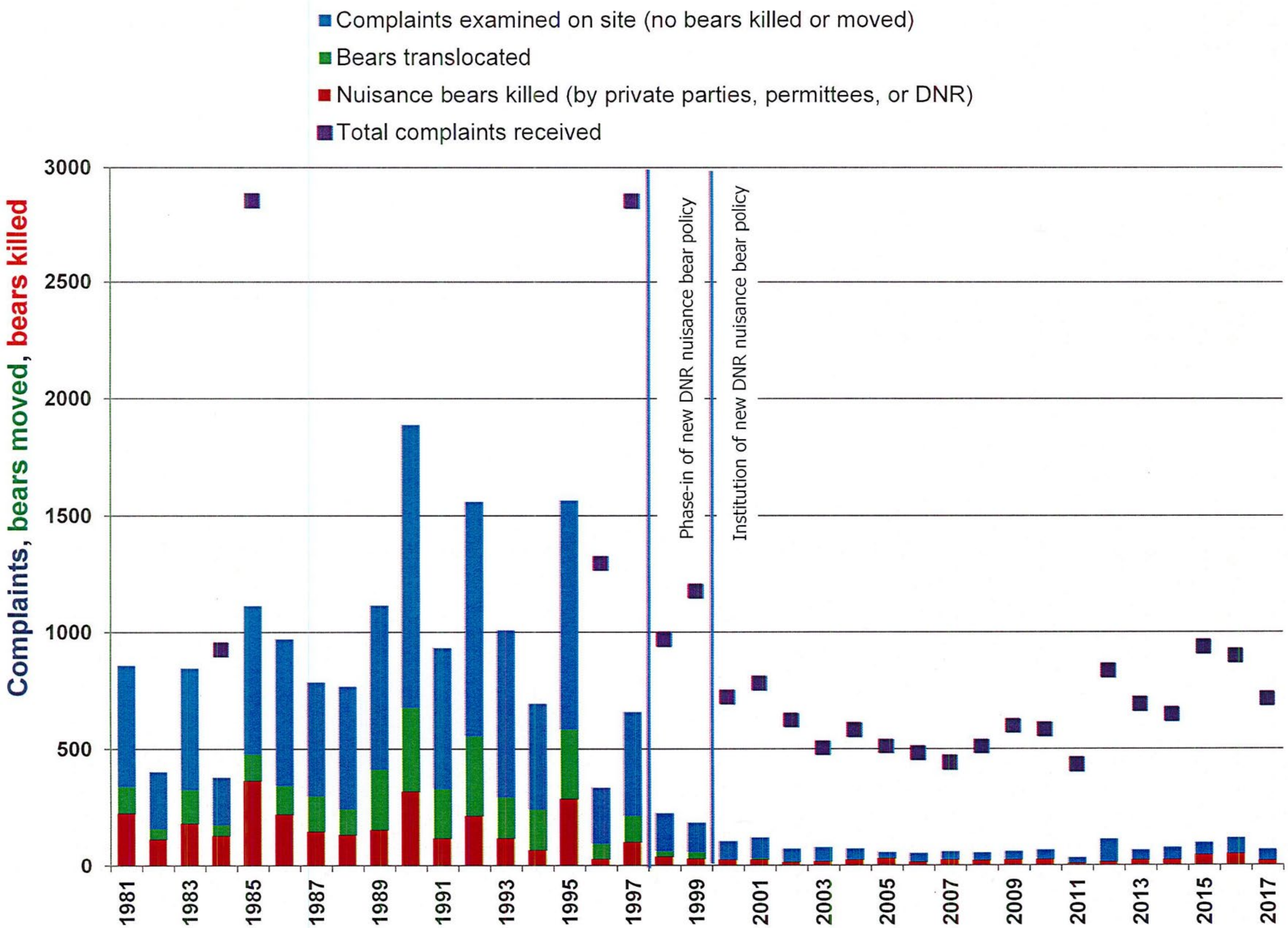

Figure. 5. Trends in nuisance bear complaints, and nuisance bears killed and moved, 1981–2017, showing dramatic effect of change in nuisance bear policy, and slight increasing trend over past decade.

Table 3. Number of bear hunting quota area permits available, 2012–2017. Highlighted values show a change from the previous year. BMUs 26 and 44 were divided into 27/28 and 46/47, respectively, in 2016.

BMU	2012	2013	2014	2015	2016		2017
					Before BMU split [a]	After BMU split	
12	300	200	200	150	150	150	125
13	400	250	250	250	250	250	225
22	100	50	50	50	50	50	50
24	300	200	200	200	200	200	175
25	850	500	500	500	500	500	400
26	550	350	350	350	325		
27						250	225
28						75	60
31	900	550	550	550	550	550	500
41	250	150	150	150	125	125	125
44	700	450	450	450	450		
46						400	350
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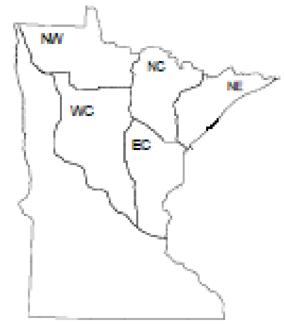
51	1450	900	900	900	1000	1000	900
Total	**1650**	**3750**	**3750**	**3700**	3850	**3850**	**1465**

[a] In 2016, the Leech Lake Reservation was split from BMUs 26 and 44 to form BMUs 28 (north) and 47 (south), with the remaining area of BMU 26 renamed BMU 28 and remaining area of BMU 44 renamed BMU 46. The column shows permit allocation before the split in order to compare with previous years.

Table 4. Regional bear food indices[a] in Minnesota's bear range, 1984–2017. Shaded blocks indicate particularly low (<45; pink) or high (≥70; green) values.

	Survey Area					
Year	NW	NC	NE	WC	EC	Range wide
1984	32.3	66.8	48.9	51.4	45.4	51.8
1985	43.0	37.5	35.3	43.5	55.5	42.7
1986	83.9	66.0	54.7	74.7	61.1	67.7
1987	62.7	57.3	46.8	67.4	69.0	61.8
1988	51.2	61.1	52.7	54.4	47.3	56.0
1989	55.4	58.8	48.1	47.8	52.9	51.6
1990	29.1	39.4	55.4	44.0	47.9	44.1
1991	59.7	71.2	64.8	72.1	78.9	68.4
1992	52.3	59.9	48.6	48.1	63.3	58.2
1993	59.8	87.8	75.0	73.9	76.8	74.3
1994	68.6	82.3	61.3	81.5	68.2	72.3
1995	33.8	46.5	43.9	42.0	50.9	44.4
1996	89.5	93.2	88.4	92.2	82.1	87.6
1997	58.2	55.5	58.8	62.0	70.1	63.9
1998	56.9	72.8	66.4	72.3	84.5	71.1
1999	63.7	59.9	61.1	63.2	60.6	62.0
2000	57.7	68.0	54.7	69.2	67.4	62.3
2001	40.6	48.7	55.6	62.2	66.0	55.8
2002	53.1	63.4	60.4	68.6	68.3	66.8
2003	59.1	57.5	55.2	58.6	49.7	58.8
2004	57.0	60.5	61.1	70.3	67.9	64.4
2005	53.4	65.9	61.4	59.9	72.6	62.3
2006	51.0	64.9	53.4	51.0	52.1	56.9
2007	68.4	79.0	57.3	67.6	70.0	69.4
2008	58.6	74.1	64.7	66.6	71.4	65.4
2009	59.9	67.8	63.2	69.2	69.5	66.5
2010	70.0	71.3	79.0	60.8	57.3	68.0
2011	64.4	59.6	57.9	66.7	63.5	62.5
2012	49.1	50.3	59.4	50.5	41.5	50.7
2013	71.9	77.1	76.0	59.1	63.2	71.8
2014	71.4	70.7	71.4	61.0	66.5	70.2
2015	47.1	56.3	41.3	64.8	45.5	48.7
2016	71.9	60.3	73.8	53.7	57.0	60.3
2017	57.2	55.7	52.7	62.2	68.3	58.9



[a] Each bear food index value represents the sum of the mean index values for 14 species, based on surveys conducted in that area. Range-wide mean is derived directly from all surveys conducted in the state (i.e., not by averaging survey area means).

Table 5. Regional mean index values[a] for bear food species in 2017 compared to the previous 33-year mean (1984-2016) in Minnesota's bear range. Shading indicates particularly high (green) or low (pink) fruit abundance relative to average (≥1 point difference for individual foods; ≥5 points difference for totals).

FRUIT	NW		NC		NE		WC		EC		Rangewide	
	33yr mean	2017 (*n* = 10[b])	33yr mean	2017 (*n* = 11)	33yr mean	2017 (*n* = 6)	33yr mean	2017 (*n* = 9)	33yr mean	2017 (*n* = 8)	33yr mean	2017 (*n* = 37)
SUMMER												
Sarsaparilla	4.5	4.3	5.7	4.9	5.2	2.7	4.5	3.3	5.3	5.9	5.0	4.3
Pincherry	3.3	3.1	4.5	3.9	4.2	4.3	3.7	3.1	3.7	4.3	3.8	3.7
Chokecherry	5.7	5.5	5.5	5.1	4.5	5.3	5.4	4.7	4.6	4.3	5.2	5.0
Juneberry	5.1	4.4	4.9	4.3	5.0	4.3	3.6	3.0	4.0	3.0	4.3	3.8
Elderberry	1.6	0.8	3.0	1.7	3.6	3.1	3.1	0.8	3.3	2.3	3.1	1.9
Blueberry	5.0	3.0	5.4	5.8	4.9	5.7	3.5	3.3	3.6	5.0	4.4	4.4
Raspberry	6.4	6.0	8.0	5.8	7.9	7.8	7.0	8.2	7.0	7.3	7.0	6.8
Blackberry	1.3	1.1	2.4	2.2	1.2	1.0	3.5	4.7	4.4	4.9	2.9	2.7
FALL												
Wild Plum	2.1	3.4	1.8	1.0	1.1	1.8	2.7	4.4	2.4	2.4	2.2	2.7
HB Cranberry	5.3	5.1	4.5	4.2	3.9	2.4	3.9	3.3	3.7	4.9	4.2	3.8
Dogwood	6.0	8.2	5.7	4.7	4.9	4.0	6.0	6.5	5.8	6.9	5.7	6.3
Oak	3.6	4.8	3.1	4.1	1.9	1.3	5.9	6.1	5.6	4.9	4.4	4.4
Mountain Ash	1.5	1.1	2.5	1.8	4.6	2.7	1.6	2.9	2.2	2.5	2.5	1.8
Hazel	6.3	6.4	7.3	6.2	7.0	6.3	7.9	7.9	7.5	9.7	7.2	7.3
TOTAL	57.9	57.2	64.3	55.7	59.7	52.7	62.3	62.2	63.3	68.3	61.9	58.9

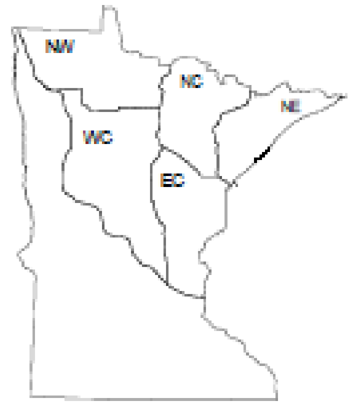
[a] Food abundance indices were calculated by multiplying species abundance ratings x fruit production ratings.

[b] *n* = Number of surveys used to calculate area-specific means

[c] Sample size for the entire range does not equal the sum of the sample sizes of 5 survey areas because some surveys were conducted on the border of 2 or more areas and were included in calculations for both.

Table 6. Regional productivity index[a] for important fall foods (oak + hazel + dogwood) in Minnesota's bear range, 1984–2017. Shading indicates particularly low (≤ 5.0; yellow) or high (≥8.0; tan) values.

	Survey Area					
Year	NW	NC	NE	WC	EC	Entire Range
1984	4.2	7.6	7.0	6.2	7.0	6.5
1985	4.9	2.8[b]	4.2	4.7	5.3	4.4
1986	7.2	5.0	4.0	7.0	6.2	6.2
1987	8.0	7.8	7.3	7.6	8.0	7.7
1988	5.5	7.2	7.3	6.8	6.1	6.7
1989	6.0	5.3	4.1	5.7	6.4	5.8
1990	3.3[b]	4.2	6.4	5.7	6.4	5.2
1991	6.2	6.2	5.4	7.2	7.7	6.7
1992	4.7	5.0	4.4	4.4[b]	6.8	5.1
1993	5.3	7.1	6.7	6.2	7.7	6.5
1994	7.1	7.8	5.8	7.8	7.1	7.2
1995	4.8	4.8	5.1	4.6	5.3	4.9
1996	8.7	8.6	8.1	9.2	8.5	8.6
1997	5.8	5.4	5.1	6.8	6.5	6.2
1998	5.8	6.0	6.3	7.1	7.8	6.7
1999	6.4	5.1	5.9	6.6	6.0	6.2
2000	5.8	7.7	7.2	7.5	8.5	7.0
2001	3.4	4.1	5.7	6.0	6.5	5.2
2002	8.7	7.1	6.6	8.8	8.2	8.1
2003	6.3	6.0	5.5	6.2	6.0	6.1
2004	6.1	5.4	5.4	6.4	6.1	5.9
2005	5.8	5.8	6.1	6.4	7.0	6.2
2006	6.7	6.1	6.0	6.7	5.8	6.3
2007	6.0	5.8	5.7	6.6	6.4	6.2
2008	6.6	7.3	6.2	7.0	8.9	7.1
2009	5.1	6.2	5.3	6.3	6.5	6.0
2010	7.7	6.4	6.5	6.2	5.4	6.6
2011	5.8	6.5	6.2	7.0	7.4	6.5
2012	6.2	6.3	6.3	6.5	4.8	6.1
2013	6.8	6.0	5.7	6.7	6.9	6.3
2014	7.0	5.6	5.4	7.7	6.1	6.7
2015	5.8	5.9	3.5[b]	8.2	3.7[b]	5.6
2016	5.7	5.2	6.0	5.4	5.3	5.3
2017	6.8	5.6	5.1	7.1	7.4	6.5



[a] Values represent the sum of mean production scores for hazel, oak, and dogwood, derived from surveys conducted in each survey area. Range-wide mean is for all surveys conducted in the state (i.e. not an average of survey area means). [b] Record low fall food score in survey area.

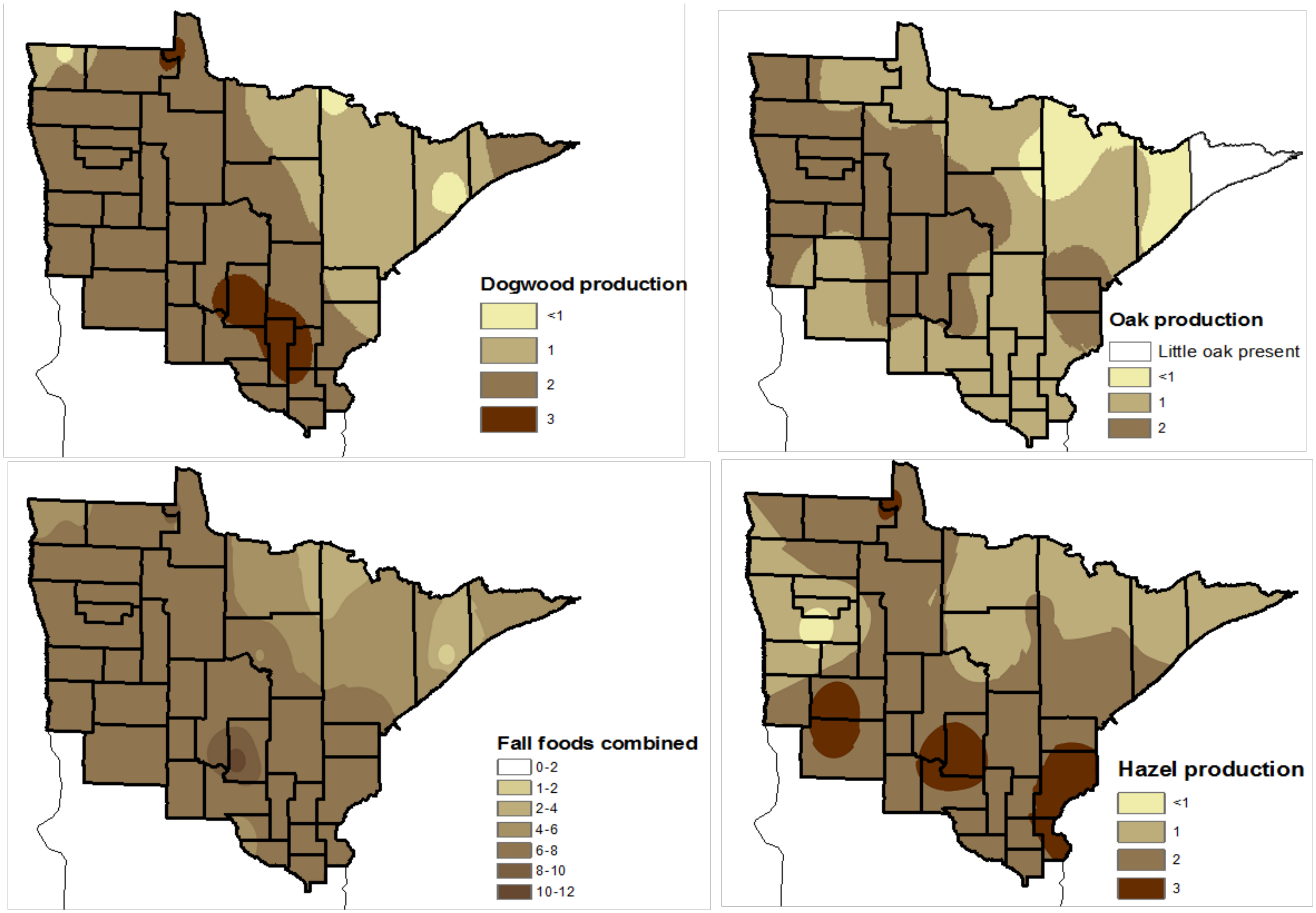
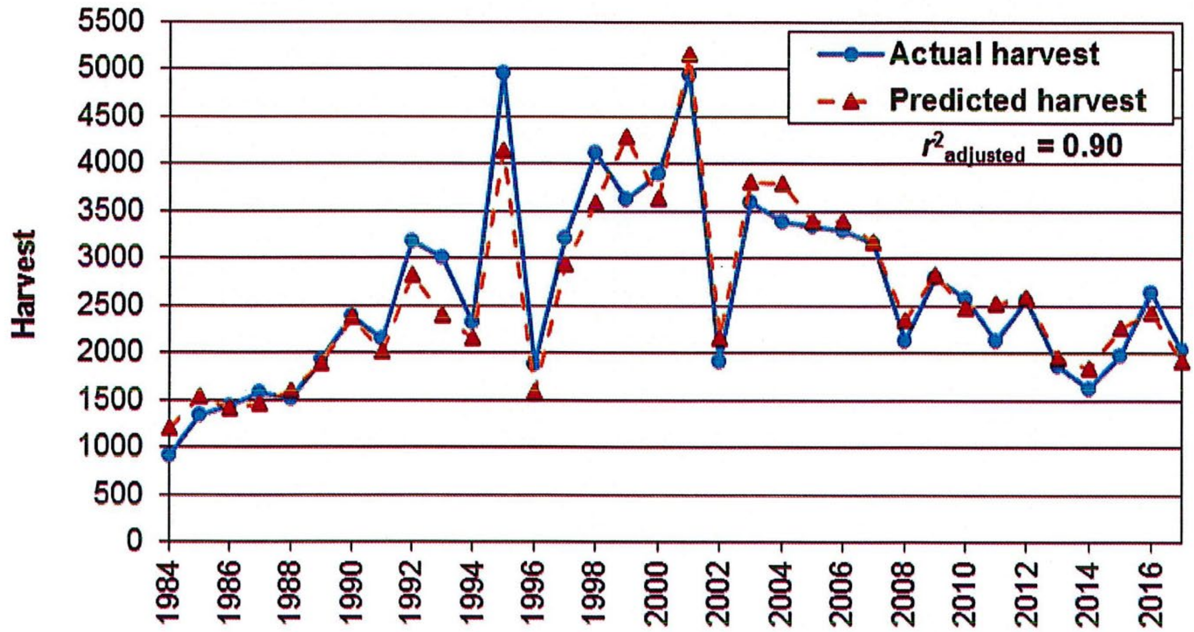


Figure 6. Production of fall bear foods (dogwood, oak, hazel) across Minnesota, 2017.



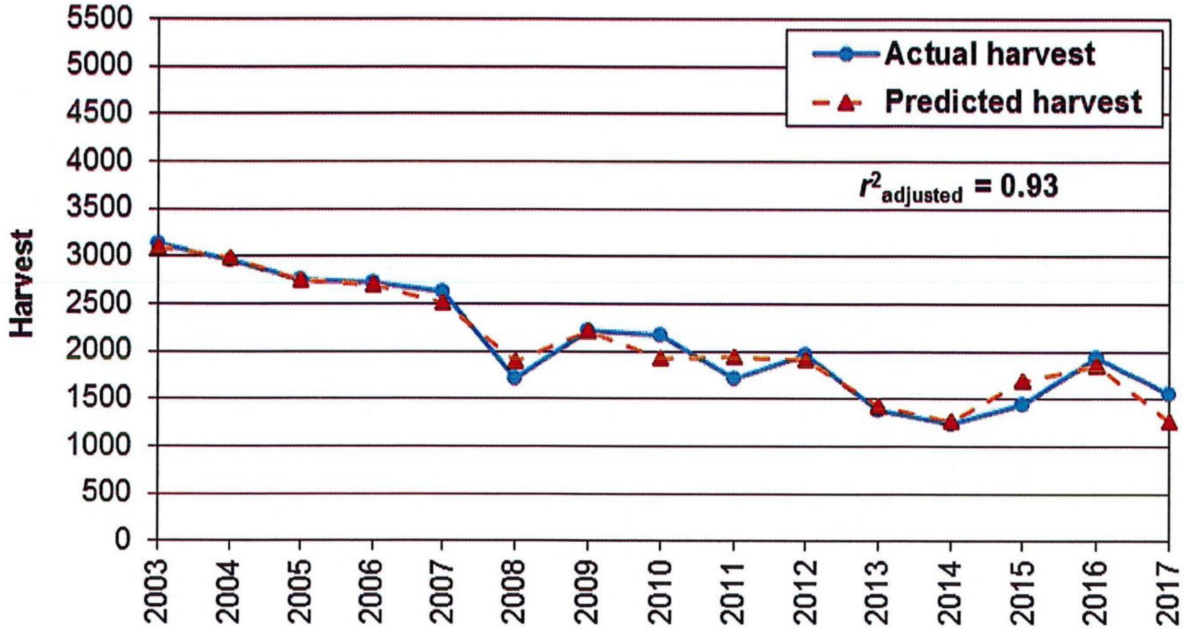


Figure 7. Number of bears harvested vs. number predicted to be harvested based on number of hunters and fall food production — top panel: statewide 1984–2017; bottom panel: quota zone only, most recent 15 years. Regression for the full dataset included an interaction term between food and hunters to better predict the drastic changes in harvest when fall foods were extremely high or low.

2018 MINNESOTA SPRING GROUSE SURVEYS

Charlotte Roy, Forest Wildlife Populations and Research Group

SUMMARY OF FINDINGS

The Minnesota DNR coordinates ruffed grouse (*Bonasa umbellus*) and sharp-tailed grouse (*Tympanuchus phasianellus*) surveys each spring with the help of wildlife staff and cooperating federal, tribal, and county agencies. In 2018, ruffed grouse surveys were conducted between 5 April and 15 May. Mean ruffed grouse drums per stop (dps) were 1.5 statewide (95% confidence interval = 1.3–1.7) and decreased (29%) from the previous year. High points in the population cycle occur on average every 10 years, and surveys this year indicate that the peak occurred last year, with counts similar to the previous peak in 2009. In more southern portions of ruffed grouse range, survey results were more similar to last year. Spring was very late in 2018, and it is possible that the drumming survey was conducted earlier than the peak in drumming this year. However, other factors likely also contributed to the decline in counts.

Sharp-tailed grouse surveys were conducted between 21 March and 20 May 2018, with 1,503 birds (males and birds of unknown sex) observed at 161 leks. The mean numbers of sharp-tailed grouse/lek were 7.3 (5.4–9.6) in the East Central (EC) survey region, 9.8 (8.8–10.9) in the Northwest (NW) region, and 9.3 (8.4–10.3) statewide. Comparisons between leks observed in consecutive years (2017 and 2018) indicated a 23% decline in birds/lek statewide ($t = 3.9$, $P = 0.0001$) and a 24% decline in the NW region ($t = 3.5$, $P = 0.0006$), but the 22% decrease in the EC region ($t = 1.8$, $P = 0.09$) was not statistically significant, likely due to the smaller number of leks surveyed in that region.

INTRODUCTION

The ruffed grouse (*Bonasa umbellus*) is the most popular game bird in Minnesota, with an annual harvest averaging >500,000 birds (~150,000 to 1.4 million birds). Ruffed grouse hunter numbers have been as high as 92,000 during the last decade, although hunter numbers did not peak with the recent peak in grouse numbers, as they have traditionally. Sharp-tailed grouse (*Tympanuchus phasianellus*) are also popular among hunters, with an annual harvest of 6,000-22,000 birds since the early-1990s and 5,000–10,000 hunters in Minnesota.

The Minnesota DNR coordinates grouse surveys each year to monitor changes in grouse populations through time. These surveys provide a reasonable index to population trends, when the primary source of variation in counts among years is change in densities. However, weather, habitat conditions, observer ability, and grouse behavior, also vary over time and can influence survey counts. Thus, making inferences from survey data over short time periods (e.g., a few years) can be tenuous. Nevertheless, over longer time periods and when large changes in index values occur, these surveys can provide a reasonable index to long-term grouse population trends. Spring surveys, in combination with hunter harvest statistics, provide evidence that the ruffed grouse population cycles at approximately 10-year intervals.

The first surveys of ruffed grouse in Minnesota occurred in the mid-1930s, and the first spring survey routes were established along roadsides in 1949. By the mid-1950s, ~50 routes were established with ~70 more routes added during the late-1970s and early-1980s. Since that time, spring drumming counts have been conducted annually to survey ruffed grouse in the forested regions of the state where ruffed grouse habitat occurs. Drumming is a low sound produced by males as they beat their wings rapidly and in increasing frequency to signal the location of their territory. These drumming displays also attract females that are ready to begin nesting, so the frequency of drumming increases in the spring during the breeding season. The sound produced when male grouse drum is easy to hear and thus drumming counts are a convenient way to survey ruffed grouse populations in the spring.

Sharp-tailed grouse were first surveyed in Minnesota between the early-1940s and 1960. The current survey is based on counts at dancing grounds during the spring and was first conducted in 1976. Male sharp-tailed grouse display, or dance, together in open areas to attract females in the spring. This display consists of the males stomping their feet with out-stretched wings. Females visit the dancing grounds to select males for breeding. These dancing grounds, or leks, are reasonably stable in location from year to year, allowing surveyors to visit and count individuals each spring. Surveys are conducted in openland portions of the state where sharp-tailed grouse persist, although they were formerly much more widely distributed in Minnesota at the early part of the 20th century.

METHODS

Ruffed Grouse

Surveys for ruffed grouse were conducted along established routes throughout the state. Each route consisted of 10 listening stops at approximately 1.6-km (1-mile) intervals. The placement of routes on the landscape was determined from historical survey routes, which were originally placed near ruffed grouse habitat in low traffic areas. Annual sampling of these historical routes provides information about temporal changes along the routes, but may not be representative of the counties or regions where the routes occurred.

Survey observers were solicited from among state, federal, tribal, private, and student biologists. Each observer was provided a set of instructions and route location information. No formal survey training was conducted but all observers had a professional background in wildlife science, and most had previously participated in the survey. Participants were asked to conduct surveys at sunrise during peak drumming activity (in April or May) on days that had little wind and no precipitation. Each observer drove the survey route once and listened for drumming at each stop for 4 minutes. Observers recorded the number of drums heard at each stop (not necessarily the number of individual grouse), along with information about phenology and weather at the time of the survey.

The number of drums heard per stop (dps) was used as the survey index value. I determined the mean dps for each route, for each of 4 survey regions (Figure 1), and for the entire state. For each survey region, I calculated the mean of route-level means for all routes partially or entirely within the region. Routes that traversed regional boundaries were included in the means for both regions. Because the number of routes within regions was not related to any proportional characteristic, I used the weighted mean of index values for the 4 Ecological Classification Sections (ECS) in the Northeast region and the 7 ECS sections in the state. The geographic area of the section was used as the weight for each section mean (i.e., Lake Agassiz, Aspen Parklands = 11,761 km^2, Northern Minnesota and Ontario Peatlands = 21,468 km^2, Northern Superior Uplands = 24,160 km^2, Northern Minnesota Drift and Lake Plains = 33,955 km^2, Western Superior Uplands = 14,158 km^2, Minnesota and Northeast Iowa Morainal (MIM) = 20,886 km^2, and Paleozoic Plateau (PP) = 5,212 km^2). The area used to weight drum index means for the MIM and PP sections was reduced to reflect the portion of these areas within ruffed grouse range (~50%) using subsection boundaries. A 95% confidence interval (CI) was calculated to convey the uncertainty of each mean index value using 10,000 bootstrap samples of route-level means for survey regions and the whole state. Confidence interval boundaries were defined as the 2.5th and 97.5th percentiles of bootstrap frequency distributions.

Sharp-tailed Grouse

Wildlife staff and volunteers surveyed known sharp-tailed grouse lek locations in their work areas in the Northwest (NW) and East Central (EC) portions of the state (Figure 2). The NW region consisted of Lake Agassiz & Aspen Parklands, Northern Minnesota & Ontario Peatlands, and Red River Valley ECS sections. The EC region consisted of selected subsections of the Northern Minnesota Drift & Lake Plains, Western Superior Uplands, and Southern Superior Uplands sections. In the EC region, and in eastern portions of the NW region where sharp-tailed grouse occur at low densities, most known leks are surveyed each year. Some leks may have been missed, but most managers in these regions believed that they included most of the leks in their work area, with the exception of Aitkin and Tower work areas where workloads do not permit exhaustive surveys. In the western part of the NW region, sharp-tailed grouse occur at higher densities, and thus surveying all leks is not feasible. Therefore, in the western portion of the NW region (e.g., Roseau, Thief River Falls), managers conduct surveys along 20-25 mile (32-40 km) routes. Given the uncertainty in the proportion of leks missed, especially those occurring outside traditional areas, the survey may not necessarily reflect sharp-tailed grouse numbers in larger areas such as counties or regions.

Each cooperator was provided with instructions and asked to conduct surveys on ≥1 day in an attempt to obtain a maximum count of male sharp-tailed grouse attendance at each lek. Observers were asked to conduct surveys within 2.5 hours of sunrise under clear skies and during low winds (<16 km/hr, or 10 mph) when lek attendance and ability to detect leks were expected to be greatest. Data recorded during each lek visit included the number of males, females, and birds of unknown sex. Observed lek size can vary as a function of population changes, lek numbers, and the timing, effort, and conditions of surveys, so it is important to consider all these factors when collecting data.

The number of sharp-tailed grouse per dancing ground was used as the index value and was averaged for the NW region, the EC region, and statewide, using known males and birds of unknown sex. Observations of just 1 grouse were not included in the index. Data from former survey years were available for comparison, however, survey effort and success varied among years rendering comparisons of the full survey among years invalid. Therefore, to make valid comparisons between 2 consecutive years, only counts of birds from dancing grounds that were surveyed during both years were considered. Paired t-tests were used to test the significance of comparisons among years. Confidence intervals (95%) were calculated using 10,000 bootstrap samples of lek counts for each region and statewide.

RESULTS & DISCUSSION

Ruffed Grouse

Observers from 16 cooperating organizations surveyed 122 routes between 5 April and 15 May 2018. Most routes (98%) were surveyed between 22 April and 15 May, with a median survey date of May 3, which is similar to last year (May 3) and the median survey date for the most recent 10 years. Excellent (58%), Good (35%), and Fair (7%) survey conditions were reported for 119 routes reporting conditions.

Statewide counts of ruffed grouse drums averaged 1.5 dps (95% confidence interval = 1.3–1.8 dps) during 2018 (Figure 3). Drum counts were 1.7 (1.5–2.1) dps in the Northeast (n = 101 routes), 1.0 (0.5–1.5) dps in the Northwest (n = 8), 0.9 (0.4–1.4) dps in the Central Hardwoods (n = 12), and 0.9 (0.5–1.4) dps in the Southeast (n = 7) regions (Figure 4a-d). Statewide drum counts decreased (29%) from last year. The ruffed grouse population was in the increasing phase of the 10-year cycle and was expected to peak this year or next year. Although peaks in the cycle average 10 years, they have occurred slightly before or after 10 years. Surveys this year indicate the peak occurred last year. Some portion of the decline might have been due to the very late spring in 2018, and a lack of synchrony between calendar date and the peak of drumming activity this year. However, poor synchrony is unlikely to entirely explain the drop in counts this year.

Sharp-tailed Grouse

A total of 1,503 male sharp-tailed grouse and grouse of unknown sex were counted at 161 leks (Table 1) during 21 March to 20 May 2018. The statewide index value of 9.3 (8.4–10.3) grouse/lek was centrally located among values observed since 1980 (Figure 5). In the EC survey region, 220 grouse were counted on 30 leks, and 1,280 grouse were counted on 130 leks in the NW survey region. One lek of 3 birds was counted just south of the NW region in Clearwater County. The grouse/lek index was similar statewide and in both survey regions compared to 2017 (Table 1). Leks with ≥2 grouse were observed an average of 2.1 times. Counts at leks observed during both 2017 and 2018 were 23% lower in 2018 statewide ($t = 3.9$, $P = 0.0001$) and 24% lower in the NW region ($t = 3.5$, $P = 0.0006$), but the 22% decline in the EC region was not significant ($t = 1.8$, $P = 0.09$; Table 2), likely because fewer leks were surveyed in that region (Figure 6).

Sharp-tailed grouse population index values peaked with those for ruffed grouse in 2009, and appear to have troughed with them in 2013, but sharp-tailed grouse peaks can follow those of ruffed grouse by as much as 2 years. Although decreases in the population index were not statistically significant in the EC region, 25% fewer leks were detected in the EC region this year, which diminishes statistical power to detect differences. Furthermore, a loss of small leks would tend to maintain the average lek size, while comparisons of leks surveyed in successive years would tend to decline. This is the pattern that was observed. No sharp-tailed grouse were observed in surveys in Kanabec County this year, which is the first time this has occurred in recent history, although the number of birds have dwindled slowly in this area. Sharp-tailed grouse rely on habitats that require ongoing management (e.g., prescribed fire, mowing, and shearing) for maintenance. Obstacles to successfully completing management include funding, staffing shortages, equipment, weather, and landowner permission.

In the NW region, the number of leks counted, average lek size, and comparisons between leks surveyed in successive years were all lower in 2018. Continued monitoring will document whether the NW population will continue to be a stronghold for sharp-tailed grouse in the state. During 2016–2018, the DNR allowed the capture and translocation of sharp-tailed grouse from the NW region to supplement a population of sharp-tailed grouse at Moquah Barrens in Wisconsin. The impact of this effort, if any, has not yet been examined, but only leks with ≥15 birds were trapped to try to safeguard against negative impacts.

ACKNOWLEDGEMENTS

The ruffed grouse survey was accomplished this year through the combined efforts of staff and volunteers at Chippewa and Superior National Forests (USDA Forest Service); Fond du Lac, Grand Portage, Leech Lake, Red Lake, and White Earth Reservations; 1854 Treaty Authority; Blandin Paper, Agassiz National Wildlife Refuge (U.S. Fish & Wildlife Service); Vermilion Community College; Beltrami County and Cass County Land Departments; and DNR staff at Aitkin, Baudette, Bemidji, Brainerd, Carlos Avery Wildlife Management Area (WMA), Cloquet, Crookston, Detroit Lakes, Fergus Falls, Grand Rapids, International Falls, Karlstad, Little Falls, Mille Lacs WMA, Park Rapids, Red Lake WMA, Rochester, Roseau River WMA, Sauk Rapids, Thief Lake WMA, Thief River Falls, Tower, Two Harbors, Whitewater WMA, and Winona work areas. I would like to thank DNR staff and volunteers at Aitkin, Baudette, Bemidji, Cambridge, Cloquet, Crookston, Karlstad, International Falls, Tower, Thief River Falls, and Thief Lake work areas, staff and volunteers at Red Lake and Roseau River WMAs, and partners at Agassiz National Wildlife Refuge for participating in sharp-tailed grouse surveys. Pam Coy, Alex Elliott, and Dan Ruka also helped with lek surveys this year. Laura Gilbert helped enter ruffed grouse data. Gary Drotts, John Erb, and Rick Horton organized an effort to enter the ruffed grouse survey data for 1982–2004, and Doug Mailhot and another volunteer helped enter the data. I would also like to thank Mike Larson for making helpful comments on this report. This work was funded in part through the Federal Aid in Wildlife Restoration Act.

Table 1. Sharp-tailed grouse / lek (≥2 males) at all leks observed during spring surveys each year in Minnesota.

	Statewide			Northwest[a]			East Central[a]		
Year	Mean	95% CI[b]	*n*[c]	Mean	95% CI[b]	*n*[c]	Mean	95%CI[b]	*n*[c]
2004	11.2	10.1 – 12.3	183	12.7	11.3 – 14.2	116	8.5	7.2 – 9.9	67
2005	11.3	10.2 – 12.5	161	13.1	11.5 – 14.7	95	8.8	7.3 – 10.2	66
2006	9.2	8.3 – 10.1	161	9.8	8.7 – 11.1	97	8.2	6.9 – 9.7	64
2007	11.6	10.5 – 12.8	188	12.7	11.3 – 14.1	128	9.4	8.0 – 11.0	60
2008	12.4	11.2 – 13.7	192	13.6	12.0 – 15.3	122	10.4	8.7 – 12.3	70
2009	13.6	12.2 – 15.1	199	15.2	13.4 – 17.0	137	10.0	8.5 – 11.7	62
2010	10.7	9.8 – 11.7	202	11.7	10.5 – 12.9	132	8.9	7.5 –10.5	70
2011	10.2	9.5 – 11.1	216	11.2	10.2 – 12.2	156	7.8	6.7 – 8.9	60
2012	9.2	8.2 – 10.3	153	10.7	9.3 – 12.3	100	6.3	5.4 – 7.3	53
2013	9.2	8.2 – 10.2	139	10.5	9.3 – 11.7	107	4.8	3.8 – 5.9	32
2014	9.8	8.8 – 10.9	181	10.9	9.8 – 12.1	144	5.4	4.5 – 6.4	37
2015	9.8	8.9 – 10.7	206	10.8	9.9 – 11.9	167	5.3	4.4 – 6.4	39
2016	9.5	8.6 – 10.5	182	10.2	9.2 – 11.4	152	6.0	4.9 – 7.3	30
2017	9.7	8.7 – 10.8	181	10.4	9.2 – 11.8	141	7.2	5.8 – 8.6	40
2018	9.3	8.4 – 10.3	161[d]	9.8	8.8 – 10.9	130	7.3	5.4 – 9.6	30

[a] Survey regions; see Figure 1.

[b] 95% CI = 95% confidence interval

[c] *n* = number of leks in the sample.

[d]One lek was located just south of the NW region in Clearwater County.

Table 2. Difference in the number of sharp-tailed grouse / lek observed during spring surveys of the same lek in consecutive years in Minnesota.

	Statewide			Northwest[a]			East Central[a]		
Comparison[b]	Mean	95% CI[c]	*n*[d]	Mean	95% CI[c]	*n*[d]	Mean	95%CI[c]	*n*[d]
2004 – 2005	-1.3	-2.2 – -0.3	186	-2.1	-3.5 – -0.8	112	0.0	-1.0 – 1.1	74
2005 – 2006	-2.5	-3.7 – -1.3	126	-3.6	-5.3 – -1.9	70	-1.1	-2.6 – 0.6	56
2006 – 2007	2.6	1.5 – 3.8	152	3.3	1.7 – 5.1	99	1.2	0.1 – 2.3	53
2007 – 2008	0.4	-0.8 – 1.5	166	0.0	-1.6 – 1.6	115	1.2	0.1 – 2.5	51
2008 – 2009	0.9	-0.4 – 2.3	181	1.8	-0.1 – 3.8	120	-0.8	-2.1 – 0.6	61
2009 – 2010	-0.6	-1.8 – 0.6	179	-0.8	-2.6 – 1.0	118	-0.1	-1.2 – 1.0	61
2010 – 2011	-1.7	-2.7 – -0.8	183	-1.8	-3.1 – -0.5	124	-1.5	-2.8 – -0.3	59
2011 – 2012	-2.0	-2.9 – -1.1	170	-1.7	-2.9 – -0.4	112	-2.4	-3.3 – -1.6	58
2012 – 2013	-0.8	-2.0 – 0.4	140	0.4	-1.3 – 2.3	88	-2.9	-4.2 – -1.8	52
2013 – 2014	1.4	0.1 – 2.7	121	1.6	-0.3 – 3.5	79	1.1	-0.1 – 2.3	42
2014 – 2015	-0.2	-1.4 – 0.9	141	-0.3	-1.9 – 1.3	102	-0.1	-1.1 – 1.1	39
2015 – 2016	-1.3	-2.3 – -0.2	167	-1.6	-2.9 – -0.2	129	-0.2	-1.3 – 0.9	38
2016 – 2017	-0.3	-1.5 – 0.9	166	-0.3	-1.8 – 1.2	128	-0.2	-1.2 – 0.8	38
2017 – 2018	-2.2	-3.3 – -1.1	159[e]	-2.4	-3.9 – -0.4	123	-1.4	-2.8 – 0.2	36

[a] Survey regions; see Figure 1.

[b] Consecutive years for which comparable leks were compared.

[c] 95% CI = 95% confidence interval

[d] *n* = number of leks in the sample. Here, a lek can have a 0 count in 1 of the 2 years and still be considered.

[e]One lek was located just south of the NW region in Clearwater County.

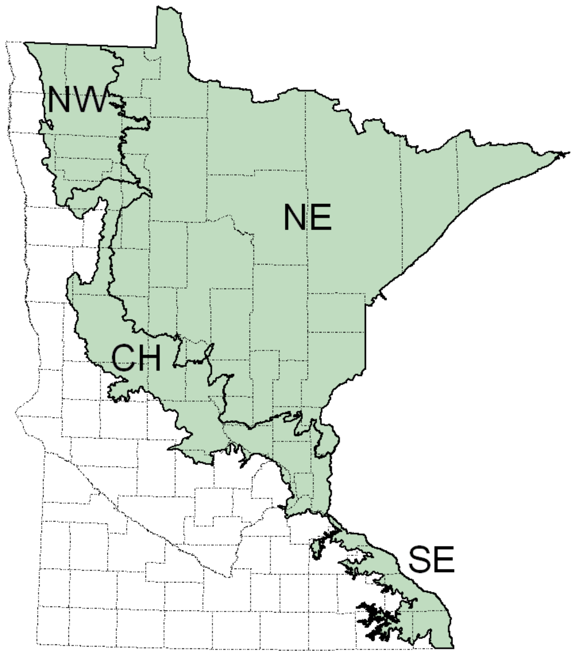


Figure 1. Survey regions for **ruffed grouse** in Minnesota. Northwest (NW), Northeast (NE), Central Hardwoods (CH), and Southeast (SE) survey regions are depicted relative to county boundaries (dashed lines) and influenced by the Ecological Classification System.

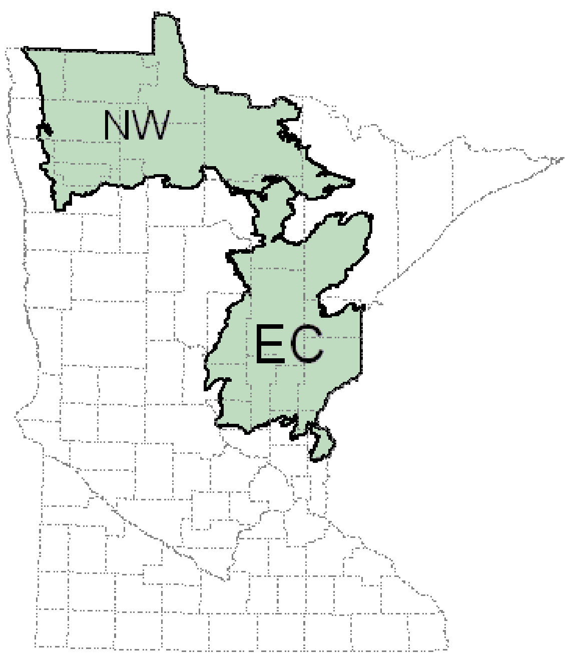


Figure 2. Survey regions for **sharp-tailed grouse** in Minnesota. Northwest (NW) and East Central (EC) survey regions are depicted relative to county boundaries (dashed lines) and influenced by Ecological Classification System Subsections boundaries.

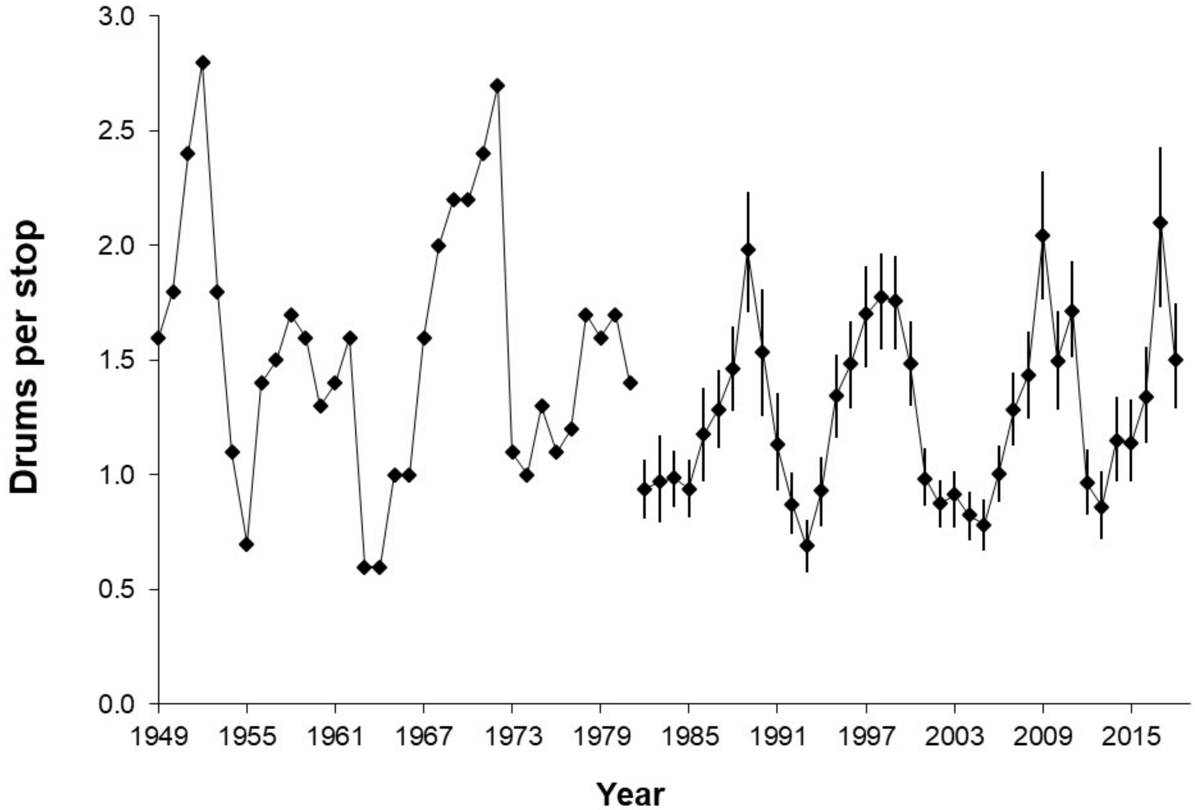
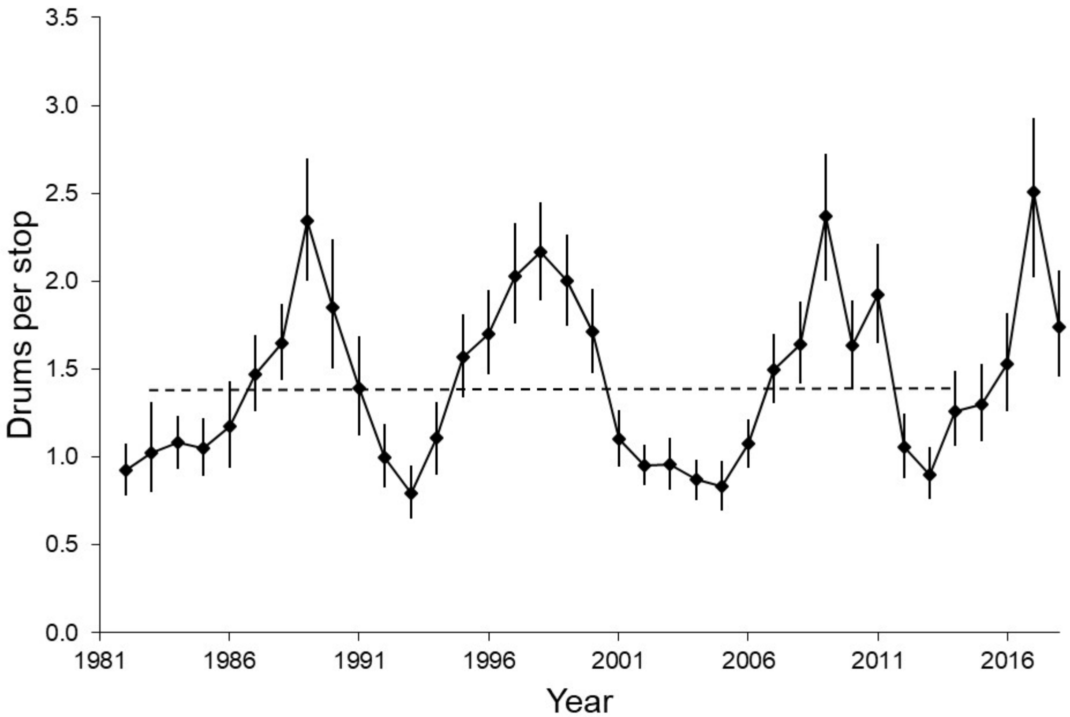
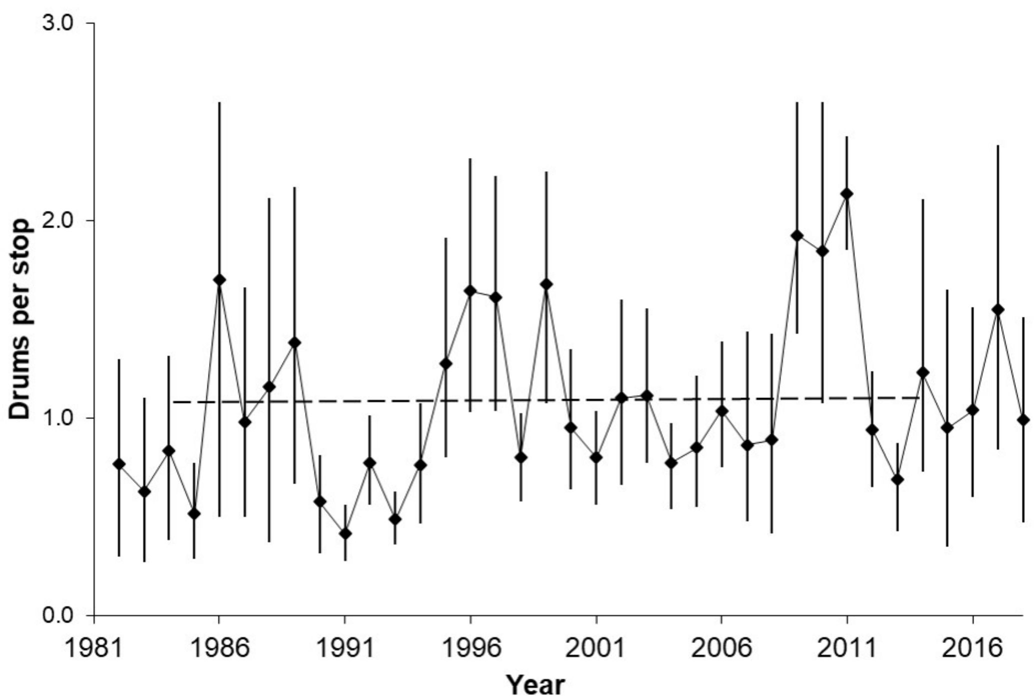


Figure 3. Statewide ruffed grouse population index values in Minnesota. Bootstrap (95%) confidence intervals (CI) are provided after 1981, but different analytical methods were used prior to this and thus CI are not available for earlier years. The difference between 1981 and 1982 is biological and not an artifact of the change in analysis methods.

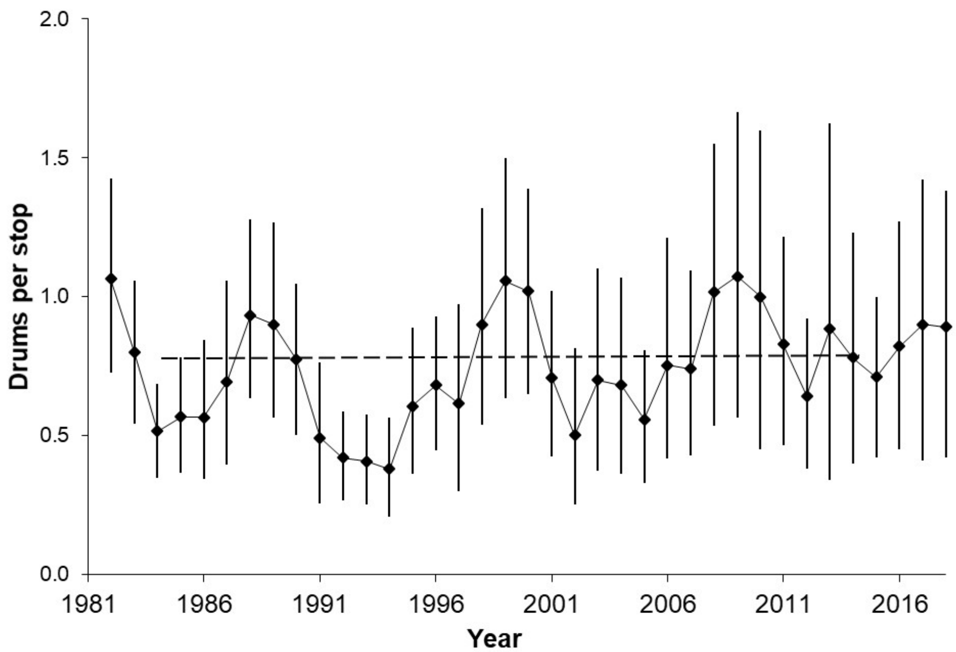
a.


3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Drums per stop
1981
1986
1991
1996
2001
2006
2011
2016
Year

b.


3.0
2.0
1.0
0.0
Drums per stop
1981
1986
1991
1996
2001
2006
2011
2016
Year

c.



d.

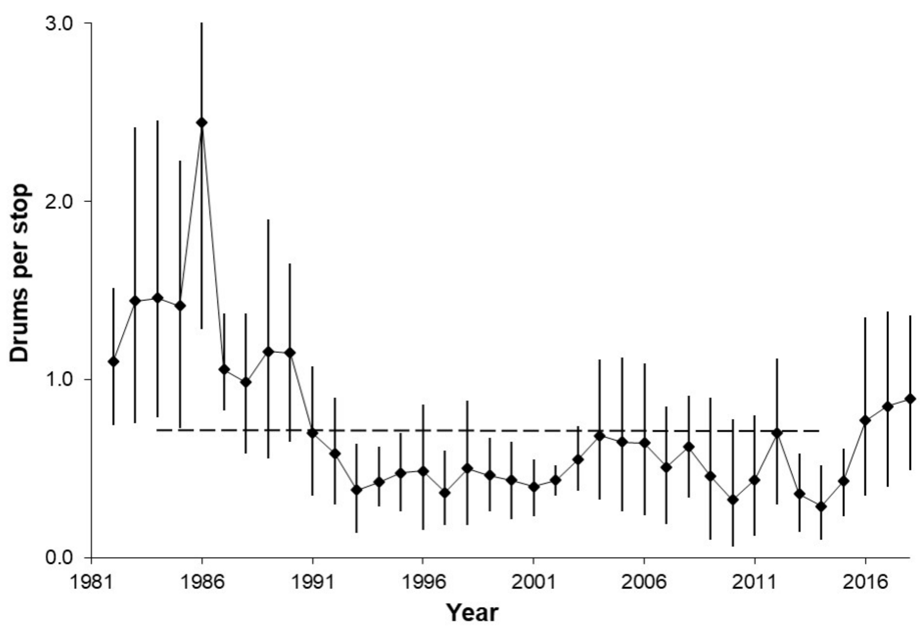


Figure 4a,b,c,d. Ruffed grouse population index values in the **Northeast** (a), **Northwest** (b), **Central Hardwoods** (c), and **Southeast** (d) survey regions of Minnesota. The mean for 1984-2014 is indicated by the dashed line. Bootstrap (95%) confidence intervals are provided for each mean. In the bottom panel, the CI for 1986 extends beyond area depicted in the figure.

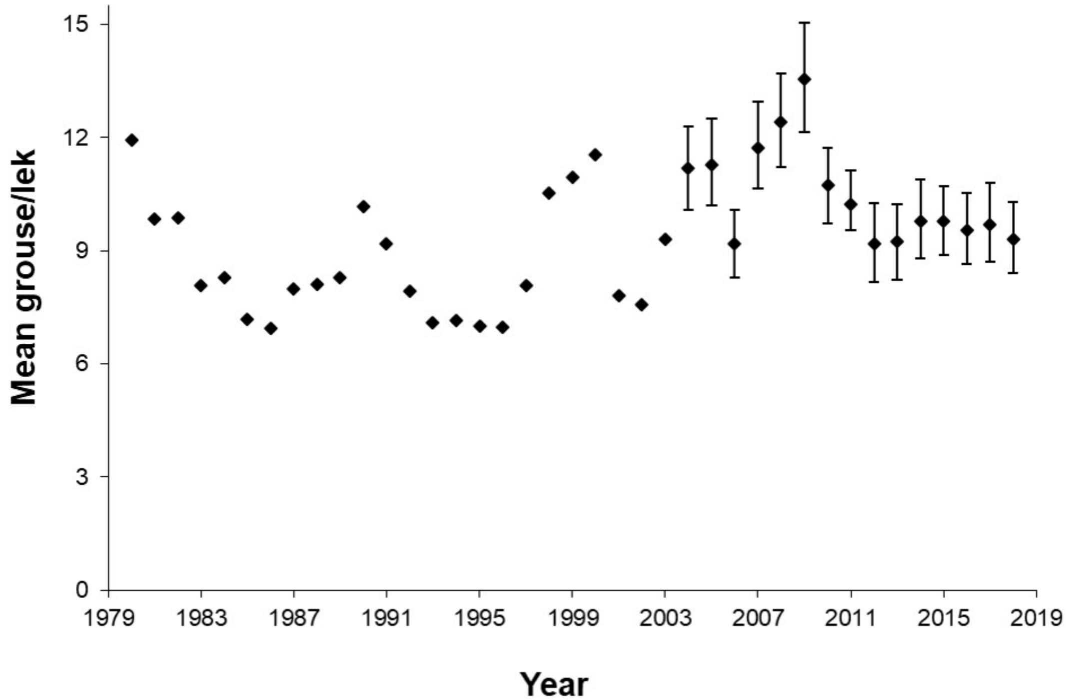


Figure 5. **Sharp-tailed grouse** counted in spring lek surveys statewide in Minnesota during 1980–2018. Bootstrap (95%) confidence intervals are provided for recent years. Annual means are not connected by lines because the same leks were not surveyed every year.

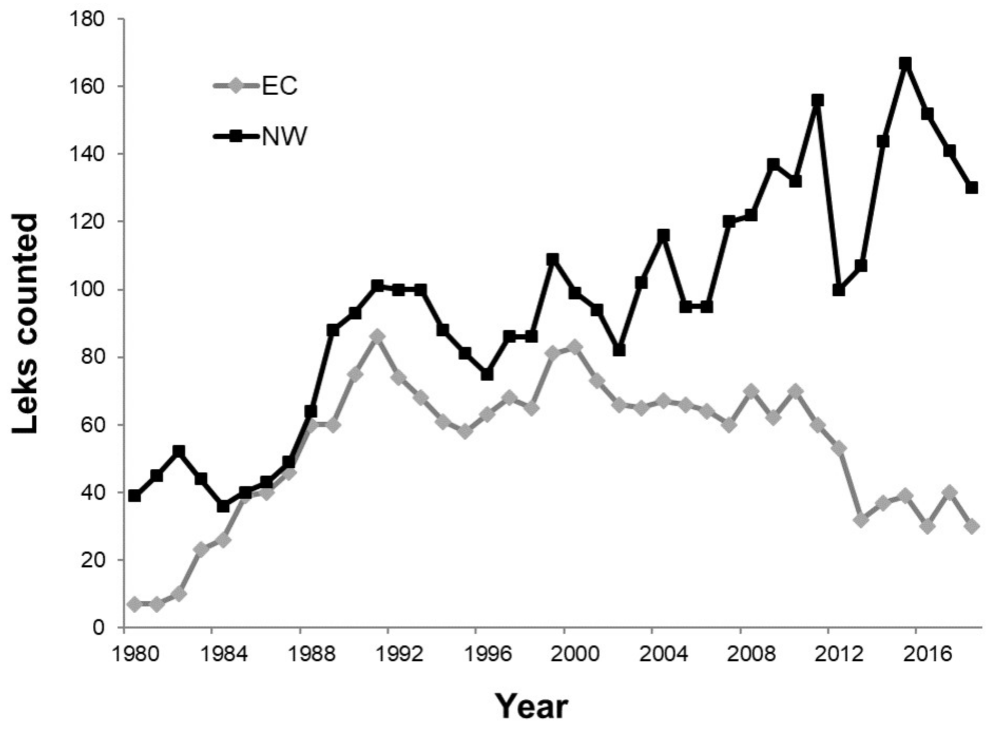


Figure 6. The number of **sharp-tailed grouse** leks counted in spring lek surveys in the Northwest (NW) and East Central (EC) survey regions of Minnesota during 1980-2018.

2018 MINNESOTA PRAIRIE-CHICKEN POPULATION SURVEY

Charlotte Roy, Forest Wildlife Populations and Research Group

SUMMARY OF FINDINGS

Greater prairie-chickens (*Tympanuchus cupido pinnatus*) were surveyed in all 17 survey blocks during the spring of 2018. Observers located 59 booming grounds and counted 630 males and birds of unknown sex in the survey blocks. They located 148 booming grounds,1,354 male prairie-chickens, and 164 birds of unknown sex throughout the prairie-chicken range. Estimated densities of 0.09 (0.06–0.11) booming grounds/km^2 and 10.7 (8.6–12.8) males/booming ground within the survey blocks were similar to densities during recent years and during the 10 years preceding modern hunting seasons (i.e., 1993–2002), but have declined since the standardized survey began in 2004. All population indices began to decline in 2008, but seem to have stabilized in recent years at a lower level.

INTRODUCTION

Historically, greater prairie-chicken (*Tympanuchus cupido pinnatus*) range in Minnesota was restricted to the southeastern portion of the state. However, dramatic changes in their range occurred in the 19th century as settlers expanded and modified the landscape with farming and forest removal, providing abundant food sources and access to new areas. However, as grass was lost from the landscape, prairie-chicken populations began to decline, their range contracted, and hunting seasons closed after 1942. In an attempt to bolster populations and expand prairie-chicken range, the Minnesota Department of Natural Resources (DNR) conducted a series of translocations in the Upper Minnesota River Valley during 1998-2006. Today, the beach ridges of glacial Lake Agassiz hold most of Minnesota's prairie-chickens, but their populations do extend southward (Figure 1). Hunting was re-opened using a limited-entry season in 2003, and approximately 120 prairie-chickens are now harvested annually.

With the opening of the new hunting season, the DNR had a greater interest in the monitoring of prairie-chicken populations, which the Minnesota Prairie-Chicken Society (MPCS) had been coordinating since 1974. The DNR, in collaboration with MPCS members, began coordinating prairie-chicken surveys and adopted a standardized survey design in 2004. These surveys are conducted at small open areas called leks, or booming grounds, where male prairie-chickens display for females in the spring and make a low-frequency booming vocalization that can be heard for miles.

Prairie-chickens continue to be surveyed to monitor changes in population densities over time. However, density estimates can be costly and difficult to obtain, so instead we count individuals and make the assumption that changes in density are the primary source of variation in counts among years. If true, counts should provide a reasonable index to long-term trends in prairie-chicken populations. However, counts are also influenced by weather, habitat conditions, observer ability, and bird behavior among other factors, which make it difficult to make inferences over short periods of time (e.g., a few annual surveys) or from small changes in index values. Nevertheless, over long time periods and when changes in index values are large, inferences from prairie-chicken surveys are more likely to be valid.

METHODS

Cooperating biologists and volunteers surveyed booming grounds in all 17 designated survey blocks in western Minnesota (Figure 2) during late-March through May. Each survey block was nonrandomly selected so that surveys would be conducted in areas where habitat was expected to be good (i.e., grassland was relatively abundant) and leks were known to occur. Each observer attempted to find and survey each booming ground repeatedly in his/her assigned block, which comprised 4 sections of the Public Land Survey (approximately 4,144 ha). Observers obtained multiple counts at each booming ground in the morning because male attendance at leks varies throughout the season and throughout the day.

During each survey, observers obtained visual counts of males, females, and birds of unknown sex from a distance with binoculars. Sex was determined through behavior; males display conspicuously, and females do not. If no birds were displaying during the survey period, then sex was recorded as unknown. When a reliable count could not be obtained visually because vegetation or topography prevented it, birds were flushed for counts and sex was recorded as unknown. Most birds for which sex was unknown were likely male because female attendance at leks is sporadic, and they are less conspicuous during lek attendance than displaying males.

In the analysis, I used counts of males and unknowns at each booming ground but not females. Leks were defined as having ≥2 males, so observations of single males were not counted as leks. Data were summarized by hunting permit area and spring survey block. The survey blocks were separated into a core group and a periphery group for analysis. The core group had a threshold density of approximately 1.0 male/km^2 during 2010, and was located proximally to other such blocks (Figure 2). I compared densities of leks and prairie-chickens to estimated densities from previous years.

I also encouraged observers to submit surveys of booming grounds outside the survey blocks because these observations may provide additional information that is helpful to prairie-chicken management. These data were included in estimates of minimum abundance of prairie-chickens. However, these data were not used in the analysis of lek and prairie-chicken densities because effort and methods may have differed from those used in the survey blocks.

RESULTS & DISCUSSION

Observers from DNR Division of Fish and Wildlife, the U.S. Fish & Wildlife Service, and The Nature Conservancy, as well as many unaffiliated volunteers counted prairie-chickens between 26 March and 14 May 2018. Observers located 148 booming grounds and observed 1,354 male prairie-chickens and 164 birds of unknown sex within and outside survey blocks (Table 1). These counts represent a minimum number of prairie-chickens in Minnesota during 2018, but because survey effort outside of survey blocks is not standardized among years, these counts should not be compared among years or permit areas.

Within the standardized survey blocks, 630 males and birds of unknown sex were counted on 59 booming grounds during 2018 (Table 2). These counts are the lowest since the standardized survey began in 2004 and 1,566 males and 95 booming grounds were counted. This contrasts with the high count of 1,618 males and 114 booming grounds in 2007. Each lek was observed an average of 2.2 times (median = 2), with 39% of booming grounds observed just once. These counts should not be regarded as estimates of abundance because detection probabilities of leks and birds were not estimated. However, if we assume that detection probabilities and effort are similar among years in the survey blocks, then population indices based on survey block data can be used to monitor changes in abundance among years.

Table 1. Minimum abundance of prairie-chickens within and outside hunting permit areas in Minnesota during spring 2018. Lek and bird counts are not comparable among permit areas or years.

Permit Area	Area (km^2)	Leks	Males	Unk[a]
803A	1,411	10	71	0
804A	435	5	19	0
805A	267	22	176	10
806A	747	14	85	40
807A	440	21	234	7
808A	417	20	303	0
809A	744	12	180	0
810A	505	9	64	27
811A	706	8	39	27
812A	914	7	13	35
813A	925	6	26	18
PA subtotal	7,511	134	1,210	164
Outside PAs[b]	NA[c]	14	144	0
Grand total	NA[c]	148	1,354	164

[a] Unk = prairie-chickens for which sex was unknown,but which were probably males.
[b] Counts done outside permit areas (PA).
[c] NA = not applicable because the area outside permit areas was not defined.

Densities of prairie-chickens in the 10 core survey blocks were 0.10 (0.07–0.13) booming grounds/km^2 and 11.9 (9.4–14.5) males/booming ground (Table 2, Figure 2). In the 7 peripheral survey blocks, densities were 0.07 (0.03–0.10) booming grounds/km^2 and 8.1 (4.4–11.7) males/booming ground. The density of 0.08 (0.06–0.11) booming grounds/km^2 in all survey blocks during 2018 was similar to densities during recent years (Table 2, Figure 3) and the average of 0.08 (0.06–0.09) booming grounds/km^2 during the 10 years preceding recent hunting seasons (i.e., 1993–2002). Similarly, the density of 10.7 (8.6–12.8) males/booming ground in all survey blocks during 2018 was comparable to densities during recent years and similar to the average of 11.5 (10.1–12.9) males/booming ground observed during 1993–2002 (Table 2, Figure 3). However, these densities are lower than the years preceding 2008 when CRP enrollments in the counties containing the survey blocks were highest. Densities appear to have stabilized over the last several years at a new lower level. These changes in the population indices coincide with gains and losses in enrollments in the Conservation Reserve Program. More explicit examination of these patterns is underway in collaboration with researchers at the Minnesota Cooperative Fish and Wildlife Research Unit at the University of Minnesota.

ACKNOWLEDGMENTS

I would like to thank cooperators who conducted and helped coordinate the prairie-chicken survey. Cooperators within the DNR included Emily Hutchins, Brian Torgusson, Rob Baden, Michael Oehler, Matt Morin, Becky Ekstein, and Jason Ekstein; cooperators with The Nature Conservancy included Brian Winter, Travis Issendorf, and volunteers Pat Beauzay, Matt Mecklenburg, Tyler Larson, Derek Savage, Tony Nelson, and Carl Altenbernd; cooperators with the US Fish and Wildlife Service included Shawn Papon, Chad Raitz, Cody Townsend, Ben Walker, Erin Lentz, Traver Fields, and Stacy Salvevold; and numerous additional volunteers participated, including Dan Svedarsky, Doug Wells, Tom Kucera, Jon Voz, Ross Hier, Phil Doll, and Doug Hedtke. Bemidji State University faculty member, Brian Hiller, and students also assisted with surveys this year. This survey was funded in part by the Wildlife Restoration (Pittman-Robertson) Program W-69-S-13 Project #16. Mike Larson provided assistance and comments which improved this report.

Table 2. Prairie-chicken counts within survey blocks in Minnesota.

			2018		Change from 2017[a]	
Range[b]	Survey Block	Area (km^2)	Booming grounds	Males[c]	Booming grounds	Males[c]
Core	Polk 1	41.2	4	35	-2	-22
	Polk 2	42.0	5	65	1	20
	Norman 1	42.0	1	8	-1	-7
	Norman 2	42.2	5	30	-1	-13
	Norman 3	41.0	7	50	3	14
	Clay 1	46.0	6	104	-1	4
	Clay 2	41.0	2	55	0	-21
	Clay 3	42.0	5	86	-1	25
	Clay 4	39.0	1	3	-2	-16
	Wilkin 1	40.0	4	41	0	-2
	Core subtotal	415.0	40	477	-2	-18
Periphery	Mahnomen	41.7	3	62	0	23
	Becker 1	41.4	7	48	1	-3
	Becker 2	41.7	2	5	-3	-18
	Wilkin 2	41.7	1	3	0	-2
	Wilkin 3	42.0	3	13	-1	-20
	Otter Tail 1	41.0	2	11	0	2
	Otter Tail 2	40.7	1	11	0	3
	Periphery subtotal	290.6	19	153	-3	-15
Grand total		705.5	59	630	-5	-33

[a] The 2017 count was subtracted from the 2018 count, so positive values indicate increases.

[b] Survey blocks were categorized as within the core or periphery of the Minnesotaprairie-chicken range based upon bird densities and geographic location.

[c] Includes birds recorded as being of unknown sex but excludes lone males.

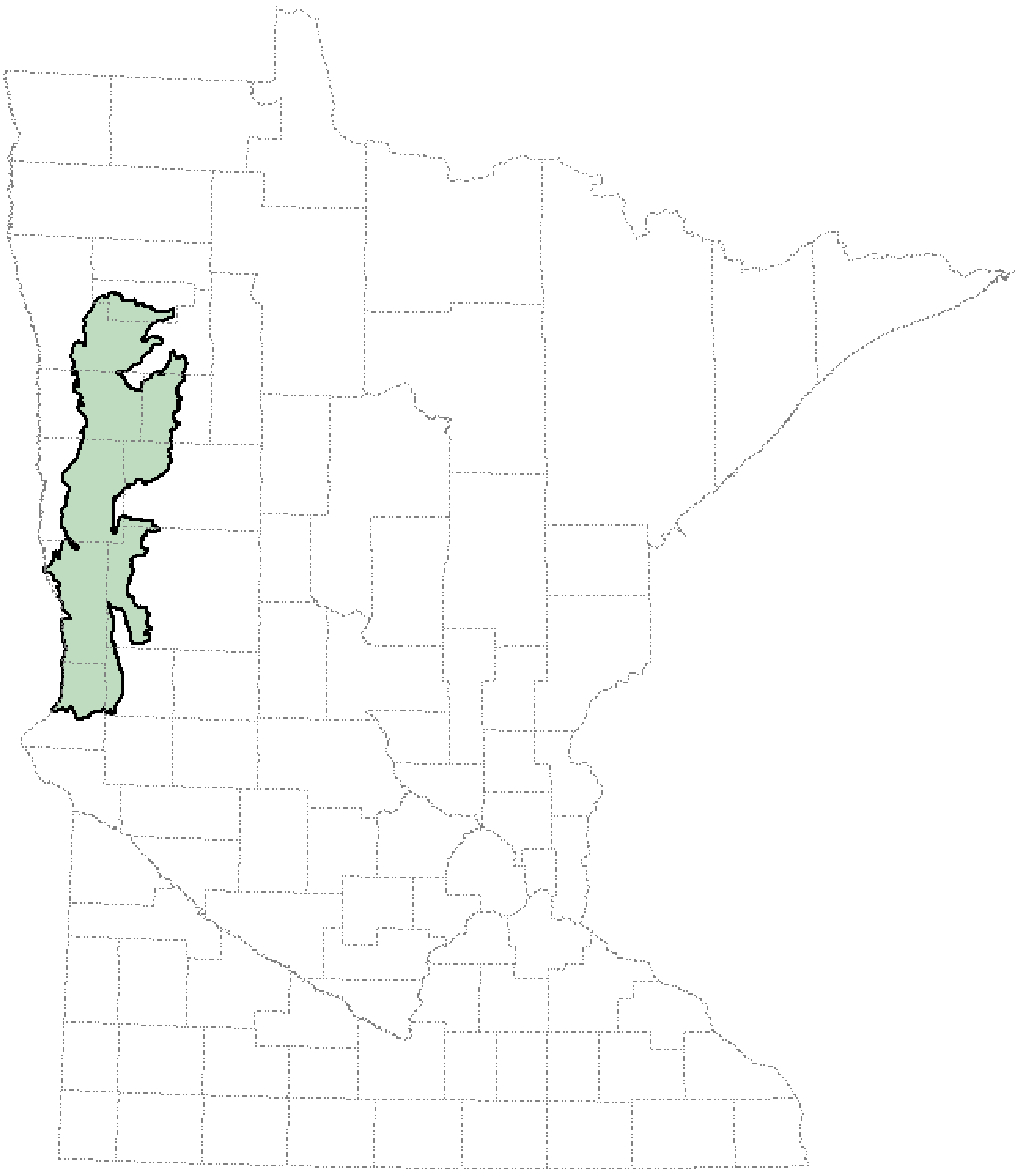


Figure 1. Primary greater prairie-chicken range in Minnesota (shaded area) relative to county boundaries. The range boundary was based on Ecological Classification System Land Type Associations and excludes some areas known to be occupied by prairie-chickens.

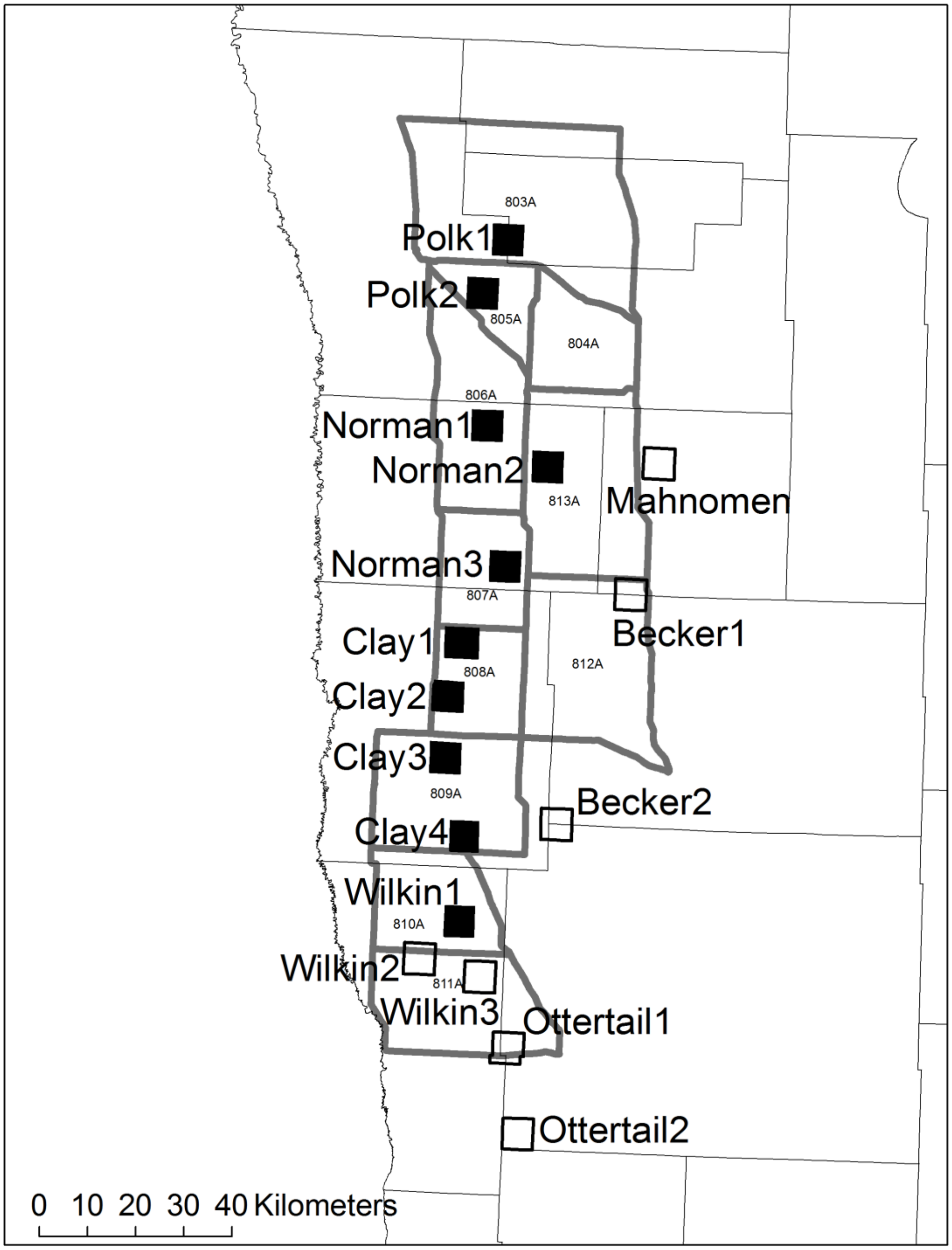


Figure 2. Prairie-chicken lek survey blocks (41 km^2, labeled squares) and hunting permit areas (thick grey lines) in western Minnesota. Survey blocks were either in the core (black) or periphery (white) of the range with a threshold of 1.0 male/km^2 in 2010, and were named after their respective counties (thin black lines). Permit areas were revised in 2013 to eliminate 801A and 802A, modify 803A, and add 812A and 813A. See previous reports for former permit area boundaries.

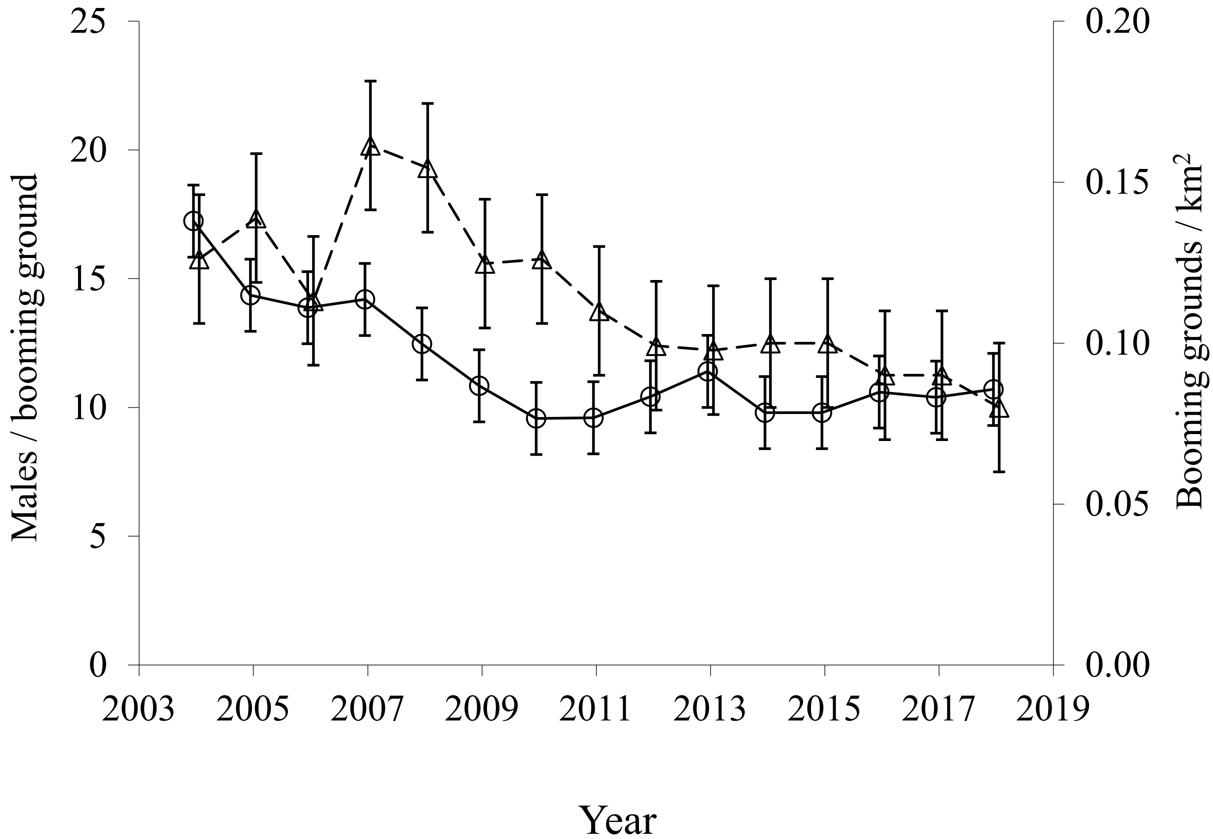


Figure 3. Mean prairie-chicken males/booming ground (circles connected by solid line) and booming grounds/km^2 (triangles connected by dashed line) in survey blocks in Minnesota with 95% confidence intervals.

DEPARTMENT OF NATURAL RESOURCES

2018 NW MINNESOTA ELK SURVEYS

Doug Franke, Area Wildlife Manager, Thief River Falls

INTRODUCTION

Minnesota DNR FAW staff used fixed-wing aircraft (Cessna 185 Skywagon) to conduct aerial elk surveys for the Lancaster and Grygla elk herds. We were also able to complete the Caribou-Vita survey again this year since Manitoba Wildlife secured funding to complete their aerial elk survey the same day on the Canadian side. We used MN DNR Forestry's Quest Kodiak turboprop airplane to complete the border survey. The MN DNR fixed-wing aircraft crew followed the same predetermined transects used in 2017—transects are spaced 1/5 mile apart and flown at an altitude of 300 to 400 feet and speeds of 80-85 mph. A pilot and two observers recorded elk locations and documented antlerless and antlered elk. Antlered elk were recorded as either branch antlered or spike bulls.

The surveys were completed between February 5th and March 11th, 2018. Snow depths and conditions varied across the elk ranges. Snow conditions were considered good in the Grygla area and fair to good in the Lancaster and Caribou-Vita survey blocks. Snow depths ranged from 12 to 15 inches in the Grygla and Caribou-Vita survey blocks and 8 to 10 inches in the Lancaster survey block. Weather conditions were average for this time of the year with temperatures ranging from a low of -15°F to a high of 34°F and mostly clear skies. We had a weather delay of one day during the Lancaster survey.

We waited again this year to complete the Caribou-Vita survey block since Manitoba Wildlife staff indicated that they were also planning to survey elk on the Canadian side in late February to early March. The surveys for both the Canadian and US border areas were completed on March 11th 2018 within a two hour period of each other.

Grygla Survey Block

This survey started on February 5th and was completed on February 6th, 2018. The area surveyed was the same 133 mi^2 area that has been used the past two years. Total aircraft engine time to complete this survey (takeoff to landing) was 11.7 hours. The entire survey area received a light snowfall the day before which made for good survey conditions. The fixed-wing crew recorded elk at 5 separate locations within the survey boundary. Total elk observed was 15 and included: 7 antlerless (cows/calves) and 8 bulls (5 branch antlered and 2 spike bulls).

Thief Lake WMA staff believed three of the seven antlerless elk were calves based upon ground observations during the summer.

Lancaster Survey Block—Water Tower and Percy WMA herds

This survey started on February 12th and after a one-day weather delay was completed on February 14th, 2018. The area surveyed was the same 167 mi^2 area that has been flown the past several years. Total aircraft time to complete the survey was 15.2 hours (takeoff to landing). The fixed-wing crew recorded elk at 5 separate locations within the survey boundary. Total elk recorded within the Lancaster survey block was 75 and included: 57 antlerless (cows/calves) and 18 bulls (13 branch antlered and 5 spike bulls). The Water Tower group had 35 antlerless elk—there were 7 branch antlered bulls located in the same woodlot as the antlerless group. The Percy WMA antlerless herd (22 elk) along with 6 branch antlered bulls and 3 spike bulls were observed approximately four miles northwest of the Percy WMA. One spike bull was located on the western edge of the Percy WMA.

Caribou-Vita Survey Block (a.k.a. border herd)

Minnesota DNR and Manitoba Wildlife staff successfully coordinated a joint aerial elk survey for the survey areas close to the US/Canadian border. This survey started and was completed on March 11th, 2018. The area surveyed in MN was the same 35.5 mi^2 area that has been surveyed the past few years. Manitoba also flew the same survey blocks as they did in 2017. Total aircraft time to complete the DNR survey was 3.0 hours (takeoff to landing). The fixed-wing crew recorded elk at one location (6 branch antlered bulls and 1 spike bull) within survey boundary. A majority of this herd was expected to be north of the Minnesota border—this assumption was as confirmed with the Manitoba aerial elk survey results. Manitoba completed an aerial survey for the Vita area the next day on March 12th.

Manitoba Wildlife staff used a Jet Ranger helicopter to fly north/south transects within predetermined survey blocks that covered a broad area along the border. They recorded 80 elk near the US/Canadian border and another 46 elk slightly north of Vita. Table 2 details the age/sex breakdown for these two populations in Canada.

Table 1 summarizes MN DNR elk observations during the past five years of NW

MN aerial elk surveys. The last two pages are maps showing the 2018 locations of elk within each survey block.

ACKNOWLEDGMENTS

I would like to thank all those that helped with the survey this year, especially the fixed-wing pilots Chris Lofstuen, Bob Geving, and Luke Ettl who provided safe flying for all of us. Observers this year included: Kyle Arola (Thief Lake Assistant Manager), Jason Wollin (Karlstad Assistant Area Wildlife Manager), and myself. Special thanks again to Brian Haroldson who put together all of the survey materials and computer used during the survey—much appreciated!

Table 1. Comparison of aerial survey elk observations between 2014 and 2018 for the Lancaster, Caribou-Vita, and Grygla herds.

	Lancaster					Caribou-Vita (US side of border)					Grygla				
	2014	2015	2016	2017	2018	2014	2015	2016	2017	2018	2014	2015	2016	2017	2018
Spike bull	3	2	6	2	5	10	5	0	0	1	2	3	2	4	2
Branch antlered bull	14	16	12	14	13	7	17	6	1	6	4	6	9	6	6
Total bulls	17	18	18	16	18	17	22	6	1	7	6	9	11	10	8
Antlerless	20	16	34	45	57	34	57	4	0	0	14	9	10	7	7
Total elk	37	34	52	61	75	51	79	10	1	7	20	18	21	17	15

Table 2. Aerial survey elk observations recorded by Manitoba Wildlife – 2017 and 2018.

	Border (Caribou)		Vita		Combined Total	
	2017	2018	2017	2018	2017	2018
Spike bull	2	3	4	2	6	5
Branch antlered bull	17	12	7	5	24	17
Total bulls	19	15	11	7	30	22
Cow	68	*	32	*	100	*
Calf	21	*	12	*	33	*
Total antlerless	89	65	44	39	133	104
Total elk	108	80	55	46	163	126

*Manitoba Wildlife did not differentiate antlerless elk between cows and calves in 2018.

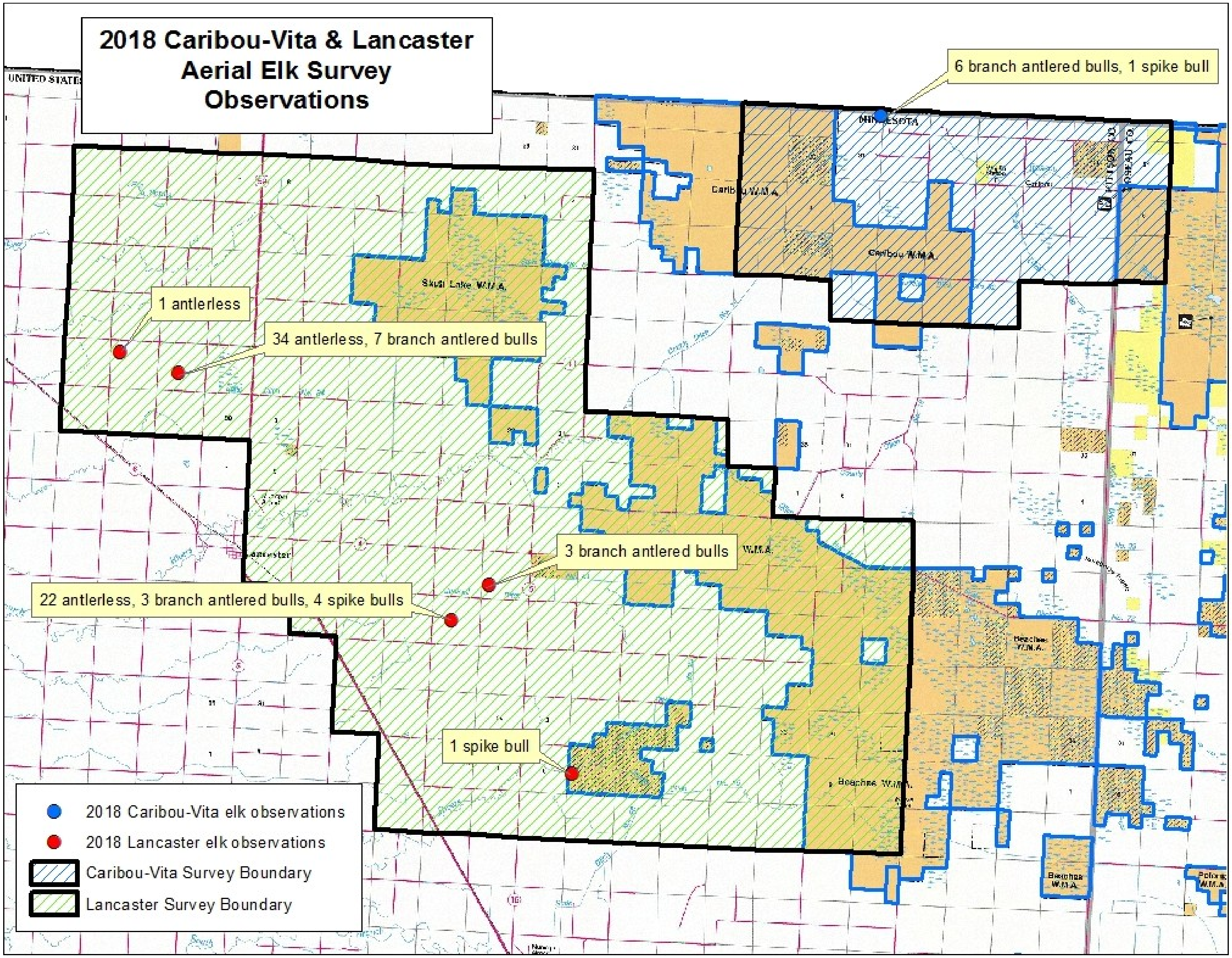


Figure 1. Locations of elk observed within the Caribou-Vita and Lancaster area survey blocks, 2018.

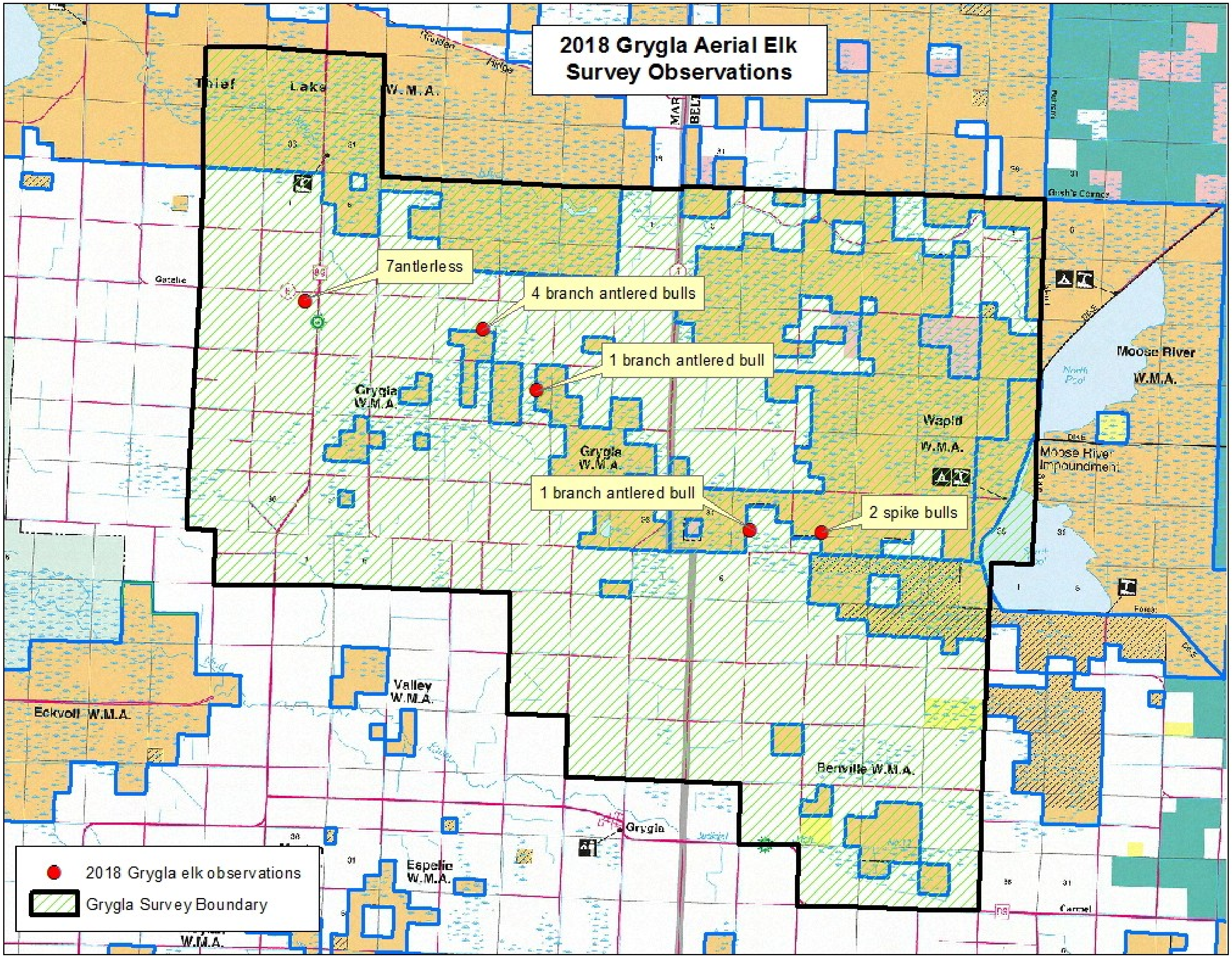


Figure 2. Locations of elk observed within the Grygla area survey blocks, 2018.

2018 AERIAL MOOSE SURVEY

Glenn D. DelGiudice, Forest Wildlife Populations and Research Group

INTRODUCTION

Each year we conduct an aerial survey in northeastern Minnesota to estimate the moose (Alces americanus) population and to monitor and assess changes in the overall status of the state's largest deer species. Specifically, the primary objectives of this annual survey are to estimate moose abundance, percent calves, and calf:cow and bull:cow ratios. These demographic data help us to 1) best determine and understand the population's long-term trend (decreasing, stable, or increasing), composition, and distribution; 2) set the harvest quota for the subsequent State hunting season (when applicable); 3) with research findings, improve our understanding of moose ecology; and 4) otherwise contribute to sound future management strategies.

METHODS

The survey area is approximately 5,985 mi^2 (almost 4 million acres, Lenarz 1998, Giudice et al. 2012). We estimate moose numbers, and age and sex ratios by flying transects within a stratified random sample of the 436 total survey plots that cover the full extent of moose range in northeastern Minnesota (Figure 1). To keep the stratification current, all survey plots are reviewed and re-stratified as low, medium, or high moose density about every 5 years based on past survey observations of moose, locations of recently harvested moose, and extensive field experience of moose managers and researchers. Low, medium, or high moose density classes are based on whether ≤ 2, 3–7, or ≥8 moose, respectively, would be expected to occur in a specific plot. The most recent re-stratification was conducted in November 2013 for the 2014 survey, but additionally, individual plots are re-stratified after each annual survey as warranted by aerial observations. Stratification is most important to optimizing precision of our survey estimates. In 2012, we added a 4th stratum represented by a series of 9 plots (referred to as "habitat plots") which have already undergone, or will undergo, significant disturbance by wildfire, prescribed burning, or timber harvest. These same 9 plots are surveyed each year in an effort to better understand moose use of disturbed areas and evaluate the effect of forest disturbance on moose density over time. In total, we surveyed 52 (43 randomly sampled and the 9 habitat plots) of the 436 plots this year.

All 436 survey plots in the grid (designed in 2005) are 13.9-mi^2 rectangles (5 x 2.77 mi), oriented east to west, with 8 flight-transects evenly spaced 0.3 mi apart. Minnesota Department of Natural Resources (MNDNR) Enforcement pilots flew the 2 helicopters used to conduct the survey—1 Bell Jet Ranger (OH-58) and 1 MD500E. We determined the sex of moose using the presence of antlers or the presence of a vulva patch (Mitchell 1970), nose coloration, and bell size and shape. We identified calves by size and behavior. We used the program DNRSurvey on tablet-style computers (Toughbook®) to record survey data (Wright et al. 2015). DNRSurvey allowed us to display transect lines superimposed on aerial photography, topographical maps, or other optional backgrounds to observe each aircraft's flight path over the selected background in *real time*, and to efficiently record data using a tablet pen with a menu-driven data-entry form. Two primary strengths of this aerial moose survey are the consistency and standardization of the methods since 2005 and the long-term consistency of the survey team's personnel, survey biometrician, and geographic information system (GIS) specialists.

We accounted for visibility bias using a sightability model (Giudice et al. 2012). This model was developed between 2004 and 2007 using adult moose that were radiocollared as part of a study of survival and its impact on dynamics of the population (Lenarz et al. 2009, 2010). Logistic regression indicated that "visual obstruction" (VO) was the most important covariate in determining whether radiocollared moose were observed. We estimated VO within a 30-ft radius (roughly 4 moose lengths) of the observed moose. Estimated VO was the proportion of a circle where vegetation would prevent you from seeing a moose from an oblique angle when circling that spot in a helicopter. If we observed more than 1 moose (a group) at a location, VO was based on the first moose sighted. We used uncorrected estimates (no sightability correction) of bulls, cows, and calves, adjusted for sampling, to calculate the bull:cow and calf:cow ratios at the population level (i.e., using the combined ratio estimator; Cochran 1977:165).

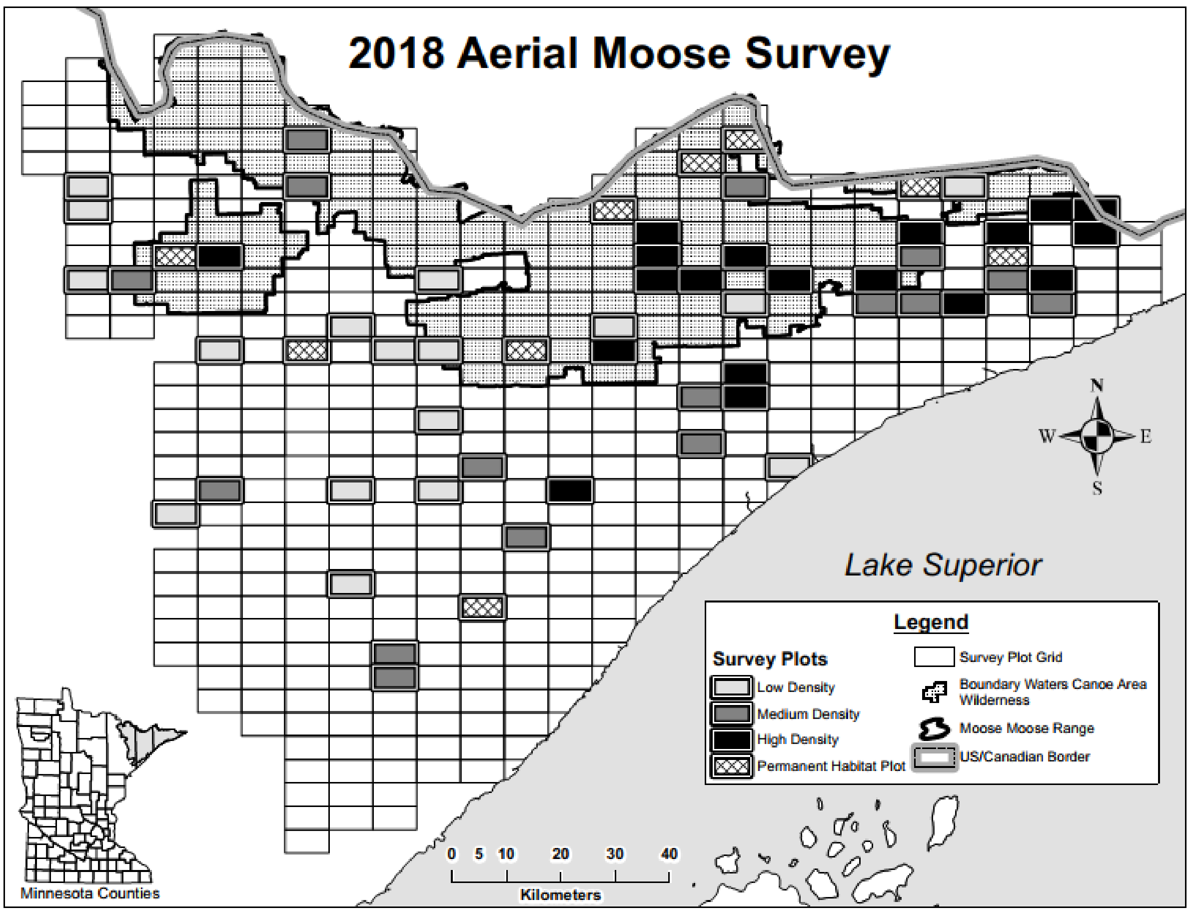


Figure 1. Moose survey area and 52 sample plots flown in the 2018 aerial moose survey.

RESULTS AND DISCUSSION

The survey was conducted from 3 to 13 January 2018. It consisted of 9 actual survey days, and as in 2014, 2015, and 2016, and 2017, it included a sample of 52 survey plots. This year, based on optimal allocation analyses, we surveyed 14 low-, 13 medium-, and 16 high-density plots, and the 9 permanent or habitat plots (Giudice 2018). Generally, 8" of snow cover is our minimum threshold depth for conducting the survey. Snow depths were 8–16” and >16” on 65% and 31% of the sample plots, respectively. Overall, survey conditions were rated as good for 98% and fair for 2% of the plots when surveyed. Average survey intensity was 48 minutes/plot (13.9 mi^2) and ranged from 40 to 60 minutes/plot (Giudice 2018).

This year a total of 415 moose were observed on 37 (71%) of the 52 plots surveyed (a total 723 mi^2), less than the 508 moose observed on 47 of 52 plots during the 2017 survey. An average of 11.2 moose (range = 1–31) were observed per “occupied” plot. Plot occupancy during the past 14 years averaged 82% (range = 65–95%) with a mean 11.8 moose observed per occupied plot. This year’s 415 observed moose included 181 bulls, 170 cows, 63 calves, and 1 unclassified adult. Overall, estimated VO averaged 37% (range = 0−85%) and average estimated detection probability was 0.61 (range = 0.23−0.85); both were comparable to those of previous years.

After adjusting for sampling and sightability, we estimated the population in northeastern Minnesota at 3,030 (2,320–4,140, 90% confidence interval [CI]) moose (Table 1, Figure 2). As can be noted from the 90% confidence intervals associated with the population point estimates, statistical uncertainty inherent in aerial wildlife surveys can be quite large, even when surveying large, dark, relatively conspicuous animals such as moose against a white background during winter. This is attributable to the varied (1) occurrence of dense vegetation, (2) habitat use by moose, (3) behavioral responses to aircraft, (4) effects of annual environmental conditions (e.g., snow depth, ambient temperature) on their movements, and (5) interaction of these and other factors. Consequently, year-to-year statistical comparisons of population estimates are *not* supported by these surveys. These data are best suited to establishing long-term trends; even short-term trends must be viewed cautiously.

Past aerial survey and research results have indicated that the long-term trend of the population in northeastern Minnesota has been declining since 2006 (Lenarz et al. 2010, DelGiudice 2017). The current population estimate is 65% less than the estimate in 2006 and the declining linear trend during the past decade remains statistically significant (r^2 = 0.81, P< 0.001, Figure 2). However, the leveling since 2012 persists, and a piecewise polynomial curve indicates that the trend from 2012 to 2018 is not declining (Figure 3). While this recent short-term trend (7-year) is noteworthy, it applies only to the existing survey estimates, and does not forecast the future trajectory of the population (Giudice 2018).

The January 2018 calf:cow ratio of 0.37 is low but similar to the 13-year average since 2005 (0.35, Table 1, Figure 4). Calves were 15.1% of the total 415 moose actually observed and represented 15% of the estimated population (Table 1, Figure 4). Twin calves were observed with 6 of the 170 (4%) cow moose (Table 1). Although we know from recent field studies that fertility (pregnancy rates) of the population’s adult females has been robust, overall, survey results indicate calf survival to January2018 remains low, typical compared to most years since the population decline began following the 2006 survey (Table 1). Calf survival during the January-April interval can decline markedly (Schrage et al., unpublished data), and annual spring recruitment of calves (survival to 1 year old) can have a significant influence on the population’s performance and dynamics. Findings of a recent field study documented similar low calf survival (0.442-0.485) to early winter in 2015-16 and 2016-17 (Obermoller 2017, Severud 2017). Calf survival by sprint 2017 (recruitment) had declined to just 0.33. But it is also important to note that adult moose survival has the greatest long-term impact on annual changes in the moose population (Lenarz et al. 2010). Consistent with the recent relative stability of the population trend, the annual survival rate of adult GPS-collard moose has changed little (85-88%) during 2014-2017 (Carstensen et al. 2017, unpublished data), but is slightly higher than the previous long-term (2002-2008) average of 81% (Lenarz et al. 2009).

The January 2018 estimated bull:cow ratio (1.25, Table 1; Figure 5) appears to be elevated compared to the long-term mean of 0.98 during 2005-2017, and compared to the mean ratio (0.87) of 2009-2012, when the population decline was steepest. Estimated bull:cow ratios have been this high previously (2013 and 2014) during the recent interval of apparent stability; however, due to the notable annual variability associated with the bull:cow ratios, there is no apparent upward or downward long-term trend (Figure 5).

Table 1. Estimated moose abundance, 90% confidence intervals, calf:cow ratios, percent calves in the population, percent cows with twins, and bull:cow ratios estimated from aerial surveys in northeastern Minnesota, 2005–2018.

SURVEY	Estimate	90% CONFIDENCE INTERVAL	CALF: COW	% Calves	% Cows w/ twins	Bull: Cow
2005	8,160	6,090 – 11,410	0.52	19	9	1.04
2006	8,840	6,790 – 11,910	0.34	13	5	1.09
2007	6,860	5,320 – 9,100	0.29	13	3	0.89
2008	7,890	6,080 – 10,600	0.36	17	2	0.77
2009	7,840	6,270 – 10,040	0.32	14	2	0.94
2010	5,700	4,540 – 7,350	0.28	13	3	0.83
2011	4,900	3,870 – 6,380	0.24	13	1	0.64
2012	4,230	3,250 – 5,710	0.36	15	6	1.08
2013	2,760	2,160 – 3,650	0.33	13	3	1.23
2014	4,350	3,220 – 6,210	0.44	15	3	1.24
2015	3,450	2,610 – 4,770	0.29	13	3	0.99
2016	4,020	3,230 – 5,180	0.42	17	5	1.03
2017	3,710	3,010 – 4,710	0.36	15	4	0.91
2018	3,030	2,320 – 4,140	0.37	15	4	1.25

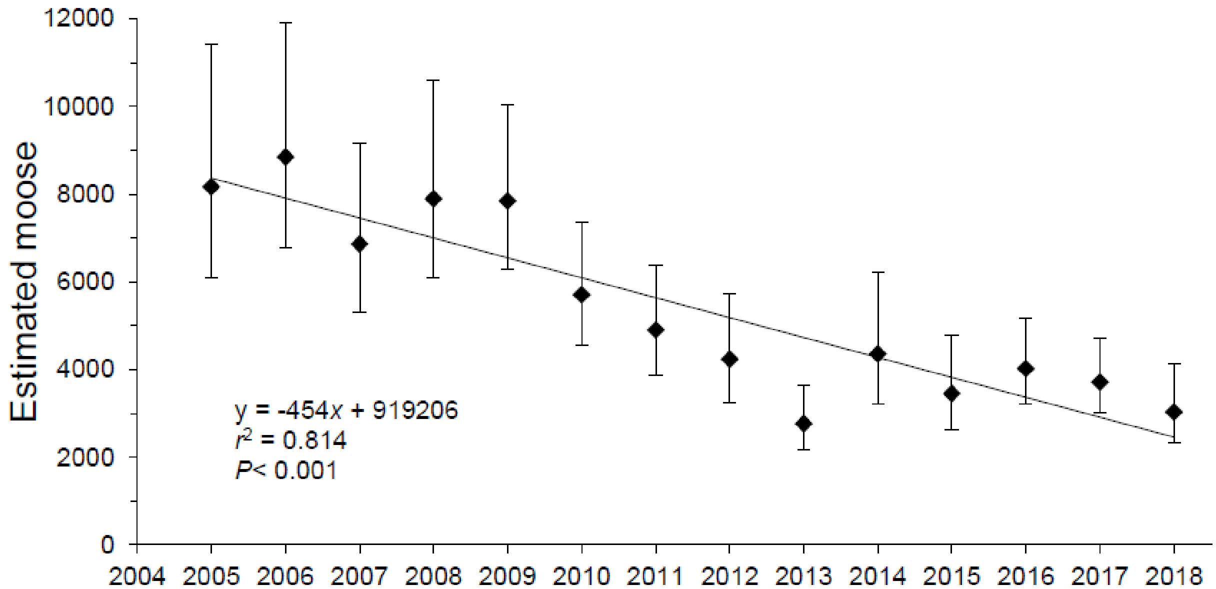


Figure 2. Point estimates, 90% confidence intervals, and a linear trend line of estimated moose abundance in northeastern Minnesota, 2005–2018. (Note: The 2005 survey was the first to be flown with helicopters and to include a sightability model and a uniform grid of east-west oriented rectangular 13.4-mi^2 plots).

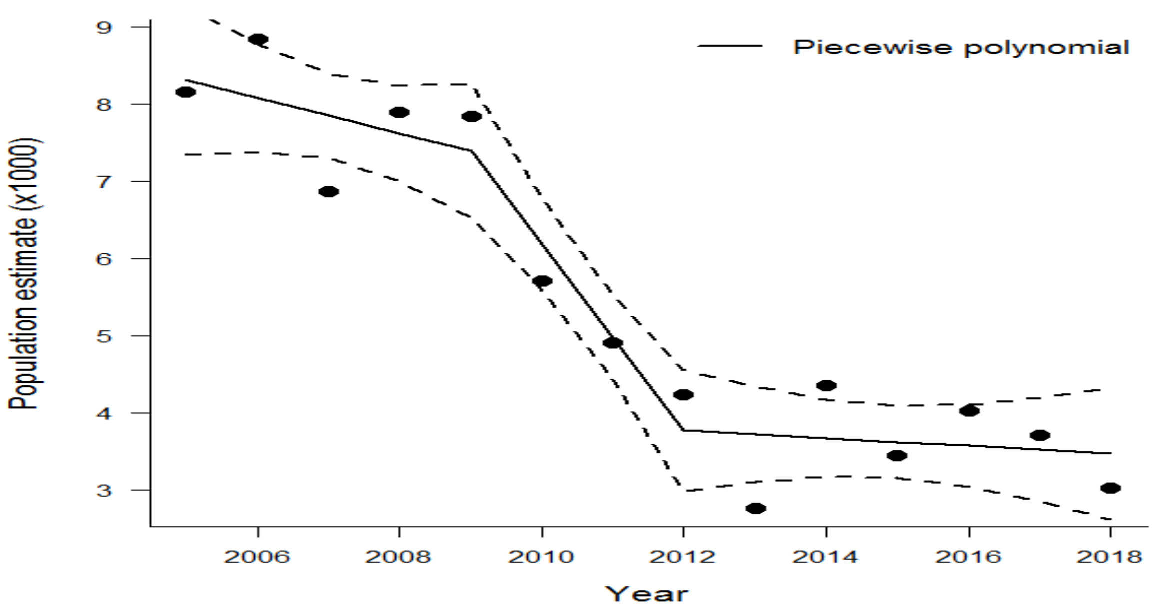


Figure 3. Point estimates, 90% confidence intervals, and a piecewise polynomial curve of moose abundance in northeastern Minnesota, 2005–2018. This curve shows a change in the short-term slope of the trend from 2012 to 2018 compared to 2009 to 2012.

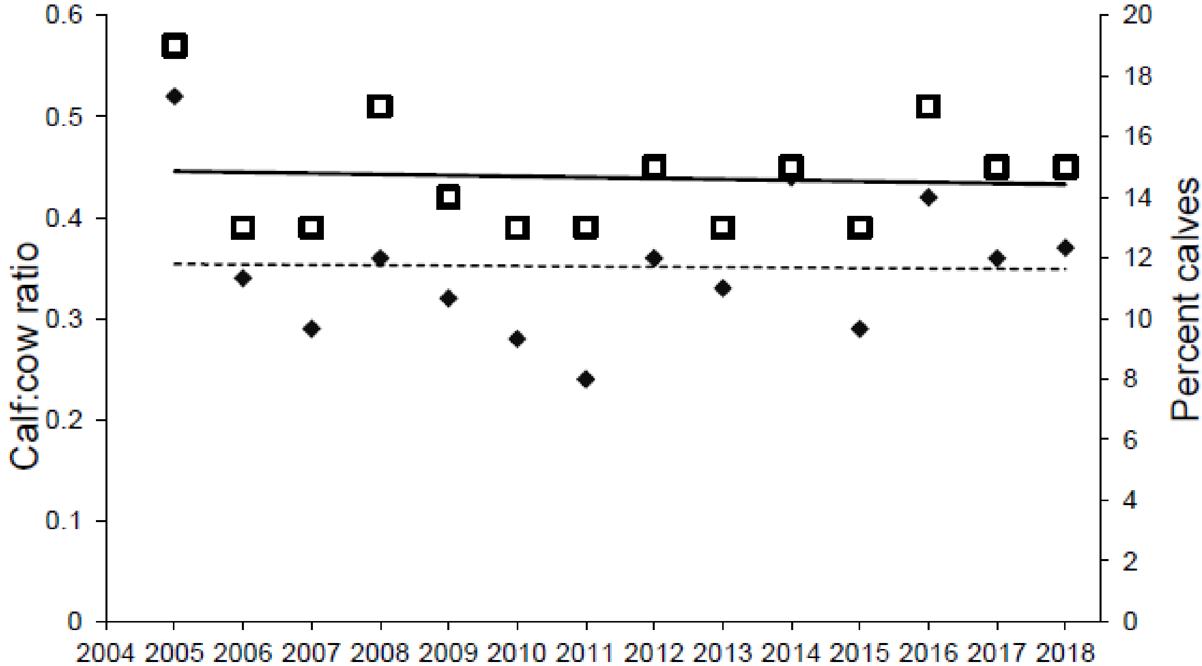


Figure 4. Estimated calf:cow ratios (solid diamonds, dashed trend line) and percent calves (open squares, solid trend line) of the population from aerial moose surveys in northeastern Minnesota, 2005–2018.

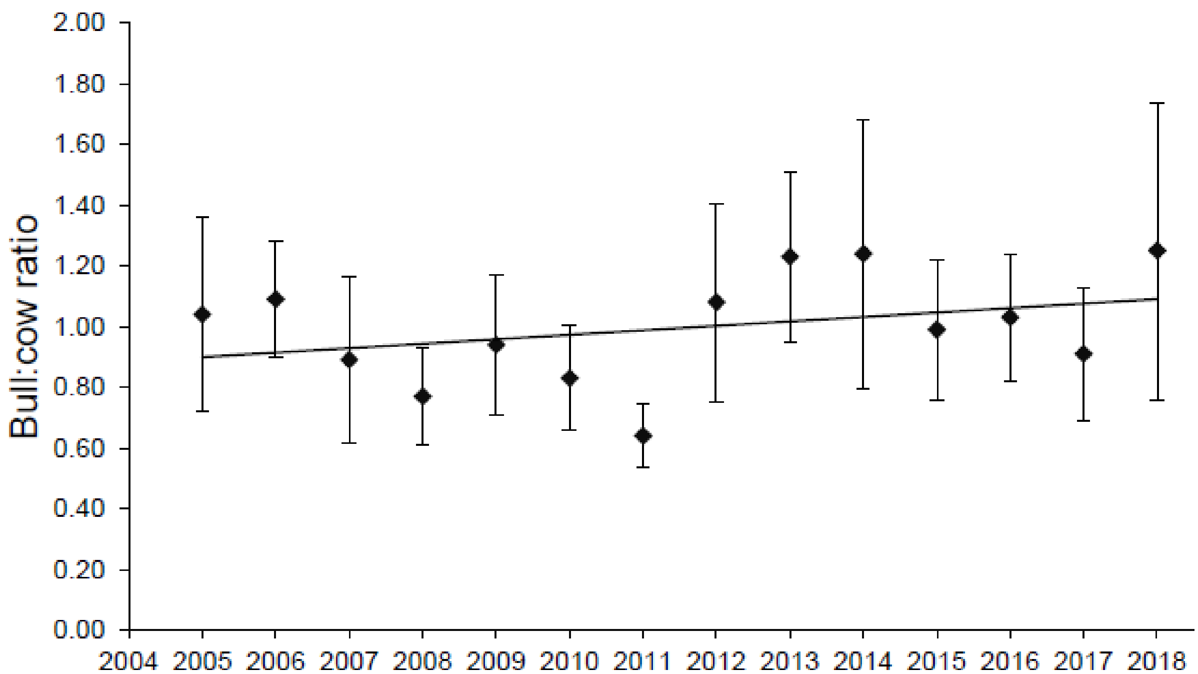


Figure 5. Estimated bull:cow ratios, 90% confidence intervals, and trend line from aerial moose surveys in northeastern Minnesota, 2005–2018.

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This survey is an excellent partnership between the Divisions of Enforcement and of Fish and Wildlife, the Fond du Lac Band of Lake Superior Chippewa, and the 1854 Treaty Authority. Specifically, thank you to Thomas Buker, Chief Pilot, for coordinating all of the aircraft and pilots; Tom Rusch for coordinating flights, survey crews, and other important parts of this effort; and Mike Schrage (Fond du Lac Band of Lake Superior Chippewa) and Andy Edwards (1854 Treaty Authority) for securing supplemental survey funding from their respective groups. Enforcement pilots, Brad Maas and John Heineman, and Luke Ettl (MIFC) skillfully piloted the aircraft during the surveys; Tom Rusch, Andy Edwards, Mike Schrage, and Nancy Hansen flew as our seasoned observers. Thank you to John Giudice who continues to provide critical statistical consultation and analyses, and to Barry Sampson for creating the process to generate the GIS survey maps and GPS coordinates for the transect lines, and for his work on re-stratification of the survey plots. We gratefully acknowledge Bob Wright, Brian Haroldson, and Chris Pouliot for creating the program, DNRSurvey. Bob also modifies the software as needed, updates specific maps, and provided refresher training for survey observers using DNRSurvey. The efforts of all of these people contribute to survey improvements, ensure the survey's rigor and the comparability of long-term results. This report has been reviewed by Paul Telander, Lou Cornicelli, Mike Larson, John Giudice, Mike Schrage, and Andy Edwards. This project was funded in part by the Wildlife Restoration (Pittman-Robertson) Program.

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DISTRIBUTION AND ABUNDANCE OF WOLVES IN MINNESOTA, 2017-18

John Erb, Carolin Humpal, and Barry Sampson, Minnesota Department of Natural Resources

At the time wolves were federally protected in the mid-1970s, Minnesota contained the only known reproducing wolf population in the lower 48 states, except for that on Isle Royale. Over the years, much attention has been focused on studying and monitoring Minnesota's wolves. Research efforts began in the mid-1930s (Olson 1938) and with few lapses continue to this day. Efforts to delineate wolf distribution and enumerate populations have also been made at various times over the last 50 years (Erb and DonCarlos 2009).

Early estimates of Minnesota's wolf population, often derived from bounty records and anecdotal information, were by necessity subjective. With the advent of radio-telemetry, geographic information systems (GIS), and global positioning systems (GPS), more detailed monitoring and mapping of wolf populations has been possible. However, financial and logistical considerations often limit intensive monitoring to small study areas.

Enumerating elusive carnivore populations over large areas remains a difficult task, particularly in forested landscapes (Kunkel et al. 2005). Complete territory mapping (Fuller and Snow 1988, Burch et al. 2005) is usually not possible over large areas, though various sampling designs can be considered (Potvin et al. 2005). Use of standard mark-recapture methods may not be practical given the difficulties of capturing and recapturing sufficient samples. However, genetic mark-recapture methods have recently been applied to wolves (Marucco et al. 2009) but may also be impractical over large areas.

Population estimation approaches based on prey or habitat assessments (e.g., Fuller 1989, Boyce and Waller 2003, Cariappa et al. 2011) may be useful for estimating potential abundance of large carnivores but may not always match realized abundance due to other time-varying factors that may limit populations (e.g., disease, weather, lagged responses to changes in prey). Newer aerial sampling methods exist (Becker et al. 1998, Patterson et al. 2004) but may be logistically challenging when applied to broad expanses of dense forest. Initial evaluation of these aerial snow-tracking methods in Minnesota was not promising (J.E., unpublished data). Further evaluation may be needed, including a cost-benefit analysis, but many assumptions of the method appear difficult to meet in Minnesota's forested landscape with moderate to high deer abundance.

Since the late-1970s Minnesota has monitored its statewide wolf population using an approach that combines attributes of territory mapping with an *ad hoc* approach to determine the total area occupied by pack wolves. The methods employed have changed only slightly during this time. During 1978-1998, surveys were conducted at 10-year intervals. During 1998-2012, surveys were conducted at approximately 5-year intervals, in part for consistency with the survey timeline specified in the Minnesota Wolf Management Plan (first and fifth year after delisting; Minnesota Department of Natural Resources 2001). Results indicated a geographically and numerically expanding population through the 1997-98 survey, with little geographic expansion from 1998 to 2007 (Erb and DonCarlos 2009) and only slight geographic expansion between 2007 and 2012 (Erb and Sampson 2013). These results have been coarsely consistent with separate wolf population trend indicators in Minnesota (i.e., annual scent station survey, winter track survey, and number of verified depredations).

In 2012, wolves in the Great Lakes Distinct Population Segment were removed as a listed species under the federal Endangered Species Act (ESA). From 2012 to 2014, a regulated public harvest of wolves was allowed, with annual harvests in Minnesota ranging from 238 to 413 wolves. As a result of a court ruling in late-2014, ESA protections were reinstated on wolves in the Great Lakes and no public harvest of wolves has since occurred in Minnesota. Beginning in 2012, the Minnesota Department of Natural Resources (DNR), with assistance from numerous collaborators, began deriving wolf population estimates annually. However, one component of the surveys - delineation of total and occupied wolf range (defined below) - is still being re-assessed only at 5-year intervals, as was the case from 1998 to 2012. Winter 2017-18 marks the 5th year since wolf range has been re-assessed, and re-assessment of wolf range was included in this winter's wolf survey.

METHODS

The approach we used to delineate wolf distribution and estimate population size was essentially identical to the previous 5 wolf range surveys (Fuller et al. 1992, Berg and Benson 1998, Erb and Benson 2004, Erb 2008, Erb and Sampson 2013), and conceptually similar to the 1978-79 wolf range survey (Berg and Kuehn 1982). Primary cooperators were similar to previous wolf range surveys and included natural resources staff within: 1) DNR; 2) U.S. Forest Service; 3) U.S. Fish and Wildlife Service; 4) U.S. Department of Agriculture - Wildlife Services; 5) U.S. Geological Survey; 6) Tribal and Treaty resource authorities; 7) County Land Departments; 8) Camp Ripley Military Facility; 9) Voyageurs National Park; and 10) various University collaborators and research projects.

We mailed instructions to participants in October 2017 and asked them to record a location and group size estimate for all wolf sign (e.g., visual, track, scat) observed during the course of normal work duties from November 2017 until snowmelt the following spring (~ mid-May 2018). Participants could record locations on forms or maps then provided to us for later data entry, but most data were entered directly by participants in a web-based GIS survey application. As in previous wolf range surveys, we used the Public Land Survey township (~93 km^2, with some exceptions) as the spatial scale for classifying wolf observations.

Although recorded estimates of wolf group size are not used directly for population enumeration, the assessment of township-specific wolf occupancy, as discussed below, treats observations of single wolves differently than pack (>1 wolf) detections. We conservatively assumed group size to be 1 in situations where sign was recorded but no group size was noted. If group size was recorded as 'numerous', it was set to 2 (i.e., a pack). We then combined this database with wolf observations recorded on other wildlife surveys during 2017-18 (e.g., carnivore scent station survey, furbearer winter track survey, moose/deer/elk surveys, etc.). This combined database is hereafter referred to as 'WISUR18'. Locations of verified wolf depredations from 2013 to 2018, as well as locations of wolves harvested during the 2012-2014 regulated wolf seasons, were also consulted for purposes of delineating total wolf range, but they were not used in any assessment of townships currently occupied by wolf packs and are not part of the WISUR18 database.

Delineation of both total range and occupied range includes, but is not limited to, consideration of whether townships meet human and road density criteria defined by Fuller et al. (1992; i.e., townships within wolf range are presumed to be occupied by wolves if road density is <0.7 km/km^2 and human density is <4/km^2, <u>or</u> if road density is <0.5 km/km^2 and human density is <8/km^2; hereafter termed 'modeled' townships). As in previous surveys, human density was calculated using the most recent (i.e., 2010) U.S. Census Data as incorporated into the 2010 Minor Civil Divisions GIS layer produced by the Minnesota Legislative Coordinating Commission. Road density calculations are based on the Minnesota Department of Transportation's 1:24,000 GIS roads layer (excluding 'forest roads') and summarized within each township as the number of kilometers of road per km^2.

Delineation of total wolf range is intended to encompass those areas within the state where consistent or sufficient wolf detections occur (either singles or packs) more than might be expected from 'random' temporally-irregular dispersals. Total wolf range depicts the coarse distribution of wolves within the state and is useful for documenting larger-scale expansions or contractions of wolf range. Although Minnesota's wolf range has expanded south and west since the 1970s, it has remained essentially contiguous with the Canadian border to the north and Lake Superior and Wisconsin to the east.

Because systematic searches for wolf sign are not conducted and much of the southern and western periphery of wolf range in Minnesota is private land, there is some subjectivity in the approach used to delineate the south and west boundary. Using the previously delineated boundary as the reference point, we re-evaluated the south and west border based on the following data: 1) all WISUR18 observations; 2) modeled townships; 3) land use and cover; and 4) knowledge of wolf activities in the area since the last survey (e.g., wolf depredation sites, 2012-14 wolf harvest locations). While maintaining a contiguous total wolf range, the overall approach is designed to maximize inclusion of areas with periodic (since last survey) or recently abundant wolf observations and modeled townships, while minimizing inclusion of areas that neither fit the model nor contained numerous or consistent wolf observations.

We computed occupied range by subtracting from the total range all townships that neither contained current observations of a pack (defined as >1 animal) nor fit the human-road density model criteria. We also fully excluded lakes larger than 200 km^2 (n = 5) from calculations of both total and occupied range.

To radio-collar wolves for use in estimation of territory and pack sizes, we and various collaborators captured wolves using foothold traps (LPC # 4, LPC #4 EZ Grip, or LPC #7 EZ Grip) approved as part of research conducted under the Association of Fish and Wildlife Agencies Best Management Practices for trapping program. In addition, numerous wolves were captured using live-restraining neck snares during winter. Wolves were typically immobilized using a mixture of either Ketamine:Xylazine or Telazol:Xylazine. After various project-specific wolf samples and measurements were obtained, the antagonist Yohimbine and an antibiotic were typically administered to animals prior to release. Various models of radio-collars were deployed depending on study area and collar availability. Most GPS radio- collars were programmed to take 3-6 locations per day, while wolves fitted with VHF-only radio-collars were relocated at approximately 7- to 10-day intervals throughout the year, or in some cases primarily from early winter through spring.

To estimate average territory size, we delineated territories of radio-collared packs using minimum convex polygons (MCP) for consistency with previous surveys. Prior to delineating wolf pack territories, we removed 'outlier' radiolocations using the following guidelines, though subjective deviations were made in some cases as deemed biologically appropriate: 1) for wolves with approximately weekly VHF radiolocations only, locations >5 km from other locations were excluded as extraterritorial forays (Fuller 1989); 2) for GPS-collared wolves with temporally fine-scale movement information, we removed obvious movement paths if the animal did not travel to that area on multiple occasions and if use of the path would have resulted in overly-excessive inclusion of obviously unused areas in the MCP; and 3) for consistency with the way in which the data is used (i.e., to estimate number of packs), points that result in notable overlap with adjacent territories are removed.

In past surveys where the majority of territories were delineated using VHF radiolocations, territory sizes were increased 37% to account for the average amount of interstitial space between wolf pack territories as estimated from several Minnesota studies (Fuller et al. 1992:50) where the number of radiolocations per pack typically averaged 30-60. Interstitial spaces are a combination of small voids created by landscape geometry and wolf behavior but are much more likely to be an artifact of territory underestimation when there are comparatively sparse radiolocations. Hence, for packs with <100 radiolocations (n = 9; mean number of radiolocations = 38) we multiplied the area of each estimated territory by 1.37 as in the past. For packs with >100 radiolocations (n = 36; mean number of radiolocations = 1,301), territories were assumed to be fully delineated and were not re-scaled.

To estimate the number of packs within occupied wolf range, the area of occupied range is divided by average scaled territory size. The estimated number of packs is then multiplied by average mid-winter pack size to produce an estimate of pack-associated wolves, which is then divided by 0.85 to account for an estimated 15% lone wolves in the population (Fuller et al. 1992:46, Fuller et al. 2003:170).

Specifically,

N = [(km^2 of occupied range/mean scaled territory size)*mean pack size]/0.85.

Using the accelerated bias-corrected percentile method (Manly 1997), the 90% confidence interval for population size was generated from 9,999 bootstrapped re-samples of the pack and territory size data, and does not incorporate uncertainty in estimates of occupied range or percent lone wolves.

RESULTS

A total of 1,601 opportunistic wolf sign observations were recorded during the 2017-18 wolf range survey (Figure 1). Observations consisted of 65% tracks, 15% visuals, 4% scats, and 16% other (howls, deer kills, depredation sites, etc.).

Distribution

We evaluated potential shifts in total wolf range by examining available information near the southern and western edge of the previously-delineated wolf range boundary. After considering the totality of information (see Methods), we concluded that sufficient data existed to extend the previous wolf range line in numerous areas along the southern and western periphery. Revised total wolf range was estimated to be 111,862 km^2, an increase of ~18% from 2012 (Figure 1, Table 1).

After removing townships within the revised total range that neither met human-road model criteria nor contained WISUR18 pack observations, estimated occupied range was 73,972 km^2 (Figure 1), a 4.8% increase from the 2012 survey (Figure 1, Table 1). Of the total estimated occupied range, 66% was confirmed to be occupied based on pack detection in the township, and 34% was presumed to contain packs because of low human and road density (i.e., modeled townships; Table 1). Of all the townships in wolf range that contained pack observations, 27% had higher human and/or road density than the thresholds in the road-human density model previously developed (Table 1).

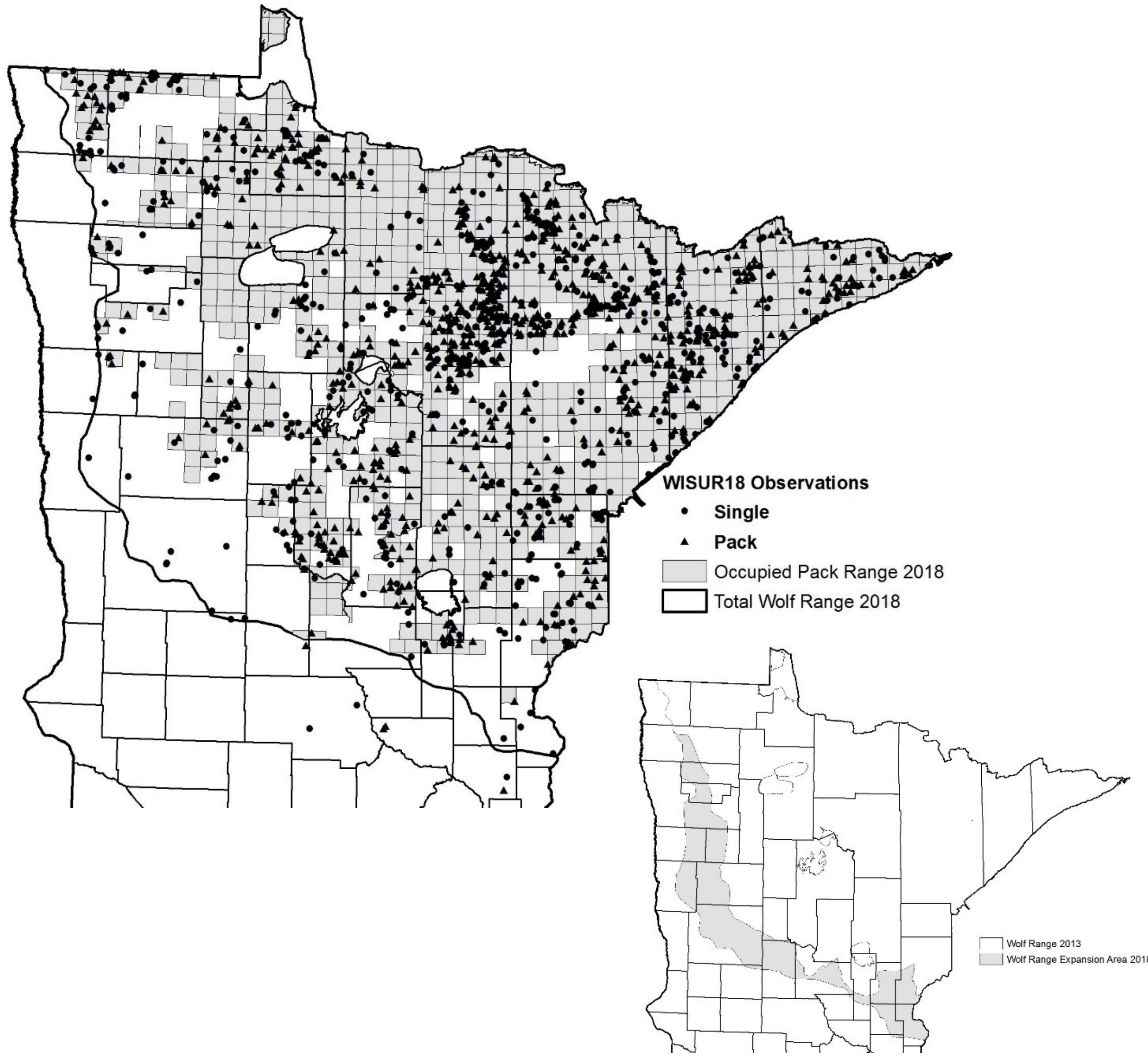

Figure 1. Wolf sign observations, total wolf range, and occupied townships delineated as part of the 2017-18 winter wolf survey in Minnesota. Small inset highlights area of range expansion since 2012.

Table 1. Comparison of Minnesota wolf range assessments, 1988 – 2018.

	1988/89	1997/98	2003/04	2007/08	2012/13	2017/18
Total Wolf Range (km^2)	60,229	88,325	88,325	88,325	95,098	111,862
Occupied Range (km^2)	53,100	73,920	67,852	71,514	70,579	73,972
% Occupied Range confirmed by pack detection in township	55	84	54	68	70	66
% occupied area with pack detection that exceeds human/road density thresholds [a]	11	17	19	20	30	27
Wolf Population Density (wolves/100 km^2)	2.86	3.31	4.45	4.08	3.13	3.59

[a] thresholds from Fuller et al. (1992)

Pack and Territory Size

We obtained sufficient location data to generate territories for 45 packs (Figure 2); their collective territory area represented 10% of occupied wolf range. Winter pack size counts were obtained for 41 packs, including 6 packs with insufficient location data for territory delineation.

A land cover comparison using the 2011 National Land Cover Database suggests that the location of collared packs this winter led to some over-representation of habitat classified as woody wetlands and under-representation of deciduous forest (Table 2), likely a combined result of more collared packs (and with large territories) near Red Lake and fewer collared packs in our southwest study area. In addition, collared pack territories under-represented, as is typically the case, areas in occupied range classified as hay/pasture/cropland, largely a result of these areas being on private land where less wolf collaring is undertaken. Average spring 2017 deer density in the larger deer permit areas within which the wolf territories were situated, weighted by the number of radio-marked wolf packs within a given permit area, was 11.1 deer/mi^2. In comparison, spring deer density for the forest zone of Minnesota, a close approximation of wolf range, was 13.3 deer/mi^2 in spring 2017. Considering this collective information, we suspect that the sample of collared packs this winter might be slightly biased towards areas of lower quality wolf habitat compared to last winter.

After applying the 'interstitial scaling factors' discussed in the Methods, average territory size for radio- marked packs was 158.97 km^2 (Figure 3). Average winter pack size was 4.85 wolves (Figure 4).

Wolf Numbers

Dividing estimated occupied range (73,972 km^2) by average territory size (158.97 km^2) results in an estimate of 465 wolf packs in Minnesota (Figure 5). Multiplying by average pack size (4.85) and accounting for an estimated 15% lone wolves yields a population point estimate of 2,655 wolves (Figure 6), or 3.6 wolves per 100 km^2 of occupied range (Table1). The 90% confidence interval ranges from 1,972 wolves to 3,387 wolves (Figure 6).

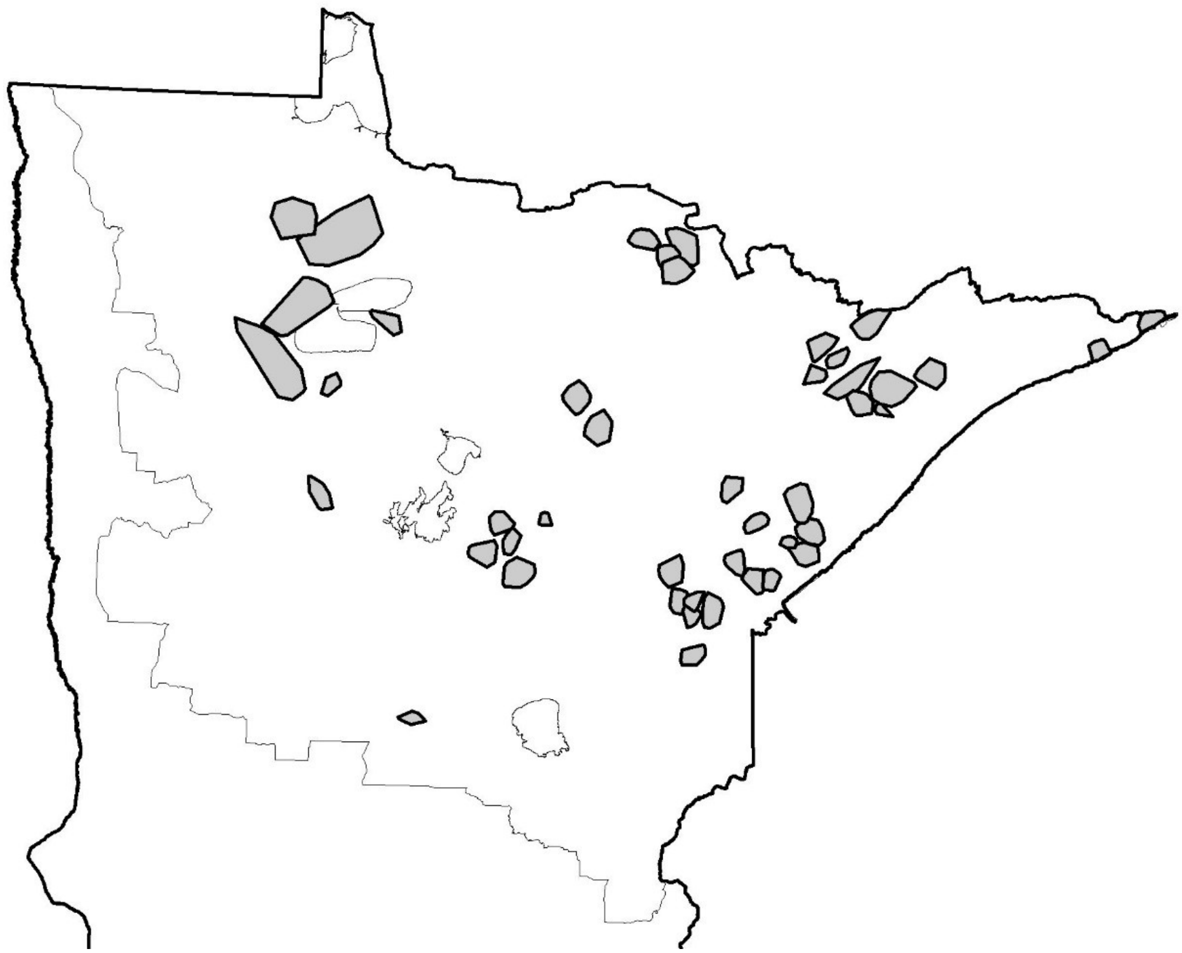

Figure 2. Location of radio-marked wolf packs in Minnesota from which data on territory and pack size were derived during the 2017-18 survey.

Table 2. Comparison of land cover[a] in territories of radio-collared wolf packs during winter 2017-18 with land cover in all of occupied wolf range in Minnesota.

Land Cover Category	Overall Occupied Wolf range % Area	Radio-collared Wolf Territories % Area
Woody Wetlands	31.9	37.2
Deciduous Forest	23.1	18.1
Emergent Herbaceous Wetlands	10.1	13.2
Mixed Forest	6.9	7.1
Evergreen Forest	6.7	8.5
Open Water	5.2	4.5
Shrub/Scrub	4.5	4.8
Pasture/Hay/Grassland/Crops	9.3	4.9
Developed, All	2.4	1.8

[a] Land cover data derived from the 2011 National Land Cover Database

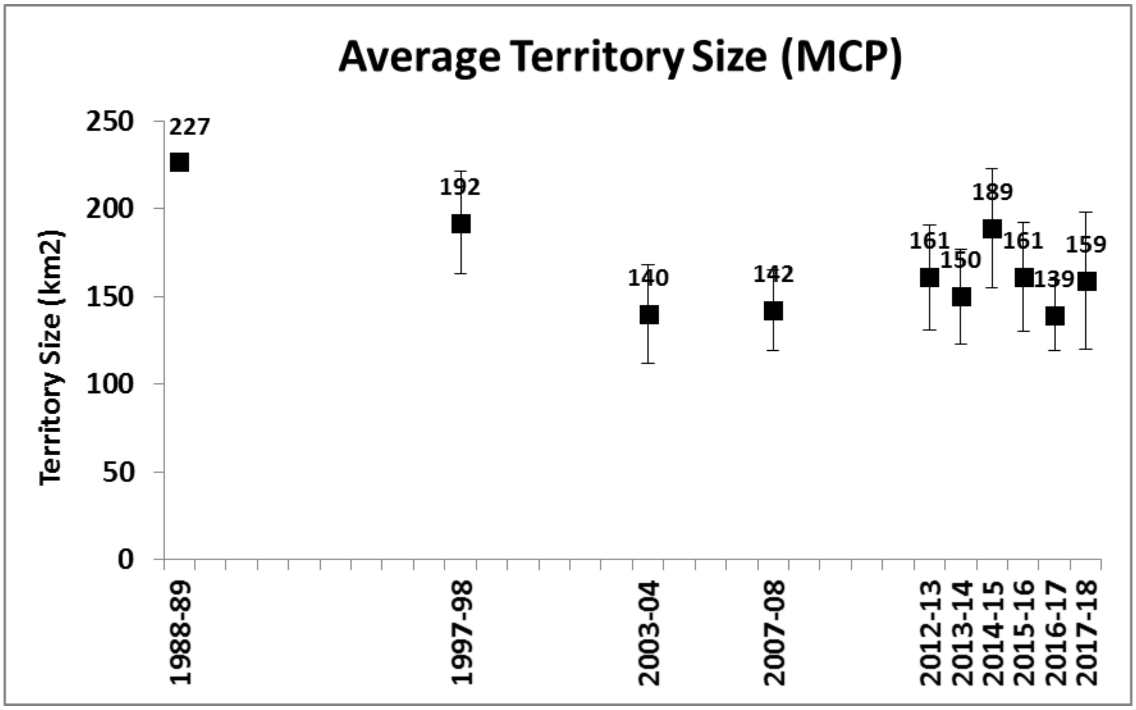

Figure 3. Average scaled territory size for radio-marked wolf packs in Minnesota from 1989 to 2018.

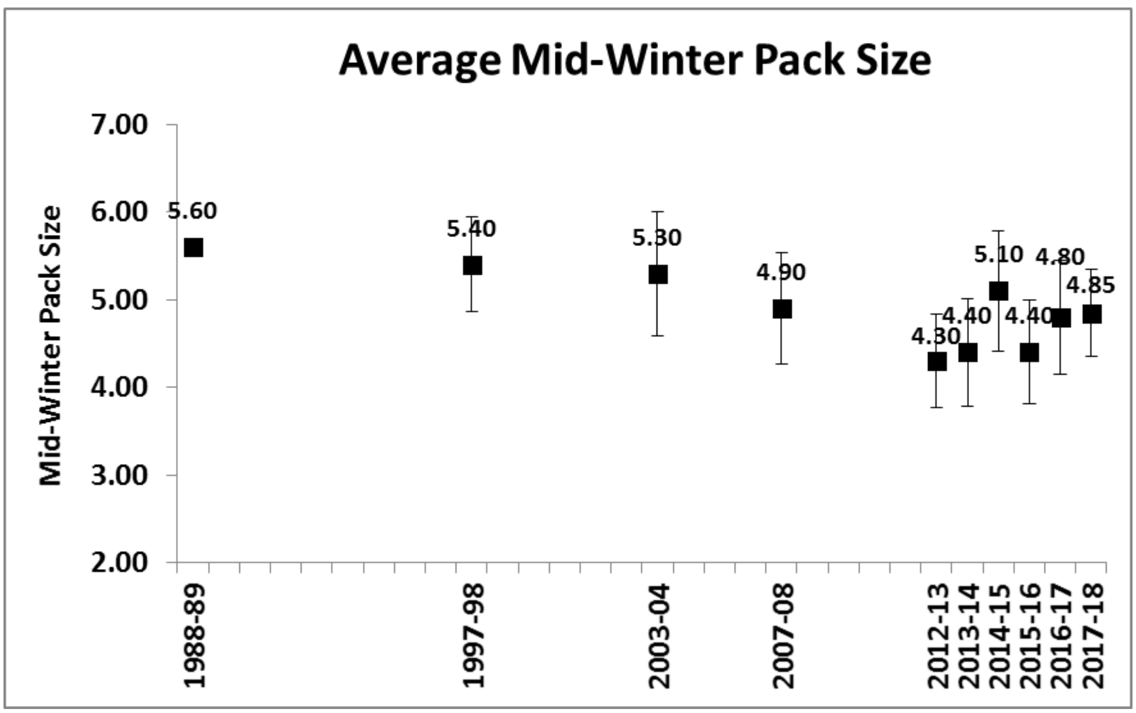

Figure 4. Average mid-winter pack size for radio-marked wolf packs in Minnesota from 1989 to 2018.

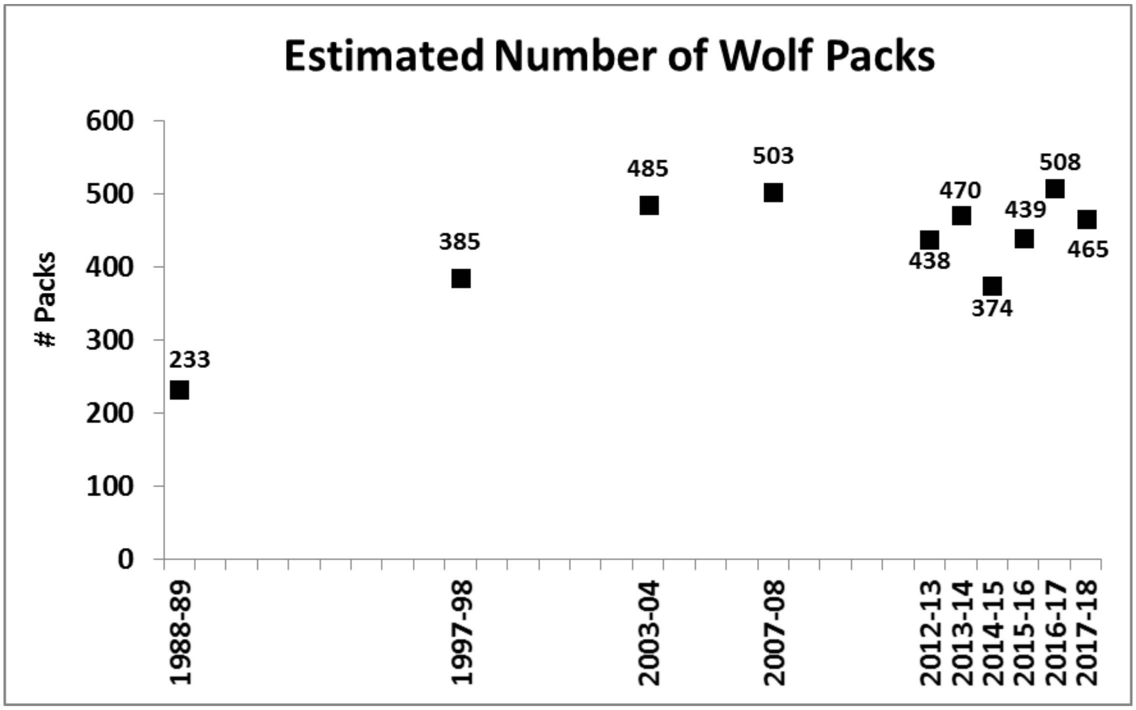

Figure 5. Estimated number of wolf packs in Minnesota at periodic intervals from 1989 to 2018.

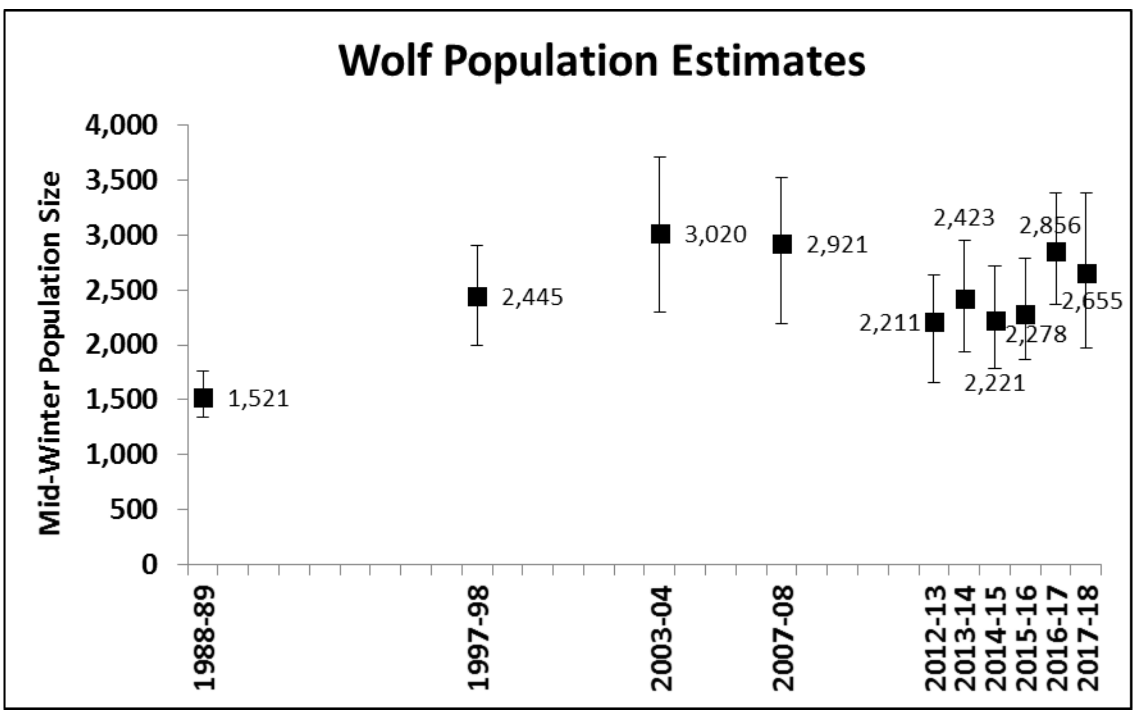

Figure 6. Wolf population estimates from periodic standardized surveys in Minnesota, 1989 to 2018.

DISCUSSION

Available information since the 2012 survey indicates that wolf range has expanded in several areas along the southern and western periphery. In these areas, we repositioned the wolf range line after considering multiple data sources, resulting in an 18% increase in wolf range to 111,862 km^2. Although much of the area of expansion was not concluded to be occupied by packs based on either the human- road density model or pack detections, and hence was not included in occupied range, we felt sufficient confirmations have occurred in these areas since the last survey to justify range expansion. It is also likely that wolves remain under-detected by survey participants in these areas during winter due to private ownership of much of the land.

Approximately two-thirds of total wolf range, or 73,972 km^2, was estimated to be occupied by wolf packs during winter 2017-18. This represents an approximately 5% increase in occupied range since the 2012- 13 wolf range survey; the 4 estimates of occupied wolf range since then have fluctuated between approximately 68,000 and 74,000 km^2. Because delineation of wolf range relies on opportunistic wolf sign observations, effort across surveys likely varies as a result of fluctuations in the number of personnel able to contribute wolf sign observations or the number of hours spent afield by survey participants. Hence, we can't rule out sampling variation as the cause of slight changes in the estimate of occupied range, though changes in wolf demographics likely contribute to the fluctuations as well. Since 1998, there has been no consistent increasing or decreasing trend in the amount of occupied range.

Because 34% of the townships were deemed occupied based only on 'low' human/road density (i.e., not via pack detections), it remains possible that occupied range could be overestimated. However, in a majority of cases a lack of pack detections likely reflects a lack of sampling effort rather than a lack of wolves. Some wolves occupy remote areas (e.g., the BWCAW) and are unlikely to be opportunistically detected, and notable amounts of private land, particularly in the southern and western portion of the range, are also unlikely to be opportunistically surveyed. Stated differently, pack detection probability is undoubtedly less than 1 in many areas. Finally, while prey- or habitat-based models have some potential to overestimate occupancy at any given time, the 1988-89 human-road density model (Fuller et al. 1992) utilized in our methodology has generally been a conservative descriptor of wolf 'habitat' in Minnesota.

The percentage of township area containing pack observations but exceeding the occupancy thresholds in the 1988-89 road-human density model had increased from 1988 (17%) to 2012 (30%), but may now have stabilized; results from the 2017-18 survey indicate that 27% of the townships in which wolf packs were confirmed have human-road densities that exceed the thresholds.

From 1988 to 2003, wolf pack territory sizes declined in Minnesota. Although numerous factors can influence territory size, we believe 2 largely explain this pattern. First, expanding wolf populations (or portions thereof) that compose a significant number of colonizing packs have been shown to exhibit declines in average pack territory size as the population becomes more established or available range more saturated (Fritts and Mech 1981, Hayes and Harestad 2000), a characterization that applies to the Minnesota wolf population from early recovery up to approximately 2003. Second, territory size is negatively correlated with prey density (Mech and Boitani 2003, Fuller et al. 2003), and Minnesota's deer population exhibited an increasing trend during much of wolf recovery in Minnesota. Since 2003, our estimates of average territory size have been comparatively stable, with fluctuations in point estimates likely driven by sampling variability and the direct or lagged influence of deer density fluctuations.

Average mid-winter pack size as estimated from radio-marked packs was approximately 4.9 and has generally exhibited only minor fluctuations over time. The correlation between winter pack size and prey density is not as strong as the correlation between prey density and wolf territory size, though prey density certainly has an influence on pack size, particularly via changes in pup survival (Fuller et al. 2003). Our estimates of winter pack size are highly likely to underestimate true pack sizes, though we suspect not substantially so. Underestimation results from the difficulties of obtaining counts at times when the full pack is together, and in locations and conditions in which all are detectable from the air or ground.

Accuracy in estimates of average territory and pack size is dependent, in part, on radio-collaring a representative sample of wolf packs. Because it is not feasible to identify and stratify all wolf packs to employ true random sampling, our efforts have focused on identifying study areas for radio-collaring that are believed to be collectively representative of overall wolf range, particularly with respect to land cover and deer density. Even so, annual capture success in those areas varies, some collared wolves die or disperse, and some radio-collars prematurely fail. This creates annual variability in the degree to which collared packs are representative of the entire population. Examination of land cover and deer density data from this past winter suggests that location of collared packs may have been somewhat biased towards less productive areas, with the potential result being a population point estimate biased low.

Nonetheless, confidence intervals for the past 2 surveys widely overlap (Figure 6), indicating no significant population change from last year.

We estimate the current population of wolves to be 2,655 (+/- ~ 700), or 3.6 wolves/100 km^2. We estimate total wolf range to have increased by an estimated 18% since 2012, while occupied range was estimated to have increased ~5%. Since wolf population estimates have been derived annually (2012– present), wolf population estimates appear to coarsely track changes in deer density (Figure 7), and wolves remain widely distributed throughout Minnesota’s forest zone.

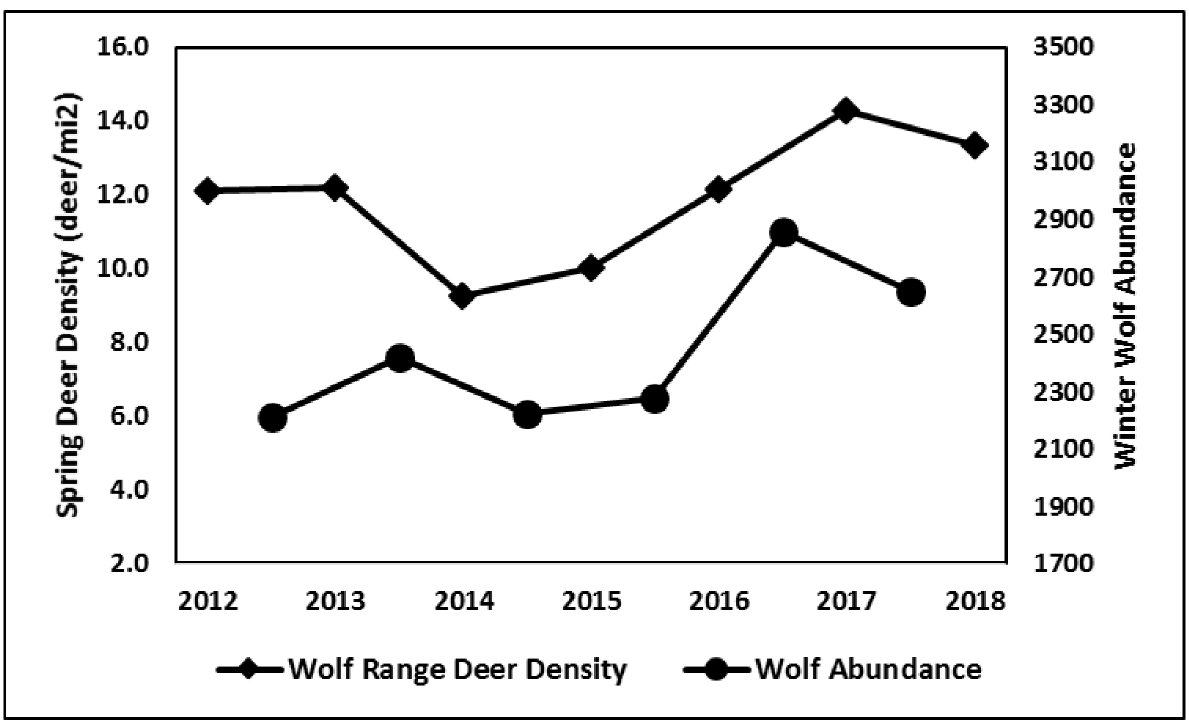

Figure 7. Comparison of estimated pre-fawn deer density in wolf range with winter wolf abundance in Minnesota, 2012-2018.

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2018 WATERFOWL BREEDING POPULATION SURVEY, MINNESOTA

Steve Cordts, Minnesota DNR, Waterfowl Staff Specialist

ABSTRACT

The number of breeding waterfowl in a portion of Minnesota has been estimated each year since 1968 as a part of the overall inventory of North American breeding waterfowl. The survey consists of aerial observations in addition to more intensive ground counts on selected routes to determine the proportion of birds counted by the aerial crew. Procedures used are similar to those used elsewhere across the waterfowl breeding grounds. The 2018 aerial survey portion was flown from May 7-21. Spring ice-out dates in the southern 1/2 of the state were at or near record late and 3-4 weeks later than median dates. In the northern 1/2 of the state, ice out dates were about 1-2 weeks later than median dates. Temperatures in April averaged 11°F below normal statewide and was the 3rd coldest April on record based on 124 years of data. Temperatures in May averaged 6°F above normal statewide and was the 4th warmest May on record. Precipitation was 0.83 inches below normal in April and 0.2 inches above normal in May with drier conditions in the northern ½ of the state. Overall, wetland numbers (Types II-V) were 1% lower than 2017 and near the 10-year (-6%) and long-term (4%) averages.

The 2018 estimated mallard breeding population was 295,000, which was 38% above last year's estimate of 214,000 mallards, but statistically unchanged (P=0.15). Mallard numbers were 18% above the 10-year average and 30% above the long-term average of 228,000 breeding mallards. The estimated blue-winged teal population was 191,000, which was 20% above last year's estimate of 159,000 blue-winged teal, but statistically unchanged (P=0.74). Blue-winged teal numbers were 16% above the 10-year average and 10% below the long-term average of 213,000 blue-winged teal. The combined population index of other ducks, excluding scaup, was 207,000 ducks, which was 21% below last year's estimate and 7% above the 10-year average and 15% above the long-term average of 179,000 other ducks.

The estimate of total duck abundance (693,000), which excludes scaup, was 9% above last year's estimate and 14% above the 10-year average and 12% above the long-term average of 620,000 ducks. The estimated number of Canada geese was 162,000 and 7% higher than last year and 8% above the 10-year average and 2% above the long-term average. Due to the conditions in April, goose production was extremely late and likely will be below average.

METHODS

The aerial survey is based on a sampling design that includes three survey strata (Table 1, Figure 1). The strata cover 39% of the state area and are defined by density of lake basins (>10 acres) exclusive of the infertile northeastern lake region. The strata include the following:

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

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

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

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

All aerial transects in Strata I-III (Table 1) were flown using an American Champion Scout. Wetlands were counted on only the observer's side of the plane (0.125 mile wide transect); a correction factor obtained in 1989 (123,000/203,000 = 0.606) was used to adjust previous estimates (1968-88) of wetland abundance (Type II-V; Table 2) that were obtained when the observer counted wetlands on both sides of the plane (0.25 mile wide transect). All wetland and waterfowl data were recorded on digital voice recorders and transcribed by the observer from the digital files.

Visibility correction factors (VCFs) were derived from intensive ground surveys on 14 selected routes flown by the aerial crew. Many of these routes use a county road as the mid-point of the transect boundary which aids in navigation and helps ensure the aerial and ground crews survey the same area. Ground routes each originally included about 100 wetland areas; however, drainage has reduced the number of wetlands on most of the routes. All observations from both ground crews and aerial crews were used to calculate the VCFs.

The SAS computer program was modified in 1992 to obtain standard errors for mallard and blue-winged teal breeding population estimates. These calculations were based upon SAS computer code written by Graham Smith, USFWS-Office of Migratory Bird Management. Estimates for 2017 and 2018 were compared using two-tailed Z-tests.

SURVEY CHRONOLOGY

The 2018 aerial survey began on 7 May in southern Minnesota and concluded in northern Minnesota on 21 May. The survey start date was delayed for 1 week due to ice coverage still present. Transects were flown on 9 days and completed in 51 flight hours. Flights began near 7 AM and were completed by 12:00 PM each day. The median date for survey completion was May 15, which was 9 days later than last year.

WEATHER AND HABITAT CONDITIONS

Statewide, April was the 3rd coldest in state history and May was the 4th warmest in history based on 124 years of climate records. For the southern part of the state, ice out was extremely late with many lakes 3-4 weeks later than average. In northern Minnesota, ice-out dates were about 1-2 weeks later than average. In mid-April, much of southern Minnesota, mainly south of Willmar, received 8-20"+ inches of snow. Temperatures in April averaged 10.7°F below normal and precipitation was 0.83 inches below normal statewide. Temperatures in May averaged 6.2°F above normal statewide and precipitation was 0.2 inches above normal statewide (http://climate.umn.edu). Precipitation from early April until the survey was completed showed above average precipitation in southern Minnesota and below average precipitation in northern Minnesota (Appendix A).

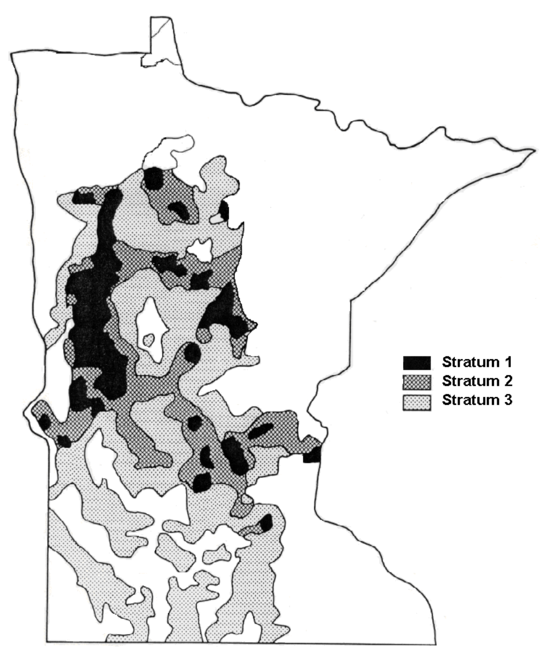

Figure 1. Location of waterfowl breeding population survey strata in Minnesota.

Overall wetland conditions in spring 2018 were similar to last year. In early May 2018, the U.S. drought monitor indicated 96% of the state was under no dryness designation. By late May, 44% of the state was under no drought designation and 56% was classified as abnormally dry, mainly in central and northern MN. On May 6, statewide topsoil moisture indices were rated as 1% very short, 6% short, 71% adequate and 22% surplus moisture. By May 29, statewide topsoil moisture indices were rated as 4% very short, 13% short, 76% adequate and 7% surplus moisture (http://droughtmonitor.unl.edu).

Wetland numbers (Types II-V) in 2018 were 263,000 ponds which was 1% below last year's estimate of 265,000 ponds. Wetland numbers were 6% below the 10-year average and 4% above the long-term average (Table 2; Figure 2). The number of temporary (Type 1) sheet water wetlands was 64% lower than last year and 67% below the long-term average.

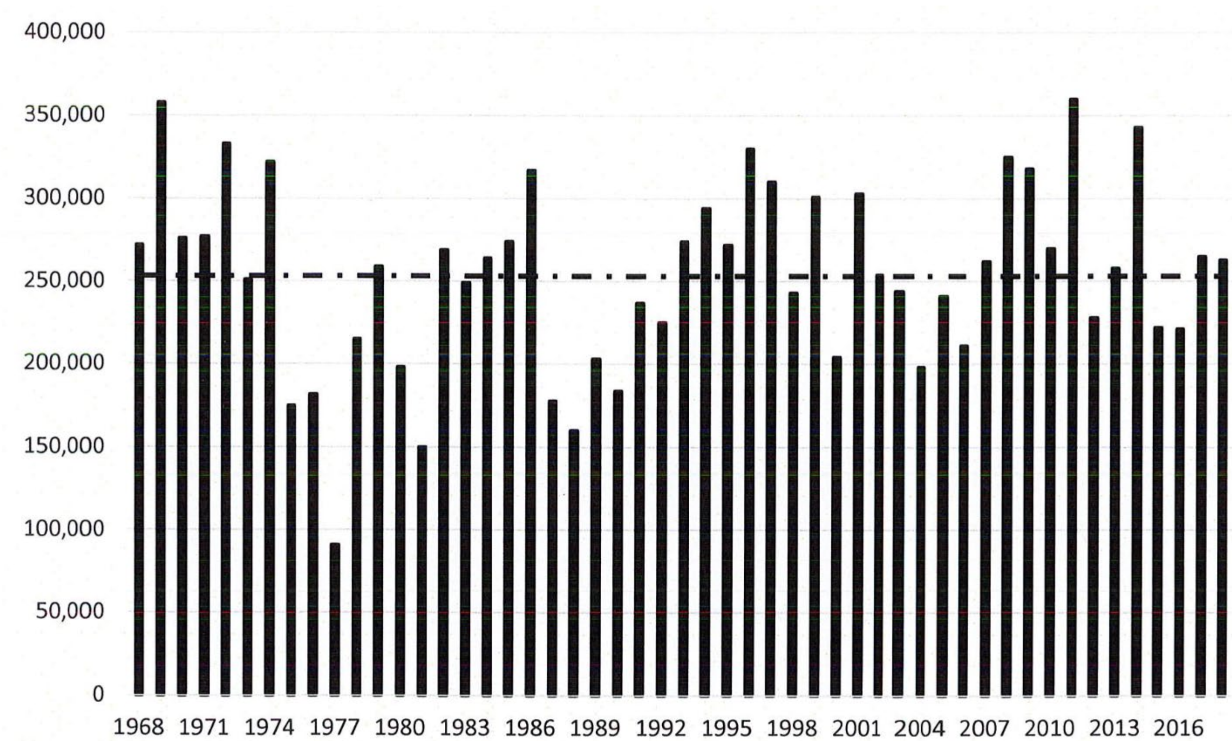

Figure 2. Number of May ponds (Type II-V) and long-term average (dashed line) in Minnesota, 1968-2018.

Planting dates for row crops were late in 2018. By May 6, about 9% of the corn acres had been planted which was 9 days behind last year and 16 days behind average. By June 3rd, about 24% of alfalfa hay had been cut, 3 days behind last year and 1 day behind average (Minnesota Agricultural Statistics Service Weekly Crop Weather Reports, (http://www.nass.usda.gov/mn/).

WATERFOWL POPULATIONS

The number of ducks, Canada geese, coots, and swans, by stratum, are shown in Tables 3-5; total numbers are presented in Table 6. These estimates are expanded for area but not corrected for visibility bias. Table 7 and Table 8 provide the unadjusted population index (Unad. PI), which is multiplied by the visibility correction factor (VCF) to obtain the population index (PI) for ducks and Canada geese. The standard error (SE) of the estimate is also provided for mallard and blue-winged teal estimates.

The 2018 breeding population estimate of mallards was 295,370 (SE = 46,578), which was 38% higher than the 2017 estimate of 213,644 mallards, but statistically unchanged ($Z = 1.44$, $P = 0.15$) (Table 7, Figure 3). Mallard numbers were 18% above the 10-year average and 30% above the long-term average of 228,000 mallards. In 2018, the mallard population was comprised of 83% lone or flocked males, 9% pairs, and 8% flocked mallards. The 5-year average is 76% lone or flocked males, 16% pairs, and 8% flocked mallards.

The estimated blue-winged teal population was 190,695 (SE = 77,961), which was 20% higher than the 2017 estimate of 159,483 blue-winged teal, but statistically unchanged ($Z = 0.33$, $P = 0.74$). Blue-winged teal numbers were 16% above the 10-year average and 10% below the long-term average (Table 7, Figure 4). The blue-winged teal population was comprised of 6% lone males, 33% pairs, and 61% flocks. The 5-year average is 8% lone males, 42% pairs, and 50% flocks.

The combined population estimate of other ducks (excluding scaup) was 206,505 which was 21% below last year's estimate of 262,867 other ducks but 7% above the 10-year average and 15% above the long-term average (Table 7, Figure 5). Ring-necked ducks and wood ducks were the most abundant species of other ducks (Table 6). Scaup numbers (31,000) were 59% below last year's estimate and 48% below the long-term average.

The total duck population index, excluding scaup, was 693,000 ducks and was 9% above last year's index of 636,000 ducks and 14% above the 10-year average and 12% above the long-term average (Table 8, Figure 6).

The population index for total ducks was 724,000 ducks, which was 13% above the 10-year average and 6% above the long-term average.

Visibility Correction Factors (VCFs) were higher for mallards, blue-winged teal, and other ducks in 2018 compared to 2017 (Table 7, Table 8). The mallard VCF (2.76) was 9% above the 10-year average. The blue-winged teal VCF (3.45) was 8% below the 10-year average. The VCF for other ducks (2.88) was 6% above the 10-year average. The VCF for Canada geese (1.75) was 15% below the 10-year average.

The population estimate of Canada geese (adjusted for visibility) was 162,000, which was 7% above last year's estimate and 8% above the 10-year average (Table 8, Figure 7). A total of 2 Canada goose broods were observed, compared to 43 in 2017. This was the fewest goose broods observed in the past 15 years.

The estimated coot population, uncorrected for visibility, was 27,000 compared to 31,000 in 2017.

The estimated number of swans (likely trumpeters) was 22,850 swans compared to last year's estimate of 17,230 (Table 6; Figure 8). Lone swans are not doubled and the estimate is expanded for area but not visibility, although visibility of swans is extremely high. Trumpeter swans continue to expand their range and dramatically increase in number.

ACKNOWLEDGMENTS

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Data supplied by: Minnesota Department of Natural Resources (MNDNR) and U.S. Fish and Wildlife Service (USFWS)

<u>Air Crew:</u>

Pilot/Observer: Bob Geving, Conservation Officer Pilot, MNDNR, Division of Enforcement

Observer: Steve Cordts, Waterfowl Staff Specialist, MNDNR, Division of Wildlife

Ground Crew Leaders: Kelly VanBeek, Migratory Birds, USFWS, Region III, Madison, WI; Wayne Brininger, USFWS, Tamarac National Wildlife Refuge; Dan Hertel and Kylie Jensen, USFWS, HAPET, Fergus Falls; Tom Cooper, Jim Kelley, Sean Kelly (retired), USFWS, Twin Cities; Ed Zlonis, Minnesota DNR; Kris Spaeth, USFWS, Sherburne National Wildlife Refuge

Ground Crew Assistants: Kevin Kotts, Minnesota DNR; Gina Kemper, Meta Griffin, Ken Mattson, Larry Michelson, USFWS, Tamarac National Wildlife Refuge; Jacob Hernandez and John Riens, USFWS, Private lands; Steve Lewis, USFWS, retired; Cody Carlstrom, USFWS, Sherburne National Wildlife Refuge

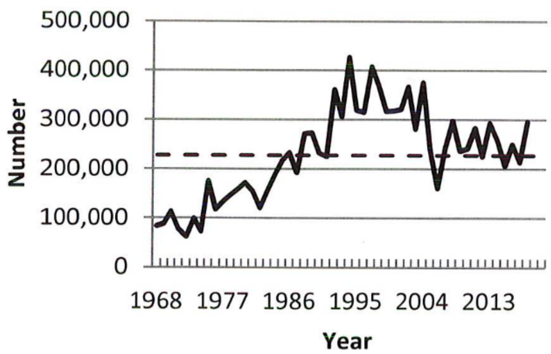

Figure 3. Mallard population estimates (adjusted for visibility bias) and long-term average (dashed line) in Minnesota, 1968-2018.

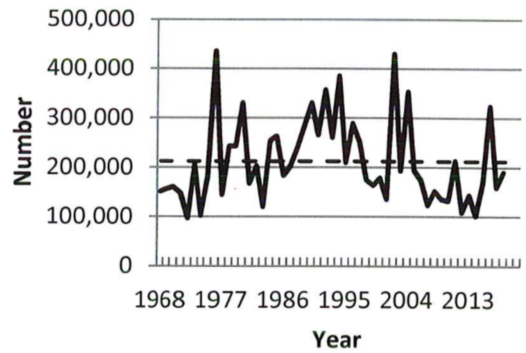

Figure 4. Blue-winged teal population estimates (adjusted for visibility bias) and long-term average (dashed line) in Minnesota, 1968-2018.

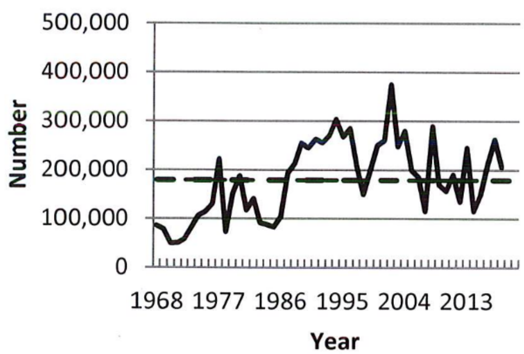

Figure 5. Other duck (excluding scaup) population estimates (adjusted for visibility bias) and long-term average (dashed line) in Minnesota, 1968-2018

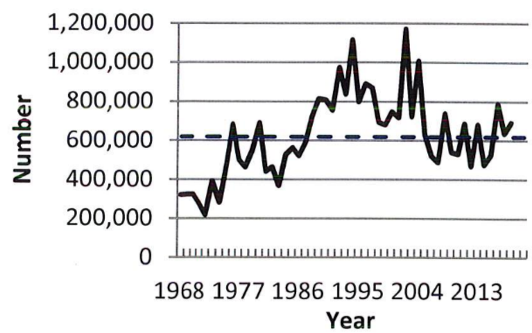

Figure 6. Total duck (excluding scaup) population estimates (adjusted for visibility bias) and long-term average (dashed line) in Minnesota, 1968-2018

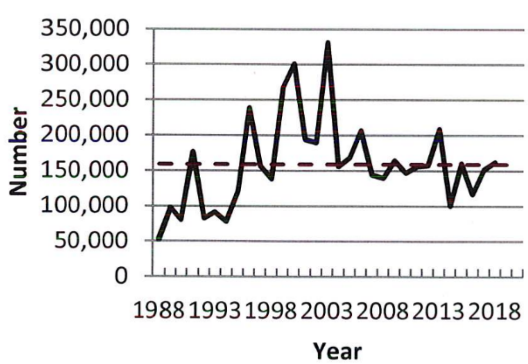

Figure 7. Canada goose population (adjusted for visibility bias) and long-term average (dashed line) in Minnesota, 1988-2018.

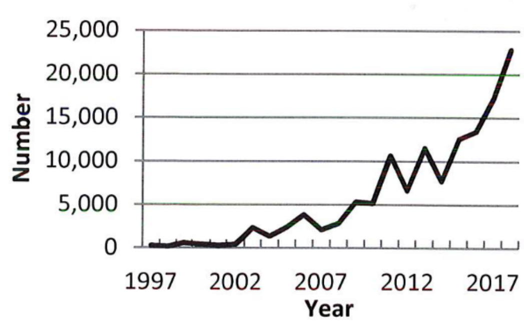

Figure 8. Trumpeter swan population in Minnesota, 1997-2018.

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Table 1. Survey design for Minnesota, May 2018.[1]

	Stratum 1	2	3	Total
Survey design				
Square miles in stratum	5,075	7,970	17,671	30,716
Square miles in sample - waterfowl	182.75	136.375	203.125	522.25
Square miles in sample - ponds	91.375	68.1875	101.5625	261.125
Linear miles in sample	731.0	545.5	812.5	2,089.0
Number of transects in sample	39	36	40	115
Minimum transect length (miles)	5	6	7	5
Maximum transect length (miles)	36	35	39	39
Expansion Factor - waterfowl	27.770	58.442	86.996	
Expansion Factor - ponds	55.540	116.884	173.991	
Current year coverage				
Square miles in sample - waterfowl	182.75	136.375	203.125	522.25
Square miles in sample - ponds	91.375	68.1875	101.5625	261.125
Linear miles in sample	731.0	545.5	812.5	2,089.0
Number of transects in sample	39	36	40	115
Minimum transect length (miles)	5	6	7	5
Maximum transect length (miles)	36	35	39	39
Expansion Factor - waterfowl	27.770	58.442	86.996	
Expansion Factor - ponds	55.540	116.884	173.991	

[1] Also, 8 additional air-ground transects (total linear miles = 202.5, range - 10-60 miles) were flown to use in calculating the VCF.

Table 2. Estimated May ponds (Type 1 and Types II-V), 1968-2018.

Year	Number of Ponds[1]		Year	Type 1 wetlands	Number of Ponds[1]
1968	272,000		1991	83,000	237,000
1969	358,000		1992	10,000	225,000
1970	276,000		1993	200,000	274,000
1971	277,000		1994	124,000	294,000
1972	333,000		1995	140,000	272,000
1973	251,000		1996	148,000	330,000
1974	322,000		1997	31,000	310,000
1975	175,000		1998	21,000	243,000
1976	182,000		1999	153,000	301,000
1977	91,000		2000	5,000	204,000
1978	215,000		2001	66,000	303,000
1979	259,000		2002	31,000	254,000
1980	198,000		2003	34,000	244,000
1981	150,000		2004	9,000	198,000
1982	269,000		2005	31,000	241,000
1983	249,000		2006	57,000	211,000
1984	264,000		2007	32,000	262,000
1985	274,000		2008	70,000	325,000
1986	317,000		2009	39,000	318,000
1987	178,000		2010	27,000	270,000
1988	160,000		2011	89,000	360,000
1989	203,000		2012	31,000	228,000
1990	184,000		2013	10,000	258,000
			2014	54,000	343,000
			2015	22,000	222,000
			2016	34,000	221,000
			2017	54,000	265,000
			2018	20,000	263,000
		Averages:	10-year	43,000	281,000
			Long-term	59,000	253,000
		% change from:	2017	-64%	-1%
			10-year	-55%	-6%
			Long-term	-67%	4%

[1] Type II-V, correction factor from 1989 (123,000/203,000=0.606) used to adjust 1968-88 pond numbers.

Table 3. Minnesota waterfowl breeding populations by species for Stratum I (high wetland density), expanded for area but not visibility, 2000-2018.

Species	Year 2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Dabblers:																			
Mallard	26,604	28,742	29,297	25,937	29,381	19,050	16,829	16,357	25,104	19,467	18,439	19,856	18,911	21,161	19,522	19,633	26,020	21,688	23,160
Black Duck	0	0	0	0	0	56	0	0	0	0	0	0	0	333	167	222	0	56	0
Gadwall	833	1,333	944	1,250	2,111	1,166	1,444	889	1,166	1,055	1,000	167	1,389	722	555	1,083	1,000	2,138	1,888
American Wigeon	56	111	0	56	555	167	0	56	111	56	56	111	222	222	167	111	111	167	167
Green-winged Teal	278	56	278	222	444	56	56	167	278	167	56	56	56	0	0	56	111	278	0
Blue-winged Teal	11,247	7,387	14,218	9,664	23,771	9,303	5,665	5,332	9,942	5,998	7,304	4,665	5,110	4,193	3,388	4,360	6,998	8,609	4,888
Northern Shoveler	1,055	305	1,277	278	1,166	333	167	56	1,000	666	1,027	111	56	333	722	111	666	916	333
Northern Pintail	167	389	56	111	56	0	56	0	56	56	0	111	0	111	167	222	0	111	111
Wood Duck	10,219	6,720	2,888	4,499	8,081	5,498	3,555	2,666	6,665	4,277	3,999	3,416	4,138	3,249	2,527	2,222	5,610	4,971	6,498
Dabbler Subtotal	50,459	45,043	48,958	42,017	65,565	35,629	27,772	25,523	44,322	31,742	31,881	28,493	29,882	30,324	27,215	28,020	40,516	38,934	37,045
Divers:																			
Redhead	583	1,444	750	333	805	666	666	916	1,389	472	944	805	750	861	1,333	583	2,166	1,000	333
Canvasback	1,222	2,027	1,833	1,333	666	972	833	1,000	2,277	1,333	1,222	833	722	1,555	1,777	1,027	1,944	2,666	1,277
Scaup	7,415	5,832	2,444	2,055	5,971	4,110	111	555	6,276	8,553	2,777	2,222	1,055	1,000	1,250	5,526	10,969	7,359	1,500
Ring-necked Duck	4,776	2,444	2,777	1,361	5,165	1,722	2,055	1,555	21,494	6,859	3,138	4,804	2,666	3,582	4,554	3,110	8,220	12,608	4,221
Goldeneye	56	333	111	0	222	222	56	222	278	278	222	56	56	333	444	278	278	1,000	500
Bufflehead	56	111	222	111	389	167	222	56	1,611	833	389	278	56	611	56	278	500	2,444	611
Ruddy Duck	0	83	1,305	417	305	1,222	305	0	1,027	861	28	56	0	305	111	694	1,500	222	1,722
Hooded Merganser	500	722	555	333	278	333	555	111	666	944	555	500	555	333	666	1,000	1,222	1,222	1,222
Large Merganser	0	111	0	972	0	111	0	278	333	333	333	111	56	222	139	167	56	167	56
Diver Subtotal	14,608	13,107	9,997	6,915	13,801	9,525	4,803	4,693	35,351	20,466	9,608	9,665	5,916	8,802	10,330	12,663	26,855	28,688	11,442
Total Ducks	65,067	58,150	58,955	48,932	79,366	45,154	32,575	30,216	79,673	52,208	41,489	38,158	35,798	39,126	37,545	40,683	67,371	67,622	48,487
Other:																			
Coot	3,999	1,722	2,888	2,666	21,411	2,444	639	139	16,829	2,166	139	2,194	444	10,386	2,360	1,972	10,608	13,191	7,137
Canada Goose	22,160	24,882	24,104	22,160	23,160	22,938	21,633	29,797	18,717	16,523	16,440	13,691	26,437	23,771	18,578	23,077	17,995	18,273	25,854
Swan	0	0	111	1,000	305	417	861	389	694	500	694	1,611	1,277	2,944	1,944	2,472	3,693	4,054	3,804

Table 4. Minnesota waterfowl breeding populations by species for Stratum II (medium wetland density), expanded for area but not visibility, 2000-2018.

	Year																		
Species	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Dabblers:																			
Mallard	49,559	44,650	43,773	34,715	44,474	26,883	25,130	24,779	27,935	23,494	21,507	30,974	29,689	27,409	28,987	24,078	32,085	26,299	26,533
Black Duck	0	117	0	0	0	0	0	0	0	0	0	0	0	0	0	117	0	0	117
Gadwall	3,039	1,636	701	584	3,565	584	1,052	234	3,039	1,169	1,286	935	1,987	701	234	818	1,286	4,442	2,805
American Wigeon	468	0	0	0	2,513	117	0	0	351	0	351	0	117	234	0	234	234	1,052	234
Green-winged Teal	117	117	468	234	234	0	117	0	0	234	117	0	0	117	351	584	0	0	0
Blue-winged Teal	19,637	9,701	21,390	15,955	30,624	11,513	9,000	8,416	12,740	11,104	8,474	12,390	9,000	4,383	7,364	5,026	10,753	15,487	8,007
Northern Shoveler	4,675	1,052	2,221	1,403	1,753	234	584	351	468	701	2,513	1,052	0	351	935	877	935	3,857	584
Northern Pintail	117	117	0	117	0	0	0	234	0	0	0	234	0	0	117	0	0	0	0
Wood Duck	13,792	7,831	5,143	4,558	8,766	3,273	1,753	2,221	6,546	5,260	6,312	6,955	5,143	4,792	1,636	1,753	4,149	4,851	5,961
Dabbler subtotal	91,404	65,221	73,696	57,566	91,929	42,604	37,636	36,235	51,079	41,962	40,560	52,540	45,936	37,987	39,624	33,487	49,442	55,988	44,241
Divers:																			
Redhead	2,805	2,455	234	584	1,110	292	175	935	935	584	760	1,578	468	468	526	468	1,110	818	117
Canvasback	935	0	468	1,052	234	0	0	1,169	468	234	117	584	117	935	1,286	1,169	1,403	2,338	234
Scaup	6,779	3,039	5,961	2,279	7,188	2,981	468	643	3,097	2,104	0	1,929	935	2,045	2,396	4,909	5,318	5,260	1,344
Ring-necked Duck	5,610	3,799	6,370	2,455	5,377	1,929	3,331	1,578	13,149	9,117	2,396	11,455	1,695	6,253	5,143	4,325	4,792	9,292	4,968
Goldeneye	584	468	234	234	351	117	117	0	351	584	468	468	584	935	1,519	935	1,169	818	234
Bufflehead	0	0	1,169	117	468	351	117	117	1,403	818	643	1,403	468	0	818	0	234	2,279	584
Ruddy Duck	0	0	1,870	2,688	0	351	58	0	0	175	409	58	234	117	0	351	643	468	0
Hooded Merganser	935	1,403	701	701	234	234	351	234	584	701	117	2,221	1,636	701	234	1,169	2,455	3,448	1,403
Large Merganser	117	117	0	0	234	351	0	0	351	0	0	234	0	234	117	234	117	0	117
Diver subtotal	17,765	11,281	17,007	10,110	15,196	6,606	4,617	4,676	20,338	14,317	4,910	19,930	6,137	11,688	12,039	13,560	17,241	24,721	9,001
Total Ducks	109,169	76,502	90,703	67,676	107,125	49,210	42,253	40,911	71,417	56,279	45,470	72,470	52,073	49,675	51,663	47,047	66,683	80,709	53,242
Other:																			
Coot	1,110	468	4,909	1,519	8,007	584	292	409	23,961	0	117	292	292	2,571	877	0	0	6,370	584
Canada Goose	25,831	24,604	20,688	22,091	28,461	20,688	26,825	25,890	19,753	22,675	18,935	14,201	23,260	22,442	20,572	24,312	17,533	21,799	27,994
Swan	58	117	292	994	701	1,461	994	468	1,519	2,922	2,279	7,188	3,507	6,604	3,740	5,318	4,325	5,084	10,169

Table 5. Minnesota waterfowl breeding populations by species for Stratum III (low wetland density), expanded for area but not visibility, 2000-2018.

	Year																		
Species	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Dabblers:																			
Mallard	81,690	72,642	72,121	55,156	84,561	36,539	30,884	35,843	50,371	35,408	40,976	51,415	47,848	62,638	62,899	51,154	59,593	56,983	57,505
Black Duck	0	0	0	0	174	0	0	174	174	0	0	0	174	174	0	0	0	0	0
Gadwall	2,610	10,701	3,306	1,566	6,960	2,001	5,568	4,176	870	1,392	1,392	4,089	1,566	5,220	1,914	2,088	9,570	5,046	7,134
American Wigeon	522	174	1,218	174	1,566	1,044	174	348	348	174	348	1,044	174	348	174	1,566	870	174	0
Green-winged Teal	1,218	1,392	522	174	0	174	522	0	0	0	0	174	348	696	0	348	0	348	174
Blue-winged Teal	29,405	20,618	56,374	21,140	39,758	27,578	23,663	15,659	18,095	20,183	16,964	44,716	35,669	18,617	21,227	24,098	53,155	39,323	42,455
Northern Shoveler	20,444	10,701	6,264	870	3,828	348	522	870	4,002	2,088	6,873	2,088	8,265	6,786	522	1,914	4,959	3,219	1,392
Northern Pintail	696	522	0	174	348	174	174	348	174	0	174	0	174	174	0	174	522	174	522
Wood Duck	25,055	17,225	13,572	12,702	20,705	7,482	7,308	5,394	14,442	10,266	12,354	13,659	10,962	12,180	9,657	8,265	8,700	16,094	11,919
Dabbler subtotal	161,640	133,975	153,377	91,956	157,900	75,340	68,815	62,812	88,476	69,511	79,081	117,185	105,180	106,833	96,393	89,607	137,369	121,361	121,101
Divers:																			
Redhead	2,523	3,654	1,305	174	1,740	1,479	0	522	783	870	174	4,350	3,306	1,827	1,566	1,305	1,044	3,480	1,914
Canvasback	3,915	522	696	1,131	2,784	0	0	348	1,566	1,218	348	1,044	1,044	696	522	696	348	1,914	522
Scaup	18,182	6,873	4,611	783	17,747	5,307	1,392	696	5,481	1,914	522	5,133	696	8,874	2,871	435	3,915	22,271	8,091
Ring-necked Duck	8,178	8,526	7,395	1,479	5,133	10,179	6,699	1,392	8,526	6,525	3,045	6,264	9,135	6,960	5,568	3,480	4,089	18,095	6,177
Goldeneye	1,044	1,566	3,132	1,305	696	1,044	1,044	870	348	522	174	870	0	348	174	1,218	870	1,566	1,392
Bufflehead	0	0	1,218	783	2,088	0	174	696	1,218	870	174	2,871	174	3,915	4,698	522	2,523	1,740	348
Ruddy Duck	0	696	18,878	87	2,262	870	696	261	87	348	0	3,828	522	522	174	0	87	1,305	783
Hooded Merganser	957	174	2,175	174	1,740	1,218	870	174	696	348	1,218	1,044	1,044	348	348	522	1,392	1,653	3,132
Large Merganser	0	0	522	0	0	261	957	348	348	348	348	174	174	0	0	0	870	957	0
Diver subtotal	34,799	22,011	39,932	5,916	34,190	20,358	11,832	5,307	19,053	12,963	6,003	25,578	16,095	23,490	15,921	8,178	15,138	52,981	22,359
Total Ducks	196,439	155,986	193,309	97,872	192,090	95,698	80,647	68,119	107,529	82,474	85,084	142,763	121,275	130,323	112,314	97,785	152,507	174,342	143,460
Other:																			
Coot	67,684	3,132	14,007	7,134	77,427	8,613	14,702	5,742	15,137	7,047	435	1,479	25,664	27,578	15,746	7,917	5,829	10,962	19,139
Canada Goose	57,940	39,932	33,407	43,412	46,717	39,758	27,230	42,629	31,841	28,274	30,710	32,711	37,496	48,022	24,707	43,498	31,145	30,101	38,888
Swan	348	174	0	348	348	522	2,001	1,218	609	1,914	2,175	1,827	1,827	2,088	2,001	4,785	5,394	8,091	8,874

Table 6. Minnesota waterfowl breeding populations by species for Stratum I-III combined, expanded for area coverage but not for visibility, 2000-2018.

	Year																		
Species	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Dabblers:																			
Mallard	157,853	146,034	145,191	115,974	158,416	82,472	72,843	76,979	103,411	78,368	80,922	102,245	96,448	111,208	111,408	94,866	117,698	104,970	107,198
Black Duck	0	117	0	0	174	56	0	174	174	0	0	0	174	507	167	339	0	56	117
Gadwall	6,482	13,670	4,951	3,400	12,635	3,752	8,064	5,298	5,075	3,616	3,677	5,191	4,941	6,643	2,703	3,989	11,855	11,626	11,827
American Wigeon	1,045	285	1,218	230	4,634	1,327	174	404	810	230	754	1,155	513	804	341	1,911	1,215	1,393	400
Green-winged Teal	1,613	1,564	1,267	630	678	230	694	167	278	400	172	230	404	813	351	988	111	626	174
Blue-winged Teal	60,288	37,706	91,982	46,759	94,152	48,394	38,328	29,407	40,777	37,286	32,742	61,772	49,779	27,194	31,979	33,484	70,907	63,418	55,349
Northern Shoveler	26,175	12,058	9,762	2,550	6,747	915	1,273	1,276	5,469	3,456	10,413	3,251	8,320	7,470	2,179	2,902	6,560	7,992	2,310
Northern Pintail	979	1,028	56	402	404	174	230	582	230	56	174	345	174	285	284	396	522	285	633
Wood Duck	49,067	31,777	21,603	21,759	37,553	16,253	12,616	10,281	27,652	19,802	22,664	24,029	20,242	20,221	13,820	12,240	18,459	25,916	24,378
Dabbler subtotal	303,502	244,239	276,030	191,704	315,393	153,573	134,222	124,568	183,876	143,214	151,518	198,218	180,995	175,145	163,232	151,115	227,327	216,282	202,386
Divers:																			
Redhead	5,911	7,552	2,289	1,092	3,656	2,438	842	2,373	3,107	1,926	1,878	6,733	4,523	3,155	3,425	2,356	4,320	5,298	2,364
Canvasback	6,072	2,549	2,996	3,516	3,684	972	833	2,517	4,311	2,785	1,687	2,461	1,883	3,186	3,585	2,892	3,694	6,918	2,033
Scaup	32,376	15,743	13,016	5,117	30,906	12,397	1,971	1,894	14,854	12,571	3,299	9,283	2,686	11,919	6,517	10,870	20,202	34,890	10,934
Ring-necked Duck	18,565	14,768	16,542	5,294	15,675	13,829	12,085	4,525	43,169	22,501	8,579	22,523	13,495	16,795	15,265	10,915	17,101	39,995	15,365
Goldeneye	1,684	2,367	3,477	1,539	1,269	1,383	1,216	1,092	976	1,384	864	1,393	640	1,616	2,138	2,431	2,317	3,384	2,126
Bufflehead	56	111	2,609	1,011	2,944	517	513	868	4,231	2,521	1,206	4,551	697	4,526	5,572	800	3,257	6,463	1,543
Ruddy Duck	0	779	22,054	3,192	2,567	2,443	1,060	261	1,114	1,384	437	3,942	756	944	285	1,045	2,229	1,995	2,505
Hooded Merganser	2,392	2,299	3,432	1,209	2,251	1,785	1,776	519	1,947	1,993	1,890	3,765	3,236	1,383	1,248	2,691	5,068	6,323	5,756
Large Merganser	117	228	522	972	234	723	957	626	1,032	681	681	519	230	456	256	400	1,042	1,124	172
Diver subtotal	67,173	46,396	66,937	22,942	63,186	36,487	21,253	14,675	74,741	47,746	20,521	55,170	28,146	43,980	38,291	34,400	59,230	106,390	42,798
Total Ducks	370,675	290,635	342,967	214,646	378,579	190,060	155,475	139,243	258,617	190,960	172,039	253,388	209,141	219,125	201,523	185,515	286,557	322,672	245,184
Other:																			
Coot	72,793	5,321	21,804	11,319	106,845	11,641	15,633	6,290	55,927	9,213	691	3,965	26,401	40,535	18,984	9,888	16,437	30,523	26,861
Canada Goose	105,932	89,418	78,200	87,663	98,339	83,384	75,688	98,316	70,311	67,473	66,085	60,603	87,193	94,235	63,857	90,887	66,672	70,172	92,735
Swan	406	291	403	2,341	1,355	2,400	3,855	2,074	2,823	5,336	5,148	10,626	6,611	11,500	7,700	12,575	13,412	17,230	22,847

Table 7. Mallard, blue-winged teal, and other duck (excluding scaup) populations in Minnesota, 1968-2018.

	Mallard				Blue-winged teal				Other ducks (exc. scaup)		
Year	Unad. PI	VCF	PI	SE	Unad. PI	VCF	PI	SE	Unad. PI	VCF	PI
1968	41,030	2.04	83,701		61,493	2.44	151,141		41,419	2.08	86,152
1969	53,167	1.67	88,789		45,180	3.45	155,871		34,605	2.27	78,553
1970	67,463	1.69	113,945		31,682	5.06	160,343		30,822	1.62	49,932
1971	47,702	1.65	78,470		42,445	3.49	148,218		29,520	1.71	50,450
1972	49,137	1.27	62,158		49,386	1.96	96,895		34,405	1.69	58,127
1973	56,607	1.76	99,832		53,095	3.92	208,292		33,155	2.45	81,362
1974	44,866	1.62	72,826		39,402	2.59	102,169		38,266	2.79	106,609
1975	55,093	3.19	175,774		45,948	3.95	181,375		34,585	3.31	114,459
1976	69,844	1.69	117,806		89,370	4.87	435,607		39,022	3.35	130,669
1977	60,617	2.21	134,164		37,391	3.86	144,187		18,633	11.95	222,748
1978	56,152	2.61	146,781		28,491	8.53	242,923		22,034	3.30	72,798
1979	61,743	2.57	158,704	28,668	46,708	5.21	243,167	62,226	39,749	3.79	150,545
1980	83,775	2.05	171,957	22,312	50,966	6.49	330,616	40,571	47,322	3.97	188,020
1981	79,562	1.95	154,844	16,402	64,546	2.59	167,258	23,835	30,947	3.80	117,667
1982	51,655	2.33	120,527	17,078	42,772	4.75	203,167	34,503	32,726	4.32	141,501
1983	73,424	2.12	155,762	15,419	42,728	2.81	119,980	20,809	32,240	2.84	91,400
1984	94,514	1.99	188,149	24,065	89,896	2.82	253,821	33,286	40,326	2.18	87,709
1985	96,045	2.26	216,908	32,935	90,453	2.91	263,607	33,369	35,018	2.35	82,383
1986	108,328	2.16	233,598	30,384	68,235	2.69	183,338	28,204	38,900	2.67	103,851
1987	165,881	1.16	192,289	23,500	102,480	1.99	203,718	32,289	76,746	2.51	192,947
1988	155,543	1.75	271,718	38,675	101,183	2.38	240,532	39,512	81,514	2.61	212,988
1989	124,362	2.19	272,968	26,508	90,300	3.16	285,760	39,834	88,109	2.89	254,887
1990	140,879	1.65	232,059	26,316	107,177	3.09	330,659	44,455	124,531	1.97	245,152
1991	128,315	1.75	224,953	28,832	91,496	2.90	265,138	42,057	93,784	2.81	263,619
1992	144,126	2.50	360,870	43,621	93,107	3.83	356,679	53,619	109,779	2.33	255,774
1993	123,771	2.47	305,838	31,103	64,670	4.02	260,070	36,307	82,612	3.28	271,263
1994	138,482	3.08	426,455	66,240	70,324	5.48	385,256	82,580	85,671	3.55	303,847
1995	142,557	2.24	319,433	48,124	47,737	4.40	210,043	40,531	66,096	4.05	267,668
1996	153,473	2.05	314,816	53,461	57,196	5.05	288,913	64,064	107,950	2.64	285,328
1997	160,629	2.54	407,413	65,771	45,496	5.57	253,408	67,526	76,095	2.72	207,316
1998	188,972	1.95	368,450	61,513	47,788	3.66	174,848	33,855	91,478	1.64	149,786
1999	169,213	1.87	316,394	51,651	36,106	4.53	163,499	36,124	80,459	2.49	200,570
2000	157,853	2.02	318,134	36,857	60,288	2.97	179,055	32,189	120,158	2.09	250,590
2001	146,034	2.20	320,560	39,541	37,706	3.60	135,742	19,631	91,152	2.85	260,051

	Mallard				Blue-winged teal				Other ducks (exc. scaup)		
Year	Unad. PI	VCF	PI	SE	Unad. PI	VCF	PI	SE	Unad. PI	VCF	PI
2002	145,191	2.53	366,625	46,264	91,982	4.67	429,934	87,312	92,778	4.04	374,978
2003	115,974	2.42	280,517	34,556	46,759	4.13	193,269	36,176	46,796	5.30	248,019
2004	158,416	2.37	375,313	57,591	94,152	3.75	353,209	56,539	95,105	2.94	279,802
2005	82,472	2.89	238,500	28,595	48,394	4.01	194,125	37,358	46,797	4.26	199,355
2006	72,843	2.21	160,715	24,230	38,328	4.53	173,674	60,353	42,333	4.41	186,719
2007	76,979	3.15	242,481	30,020	29,407	4.20	123,588	20,055	30,963	3.73	115,390
2008	103,411	2.88	297,565	27,787	40,777	3.74	152,359	24,157	99,575	2.91	289,629
2009	78,368	3.02	236,436	36,539	37,286	3.63	135,262	32,155	62,725	2.70	169,568
2010	80,922	2.99	241,884	33,940	32,742	4.04	132,261	27,430	55,076	2.84	156,599
2011	102,245	2.77	283,329	49,845	61,772	3.46	213,584	88,720	79,743	2.39	190,586
2012	96,448	2.33	224,965	45,057	49,779	2.18	108,607	31,971	60,228	2.24	135,017
2013	111,208	2.64	293,239	58,463	27,194	5.29	143,927	46,635	68,804	3.57	245,729
2014	111,408	2.31	256,996	55,366	31,979	3.18	101,640	24,089	51,619	2.24	115,751
2015	94,866	2.17	206,229	37,498	33,484	5.04	168,615	56,787	46,295	3.23	149,330
2016	117,698	2.13	250,204	42,850	70,907	4.57	323,916	94,952	77,750	2.74	212,967
2017	104,970	2.04	213,644	32,704	63,418	2.51	159,483	55,100	119,394	2.20	262,867
2018	107,198	2.76	295,370	46,578	55,349	3.45	190,695	77,961	71,703	2.88	206,505
Averages:											
10-year	100,154	2.53	250,449	42,005	44,934	3.76	163,965	48,200	72,121	2.71	192,804
Long-term	102,885	2.22	227,914	37,700	57,432	3.88	212,655	44,132	62,116	3.09	179,381
% change from											
2017	2%	35%	38%	42%	-13%	37%	20%	41%	-40%	31%	-21%
10-year average	7%	9%	18%	11%	23%	-8%	16%	62%	-1%	6%	7%
Long-term average	4%	24%	30%	24%	-4%	-11%	-10%	77%	15%	-7%	15%

Table 8. Scaup, total ducks (excluding scaup), total ducks, and Canada goose populations in Minnesota, 1968-2018.

	Scaup			Total Ducks (exc. scaup)		Total ducks		nada geese		
Year	Unad. PI	VCF	PI	Unad. PI	PI	Unad. PI	PI	Unad. PI	VCF	PI
1968	22,834	2.08	47,495	144,392	320,994	167,226	368,488			
1969	9,719	2.27	22,062	132,952	323,213	142,671	345,275			
1970	12,105	1.62	19,610	129,967	324,219	142,072	343,829			
1971	5,713	1.71	9,764	119,667	277,137	125,380	286,901			
1972	12,062	1.69	20,379	132,928	217,181	144,990	237,560	366		
1973	10,633	2.45	26,093	142,857	389,486	153,490	415,580	1,965		
1974	18,378	2.79	51,201	122,534	281,605	140,912	332,806	8,835		
1975	9,563	3.31	31,649	135,626	471,608	145,189	503,257	5,997		
1976	22,494	3.35	75,323	198,236	684,082	220,730	759,405	5,409		
1977	2,971	11.95	35,517	116,641	501,099	119,612	536,616	7,279		
1978	14,774	3.35	48,812	106,677	462,502	121,451	511,314	7,865		
1979	92,134	3.79	348,948	148,200	552,416	240,334	901,364	4,843		
1980	12,602	3.97	50,070	182,063	690,593	194,665	740,663	6,307		
1981	19,844	3.88	75,451	175,055	439,769	194,899	515,220	10,156		
1982	21,556	4.32	93,204	127,153	465,195	148,709	558,399	6,600		
1983	9,551	2.84	27,077	148,392	367,142	157,943	394,219	11,081		
1984	15,683	2.18	34,111	224,736	529,679	240,419	563,790	14,051		
1985	7,409	2.35	17,430	221,516	562,898	228,925	580,328	16,658		
1986	6,247	2.67	16,678	215,463	520,787	221,710	537,465	19,599		
1987	10,306	2.51	25,910	345,107	588,954	355,413	614,864	29,960		
1988	10,545	2.61	27,553	338,240	725,238	348,785	752,791	39,057	1.36	53,004
1989	71,898	2.89	207,991	302,771	813,615	374,669	1,021,606	51,946	1.88	97,898
1990	40,075	1.97	78,892	372,587	807,870	412,662	886,761	58,425	1.37	80,147
1991	40,727	2.81	114,480	313,595	753,710	354,322	868,191	42,231	4.18	176,465
1992	66,071	2.33	153,939	347,012	973,323	413,083	1,127,262	33,965	2.43	82,486
1993	11,801	3.28	38,750	271,053	837,172	282,854	875,921	43,858	2.08	91,369
1994	57,670	3.55	204,536	294,477	1,115,558	352,147	1,320,095	48,595	1.68	77,878
1995	28,421	4.05	115,096	256,390	797,144	284,811	912,241	58,065	2.08	120,775
1996	65,585	2.64	173,351	318,619	889,057	384,204	1,062,408	60,870	3.92	238,708
1997	31,138	2.72	84,834	282,220	868,137	313,358	952,971	60,449	2.59	156,817
1998	28,416	1.64	46,528	328,238	693,084	356,654	739,612	79,147	1.75	138,507
1999	14,041	2.49	35,002	285,778	680,463	299,819	715,465	80,012	3.35	268,168
2000	32,376	2.09	67,520	338,299	747,779	370,675	815,299	105,932	2.84	301,298
2001	15,743	2.85	44,914	274,892	716,353	290,653	761,267	89,418	2.17	193,887

	Scaup			Total Ducks (exc. scaup)		Total ducks		nada geese		
Year	Unad. PI	VCF	PI	Unad. PI	PI	Unad. PI	PI	Unad. PI	VCF	PI
2002	13,016	4.04	52,606	327,951	1,171,537	340,967	1,224,143	78,200	2.42	189,353
2003	5,117	5.30	27,120	209,529	721,805	214,646	748,925	87,663	3.78	331,094
2004	30,906	2.94	90,926	347,673	1,008,324	378,579	1,099,250	98,339	1.58	155,859
2005	12,397	4.26	52,811	177,663	631,980	190,060	684,791	83,384	2.02	168,469
2006	1,971	4.41	8,692	153,504	521,109	155,475	529,801	75,688	2.73	206,757
2007	1,894	3.73	7,058	137,349	488,517	139,243	495,575	98,316	1.47	144,289
2008	14,854	2.91	43,205	243,763	739,553	258,617	782,758	70,311	1.99	139,708
2009	12,571	2.70	33,979	178,379	541,266	190,950	575,245	67,473	2.44	164,405
2010	3,299	2.84	9,380	168,740	530,744	172,039	540,124	66,085	2.22	146,960
2011	9,283	2.39	22,186	244,105	687,499	253,043	709,685	60,603	2.57	155,750
2012	2,686	2.24	6,021	206,455	468,589	209,141	474,610	87,193	1.81	157,706
2013	11,919	3.57	42,568	207,206	682,895	219,125	725,463	94,235	2.22	208,825
2014	6,517	2.24	14,614	195,006	474,387	201,523	489,001	63,857	1.57	100,255
2015	10,870	3.23	35,062	174,645	524,174	185,515	559,236	90,887	1.77	160,427
2016	20,202	2.74	55,336	266,355	787,087	286,557	842,423	66,672	1.75	117,096
2017	34,890	2.20	76,817	287,782	635,994	322,672	712,811	70,172	2.16	151,740
2018	10,934	2.88	31,490	234,250	692,570	245,184	724,060	92,735	1.75	162,286
Averages:										
10-year	12,709	2.71	33,917	217,244	607,219	229,918	641,136	73,749	2.05	150,287
Long-term	20,870	3.09	60,971	222,409	620,090	243,272	681,061	49,305	2.27	159,203
% change from										
2017	-69%	31%	-59%	-19%	9%	-24%	2%	32%	-19%	7%
10-year average	-14%	6%	-7%	8%	14%	7%	13%	26%	-15%	8%
Long-term average	-48%	-7%	-48%	5%	12%	1%	6%	88%	-23%	2%

Appendix A. Precipitation in selected regions of Minnesota, 1 April - 21 May 2018 (Source: Minnesota DNR; http://www.dnr.state.mn.us/climate/historical/summary.html).

Region	Precipitation	Departure from normal
Northwest	1.86	-1.38
North Central	1.87	-1.93
Northeast	1.84	-2.40
West Central	1.91	-2.32
Central	2.48	-2.26
East Central	2.18	-2.80
Southwest	5.10	-0.07
South Central	7.18	1.53
Southeast	7.91	1.71
Statewide	4.00	-0.83

Waterfowl information is taken from the U.S. Fish and Wildlife Service report Waterfowl Population Status, 2018 by Joshua Dooley, Walt Rhodes, and Nathan Zimpfer. The entire report is available on the Division of Migratory Bird Management website (http://www.fws.gov/birds/surveys-and-data/reports-and-publications.php).

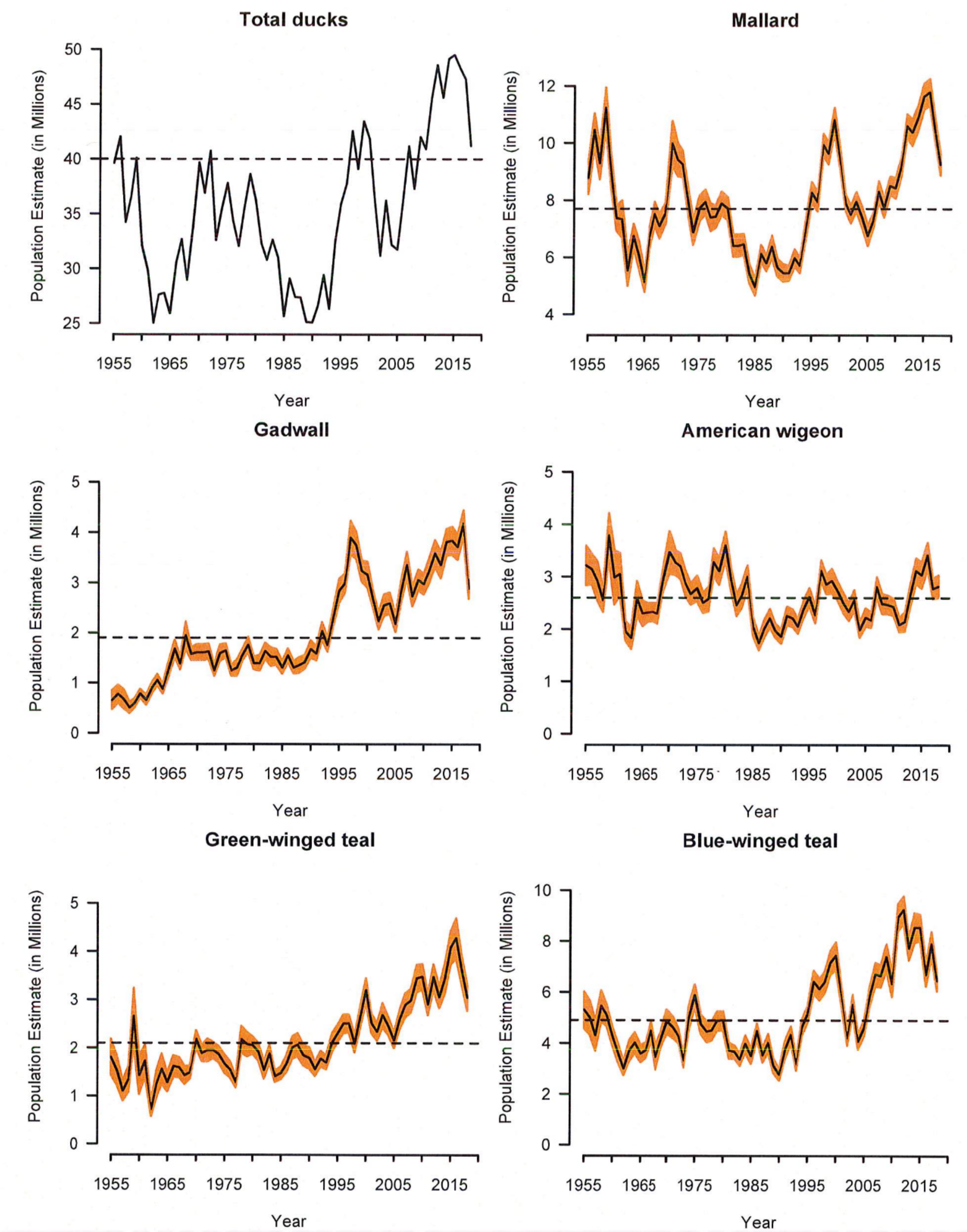

Figure 1 Estimates of North American breeding populations, 90% confidence intervals, and North American Waterfowl Management Plan population goal (dashed line) for selected species and number of water areas in May in Prairie Canada and Northcentral U.S (from: U.S. Fish and Wildlife Service 2017).

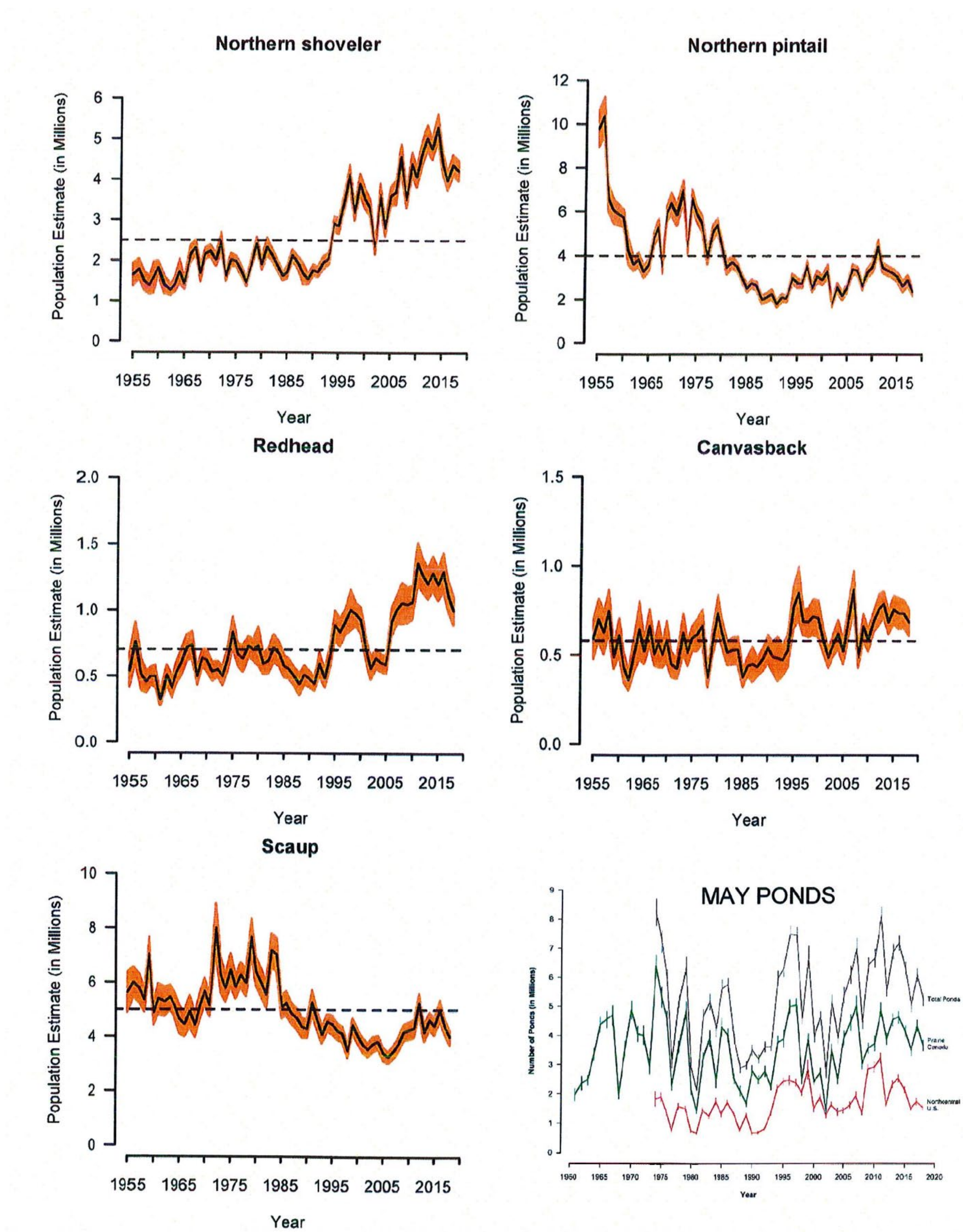

Figure 1 (continued).

Mourning dove information is taken from the U.S. Fish and Wildlife Service report by Seamans, M.E. 2018. Mourning dove population status, 2018. U.S. Department of the Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Washington, D.C. 22 pp. The entire report is available on the Division of Migratory Bird Management web site

(https://www.fws.gov/migratorybirds/pdf/surveys-and-data/Population-status/MourningDove/MourningDovePopulationStatus18.pdf).

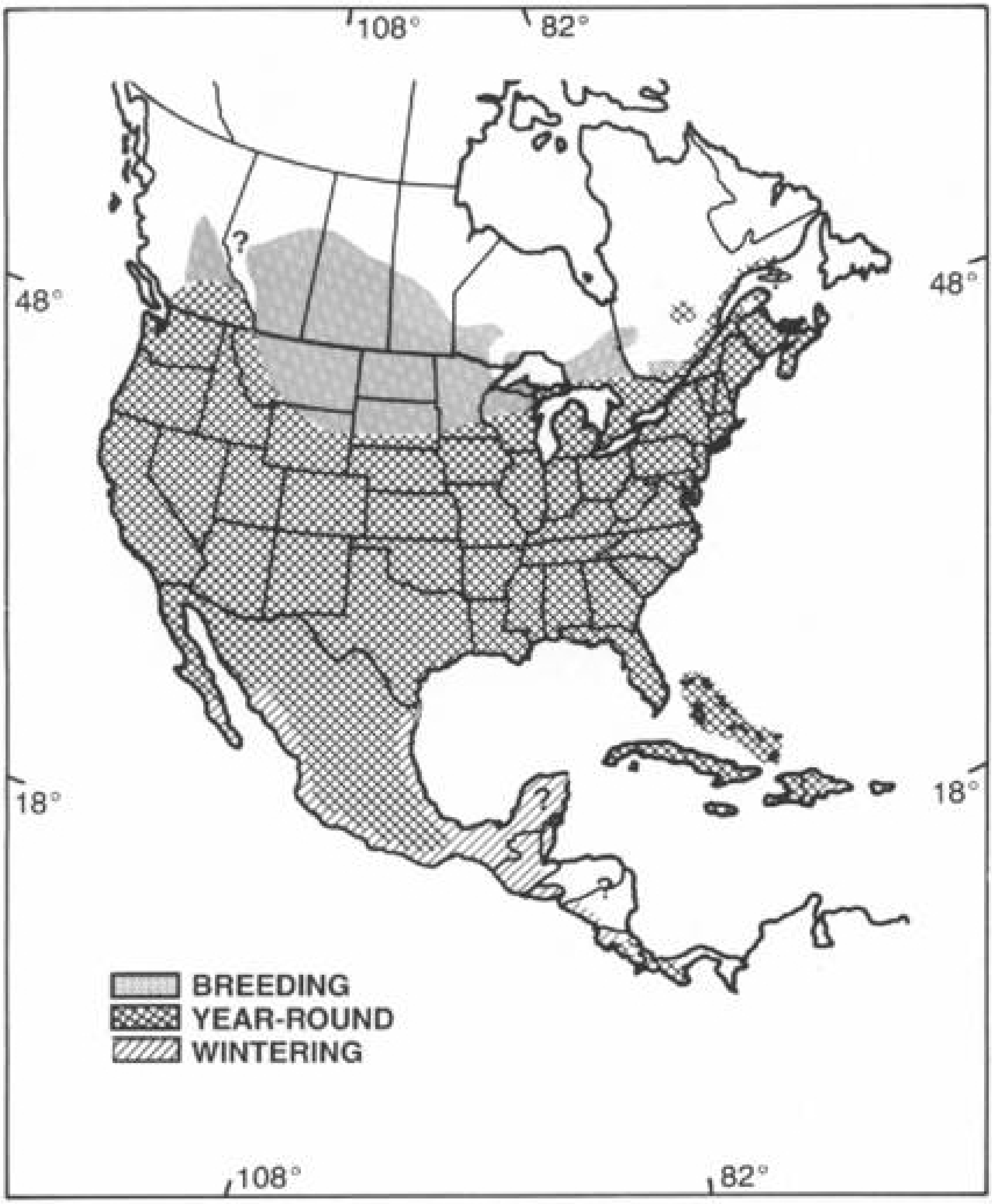

Figure 1. Breeding and wintering ranges of the mourning dove (adapted from Mirarchi and Baskett 1994). (From: Seamans, M.E. 2018. Mourning dove population status, 2018. U.S. Department of the Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Washington, D.C. 22 pp.)

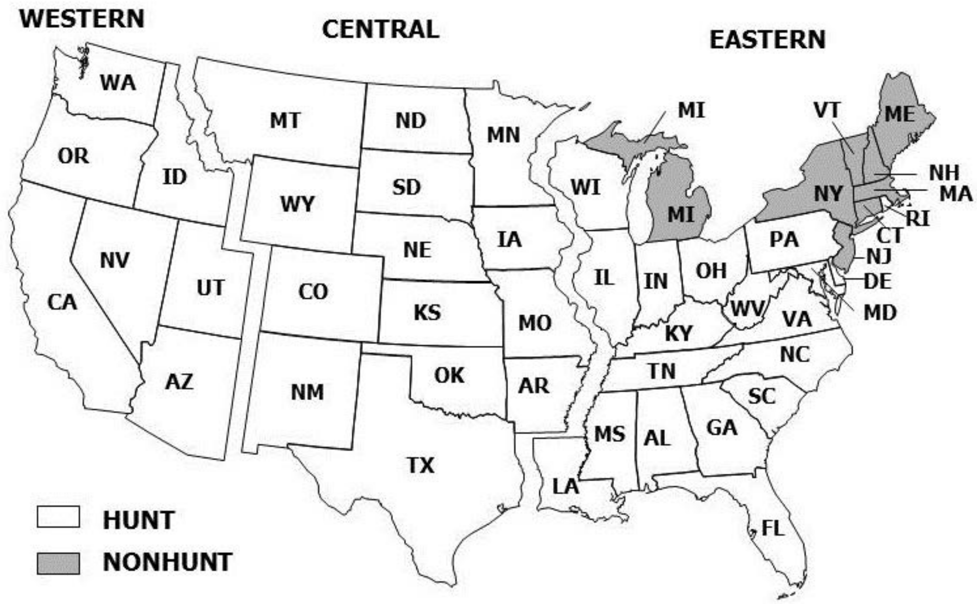

Figure 2. Mourning dove management units with 2017 -18 hunting and non-hunting states. (From: Seamans, M.E. 2018. Mourning dove population status, 2018. U.S. Department of the Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Washington, D.C. 22 pp.)

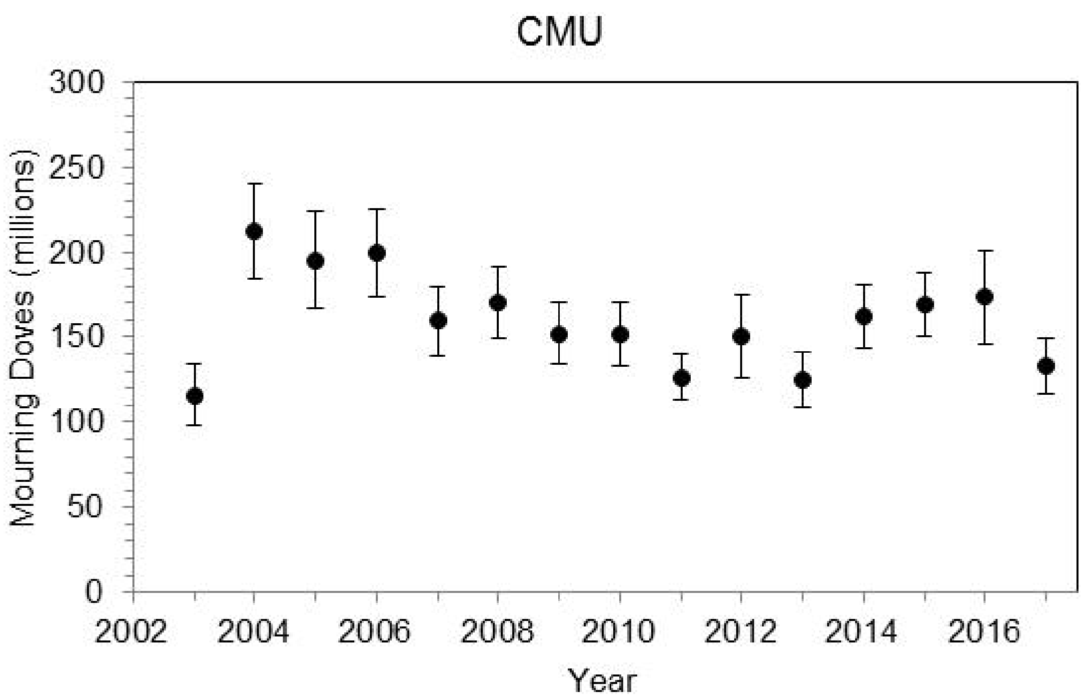

Figure 3. Estimates and 95% confidence intervals of mourning dove absolute abundance by in the Central Management Unit (CMU), 2003-17. Estimates based on band recovery and harvest data. (From: Seamans, M.E. 2018. Mourning dove population status, 2018. U.S. Department of the Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Washington, D.C. 22 pp.)

Table 1. Preliminary estimates and 95% confidence intervals (CI, expressed as the interval half width in percent) of mourning dove harvest and hunter activity for the Central management unit during the 2015, 2016 and 2017 seasons [a]. (From: Seamans, M.E. 2018. Mourning dove population status, 2018. U.S. Department of the Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Washington, D.C. 22 pp.)

Management unit / State	Active Hunters			Hunter Days Afield			Total Harvest		
	2015	2016	2017	2015	2016	2017	2015	2016	2017
CENTRAL	369,800 [b]	430,400 [b]	332,200 [b]	1,235,000 ±10	1,344,400 ±13	1,058,800 ±11	7,180,300 ±9	7,334,600 ±14	5,462,800 ±10
AR	17,88 ±24	16,300 ±28	16,200 ±29	37,600 ±22	36,200 ±27	35,500 ±30	252,400 ±22	258,200 ±29	287,100 ±35
CO	14,200 ±15	13,100 ±18	11,300 ±19	38,900 ±23	29,700 ±19	24,100 ±20	204,500 ±22	141,200 ±20	117,600 ±25
IA	9,200 ±15	9,700 ±15	11,200 ±13	24,600 ±16	25,300 ±17	28,300 ±17	111,500 ±18	128,100 ±19	134,900 ±16
KS	28,600 ±13	28,600 ±12	21,800 ±24	86,400 ±18	77,200 ±17	58,300 ±35	558,200 ±20	427,600 ±18	290,600 ±34
MN	9,700 ±48	6,500 ±58	6,800 ±63	28,200 ±54	18,000 ±55	16,200 ±45	96,700 ±86	96,700 ±79	39,100 ±30
MO	22,500 ±14	25,200 ±14	27,400 ±13	54,300 ±17	65,100 ±21	65,700 ±16	307,400 ±24	321,600 ±20	367,200 ±18
MT	1,600 ±49	1,900 ±44	1,300 ±57	5,100 ±54	3,500 ±43	2,200 ±63	18,000 ±54	16,000 ±53	8,900 ±45
NE	9,000 ±17	9,700 ±19	12,300 ±16	25,500 ±18	24,500 ±18	31,000 ±15	160,600 ±17	132,000 ±22	177,900 ±16
NM	7,000 ±11	4,400 ±18	5,500 ±57	23,100 ±14	12,800 ±33	16,800 ±70	111,900 ±22	47,900 ±26	73,900 ±51
ND	4,200 ±23	5,300 ±24	4,100 ±26	12,800 ±25	15,800 ±35	11,400 ±31	73,500 ±25	76,900 ±30	59,400 ±26
OK	18,200 ±15	23,800 ±14	17,500 ±16	45,300 ±17	58,500 ±21	45,600 ±24	294,000 ±18	400,400 ±28	315,600 ±29
SD	5,300 ±15	5,600 ±22	5,700 ±22	16,000 ±25	17,100 ±33	18,400 ±26	84,500 ±30	112,400 ±46	111,600 ±31
TX	220,700 ±11	278,700 ±13	190,500 ±13	834,000 ±14	956,800 ±18	703,300 ±17	4,892,100 ±13	5,155,300 ±19	3,469,500 ±14
WY	1,700 ±23	1,700 ±27	700 ±42	3,300 ±30	3,700 ±36	2,200 ±84	14,900 ±28	20,100 ±40	9,400 ±57

[a] Hunter number estimates at the Management Unit and national levels may be biased high, because the HIP sample frames are state specific; therefore hunters are counted more than once if they hunt in >1 state. Variance is inestimable.
[b] No estimate available.

American Woodcock information is taken from the U.S. Fish and Wildlife Service report American Woodcock Population Status, 2018. Seamans, M.E. and R.D. Rau. U.S. Fish and Wildlife Service, Laurel, MD. 20 pp.

The entire report is available on the Division of Migratory Bird Management home page (https://www.fws.gov/migratorybirds/pdf/surveys-and-data/Population-status/Woodcock/AmericanWoodcockStatusReport18.pdf)

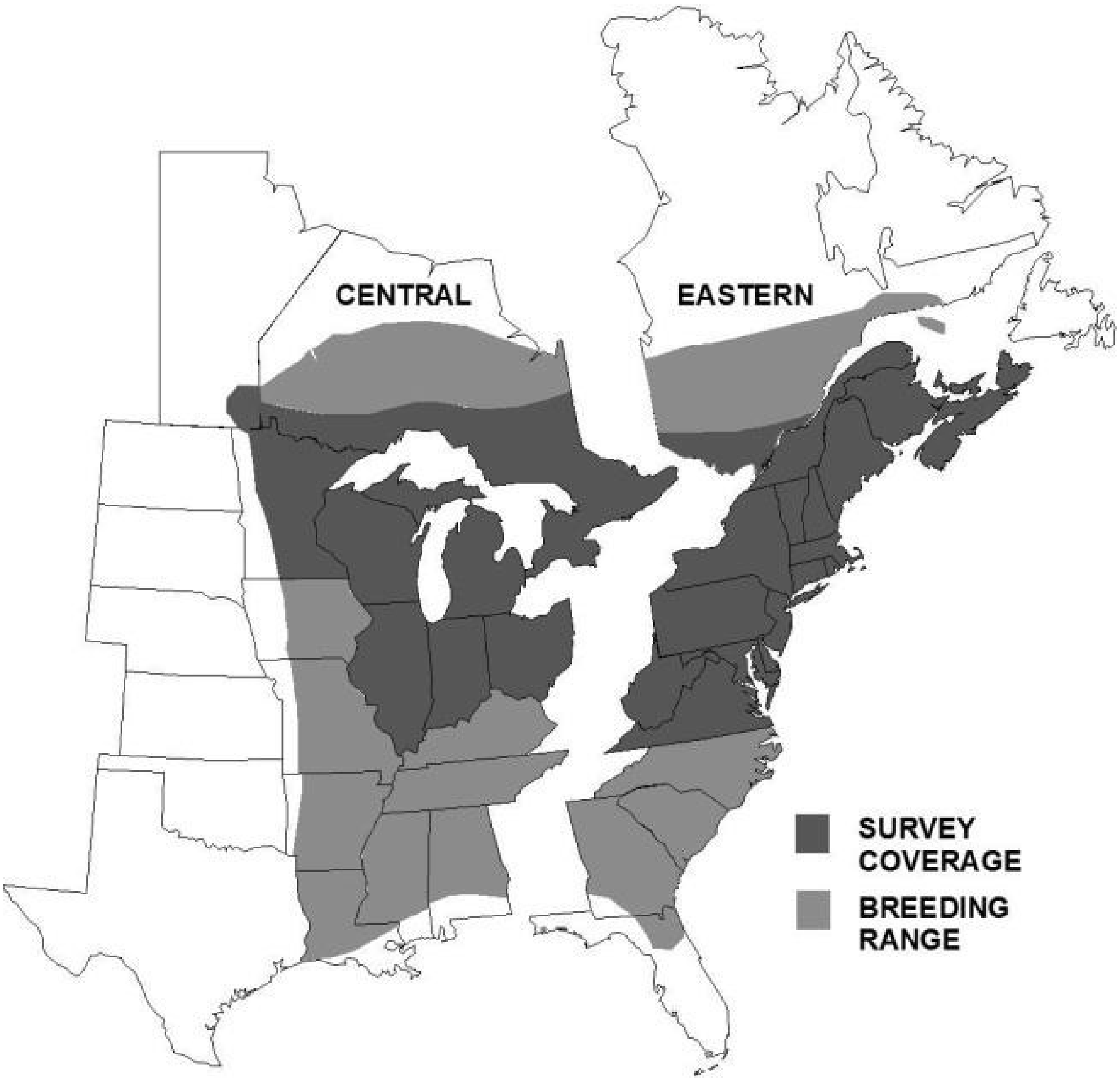

Figure 1. Woodcock management regions, breeding range, singing-ground survey coverage. (from: Seamans, M.E. and R.D. Rau. 2018. American woodcock population status, 2018. U.S. Fish and Wildlife Service, Laurel, MD. 20 pp.).

Table 1. Short term (2017 – 18), 10 –year (2008-2018), and long-term (1968-2018) trends (% change per year [a]) in the number of American woodcock heard during the Singing-ground Survey as determined by using the hierarchical log-linear modeling technique (Sauer et al. 2008) (from: Seamans, M.E. and R.D. Rau. 2018. American woodcock population status, 2018. U.S. Fish and Wildlife Service, Laurel, MD. 20 pp.).

Management Unit/State	Number of Routes[b]	n[c]	2017-18			2008-18			1968-18		
			% Change	95% CI[d] lower	upper	% Change	95% CI[d] lower	upper	% Change	95% CI[d] lower	upper
CENTRAL	460	780	-17.20	-22.88	-10.91	- 0.96	-1.76	- 0.15	- 0.96	-1.20	-0.73
IL	19	47	-10.79	-69.87	162.00	-2.62	-12.09	7.20	-0.98	-3.55	1.88
IN	16	62	6.52	-34.06	86.84	-2.52	- 7.20	3.47	- 3.79	-4.95	-2.70
MB[e]	13	30	-18.53	-42.55	10.14	1.10	- 2.49	5.04	0.14	-1.49	1.69
MI	112	156	-25.13	-34.50	-14.43	-1.96	- 3.36	-0.57	- 1.31	-1.67	-0.95
MN	83	123	-12.96	-25.49	1.53	2.17	0.47	3.97	0.66	0.10	1.23
OH	38	73	2.79	-18.48	33.91	-0.89	- 3.35	2.09	- 1.59	-2.33	-0.90
ON	89	165	-13.88	-26.18	0.06	-2.33	- 4.12	-0.63	- 1.23	-1.69	-0.79
WI	90	124	-18.35	-31.20	-3.80	-0.43	- 2.17	4.48	- 0.44	-0.90	0.05

[a] Median of route trends estimated used hierarchical modeling. To estimate the total percent change over several years, use: $100(\% \text{ change}/100+1)^y)-100$ where y is the number of years. Note: extrapolating the estimated trend statistic (% change per year) over time (e.g., 30 years) may exaggerate the total change over the period.

[b] Total number of routes surveyed in 2018 for which data were received by 24 July, 2018.

[c] Number of routes with at least one year of non-zero data between 1968 and 2018.

[d] 95% credible interval, if the interval overlaps zero, the trend is considered non-significant.

[e] Manitoba began participating in the Singing-ground survey in 1992.

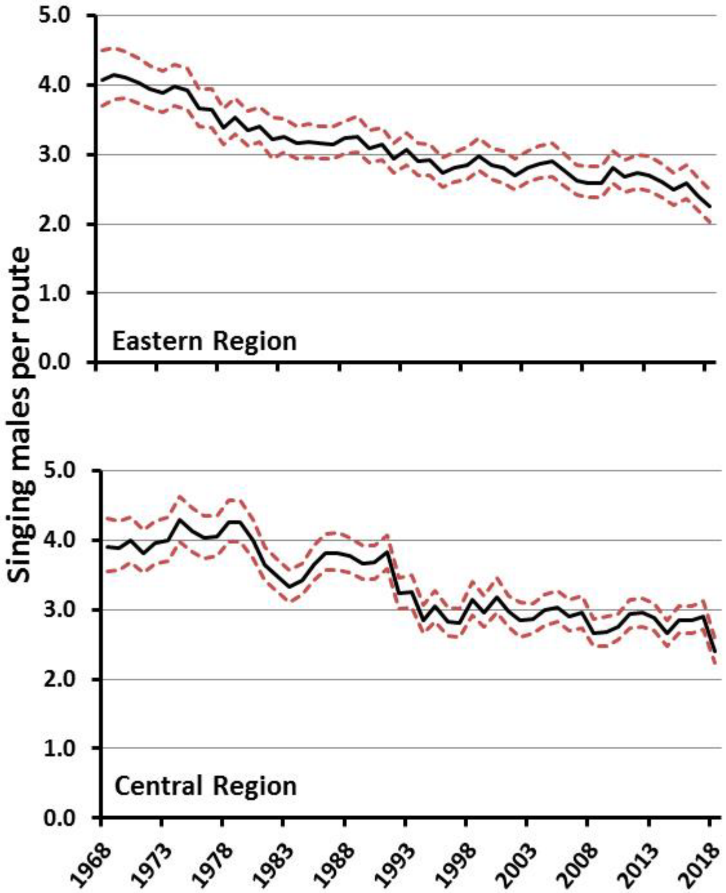

Figure 2. Annual indices of the number of woodcock heard on the Singing-ground Survey, 1968-2018. The dashed lines represent the 95 % credible interval. (from: Seamans, M.E. and R.D. Rau. 2018. American woodcock population status, 2018. U.S. Fish and Wildlife Service, Laurel, MD. 20 pp.).

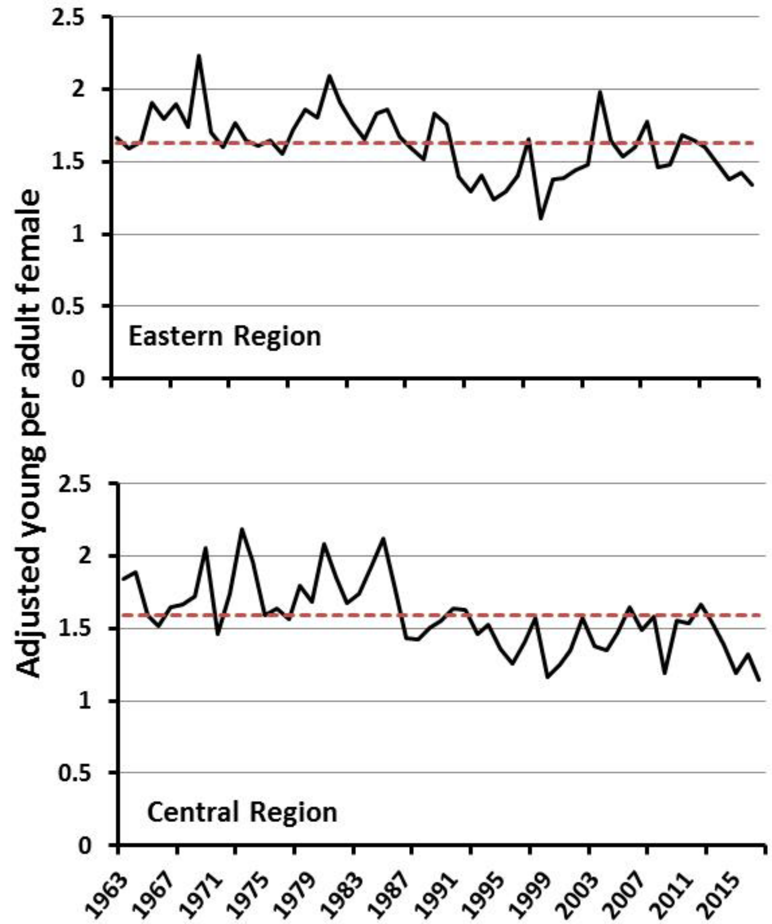

Figure 3. Weighted annual indices of American woodcock recruitment, 1963-2017. Dashed line is the 1963-2016 average. (from: Seamans, M.E. and R.D. Rau. 2018. American woodcock population status, 2018. U.S. Fish and Wildlife Service, Laurel, MD. 20 pp.).

Table 2. Preliminary estimates of woodcock hunter numbers, days afield, and harvest for selected states, from the 2014-15, 2015-16 2016-17, and 2017-18 Harvest Information Program surveys. (from: Seamans, M.E. and R.D. Rau. 2018. American woodcock population status, 2018. U.S. Fish and Wildlife Service, Laurel, MD. 20 pp.).

Management Unit / State	Active woodcock hunters ([a])				Days afield ([a, c])				Harvest ([a, c])			
	2014-15	2015-16	2016-17	2017-18	2014-15	2015-16	2016-17	2017-18	2014-15	2015-16	2016-17	2017-18
Central Region	n.a. [b]	n.a. [b]	n.a. [b]	n.a. [b]	227,600 ±13.6	284,200 ±16	300,200 ±32,500	272,400 ±22,800	141,500 ± 23	145,700 ± 19	158,000 ±16,300	140,900 ±15,500
IL	800 ± 169	1,000 ± 170	1,500 ±1,000	100 <100	2,600 ± 162	1,300 ± 133	13,200 ±11,000	300 ±100	300 ± 132	200 ± 114	1,600 ±1,400	400 ±300
IN	300 ± 99.7	400 ± 99	300 ±200	1,100 ±400	900 ± 88.1	1,100 ± 83	1,300 ±500	2,900 ±1,000	700 ± 43	600 ± 56	900 ±200	1,500 ±1,100
MI	19,400 ± 21.1	26,000 ± 18	24,100 ±2,300	24,100 ±2,300	87,500 ± 19.1	124,700 ± 21	107,100 ±11,600	122,800 ±15,200	53,500 ± 29	63,200 ± 23	64,900 ±8,600	66,100 ±10,300
MN	13,500 ±33.5	13,500 ±34	13,500 ±2,300	11,900 ±2,100	47,500 ± 31.8	47,600 ± 40	46,000 ±8,200	45,700 ±8,200	23,900 ± 45	25,600 ± 42	25,900 ±4,700	26,700 ±5,000
OH	1,600 ± 85.4	1,900 ± 80	2,600 ±900	1,900 ±800	4,500 ± 94.2	7,500 ± 95	8,200 ±3,700	5,000 ±1,800	300 ± 90	2,100 ± 85	3,200 ±1,300	400 ±200
WI	16,200 ± 25	14,700 ± 27	11,700 ±1700	11,700 ±1,800	66,400 ± 26.9	66,600 ± 29	55,100 ±8,900	52,400 ±7,700	49,300 ± 45	31,000 ± 25	35,100 ±4,400	31,100 ±4,600

[a] All 95% Confidence Intervals are expressed as a % of the point estimate.

[b]. Regional estimates of hunter numbers cannot be obtained due to the occurrence of individual hunters being registered in the Harvest Information Program in more than one state.

[c]. Days afield and Harvest estimates are for the entire 18 state Central Region.

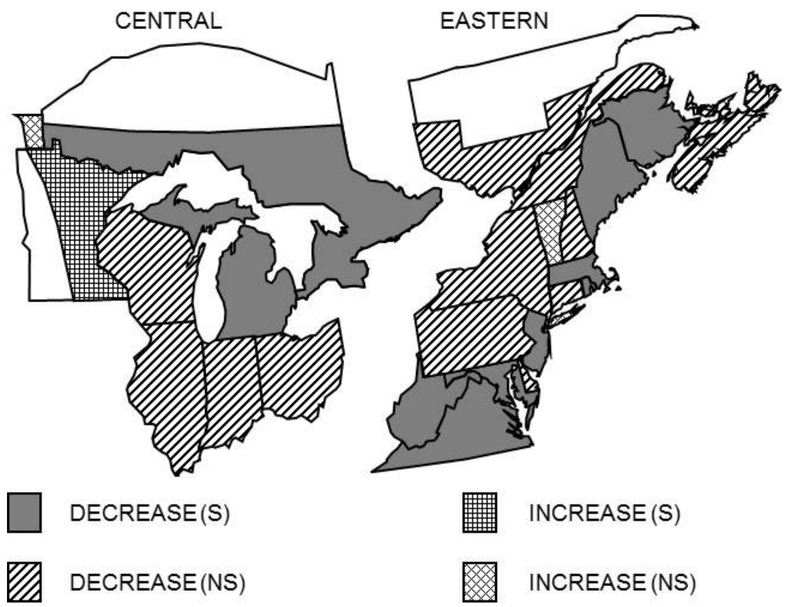

Figure 4. Ten-year trends in number of American woodcock heard on the Singing-ground Survey; 2008-18, as determined by the hierarchical modeling method. A significant trend (S) does not include zero in the 95% credible interval, while a non-significant (NS) trend does include zero. Note, Minnesota is the only state or province that had a significant increase. (from: Seamans, M.E. and R.D. Rau. 2018. American woodcock population status, 2018. U.S. Fish and Wildlife Service, Laurel, MD. 20 pp.).

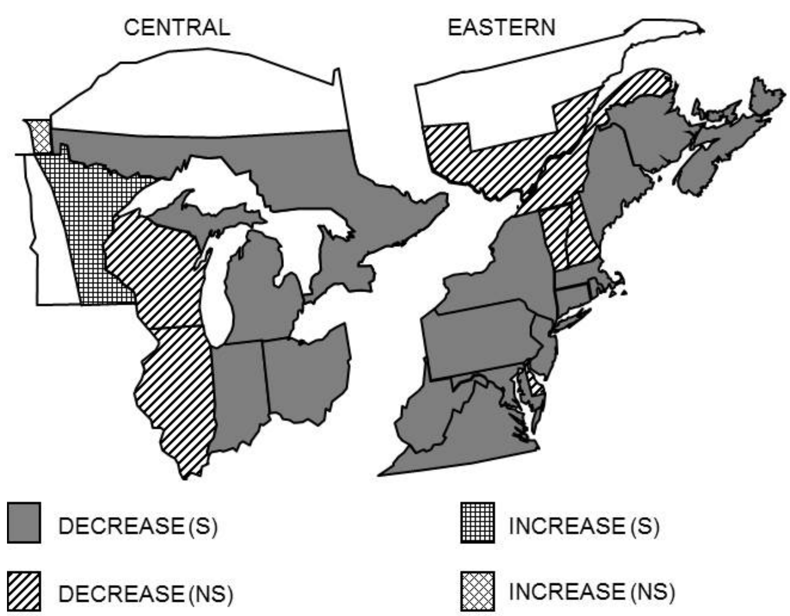

Figure 5. Long-term trends in number of American woodcock heard on the Singing-ground Survey; 1968-2018, as determined by the hierarchical modeling method. A significant trend (S) does not include zero in the 95% credible interval, while a non-significant (NS) trend does include zero. Note, Minnesota is the only state or province that had a significant long-term increase. (from: Seamans, M.E. and R.D. Rau. 2018. American woodcock population status, 2018. U.S. Fish and Wildlife Service, Laurel, MD. 20 pp.).

HUNTING HARVEST STATISTICS

Division of Fish and Wildlife
500 Lafayette Road, Box 20
Saint Paul, MN 55155 - 4020
(651) 259-5207

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2017 SMALL GAME HUNTER MAIL SURVEY

Margaret Dexter, Wildlife Research Unit

INTRODUCTION

The Minnesota Department of Natural Resources (DNR), Division of Fish and Wildlife, Wildlife Research unit annually conducts a mail survey of small game hunters. The small game mail survey was initiated in 1976 as a means to gather small game harvest information, which is used to inform our constituency and guide decisions about hunting regulations and season structure.

METHODS

A postcard survey (Fig. 1) was mailed in early March following the close of the small game hunting season. Hunters who returned it within three weeks were eliminated from a follow-up mailing to non-respondents. The sampling frame consisted of individuals who purchased a small game hunting license (any type) for the 2017-18 small game hunting season (N=243,130). A stratified random sample (n=7,000, 2.9%), allocated proportionally by license type, was drawn from the Minnesota DNR electronic licensing system (ELS) database. Small game license types included: Resident Senior Citizen, Resident Youth, Resident Adult, Resident Individual Sport, Resident Combination Sport, Resident Lifetime, Resident Lifetime Sport, Nonresident Youth, and Nonresident Adult. For analysis, license types were pooled into “Resident” (N=236,276) and “Nonresident” (N=6,854) (Fig. 2). A free youth license was added to the sampling frame for 2010-13 but that license has since been discontinued. Estimates for those years have been recalculated without the youth license so harvest estimates and license sales are comparable among years. Also, beginning in 2017, license holders <18-yrs old at the time of the survey were excluded from the sampling frame but included in the overall expansion for sampling. This group comprised <3% of license holders and thus estimates should be comparable among years.

Recipients were asked if they hunted small game in 2017-18 and if not, they were instructed to return the survey. Respondents who hunted were asked: (1) total number of days they hunted small game, (2) number bagged by species, (3) number of days hunted by species and (4) the county in which they hunted most for each species listed. Returned surveys were checked for completeness, consistency, and biological practicability. Dual key-entry and quality control checks were used to minimize transcription errors. Data was tabulated using Viking Data Entry VDE+ software and analyzed using Program R (ver. 3.5.0; R Development Core Team 2018).

RESULTS

License sales and survey response rate are shown in Figure 2. Of the 7,000 mailed surveys, 102 surveys were returned as undeliverable; 4,163 surveys were completed and returned for an adjusted response rate of 60%. The percent of respondents who said they hunted or did not hunt is reported in Table 1. This year marks the first time in the history of this survey that the percentage of license holders who indicated they hunted was <70% whereas those who bought a license but did not hunt was >30% (Table 1). Harvest trends for the four most sought-after small game species (ducks - all species, Canada geese, pheasants, and ruffed grouse) in Minnesota since 2002 are shown in Figure 3. Overall, small game license sales declined 3.8% from the previous year (Fig. 2, Table 5). The estimated number of hunters increased for Canada goose, crows, raccoons, red foxes, gray foxes, and coyotes but declined for most other species (Table 2). Likewise, the estimated harvest per active hunter showed increases for crows (6.6 in 2016 to 9.5 in 2017), mourning doves (7.7 in 2016 to 9.9 in 2017), and raccoons (3.8 in 2016 to 7.7 in 2017) but remained relatively stable for all other species (Table 3). Mean harvest for successful hunters was up slightly for ducks (12.5 in 2017 compared to 10.9 in 2016) and raccoons (8.2 in 2017 compared to 4.1 in 2016) but all other species remained similar to 2016-2017 (Table 4). Hunter success rates showed no statistically significant changes from last year (Table 4). License sales and estimated hunter harvest are presented in Table 5. License sales continue to trend downward and are at their lowest level since 1976. Estimated harvest for ducks (all species) was 688,225. Canada goose harvest (267,192) was higher than it has been in four years. The crow harvest was estimated at 110,034 birds, and was the third highest harvest since 1989 when the season was established. Raccoon harvest was estimated at 68,685 animals, the highest it has been since 2010-11. Ring-necked pheasant harvest declined 14% with 171,883 roosters harvested in 2017-18 compared to 196,141 roosters the previous year. Ruffed grouse harvest declined slightly from 308,955 grouse in 2016 to 285,180 in 2017. Overall, nonresident license sales remained steady compared to 2016-17, as did the number of nonresident duck hunters and pheasant hunters (Table 6). Estimated nonresident hunters targeting Canada geese (1,730 hunters) were the highest since 2005 when there were 1,818 estimated hunters. Nonresident Canada goose harvest (6,994) surpassed the 1999 record harvest of 6,960. Ring-necked pheasant harvest by nonresidents was also up from the previous year (7,274 roosters in 2017 compared to 4,040 roosters taken in 2016) despite a similar number of estimated hunters.

ACKNOWLEDGMENTS

This project was funded in part by the Federal Aid in Wildlife Restoration Program.

Dear Small Game Hunter:

You have been selected at random from among Minnesota's small game hunting license buyers to assist us in evaluating the 2017-2018 small game hunting season **(March 2017-February 2018)**. We need information to estimate the season's harvest and to help set future small game seasons. Answer only for your Minnesota 2017 hunting experience.

YOUR RESPONSE IS NEEDED
EVEN IF YOU DID NOT HUNT OR HARVEST SMALL GAME

Please fill out the attached questionnaire and mail as soon as possible.
A reminder will be sent to individuals not returning the questionnaire within three weeks. No envelope or stamp is necessary; just tear along the perforation and drop into a mailbox.

THANK YOU FOR YOUR COOPERATION

Lou Cornicelli, Wildlife Research Program Manager
Division of Fish and Wildlife
Department of Natural Resources

2017 Small Game Hunter Report

1. Did you hunt small game, listed below, in Minnesota this year (March 2017 - Feb 2018)? ☐No ☐Yes (Please check box)
2. Indicate the **total number of days** spent hunting small game of all species listed below, in Minnesota. __________
3. For the species you hunted indicate your harvest, number of days hunted, and county in which you hunted most for each species, even if **None** were bagged. Report only game **you personally** bagged and retrieved in Minnesota. **Do not** include birds taken on shooting preserves or game farms.

		Number You bagged	Days Hunted	County
Ducks (all species)	01			
Coots (mud hens)	50			
Canada geese	40			
Other geese	41			
Snipe (jacksnipe)	51			
Rails and gallinules	52			
Crows	53			
Woodcock	60			
Mourning Dove	65			
Pheasants	70			
Ruffed grouse (Forest partridge)	71			
Spruce grouse	72			
Sharp-tailed grouse	73			
Hungarian (Gray) partridge	74			
Fox squirrel	89			
Gray squirrel	90			
Cottontail rabbit	91			
Jackrabbit	92			
Snowshoe hare	93			
Badger	35			
Coyote (brush wolf)	97			
Gray fox	96			
Raccoon	94			
Red fox	95			

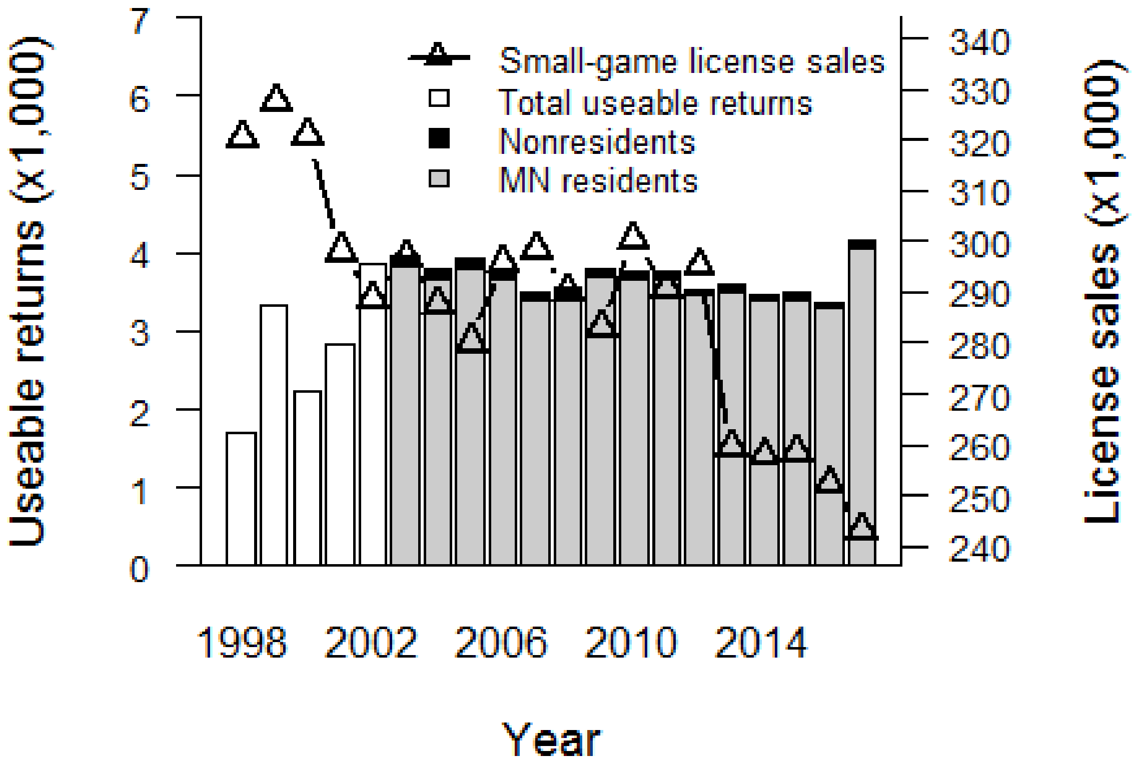

Figure 2. Number of Minnesota small game licenses sold and usable returned surveys, 1990-2017. Includes resident and non-resident licenses, and excludes duplicate and free licenses.

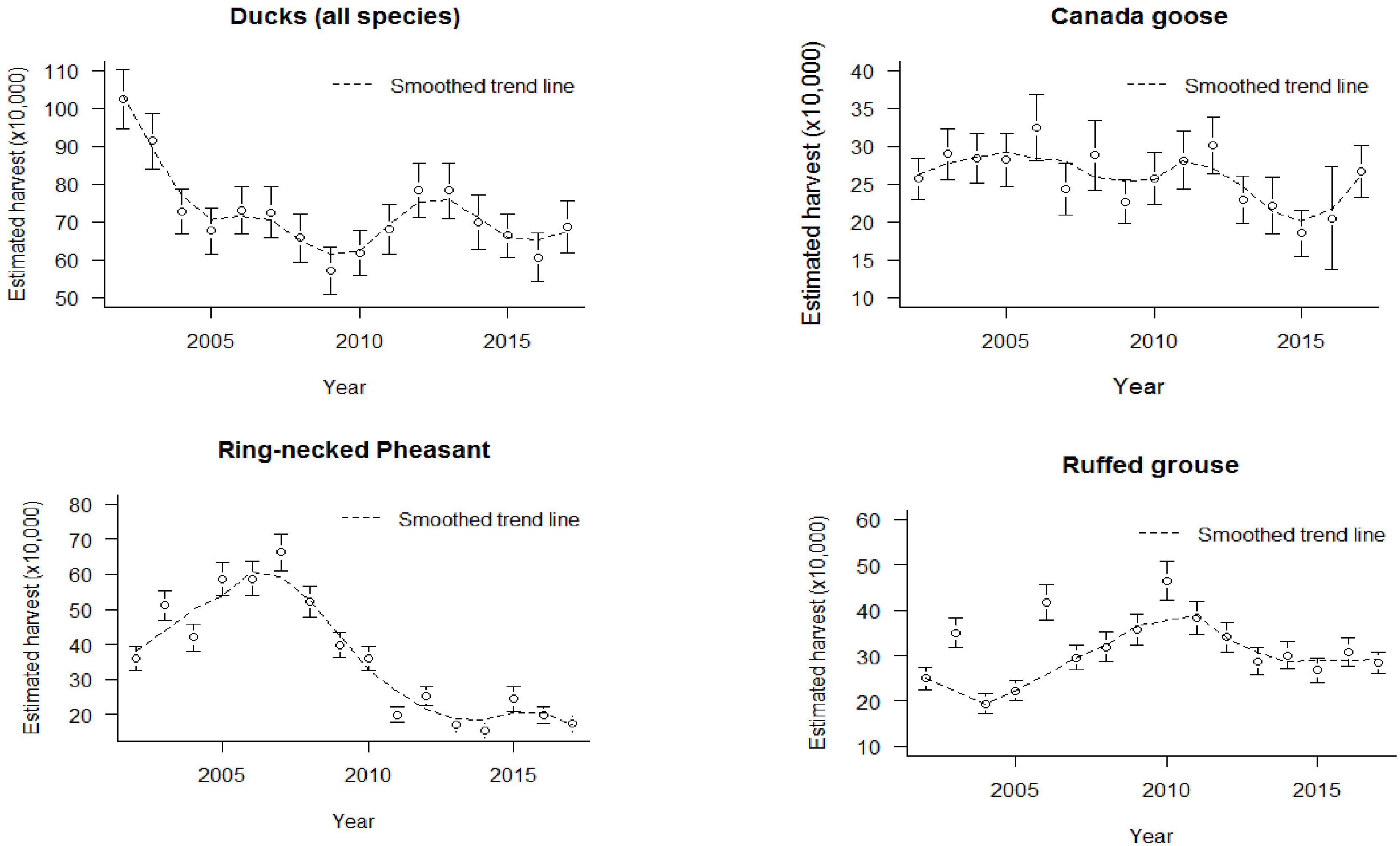

Figure 3. Harvest trends for top four small game species harvested in Minnesota, 2002-2017.

Table 1. Percent of respondents who hunted small game, 2007-08 through 2017-2018[a].

		Returns from mail survey	Projections from license sales
2007-08	Hunted Did not hunt	2,894 (78%) 822 (22%) 3,716 (100.0%)	232,505 65,961 298,467
2008-09	Hunted Did not hunt	2,678 (75%) 873 (25%) 3,551 (100.0%)	218,753 71,311 290,064
2009-10	Hunted Did not hunt	2,850 (75%) 952 (25%) 3,802 (100.0%)	212,126 70,857 282,983
2010-11	Hunted Did not hunt	2,824 (75%) 953 (25%) 3,777 (100.0%)	210,129 70,911 281,040
2011-12	Hunted Did not hunt	2,761 (74%) 987 (26%) 3,748 (100.0%)	214,137 76,549 290,686
2012-13	Hunted Did not hunt	2,669 (76%) 851 (24%) 3,520 (100%)	223,808 71,360 295,168
2013-14	Hunted Did not hunt	2,586 (72%) 1,003 (28%) 3,589 (100%)	186,317 72,264 258,581
2014-15	Hunted Did not hunt	2,476 (72%) 975 (28%) 3,451 (100%)	185,186 72,923 258,109
2015-16	Hunted Did not hunt	2,505 (72%) 980 (28%) 3,485 (100%)	185,604 72,612 258,216
2016-17	Hunted Did not hunt	2,426 (72%) 945 (28%) 3,371 (100%)	181,614 70,744 252,358
2017-18	Hunted Did not hunt	2,768 (66%) 1,395 (34%) 4,163 (100%)	161,658 81,472 243,130

[a] Includes resident and non-resident information. Excludes duplicates and free licenses (youth under 16, active-duty military and disabled veterans).

Table 2. Estimated number of statewide hunters by species, 2007-08 through 2017-18.

	2007-08	2008-09	2009-10	2010-11	2011-12[a]	2012-13[a]	2013-14	2014-15	2015-16	2016-17	2017-18
Ducks	87,468	81,358	77,480	72,770	76,090	80,770	76,950	75,170	76,243	67,301	63,426
Canada goose	62,649	59,222	55,520	53,430	57,220	58,900	51,160	48,240	45,938	40,950	44,678
Other geese	3,695	4,411	3,280	3,650	2,710	3,830	2,810	2,770	2,520	2,321	2,512
American coot	3,454	4,166	4,090	4,610	3,480	3,990	3,820	4,410	3,261	3,519	3,446
Common snipe	1,928	1,797	1,340	1,340	1,160	1,160	1,370	820	667	899	1,285
Rails / gallinules	482	408	370	220	230	500	140	300	445	75	234
Crow[b]	8,514	10,047	10,640	9,380	10,360	11,480	8,570	7,400	7,410	7,412	11,564
American woodcock	10,843	12,171	11,760	10,790	9,430	13,310	12,030	9,650	12,596	12,877	12,615
Mourning dove[c]	13,172	11,599	10,500	10,640	8,970	9,230	10,380	9,950	8,966	7,636	8,878
Ring-necked pheasant	118,311	106,763	99,440	89,140	72,840	76,950	62,110	57,590	63,350	59,965	45,263
Ruffed grouse	90,600	86,505	87,230	92,490	88,620	91,260	81,130	83,020	79,058	82,348	80,654
Spruce grouse	10,602	8,332	9,750	8,860	10,210	7,400	10,810	10,320	8,225	9,658	8,819
Sharp-tailed grouse	6,827	6,616	5,510	7,140	6,190	6,570	6,700	5,460	5,113	6,214	5,198
Gray partridge	6,667	4,411	4,240	3,720	2,400	3,080	2,450	2,540	2,075	2,097	2,103
Gray squirrel	25,863	22,382	22,260	23,740	23,280	24,710	21,690	21,240	22,303	23,806	20,967
Fox squirrel	14,779	13,233	13,180	15,630	12,060	14,220	12,030	12,790	13,411	13,625	11,798
Eastern cottontail	19,598	17,644	16,300	15,030	12,300	16,390	14,550	13,160	11,633	16,096	14,368
White-tailed jackrabbit	2,891	2,451	1,790	2,230	2,320	1,750	1,220	1,350	890	1,423	643
Snowshoe hare	4,257	4,574	3,500	3,800	3,250	4,820	3,750	4,560	4,076	3,369	4,439
Raccoon	9,558	7,433	7,300	8,260	8,040	8,570	7,640	6,880	5,632	5,840	8,936
Red fox	5,783	5,800	7,820	7,220	6,030	5,820	5,910	4,560	4,150	3,594	5,549
Gray fox	1,928	1,879	1,790	1,640	1,390	1,580	1,730	1,050	1,186	899	2,103
Coyote	16,064	19,278	19,280	19,420	17,940	21,050	17,650	17,580	18,302	15,871	22,193
Badger	482	490	370	600	310	330	500	80	297	375	701

[a] Estimates from these years were recomputed without license type 99- free youth license to be consistent with other years of data.
[b] Crow season added in 1989.
[c] Mourning dove season added in 2004.

Table 3. Estimated harvest per active hunter by species, 2007-08 through 2017-18.

	2007-08	2008-09	2009-10	2010-11	2011-12[a]	2012-13[a]	2013-14	2014-15	2015-16	2016-17	2017-18
Ducks	8.1	8.1	7.4	8.5	9.0	9.7	10.2	9.3	8.7	9.0	10.9
Canada geese	3.9	4.9	4.1	4.8	4.9	5.1	4.5	4.6	4.0	5.0	6.0
Other geese	2.1	3.2	1.9	1.1	1.8	2.3	2.5	2.4	1.8	3.1	3.2
American coot	4.6	5.7	3.6	5.7	3.0	4.2	4.0	3.9	4.9	6.1	5.8
Common snipe	2.0	1.2	1.1	1.4	1.2	1.2	1.7	0.6	0.3	2.2	1.5
Rails/gallinules	5.3	0.4	0.8	0.3	1.7	0.2	0.5	0.2	2.3	n.a.[b]	7.2
Crow[c]	6.4	5.2	5.3	6.1	7.9	7.9	7.9	7.6	7.8	6.6	9.5
American woodcock	2.6	2.4	3.0	2.8	2.6	2.3	2.7	2.7	3.0	3.6	3.1
Mourning dove[d]	7.7	11.4	10.5	9.4	8.2	10.0	7.8	10.4	10.8	7.7	9.9
Ring-necked pheasant	5.5	4.9	4.0	4.0	2.7	3.3	2.7	2.7	3.8	3.3	3.8
Ruffed grouse	3.2	3.7	4.1	5.0	4.3	3.7	3.6	3.6	3.4	3.8	3.5
Spruce grouse	1.7	2.0	2.0	1.7	1.8	1.6	1.2	1.4	1.2	1.6	1.4
Sharp-tailed grouse	2.0	2.1	1.7	2.4	1.9	1.6	1.1	1.6	1.6	1.4	2.1
Gray partridge	1.6	2.2	1.9	2.5	1.6	1.7	1.0	1.4	1.5	1.8	2.2
Gray squirrel	5.2	5.4	4.9	5.9	5.0	5.1	3.9	4.3	4.3	4.0	5.0
Fox squirrel	3.2	3.9	4.1	3.9	4.0	3.5	2.8	3.2	3.5	2.9	3.6
Eastern cottontail	4.0	4.5	3.5	3.6	2.8	3.9	2.8	2.9	3.6	3.1	3.3
White-tailed jackrabbit	3.3	2.6	1.5	3.2	2.2	1.1	1.5	0.8	0.8	0.8	0.9
Snowshoe hare	1.4	2.5	1.5	1.8	2.6	3.5	1.7	1.7	1.6	1.8	2.4
Raccoon	4.9	9.7	9.1	9.4	5.5	5.6	6.1	7.7	6.8	3.8	7.7
Red fox	1.1	0.8	1.3	1.2	1.2	1.4	0.9	0.7	0.9	0.6	1.7
Gray fox	0.3	1.3	1.0	1.5	0.8	0.2	0.2	0.6	0.7	0.2	1.8
Coyote	2.1	2.4	2.4	2.3	1.9	2.5	1.3	1.0	1.9	1.5	2.5
Badger	0.3	1.0	2.0	1.0	0.8	1.0	0.6	1.0	0.5	1.0	1.1

[a] Estimates from these years were recomputed without license type 99- free youth license to be consistent with other years of data.
[b] Only 1 respondent indicated they hunted rails and they reported 0 bagged.
[c] Crow season added in 1989.
[d] Mourning dove season added in 2004.

Table 4. Mean harvest for successful hunters and hunter success rates (%), 2007-08 through 2017-18.

	2007-08	2008-09	2009-10	2010-11	2011-12 [a]	2012-13 [a]	2013-14	2014-15	2015-16	2016-17	2017-18
Ducks	9.5 (85)	9.8 (83)	9.2(80)	10.3 (83)	10.5 (85)	11.1 (87)	11.7 (87)	11.0 (85)	10.6 (82)	10.9 (83)	12.5 (87)
Canada geese	5.5 (71)	6.4 (77)	5.6 (73)	6.1 (80)	6.3 (78)	6.5 (78)	5.8 (77)	6.6 (69)	5.7 (71)	7.1 (70)	7.4 (81)
Other geese	4.2 (50)	6.3 (50)	3.5 (55)	2.6 (41)	3.4 (51)	4.4 (52)	5.5 (46)	4.3 (54)	4.0 (44)	8.0 (39)	8.6 (37)
American coot	6.3 (74)	6.9 (82)	5.5 (65)	7.2 (79)	4.4 (69)	5.2 (81)	5.2 (75)	5.0 (78)	6.7 (73)	7.6 (81)	8.1 (71)
Common snipe	2.9 (71)	1.7 (73)	1.8 (61)	2.2 (67)	1.6 (73)	2.1 (57)	2.1 (79)	1.4 (45)	1.0 (33)	3.2 (67)	2.5 (59)
Rails / gallinules	6.4 (83)	1.0 (40)	1.3 (60)	1.0 (33)	5.0 (33)	1.0 (17)	1.0 (50)	1.0 (25)	3.5 (67)	n.a.[b]	14.5 (50)
Crow[c]	7.3 (88)	5.9 (88)	5.9 (90)	6.7 (91)	8.9 (88)	8.8 (90)	9.4 (84)	8.7 (87)	8.3 (94)	7.6 (86)	11.0 (86)
American woodcock	3.7 (69)	3.3 (74)	4.1 (73)	3.6 (76)	3.8 (70)	3.4 (68)	3.8 (70)	4.2 (64)	4.4 (67)	5.4 (67)	4.5 (69)
Mourning dove[d]	9.8 (79)	13.2 (87)	11.4 (92)	11.1 (85)	10.5 (78)	12.5 (80)	9.2 (85)	12.5 (83)	13.3 (81)	10.3 (75)	11.6 (86)
Ring-necked pheasant	7.1 (78)	6.4 (77)	5.8 (69)	5.6 (72)	4.4 (63)	4.9 (67)	4.2 (64)	4.3 (61)	5.4 (71)	5.0 (65)	5.5 (69)
Ruffed grouse	4.7 (69)	5.0 (74)	5.5 (74)	6.6 (76)	5.9 (74)	5.2 (71)	5.2 (68)	5.1 (71)	4.9 (69)	5.3 (70)	4.8 (73)
Spruce grouse	3.1 (54)	3.0 (68)	3.1 (64)	2.4 (71)	3.0 (61)	2.8 (57)	2.4 (51)	2.5 (56)	2.4 (50)	2.7 (58)	2.4 (57)
Sharp-tailed grouse	4.4 (46)	3.2 (64)	3.0 (58)	3.5 (68)	3.1 (61)	3.4 (48)	3.2 (33)	3.8 (41)	3.1 (51)	2.9 (47)	4.0 (53)
Gray partridge	3.0 (55)	3.4 (65)	3.3 (58)	4.2 (58)	3.2 (52)	3.1 (54)	2.5 (38)	4.4 (32)	2.7 (57)	3.3 (54)	4.3 (50)
Gray squirrel	5.9 (88)	6.2 (88)	5.8 (86)	7.0 (84)	6.3 (78)	6.3 (80)	5.0 (77)	5.5 (78)	5.3 (81)	5.1 (79)	5.7 (89)
Fox squirrel	3.9 (83)	4.6 (83)	4.8 (85)	4.6 (86)	5.4 (74)	4.4 (80)	3.7 (75)	4.3 (75)	4.9 (71)	3.8 (76)	4.3 (83)
Eastern cottontail	4.8 (84)	5.3 (85)	4.3 (83)	4.4 (81)	4.1 (69)	5.5 (71)	3.5 (79)	4.1 (73)	5.0 (72)	4.0 (77)	4.0 (3)
White-tailed jackrabbit	4.5 (72)	3.8 (70)	2.1 (71)	4.6 (70)	3.5 (63)	2.3 (48)	5.2 (29)	1.8 (44)	2.0 (42)	1.9 (42)	1.7 (55)
Snowshoe hare	2.2 (62)	3.5 (71)	2.6 (60)	2.6 (69)	3.8 (69)	5.0 (69)	2.9 (58)	3.0 (57)	3.0 (53)	3.2 (56)	3.9 (63)
Raccoon	5.4 (90)	10.6 (91)	9.6 (95)	10.0 (94)	6.1 (89)	6.1 (93)	6.9 (89)	8.5 (90)	7.7 (88)	4.1 (92)	8.2 (93)
Red fox	2.3 (46)	1.5 (49)	2.4 (54)	2.3 (54)	2.4 (49)	2.7 (50)	2.0 (44)	1.7 (41)	1.6 (57)	1.4 (44)	2.6 (63)
Gray fox	1.0 (29)	3.3 (39)	2.5 (42)	4.0 (36)	2.5 (33)	1.0 (16)	1.5 (17)	2.0 (29)	1.4 (50)	1.0 (25)	2.8 (64)
Coyote	4.4 (49)	4.4 (54)	4.6 (52)	4.0 (57)	4.0 (47)	5.1 (49)	2.7 (50)	2.4 (41)	3.4 (57)	3.1 (49)	4.3 (59)
Badger	1.0 (33)	1.2 (83)	2.5 (80)	1.0 (100)	1.5 (50)	1.0 (100)	1.0 (57)	1.0 (100)	1.0 (50)	1.2 (80)	1.6 (67)

[a] Estimates from these years were recomputed without license type 99- free youth license to be consistent with other years of data.
[b] Only 1 respondent indicated they hunted rails and they reported 0 bagged.
[c] Crow season added in 1989.
[d] Mourning dove season added in 2004.

Table 5[a]. Statewide (resident and non-resident) small game hunting license sales and estimated hunter harvest, 2007-08 through 2017-18.

	2007-08	2008-09	2009-10	2010-11	2011-12[b]	2012-13[b]	2013-14	2014-15	2015-16	2016-17	2017-18
Small game license sales[c]	298,467	290,064	282,983	282,227	271,768	264,063	258,581	258,109	258,208	252,358	243,130
State duck stamp sales	100,134	95,675	89,942	88,069	89,681	90,052	93,412	94,265	92,176	88,905	86,258
Pheasant stamp sales	129,315	123,270	110,456	104,286	86,868	90,541	77,597	74,295	77,750	76,920	71,925
Estimated harvest[d]											
Ducks	708,491	658,186	572,220	619,600	681,550	784,360	782,810	699,620	663,811	606,458	688,225
Canada geese	243,705	288,411	227,160	257,530	281,630	301,550	229,120	221,620	185,012	204,825	267,192
Other geese	7,723	13,895	6,250	3,940	4,800	8,820	7,130	6,510	4,448	7,188	8,062
American coot	16,061	23,871	14,810	26,340	10,520	16,720	15,130	17,050	15,861	21,564	19,976
Common snipe	3,933	2,210	1,490	1,940	1,390	1,420	2,310	520	223	1,948	1,928
Rails / gallinules	2,569	163	300	80	390	80	70	80	1,039	n.a.[e]	1,697
Crow[f]	54,319	51,742	56,350	57,300	81,500	90,260	67,440	56,020	57,576	48,590	110,034
American woodcock	27,866	29,210	35,430	29,770	24,980	30,360	31,920	25,810	37,270	46,867	38,546
Mourning dove[g]	101,161	132,577	109,940	100,230	74,000	92,760	80,480	103,370	96,552	58,618	88,021
Ring-necked pheasant	655,443	522,071	398,130	359,400	198,500	250,140	169,100	152,800	243,176	196,141	171,883
Ruffed grouse	293,544	318,338	357,420	465,580	383,150	341,320	288,410	301,190	267,997	308,955	285,180
Spruce grouse	17,705	16,997	19,130	14,960	18,640	11,980	13,110	14,590	9,856	15,348	12,032
Sharp-tailed grouse	13,790	13,695	9,530	16,820	11,600	10,650	7,130	8,530	7,929	8,610	11,097
Gray partridge	11,000	9,660	8,040	9,150	3,950	5,160	2,380	3,590	3,187	3,745	4,557
Gray squirrel	133,194	121,534	109,790	138,920	115,840	126,110	84,010	91,250	96,400	95,374	105,712
Fox squirrel	47,736	51,079	53,970	61,690	48,100	49,750	33,940	40,840	46,383	39,603	41,994
Eastern cottontail	78,588	79,927	57,760	53,870	34,640	64,140	40,710	38,820	41,716	49,187	47,135
White-tailed jack rabbit	9,482	6,446	2,610	7,220	5,180	1,910	1,870	1,050	742	1,124	585
Snowshoe hare	5,789	11,343	5,360	6,770	8,430	16,800	6,200	7,860	6,374	5,990	10,864
Raccoon	46,739	72,026	66,700	77,690	44,080	48,340	46,690	52,800	38,387	22,312	68,685
Red fox	6,188	4,408	10,270	8,780	7,120	7,990	5,190	3,220	3,780	2,247	9,229
Gray fox	559	2,443	1,860	2,380	1,160	250	430	600	816	225	3,798
Coyote	34,377	45,689	46,070	44,050	33,410	51,990	23,630	17,430	35,123	24,481	56,184
Badger	159	490	750	600	230	330	290	80	149	375	760

[a] Harvest estimates in this table, and the number of hunters and mean take per hunter in Table 4, are calculated from different questions on the survey form. The sample used in calculations differs from one estimator to the next. This is because some respondents give specific answers to one question but not to a related one. A formula is used to calculate the total estimated take for each species that appear in this table. In most years the formula produces results rather close to those obtained by multiplying the average take per hunter times the number of hunters. However, in other years results of the two methods are quite divergent, perhaps as a result of an unusual sample. This is being investigated further, and as a result, numbers may change somewhat in future reports. The most current report of survey findings will have the best data available at that time.

[b] Estimates from these years were recomputed without license type 99- free youth license to be consistent with other years of data.

[c] Includes all types of Small game licenses. Duplicate and free licenses not included.

[d] Estimates based upon response of hunters to questionnaires.

[e] Only 1 respondent indicated they hunted rails and they reported 0 bagged.

[f] Crow season added in 1989.

[g] Mourning dove season added in 2004.

Table 6. Mail survey results of nonresident small game hunters, 2007-08 through 2017-18.

	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
Nonresident licenses issued[a]	7,858	7,114	6,934	6,695	6,312	6,456	6,031	6,056	6,755	6,701	6,854
Questionnaires:											
Number mailed	185	226	196	163	169	166	162	165	169	190	200
Number not delivered	11	15	10	6	11	11	10	12	5	15	19
Number (percent) returned	101 (58)	89 (42)	105 (54)	107 (66)	91 (54)	71 (43)	81 (50)	70 (42)	73 (43)	78 (41)	99 (50)
Estimated nonresidents and (percent) of all licensed nonresidents hunting:											
Ducks	2,256 (29)	2,293 (32)	1,849 (27)	2,003 (29.9)	2,430 (38.5)	2,360 (36.6)	2,010 (33.3)	2,340 (38.6)	1,850 (27.4)	2,320 (34.6)	2,350 (34.3)
Canada goose	934 (12)	1,587(22)	726 (10)	1,314 (19.6)	1,620 (25.6)	1,360 (21.1)	1,270 (21.0)	1,300 (21.4)	650 (9.6)	770 (11.5)	1,730 (25.3)
Ruffed grouse	1,867 (24)	1,940 (27)	1,915 (28)	2,503 (37.4)	1,460 (23.1)	2,820 (43.7)	2,010 (33.3)	2,600 (42.9)	2,870 (42.5)	3,520 (52.6)	2,280 (33.3)
Ring-necked pheasant	2,645 (34)	3,116 (44)	1,519 (22)	2,003 (29.9)	1,780 (28.2)	1,910 (29.6)	1,420 (23.5)	1,380 (22.9)	1,480 (21.9)	1,550 (23.1)	1,520 (22.2)
Raccoon[b,c]	78 (1.0)	0 (0)	0 (0)	63 (0.9)	0 (0)	0 (0)	80 (1.2)	0 (0)	0 (0)	170 (2.6)	70 (1.0)
Estimated nonresident take:											
Ducks	22,718	15,463	11,755	17,055	13,840	20,380	20,410	13,060	16,863	17,701	15,717
Canada goose	3,501	5,762	3,698	6,334	4,050	2,270	3,650	2,680	1,484	1,462	6,994
Ruffed grouse	7,236	6,938	8,651	12,600	8,980	10,090	4,990	9,090	13,805	11,772	6,994
Ring-necked pheasant	17,661	10,642	6,274	8,076	4,860	6,820	3,430	3,720	6,581	4,040	7,274
Raccoon [b, c]	3,268	0	0	593	0	0	1,280	0	0	172	770

[a] Excludes duplicate licenses and nonresident shooting preserve licenses.
[b] In 2008, 2009, 2011, 2012, 2014, and 2015 no non-residents reported hunting/harvesting raccoons.
[c] In 2013 and 2017 only one non-resident reported hunting/harvesting raccoons. The extrapolated estimate is not reliable.

The following information has been excerpted from: U.S. Fish and Wildlife Service. Migratory bird hunting activity and harvest during the 2016 - 2017 and 2017-18 hunting seasons. U.S. Fish and Wildlife Service, Laurel, Maryland, U.S.A. The entire report is available on-line at https://www.fws.gov/migratorybirds/pdf/surveys-and-data/HarvestSurveys/MBHActivityHarvest2016-17and2017-18.pdf

Table 1. Species composition of the Minnesota waterfowl harvest, 2016 and 2017. (from: Raftovich, R.V., S.C. Chandler, and K.K. Fleming. 2018. Migratory bird hunting activity and harvest during the 2016-17 and 2017-18 hunting seasons. U.S. Fish and Wildlife Service, Laurel, Maryland. USA August, 2018. 71 pp).

	Minnesota Harvest					Mississippi Flyway Harvest		
Species	2016	% of Harvest	2017	% of Harvest	Percent change in Harvest 16-17	2016	2017	Percent change Harvest 16-17
Mallard	135,643	26.03	159,718	25.36	18	1,826,180	1,643,472	-11
Domestic mallard	0	0.00	0			1,186	1,184	0
American black duck	0	0.00	308	0.05		25,959	17,855	-45
Black x mallard	0	0.00	0			1,664	477	-249
Gadwall	8,198	1.57	29,543	4.69	260	662,309	623,532	-6
American wigeon	13,788	2.65	11,386	1.81	-17	91,744	108,267	15
Green-winged teal	37,637	7.22	60,317	9.58	60	627,404	717,625	13
Blue-winged /cinnamon teal	73,039	14.02	78,166	12.41	7	255,431	439,383	42
Northern shoveler	6,335	1.22	11,079	1.76	75	193,789	237,247	18
Northern pintail	9,316	1.79	13,541	2.15	45	101,403	134,643	25
Wood duck	115,520	22.17	116,326	18.47	1	582,535	610,542	5
Redhead	13,788	2.65	21,234	3.37	54	60,539	57,348	-6
Canvasback	7,080	1.36	6,155	0.98	-13	45,240	40,087	-13
Greater scaup	373	0.07	2,462	0.39	560	34,564	28,929	-19
Lesser scaup	7,080	1.36	8,617	1.37	22	67,244	185,503	64
Ring-necked duck	62,604	12.02	80,321	12.75	28	188,325	267,900	30
Goldeneye	4,099	0.79	6,770	1.07	65	33,287	31,870	-4
Bufflehead	17,887	3.43	12,925	2.05	-28	55,748	96,285	42
Ruddy duck	0	0.00	615	0.10		15,474	7,142	-117
Scoters	0	0.00	1,231	0.20		6,155	3,451	-78
Hooded merganser	8,571	1.65	8,309	1.32	-3	50,207	47,789	-5
Other mergansers	0	0.00	923	0.15		12,613	11,140	-13
Total Duck Harvest [a] (retrieved kill)	521,000 ±14%		629,900 ±15%		21	4,962,600 ±6%	5,339,800 ±5%	7

[a] Sum of all species does not equal total because of rounding error.

Table 2. Top 10 states in number of **adult duck hunters**, 2017, and number of hunter-days and retrieved duck kill. (from: Raftovich, R.V., S.C. Chandler, and K.K. Fleming. 2018. Migratory Bird Hunting activity and harvest during the 2016-17 and 2017-18 hunting seasons. U.S. Fish and Wildlife Service, Laurel, Maryland. USA August 2018. 71 pp).

State	Number of active duck hunters	Duck hunter days afield	Total duck harvest	Seasonal duck harvest per hunter
Texas	86,200 ± 20%	391,800 ± 17%	1,205,100± 26%	14.0 ± 32%
Minnesota	64,800 ± 10%	369,700 ± 13%	629,900 ± 15%	9.7 ± 18%
California	56,100 ± 13%	443,900 ± 13%	1,305,600 ± 15%	23.2 ± 20%
Arkansas	52,100 ± 11%	370,200 ± 14%	1,006,700 ± 11%	19.3 ± 15%
Louisiana	46,900 ± 12%	324,100 ± 14%	1,083,900 ± 18%	23.1 ± 21%
Wisconsin	44,100 ± 13%	286,400 ± 12%	404,600 ± 13%	9.2 ± 19%
Missouri	38,800 ± 11%	219,300 ± 15%	484,100 ± 18%	12.5 ±21%
Michigan	33,200 ± 12%	201,000 ± 14%	297,500 ± 17%	9.0 ± 21%
North Dakota	29,400 ± 7%	143,500 ± 14%	426,400 ± 21%	14.5 ± 22%
North Carolina	26,100 ± 16%	175,700 ± 28%	345,900 ± 24%	13.3 ± 28%
Mississippi Flyway		2,544,600 ± 5%	5,339,800 ± 5%	
United States		5,446,900 ± 3%	12,115,800 ± 4%	

Table 3. Top 10 states in number of **adult goose hunters**, 2017, and number of hunter-days and retrieved goose kill. (from: Raftovich, R.V., S.C. Chandler, and K.K. Fleming. 2018. Migratory Bird Hunting activity and harvest during the 2016-17 and 2017-18 hunting seasons. U.S. Fish and Wildlife Service, Laurel, Maryland. USA August, 2018. 71 pp).

State	**Number of active goose hunters**	**Goose hunter days afield**	**Total goose harvest**	**Seasonal goose harvest per hunter**
Minnesota	52,200 ± 10%	291,800 ± 15%	212,200 ± 16%	4.1 ± 19%
Texas	48,200 ± 17%	141,100 ± 24%	231,900 ± 36%	4.8 ± 40%
California [b]	43,900 ± 11%	268,200 ± 15%	239,000 ± 16%	5.4 ± 20%
Wisconsin	38,400 ± 10%	238,900 ± 14%	136,000 ± 18%	3.5 ± 20%
Michigan	34,500 ± 13%	209,500 ± 16%	180,500 ± 19%	5.2 ± 23%
Arkansas	28,400 ± 13%	116,000 ± 17%	188,800 ± 21%	6.7 ± 25%
North Dakota	26,700 ± 7%	118,200 ± 9%	220,500 ± 14%	8.2 ± 16%
Maryland [b]	24,500 ± 6%	127,800 ± 11%	185,600 ± 13%	7.6 ± 14%
Illinois	21,700 ± 14%	176,800 ± 19%	151,600 ± 32%	7.0 ± 35%
North Carolina	17,800 ± 21%	70,400 ± 42%	43,600 ± 34%	2.4 ± 40%
Mississippi Flyway		1,590,000 ± 6%	1,350,000 ± 8%	
United States [b]		3,386,000 ± 4%	3,602,500 ± 5%	

[b]. Goose hunter statistics do not include brant hunter statistics for coastal states with brant seasons: Connecticut, Delaware, Maryland, Massachusetts, New Hampshire, New Jersey, New York, North Carolina, Rhode Island, Virginia, California, Oregon, Washington, and Alaska.

2018 LIGHT GOOSE CONSERVATION ORDER HARVEST IN MINNESOTA

Steve Cordts, Wildlife Populations and Regulations Unit

Margaret Dexter, Wildlife Populations and Research Unit

INTRODUCTION

This report documents results of the 2018 Light Goose Conservation Order hunter mail questionnaire survey.

METHODS

Minnesota held a light goose Conservation Order harvest from 15 February - 30 April 2018. Participants were required to obtain a $3.50 permit. No other license, stamp or permit was required. Shooting hours were 1/2 hour before sunrise to 1/2 hour after sunset. There were no daily or possession limits. Use of electronic calls and unplugged shotguns was allowed.

All permit holders were sent a questionnaire after the season. Survey questions are listed in Figure 1.

RESULTS AND DISCUSSION

A total of 912 permits were issued and 353 responses (43%) to the questionnaire were obtained (Table 1). In calculating harvest estimates, we assumed that the 559 non-respondents participated in the conservation action and took light geese in the same manner as respondents. Three hundred twenty one people attempted to take light geese during the conservation order period. Active participants pursued light geese for 1,204 days and 1,021 light geese were shot and retrieved. This was an average retrieved take of 3.8 geese per active participant. Another 78 light geese were estimated wounded and not retrieved.

ACKNOWLEDGMENTS

J. Giudice, MNDNR Biometrics Unit analyzed all data for this report.

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Figure 1. Light Goose Conservation Order hunter mail questionnaire, 2018.

MINNESOTA 2018 LIGHT GOOSE HARVEST SURVEY
For the Period of February 15 - April 30, 2018 ONLY

You are being asked to provide information to help us evaluate the harvest of light geese (snow, blue, and Ross' geese) in Minnesota during February 15 - April 30, 2018. Your cooperation is important. Please return this survey card even if you did not hunt light geese. Please answer the following questions to the best of your ability. **Answer only for your Minnesota 2018 hunting experience.** THANK YOU! Lou Cornicelli, Wildlife Research Program Manager, Division of Fish and Wildlife, MN DNR.

1. Did you hunt light geese in Minnesota during February 15 - April 30, 2018? Yes / No

   If NO, please disregard all remaining questions and return this survey card.

2. How many days did you hunt light geese in Minnesota during February 15 - April 30, 2018? ________

3. How many light geese did you personally shoot and retrieve in Minnesota? ____________________

4. How many light geese did you personally shoot, but were UNABLE to retrieve? ________________

Table 1. Summary of Light Goose Conservation Order harvest in Minnesota, 2006 – 2018.

	Year												
Statistic	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Total permits sold	1,363	1,292	1,406	1,670	952	994	1,048	1,405	1,278	1,141	1,143	974	912
Useable returns	955	921	910	1,057	671	659	675	810	759	520	491	393	353
Response rate (%)	70.0	71.0	65.0	63.0	72.3	67.1	65.3	58.3	60.0	46	43	41	43
Active hunters (%)	37.3	39.8	54.9	66.0	40.8	45.7	56.9	54.9	44.0	50	47	48	35
Estimated total hunters	516	514	773	1,103	389	455	600	770	560	569	534	471	321
Estimated hunter days	2,665	2,302	3,404	4,647	1,475	1,830	2,270	3,070	2,580	2,434	2,605	1,966	1,204
Mean days/hunter	5.2	4.5	4.4	4.2	3.8	4.0	3.8	4.0	4.6	4	5	4	3.8
Estimated harvest (shot & retrieved)	1,360	1,786	2,409	4,366	559	1,554	2,620	2,430	2,880	3,266	2,121	1,713	1,021
Mean harvest/hunter	2.6	3.5	3.1	4.0	1.4	3.4	4.4	3.2	5.1	6	4	4	3.2
Estimated crippling losses	163	172	302	640	70	145	210	370	210	349	215	298	78
Percent using unplugged guns	42.3	43.6	46.7	46.8	44.9	44.2	43.0	49.4	48.8	NA	NA	NA	NA
Est. number hunters using unplugged guns	215	224	361	516	175	201	260	380	270	NA	NA	NA	NA
Est. number geese **shot** with unplugged guns	689	1,032	1,275	2,413	348	742	1,510	1,670	2,060	NA	NA	NA	NA
Est. harvest with shell 4-5-6	287	277	339	822	131	311	460	620	770	NA	NA	NA	NA
Percent using electronic calls	14.4	17.1	19.1	23.5	25.9	21.3	22.2	24.5	27.8	NA	NA	NA	NA
Est. number hunters using e-calls	73	88	148	260	101	97	130	190	160	NA	NA	NA	NA
Est. harvest while using e-calls	280	329	566	1,171	192	531	460	620	1,710	NA	NA	NA	NA
Percent hunting 1/2-hr after sunset	43.9	38.3	42.3	43.1	39.7	39.7	42.4	33.4	36.2	NA	NA	NA	NA
Est. number hunting after 1/2-hr sunset	223	197	326	475	154	180	250	260	200	NA	NA	NA	NA
Est. harvest 1/2-hr after sunset	246	209	511	713	87	238	240	260	550	NA	NA	NA	NA

MINNESOTA'S WILD TURKEY HARVEST – FALL 2017, SPRING 2018

Lindsey Messinger, Farmland Wildlife Populations and Research Group

SUMMARY OF SEASON STRUCTURE

This report summarizes the fall 2017 and spring 2018 Minnesota wild turkey harvest. The fall turkey season was 30 days in length (September 30 - October 29) and allowed for an unlimited number of hunters to take one wild turkey of either sex in one of 12 pre-selected permit areas (501-512, Figure 1). Fall permits for youth hunters were valid statewide (i.e., no restrictions on permit area); archery and firearms hunters were restricted to a declared permit area.

There were no major changes to the spring turkey season structure in 2018. The spring turkey season was 44 days in length (18 April – 31 May) and allowed hunters to take one bearded wild turkey (tom, jake, or bearded hen). The spring turkey season was divided into six distinct time periods with permits valid during a specified time period (A-F) and permit area (501-512; Figure 1). A restricted number of permits were available through a lottery system in each permit area during time periods A and B (A: April 18-24, and B: April 25-May 1). Permits not sold during the lottery process were available for over-the-counter surplus sales. Permits for the remaining time periods (C: May 2-8, D: May 9-15, E: May 16-22, F: May 23-31) were available over-the-counter in unlimited quantities in each permit area. Hunters possessing a permit unfilled during time periods A-E were permitted to hunt during the final time period (F) in their respective permit area. Permits for archery and youth hunters were valid the entire season and statewide (i.e., no time period or permit area restrictions).

FALL 2017 SEASON

Permits Issued

Permits issued to hunters decreased 10% from 8,469 permits in 2016 to 7,650 permits in 2017 (Table 1, Figure 2). Youth permit sales accounted for 22% of total license sales during the fall 2017 season which was similar to 2016.

Harvest

There were 1,015 harvested turkeys registered during the fall 2017 season which decreased 14% from 1,176 harvested turkeys registered in 2016 (Table 1; Figure 2). Hunter success rate increased slightly (2%) from 2016 to 13% in 2017, and was similar to the 5-year average. The greatest number of permits were issued in permit areas 507, 508, and 501. This effort was reflected in harvest with these three permit areas also registering the highest harvest (Table 2). Statewide, females (hens) represented 50% of the total harvest while juvenile males (jakes) and mature males (toms) represented 16% and 34% of the total harvest respectively (Table 2).

SPRING 2018 SEASON

Permits Issued

There were 45,399 permits issued during the spring 2018 season, including 8,739 general lottery and landowner permits, 9,807 youth permits, 11,200 archery permits, and 15,621 surplus over-the-counter permits (Table 3). The total number of permits purchased decreased 7% in

2018 (Table 4). Youth permit sales composed 22% of total permit sales while archery permits accounted for 25% of total permit sales (Table 3). Archery permits issued in 2018 were similar to 2017 (Table 4) and may indicate archery permit sales are leveling after regulation changes expanded opportunity, allowing archery hunters to hunt statewide during any time period. Purchase of lottery permits declined by 14% from 2017, continuing a declining trend. Surplus permits issued also decreased 6% in 2017. The greatest number of regular gun permits (archery and youth permits are valid state-wide) were issued in permit areas 507, 501, and 508 (in descending order; Table 5). Permit areas 507 and 501 represent core turkey range in Minnesota and permit area 508 represents an area of potentially expanding opportunity as this area was expanded in 2016 to include the entire north-central and north-eastern regions of Minnesota. Permit sales for the first non-lottery time period (C) were the highest state-wide, followed by the lottery time-periods (A & B; Table 6).

Harvest

Hunters registered 10,705 turkeys (Tables 3, 4, 5, & 7), which was below the 5-year average (11,581 turkeys, Figure 3). Although harvest remained the highest in the core turkey range in permit areas 507 (2,826 turkeys) and 501 (2,040 turkeys), harvest in permit area 508 (1,698 turkeys) surpassed 503 (1,168 turkeys) in 2018 for the second year in a row. Youth harvest (1,763 turkeys) and lottery harvest declined 18% and 19%, respectively, from 2017 whereas archery (1,661 turkeys) and surplus (4,211 turkeys) harvest were similar to 2017 (Table 3). These trends may be attributable to weather conditions (see below).

WEATHER SUMMARY

The winter of 2017-2018 was more normal with variable snowfall across the wild turkey range, but with at least one 2-week period where snow depths exceeded 6 inches across much of the core range. However, these conditions were likely not a significant factor beyond normal winter mortality for wild turkeys. Spring weather was wet and cold across much of the turkey range. There were multiple snow events in April with accumulations between 3-8 inches. Late-season snowfall likely delayed nesting activities and vegetation “green up” was later than normal. Likewise, conditions were wet, especially in permit areas 501 and 503, where precipitation was 1 inch or more above normal across much of these areas. Snow was still present across much of the turkey range during period A, despite opening almost a week later than in 2017. These weather conditions likely impacted hunter participation and effort, and therefore harvest, especially for gun hunters during the first lottery period. Warmer than normal conditions late in the season during period F may have also impacted hunter participation, effort, and ultimately harvest.

Table 1. Permits available, number of applicants, permits issued, registered harvest, and hunter success rates for fall wild turkey seasons in Minnesota, 2008-2017.

Year	Permits available	Applicants	Permits issued	Registered harvest	Hunter success (%)[a]
2008	7,560	5,834	4,981	1,187	23.8
2009	9,330	7,738	5,019	1,163	23.2
2010	10,430	6,869	6,607	1,353	20.5
2011	10,430	3,538	5,382	953	17.7
2012[b]	Unlimited	N/A	10,628	1,752	16.5
2013[b]	Unlimited	N/A	8,060	1,137	14.1
2014[b]	Unlimited	N/A	8,236	1,216	14.8
2015[b]	Unlimited	N/A	8,109	1,213	15.0
2016[b]	Unlimited	N/A	8,469	1,176	13.9
2017	Unlimited	N/A	7,650	1,015	13.3

[a] Success rates not adjusted for non-participation.

[b] Permits issued, registered harvest, and derived hunter success (%) was reviewed and adjusted to address inconsistencies in data query and previous reporting.

Table 2. Permits issued, registered harvest by sex, total registered harvest, regular gun harvest, and gun hunter success rates during the 2017 fall wild turkey season in Minnesota.

Permit Area	Regular permits issued[a]	Toms[b]	Jakes[b]	Hens[b]	Total registered harvest[b]	Regular gun harvest[c]	Regular gun success rates (%)
501	912	62	21	82	165	141	15.5
502	82	1	1	4	6	5	6.1
503	624	35	12	60	107	88	14.2
504	197	6	3	6	15	10	5.1
505	353	18	6	21	45	41	11.6
506	217	5	5	15	25	22	10.1
507	1,509	98	49	151	298	258	17.1
508	1,161	63	43	106	212	181	15.6
509	158	15	8	18	41	24	15.2
510	605	38	16	41	95	88	14.5
511	69	0	0	1	1	1	1.4
512	79	2	1	2	5	5	6.3
TOTAL	**5,968**	**343**	**165**	**507**	**1,015**	**864**	**14.5**

[a] Archery and youth permits were not included (valid in all permit areas).

[b] Total harvest for all license types.

[c] All firearm harvest except youth.

Table 3. Total permits sold, harvest, and success rate by type of permit during the spring 2018 wild turkey season in Minnesota.

	Total permits sold	Harvest	Success (%)[a]
Lottery	8,739	3,070[b]	35.2
Surplus	15,621	4,211	27.0
Youth	9,807	1,763	18.0
Archery	11,200	1,661	14.8
Total	45,367[c]	10,705	23.6

[a] Success rates not adjusted for non-participation.

[b] Includes military and military disabled veteran permit types.

[c] Does not include military permit types. There were 32 military permits issued in 2018.

Table 4. Permits available, permits issued, registered harvest, and relative success rates from 2009-2018 for all spring wild turkey hunting seasons in Minnesota.

	Permits				Harvest	
Year	Available	Issued	Issued (%)	Archery Permits Issued	Registered harvest	Success (%)[a]
2009[b]	42,328	36,193	85.5		12,210	33.7
2010[b]	55,982	46,548[c]	83.0	2,910	13,467	28.9
2011[b]	Unlimited	43,521[c]	N/A	2,462	10,055	23.1
2012[b,d]	Unlimited	38,155[c]	N/A	3,325	11,276	29.6
2013[b,d]	Unlimited	40,430[c]	N/A	3,885	10,321	25.5
2014[b,d]	Unlimited	42,134[c]	N/A	4,760	11,425	27.1
2015[b,d]	Unlimited	40,824[c]	N/A	4,930	11,694	28.6
2016[b,d]	Unlimited	38,895[c]	N/A	10,132	12,277	31.6
2017[b,d]	Unlimited	37,882 [c]	N/A	11,031	11,803	31.2
2018[b]	Unlimited	34,199[c]	N/A	11,200	10,705	31.3

[a] Success rates not adjusted for non-participation.

[b] Youth hunt data included.

[c] Permits issued to archery hunters were not included (to facilitate comparison to previous years).

[d] Permits issued, derived issued %, registered harvest, and derived hunter success (%) were reviewed and adjusted to address inconsistencies in data query and previous reporting.

Table 5. Permits issued, registered harvest, and hunter success during the 2018 spring wild turkey season in Minnesota.

Permit area	Regular permits issued[a]	Total registered harvest[b]	Regular gun harvest[c]	Regular gun success rates (%)
501	5,855	2,240	1,739	29.7
502	485	139	114	23.5
503	2,981	1,168	823	27.6
504	593	267	167	28.2
505	1,905	780	595	31.2
506	915	346	232	25.4
507	5,946	2,826	1,830	30.8
508	3,469	1,698	1,078	31.1
509	315	201	107	34.0
510	1,715	931	543	31.2
511	136	64	32	23.5
512	77	45	21	27.3
TOTAL	**24,392**	**10,705**	**7,281**	**29.8**

[a] Permits issued for the Camp Ripley disabled veterans hunt, archery, and youth permits were not included.

[b] Total harvest for all license types.

[c] All lottery, military, and surplus permit harvest, excluding youth and archery licenses.

Table 6. Permits available and issued by license type (resident and non-resident) and time period for the spring 2018 wild turkey season in Minnesota.

Time period	Permits available	General lottery[a]	Surplus	Youth	Archery
A: Apr. 18-24	7,010	5,351	217	Not applicable – Youth and archery permits were valid during all time periods.	
B: Apr. 25-May 1	7,010	3,399	2,542		
C: May 2-8	Unlimited	9	7,508		
D: May 9-15	Unlimited	8	2,989		
E: May 16-22	Unlimited	2	1,818		
F: May 23-31	Unlimited	2	547[b]		
Total[a]	**Unlimited**	**8,771**	**15,621**	**9,807**	**11,119**

[a] Includes landowner and military permits.

[b] Number of surplus licenses sold for this time period. Actual number of hunters in unknown because all unsuccessful hunters from previous time periods were permitted to hunt in the final (F) season.

Table 7. Total harvest by time period during the spring 2018 wild turkey season in Minnesota.

Time period	Total harvest	Harvest (%)
A	2,946	27.5
B	2,672	25.0
C	2,591	24.2
D	1,038	9.7
E	677	6.3
F	781	7.3
Total	**10,705**	**100**

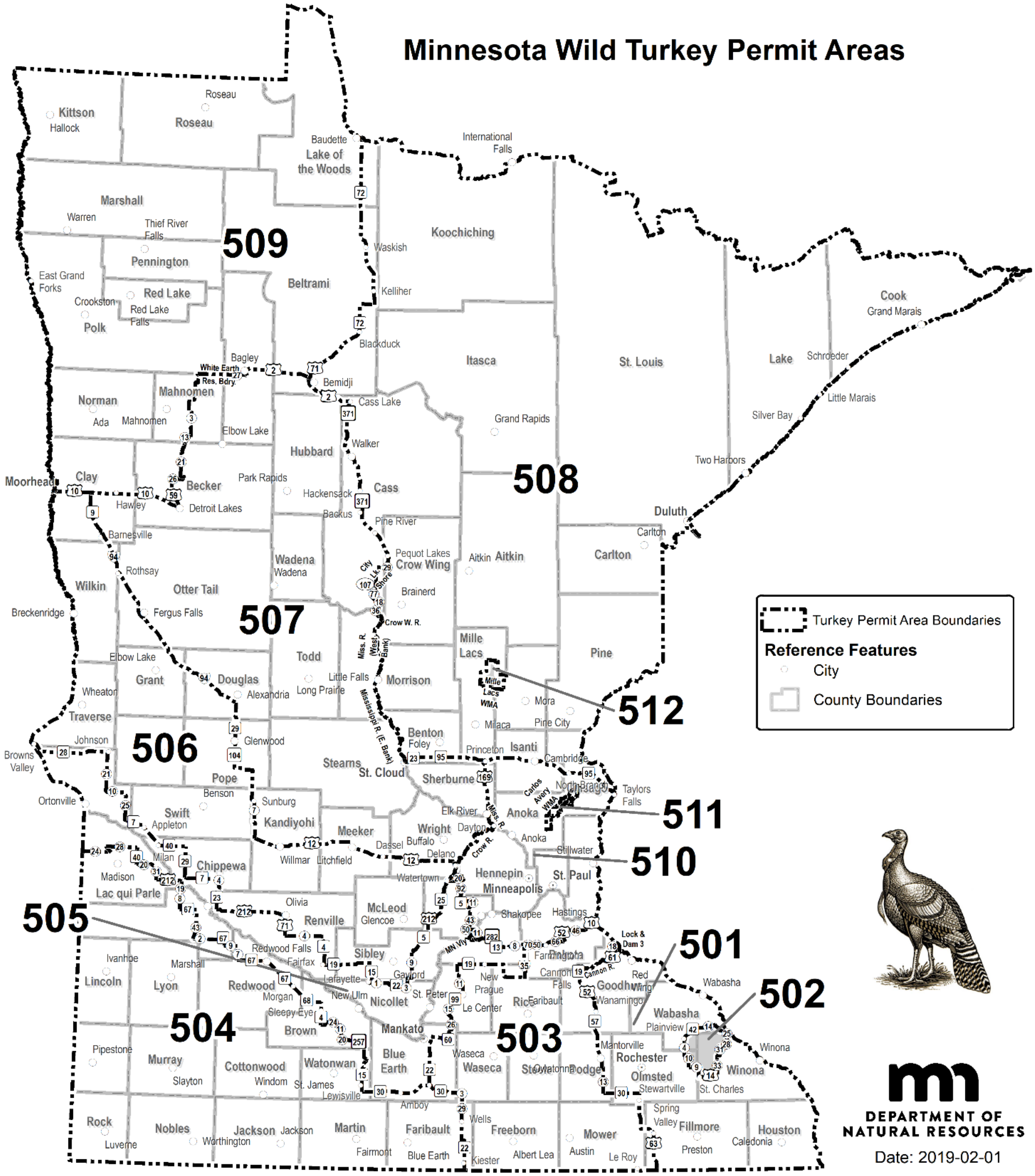

Figure 4. Permit areas open for hunting, fall 2017 and spring 2018 wild turkey seasons in Minnesota.

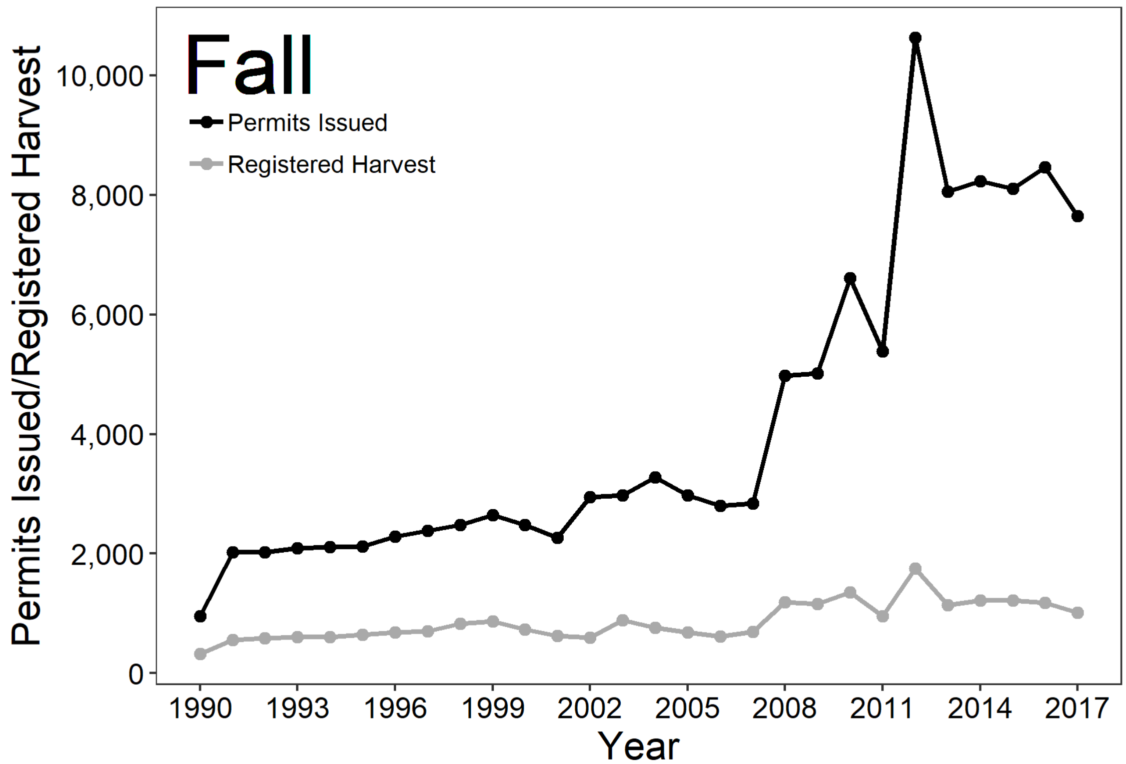

Figure 5. Permits issued and registered harvest for fall wild turkey seasons in Minnesota, 1990-2017.

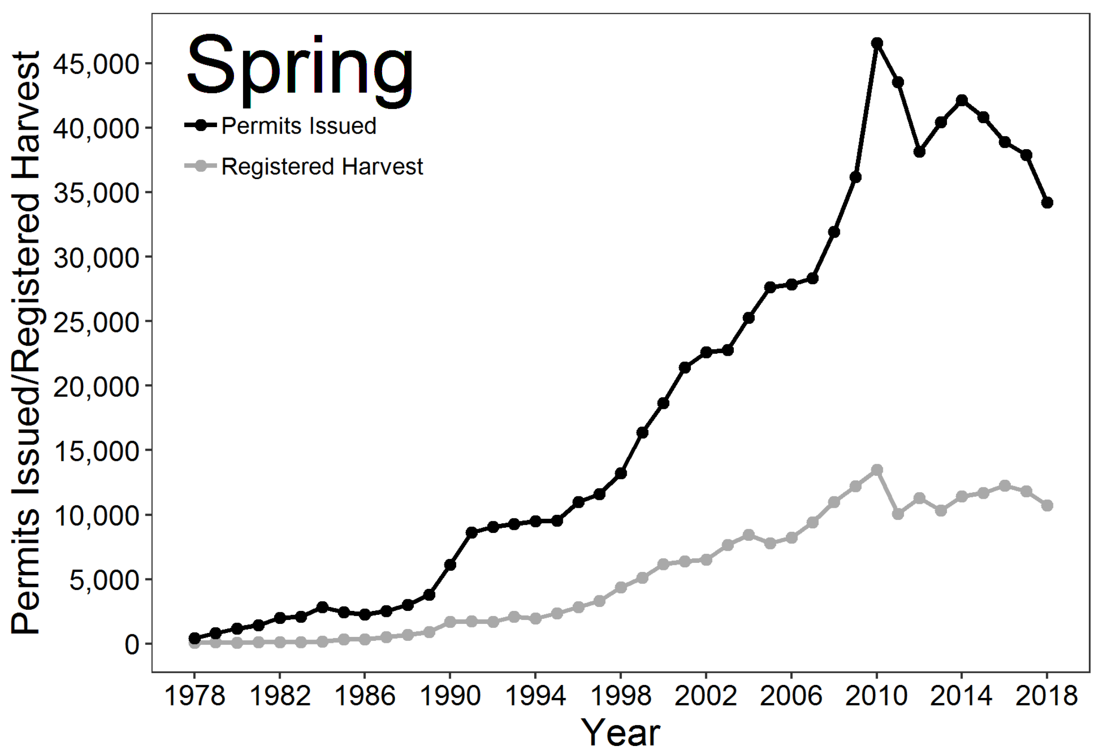

Figure 6. Permits issued and registered harvest for spring wild turkey seasons in Minnesota, 1978-2018.

2017 MINNESOTA PRAIRIE-CHICKEN HARVEST SURVEY

Charlotte Roy, Forest Wildlife Populations and Research Group

SUMMARY OF FINDINGS

The Minnesota DNR conducts a postcard survey of Greater Prairie-chicken (*Tympanuchus cupido pinnatus*) hunters each year to estimate hunter numbers and harvest, and to evaluate hunter success and satisfaction. In 2017, 97 hunters were estimated to have gone afield and harvested 86 prairie-chickens and 21 sharp-tailed grouse (*Tympanuchus phasianellus*) during prairie-chicken hunts. Hunter success (0.55) and satisfaction (4.0 on a scale of 1-5) were similar to recent years and consistent with improvement following changes to the permit areas and season (i.e., longer length and earlier dates) in 2013.

INTRODUCTION

Prairie-chicken (*Tympanuchus cupido pinnatus*) hunting in Minnesota was closed in 1943 because of population declines resulting from habitat loss. However, hunting was reopened in 2003 because prairie-chicken populations were considered robust enough to allow a limited season. During 2003-2005, a limited-entry 5-day hunting season was opened in 7 permit areas in western Minnesota. Permits were awarded through a lottery system, with a bag and season limit of 2 prairie-chickens. In 2006, 4 new permit areas were added and the number of permits was increased in some areas. Surplus licenses were offered for sale after the lottery for the first time in 2011, and in 2013, the permit areas were revised again. These most recent changes eliminated 801A and 802A, modified 803A to include portions of the former 802A and 803A, and added 812A and 813A to expand hunting eastward (Figures 1 and 2). The number of available permits was also reduced in some permit areas to more closely reflect opportunities to harvest prairie-chickens in each permit area. The season was lengthened from 5 days to 9 days to provide hunting opportunity on >1 weekend and was moved from mid-October to open in late-September. The earlier season was an attempt to improve hunter success and satisfaction by providing hunting opportunities before pheasant season opened (to reduce hunter interference and flushing distance). These changes were based on hunter comments received by DNR Wildlife Managers during prior years and input received during a public input survey during March 2013. Responses of surveyed prairie-chicken hunters in 2015 provided additional evidence that the earlier season is preferred by most, although hunter preferences were clearly divided. In 2017, the prairie-chicken season opened 30 September and closed 8 October.

Prairie-chicken hunting in Minnesota is a privilege that is only available to residents. Landowners or tenants of ≥40 acres of grassland within a permit area are eligible to apply for a landowner lottery that awards ≤20% of the available permits in a permit area. Extra landowner permits are then included with the regular lottery. Any landowner not receiving a permit through the landowner lottery can participate in the regular lottery. The lottery gives preference to persons that have applied for a permit unsuccessfully for the most years. Upon selection, lottery winners must purchase a prairie-chicken hunting permit before hunting. Although sharp-tailed grouse (*Tympanuchus phasianellus*) hunting is closed south of U.S. Highway 2 in the western part of the state (i.e., in permit areas 804A–813A), licensed prairie-chicken hunters may also take sharp-tailed grouse while hunting prairie-chickens. Harvest is documented each year in this annual report.

METHODS

Lottery applicants, winners, and permit purchasers were recorded by the Electronic Licensing System (ELS). Registration of harvested birds has not been mandatory except during 2003-2006, so I determined harvest through a postcard survey. I sent a postcard to each lottery winner the week before hunting season. Five weeks later I sent another postcard to people who had not yet responded. Postcards contained 6 questions: did you purchase a permit, did you hunt, and if so, for how many days, how many prairie-chickens did you harvest, how many sharp-tailed grouse did you harvest during prairie-chicken hunts, and how satisfied were you (on a scale of 1-5)?

Only responses from lottery winners who purchased a hunting permit were considered in the analysis. I compared responses from the first mailing to responses from the second mailing to examine possible nonresponse bias. I did not detect a bias in the number of hunters, days afield, sharp-tailed grouse harvest, and hunter satisfaction, so I assumed that non-respondents would have had the same response as respondents from both mailings when estimating these metrics. However, a nonresponse bias was detected in the number of birds harvested. Therefore, I calculated the number of birds harvested, birds per harvester, and hunter success for each permit area assuming that non-respondents were more similar to respondents from the second mailing than to those from the first mailing. Each of these metrics was calculated by permit area and summed for all areas.

RESULTS & DISCUSSION

The combined quota for the 11 permit areas during 2017 was 125 permits, and 317 individuals applied in the lottery (Table 1). Of the 127 lottery winners, 99—including 2 landowners—later purchased a permit. Three additional winners who were not on the list of purchasers returned surveys indicating that they hunted, so they were added to the sample of “purchasers” for this analysis and summary. Two permit areas (804A and 813A) had fewer applicants than permits available. The 3 surplus permits were not made available.

Ninety-one permit purchasers (89%, n = 102) responded to the survey; 70 (69%) responded to the first mailing and 21 (21%) to the second mailing. This response rate is similar to survey response rates during 2011 (90%), 2012 (95%), and 2014 (87%), and slightly higher than in 2010 (84%), 2013 (83%), and 2016 (83%). Respondents to the first mailing reported harvesting prairie-chickens at higher rates (69% vs. 25%) and reported harvesting more chickens (1.1 vs. 0.4 birds per hunter). Thus, hunters that were more successful were more likely to respond to the survey. However, respondents to the first mailing were as likely as respondents to the second mailing to have hunted (96% vs. 90% of respondents), they hunted a similar number of days (2.4 vs. 1.9), harvested a similar number of sharp-tailed grouse (0.3 vs. 0.1 birds per hunter), and reported similar satisfaction (mean 4.1 vs. 3.8, median 4 vs. 4), with 88% and 90% of respondents reporting satisfaction scores $\geq$3, respectively.

To correct for the nonresponse bias in harvest this year, I assumed that non-respondents to the survey would have had similar success to respondents to the second mailing (i.e., class method of correction). This assumption may not eliminate nonresponse bias if non-respondents were less successful than respondents to the second mailing, but should more closely approximate the actual harvest than assuming similar responses of non-respondents and all respondents.

Eighty-six respondents reported that they hunted prairie-chickens (Table 2). I estimated the total number of hunters to be 97 (i.e., purchasers who went afield) after accounting for hunting by non-respondents. Hunters reported harvesting 84 prairie-chickens and total harvest after accounting for non-respondents was estimated as 86 prairie-chickens. An estimated 53 hunters bagged $\geq$1 chicken. Survey respondents reported harvesting 21 sharp-tailed grouse while hunting prairie-chickens from permit areas 803A, 804A, 805A, and 806A (Figure 1). Although successful hunters reported higher average satisfaction (4.4) than respondents that were not successful (3.4), satisfaction of prairie-chicken hunters was high overall.

Prairie-chicken hunter success and satisfaction during 2017 were similar to 2013-2016, which is consistent with improved success and satisfaction following changes to the season framework in 2013 to accomplish this goal (Table 3). Hunter survey responses in the 2013 Wildlife Public Input Survey and through this postcard survey in 2015 indicated that hunter preferences are split, but that the majority of hunters support the current season framework. Both the 2013 and 2015 surveys asked hunters about their preference for a season opening on the last Saturday in September or an opener on the Saturday nearest 20 October. The majority of respondents to the 2013 survey (64% of respondents who expressed an opinion) indicated a preference for the earlier season. Likewise, in the 2015 survey, 56% of respondents indicated a preference for the earlier season. Supporters of the early season indicated that the birds were less wary early in the season and pheasant hunting did not affect the hunt. Reasons provided in support of a later season included cooler weather for hunters and dogs, better plumage on birds, fewer standing crops, opportunity to harvest pheasants while hunting chickens, and no conflict with the waterfowl opener. Although a large minority still indicated a preference for a later season, the current season meets the timing preferences of the majority of responding prairie-chicken hunters.

ACKNOWLEDGMENTS

This survey was funded in part by the Wildlife Restoration (Pittman-Robertson) Program. I would like to thank Laura Gilbert for preparing and mailing the postcards and entering data. I would also like to thank Mike Larson for commenting on the report. I also sincerely appreciate the efforts of the hunters that submitted samples for the genetics and pesticide studies.

Table 1. Prairie-chicken hunt lottery applicants, winners, and hunting permit purchasers in Minnesota during 2017.

Permit area	Permits available	No. of applicants	Lottery winners		Permit purchasers[a]		Surplus purchasers[c]
			No.[b]	Proportion	No.	Proportion	
803A	8	28	8	0.29	7	0.88	0
804A	10	8	8	1.00	8	1.00	0
805A	10	66	13	0.20	12	0.92	0
806A	12	33	13	0.39	8	0.62	0
807A	20	46	20	0.43	18	0.90	0
808A	20	39	20	0.51	12	0.60	0
809A	15	29	16	0.55	13	0.81	0
810A	15	33	15	0.45	13	0.87	0
811A	5	10	5	0.50	5	1.00	0
812A	5	21	5	0.24	5	1.00	0
813A	5	4	4	1.00	1	0.25	0
All	125	317	127	0.40	102	0.82	0

[a] Lottery winners who purchased a hunting permit.
[b] The number of permits may exceed the quota when the last applicant selected in the lottery belongs to a hunting party.
[c] Number of people purchasing a surplus permit after the lottery because the permit quota was not met during the lottery. Surplus permits were not offered in 2017.

Table 2. Prairie-chicken harvest in Minnesota during 2017.

Permit area	No. of hunters[a]		Birds harvested		Birds per harvester[b]	Success rate[c]
	Self-reported	Estimated	Self-reported	Estimated		
803A	5	7	1	2	1.0	0.29
804A	7	8	8	8	1.6	0.63
805A	12	12	12	12	1.3	0.75
806A	7	8	10	10	1.7	0.75
807A	16	17	17	17	1.9	0.53
808A	10	11	15	15	1.9	0.73
809A	10	13	13	14	1.8	0.62
810A	9	10	3	3	1.0	0.30
811A	4	5	1	1	1.0	0.20
812A	5	5	4	4	2.0	0.40
813A	1	1	0	0	NA	0.00
All	86	97[d]	84	86[d]	1.6[d]	0.55[d]

[a] Permit purchasers who hunted.
[b] Estimated number of birds harvested per successful hunter, assuming non-respondents had success similar to that of respondents to the second mailing.
[c] Proportion of estimated hunters harvesting ≥1 prairie-chicken.
[d] Assumed that non-respondents were represented by respondents in the second mailing.

Table 3. Summary of prairie-chicken hunting in Minnesota during 2003–2017.

Year	Permits available	Applicants	Hunters[a]	Birds harvested	Success rate[b]	Hunter satisfaction[c]
2003	100	853	92	130	0.75	4.4
2004	101	759	87	58	0.45	3.6
2005	110	500	86	94	0.63	4.0
2006	182	512	149	109	0.49	3.6
2007[d]	187	519		122	0.53	
2008	186	535	137	133	0.58	3.9
2009	186	512	143	118	0.52	3.4
2010	186	421	136	78[e]	0.32	3.0
2011	186	264	138	103	0.45	3.4
2012	186	298	158	86	0.39	3.4
2013	126	277	93[f]	96[f]	0.60[f]	3.7[f]
2014	126	305	102	95	0.54	3.7
2015	126	271	112	103	0.55	3.6
2016	126	304	111	102	0.58	3.8
2017	125	317	97	86[f]	0.55[f]	4.0[f]

[a] Estimated number who went hunting, not permit purchasers.
[b] Proportion of hunters harvesting ≥1 prairie-chicken.
[c] Mean on a scale of 1–5.
[d] A hunter survey was not conducted during 2007; results are from the Electronic Licensing System, which documented 150 permit purchasers.
[e] One hunter reported harvesting 10 prairie-chickens in 2010.
[f] Assumed that non-respondents were represented by respondents in the second mailing in 2013 and 2017.

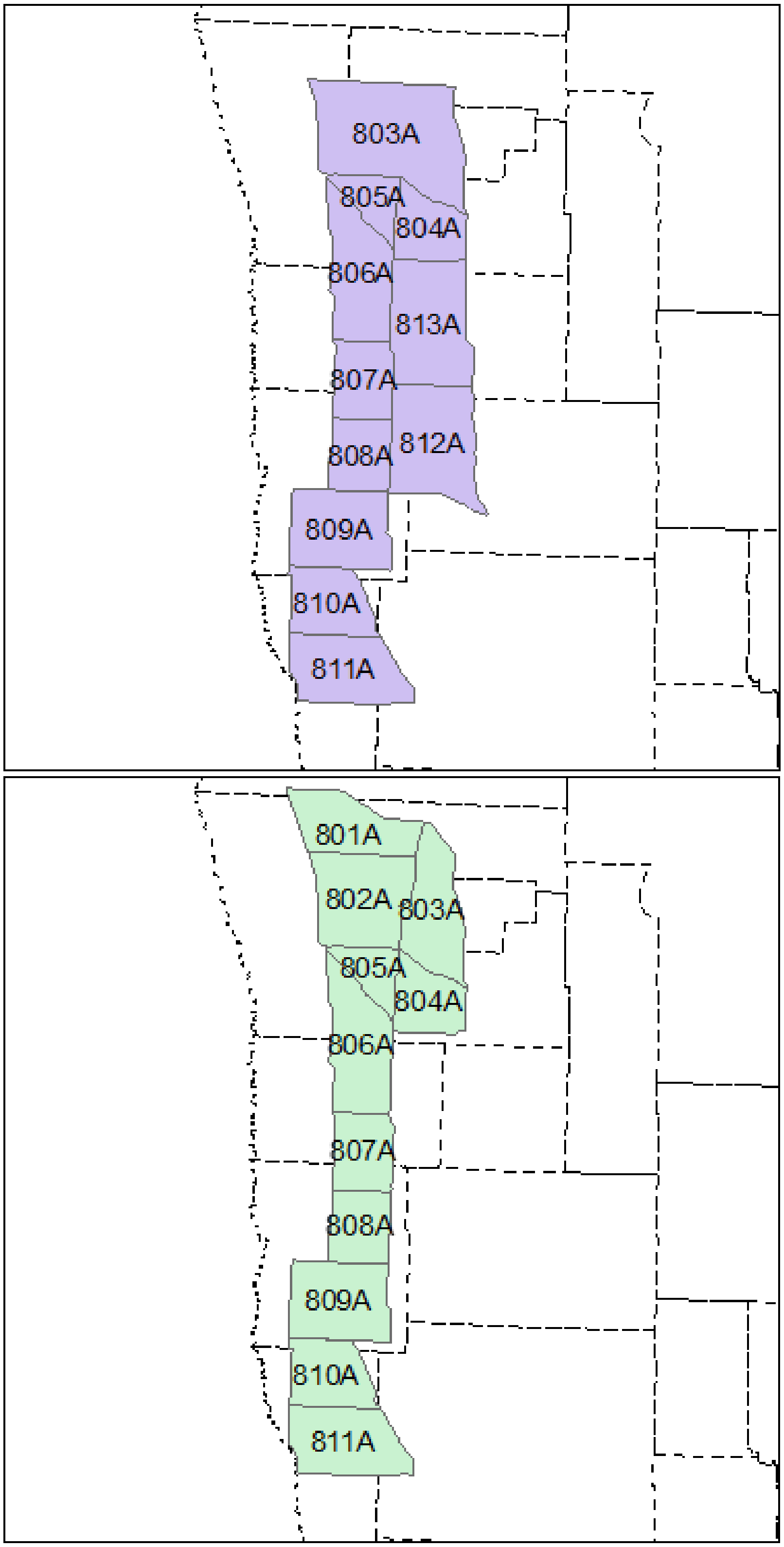

Figure 1. Prairie-chicken hunting permit area boundaries in northwestern Minnesota since 2013 (top) compared to during 2006–2012 (bottom). County boundaries are indicated by dashed lines. Permit areas 812A and 813A were added, 801A was eliminated, and 802A and portions of 803A were combined into a revised permit area 803A.

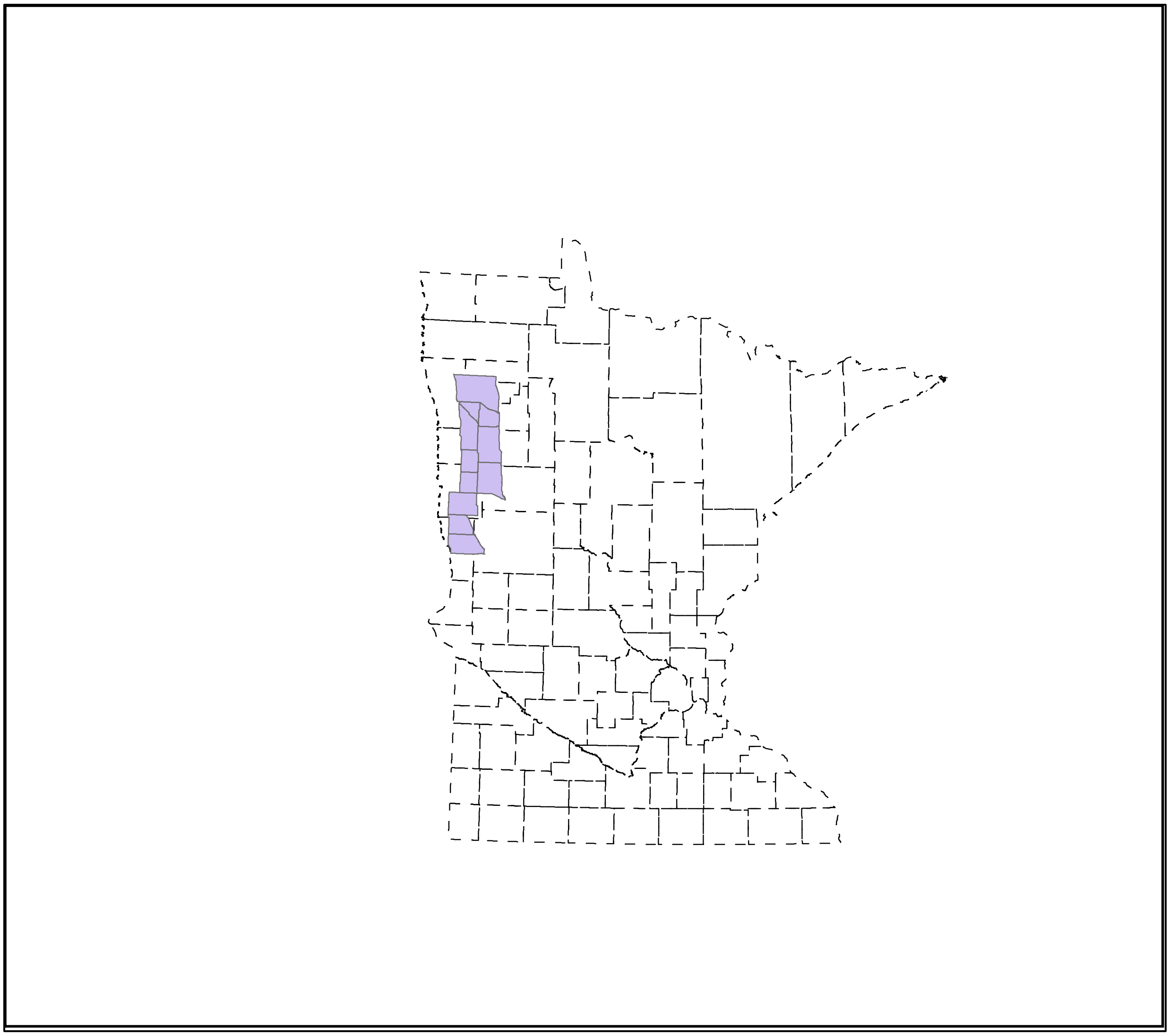

Figure 2. Northwestern location of prairie-chicken hunting permit areas within the state relative to county boundaries (dashed lines).

STATUS OF MINNESOTA BLACK BEARS, 2017

Dave Garshelis and Andy Tri, Forest Wildlife Research Group

INTRODUCTION

The Minnesota bear range has historically been divided into 11 bear management units (BMU). Each has a separate quota on hunting licenses, and hunters must enter hunters must enter a lottery (based on preference points) to obtain a license. Outside the primary bear range, where bear depredation to crops is a primary concern, license sales are unlimited (no-quota area), and hunters can purchase licenses right up to and through the season, over the counter. In all areas the season runs from September 1 through mid-October. About 80% of hunters use bait. This report summarizes status and trends in bear hunting and harvests.

METHODS

Successful hunters must register their bears, in person at designated registration stations or electronically by internet or phone. Stations are not staffed by DNR personnel. Harvest data are a simple tally of these registrations. Hunters also are required to submit a tooth from harvested bears, which is used to estimate age, and thus harvest age structure. Tooth envelopes must be acquired at registration stations.

RESULTS

Permits, licenses, harvest, and success rates

Permit applications for bear licenses exceeded 20,000 for the first time since 2002 (Table 1). However, 2,800 applicants, a record high number, applied for area 99, meaning that they only sought to raise their preference level for the permit system. Permit availability was 13% lower than 2016. The low permit availability has driven up sales of no-quota licenses, which were the highest on record in 2016 and nearly the same in 2017. Harvest was reduced 23% from 2016 because of the reduction in quota zone hunters and a slightly lower success rate of quota zone hunters (yet still the second-highest all-time success rate in the quota zone). Hunting success is inversely related to the number of hunters (Figure 1).

Quota zone permits and licenses

In 2016, Bear Management Unit (BMU, see Figure 2) 26 was divided into 27 and 28, and BMU 44 was split into 46 and 47 (BMUs 28 and 47 comprise the Leech Lake Reservation). The number of quota zone permits available in 2017 was reduced by 10–30% for all BMUs, except 22 and 41 (which remained the same, see Table 2). This was the 7th year of a system whereby licenses for the quota zone that were not purchased by permittees selected in the lottery could be purchased later as surplus. All surplus licenses (~400) were purchased (Table 3).

Quota zone applicants

Statewide, quota zone applications increased by 21% over the past 10 years, but much of that increase was for area 99 (preference level application). Among applications for specific BMUs, only BMU 45 showed a significant, steady increase, nearly tripling from 2008 to 2017. Applications for some BMUs showed a decline (Figure 3).

Quota zone lottery

The low quota zone permit availability over the past 5 years has made it more difficult to succeed in the lottery (Table 4). In 2012, before the large drop in permits (Table 2), all 3rd- year applicants (preference level 3) were drawn, and ~50% or more of 2nd-year applicants were drawn in all but two BMUs (44, 45). By 2017, with the exception of BMU 22 (wilderness area hunt), preference level 2 applicants were drawn only in two BMUs (13, 25; <20% drawn in both), and in four BMUs (28, 46, 47, 45), only some hunters with preference 4 were drawn (i.e., preference 5 was required to guarantee being drawn).

Harvest by BMU

In 2017, most BMUs had lower harvests than in 2016 (Table 5), although many were near the previous 5-year mean. The total quota zone harvest (1,547) and no-quota harvest (493) were both close to the respective 5-year means. The sex ratio of the harvest was more male-biased than normal (63%), although typical of the past 4 years (Table 1). Two BMUs had record-high percent males (69–70%). The highly skewed sex ratio may be indicative of increased hunter selection (with a lower hunter density due to reduced quotas) as well as sex-related differences in attraction to baits (given that the no-quota area had an even larger skew toward males: 68%). The only notable harvests were in BMU 10 (Figure 2) at the south-western fringe of the bear range (record high 18 bears), and the first-known bear legally harvested in southeastern Minnesota.

Harvest by quota vs no-quota zones

Permit availability continuously declined during the decade 2003–2013 (Table 1), and with that, total harvests declined and the percent of the harvest in the no-quota zone increased (Figure 4). The percent harvest in the no-quota zone has leveled off in recent years (~26%), with stabilization of the number of quota-zone permits available. However, the percent of bear hunters purchasing a no-quota license reached a new high of 50% in 2017.

Hunting success by BMU

Hunters in the quota zone had a record high (50%) success in 2016 (Table 6); this was true for most BMUs. Success rates were slightly lower, but still second-highest throughout the quota zone in 2017. BMU 45 had a record high success, and BMU 28 (split from BMU 26 in 2016) had the highest success of any BMU in any year (70%). Success rate was more normal in the no-quota zone — only one-third that of the quota zone in 2017. The distribution of hunters in the no-quota zone is gleaned from where they said they would hunt when they purchased their license: notably, a growing number (137 in 2017) indicated that they planned to hunt in the quota zone.

Harvest by date

During years of normal fall food abundance, about 70% of the harvest occurs during the 1st week of the bear season, and ~83% occurs by the end of the 2nd week (Table 7). The distribution of the harvest by date followed this normal pattern in both 2016 and 2017, which was very unlike the delayed harvest pattern in 2015.

Predictions of harvest

The 2017 statewide harvest was close to what was expected, based on regression of harvest as a function of hunter numbers and the fall food productivity index (Figure 5). This regression is particularly strong (and has accurately predicted previous harvests) when only the past 15 years are considered. However, for the quota zone, the actual harvest in 2017 was higher than predicted by this regression.

Harvest sex ratios

Sex ratios of harvested bears reflect both the sex ratio of the living population (which varies with harvest pressure) as well as the relative vulnerability of the sexes to hunters (which varies with natural food conditions and hunter selectivity). In general, harvest sex ratios favoring males provide more resilience to the population. Harvest sex ratios within BMUs varied considerably year-to-year over the past 2 decades (Figure 6).

Only two BMUs have shown a generally increasing trend in percent males that has continued through 2017 (BMUs 25, 31; both record high in 2017); however, statewide there has been a clear shift toward more males in the harvest (the last 5 years all >60% males; see Figure 8).

Harvest ages

Statewide, the median age of harvested females increased for the third year in a row (exceeding 3 years old for the first time since 2011, see Figure 7). Accordingly, the proportion of the female harvest composed of 1–2 year-olds declined and 4–10 year-olds increased. The median age of harvested males (slightly over 2 years old) has been relatively stable, but creeping upward (Figure 8). On a BMU-basis, variability in median ages has been too extreme to discern a trend over the past 20 years (only BMU 11 shows a continuing declining trend, see Figure 9).

Submission of bear teeth for aging

Ages of harvested bears are used as the principal means of monitoring population trends. Although hunters are required to submit a tooth from their harvested bear, historically >25% did not comply. Reminder notices were sent to non-compliant hunters each year since 2014, which spurred a higher initial compliance the following years (>80%). However, ~90% compliance was achieved only through a reminder mailing (Figure 10). Since 2013, hunters could register by phone or internet, and pick up a tooth submission envelope later: tooth submission compliance by these hunters has been significantly less than for hunters who registered their bear in person and picked up a tooth envelope at that time. No-quota zone hunters have the poorest rate of tooth submission (Figure 11).

Trends in harvest rates

The sex ratio of harvested bears varies by age in accordance with the relative vulnerability of the sexes. Male bears are more vulnerable to harvest than females, so males always predominate among harvested 1-year-olds (67–75%). Males also predominate, but less strongly among 2 and 3-year-old harvested bears. However, older-aged harvested bears (≥7 years) are nearly always dominated by females, because, although old females continue to be less vulnerable, there are far more of them than old males in the living population. The age at which the line fitted to these proportions crosses the 50:50 sex ratio is approximately the inverse of the harvest rate. Segregating the data into time blocks showed harvest rates increasing from 1980–1999, then declining with reductions in hunter numbers (Figure 1). Harvest rates since 2014 have been significantly less than what they were in the early 1980s, when the bear population was increasing (Figure 12).

Trends in harvest rates

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Note: All data contained herein are subject to revision, due to updated information, improved analysis techniques, and/or regrouping of data for analysis.

Table 1. Bear permits, licenses, hunters, harvests, and success rates, 1997–2017.

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Permit applications	30245	29384	29275	26824	21886	16431	16466	16153	15725	16345	17362[a]	17571[a]	18647[a]	19184[a]	18103[a]	18107[a]	18885[a]	18422[a]	19958[a]	21034[a]
Permits available	18210	20840	20710	20710	20610	20110	16450	15950	14850	13200	11850	10000	9500	7050[b]	6000	3750	3750	3700	3850	3350
Licenses purchased (total)	16737	18355	19304	16510	14639	14409	13669	13199	13164	11936	10404	9892	9689	9555	8986	6589	6620	6962	7177	6655
Quota zone [c]	14941	16563	17021	13632	12350	9833	10063	9340	9169	8905	7842	7342	7086	5684	4951	3188	3177	3257	3420	2954
Quota surplus/military [c]				235	209	2554	1356	1591	1561	526	233	77	83	1385	1070	578	583	446	441	401
No-quota zone [c]	1796	1792	2283	2643	2080	2022	2238	2268	2434	2505	2329	2473	2520	2486	2965	2823	2860	3259	3316 [h]	3300 [h]
% Licenses bought																				
Of permits available [d]	82.0	79.5	82.2	67.0	60.9	61.6	69.4	68.5	72.3	71.4	67.7	73.4	74.6	100	100	100	100	100	100	100
Of permits issued [d]	84.4	87.2	83.9	69.8	66.3	65.7	68.3	67.1	68.9	70.0	67.2	73.8	74.5	80.7	82.7	85.0	84.7	87.9	88.7	88.2
Estimated no. hunters [e]	14500	15900	16800	15500	13800	13600	12900	12500	12500	11300	9900	9400	9200	9200	8600	6300	6300	6700	6900	6400
Harvest	4110	3620	3898	4936	1915	3598	3391	3340	3290	3172	2135	2801	2699	2131	2604	1866	1627	1971	2641	2040
Harvest sex ratio (%M) [f]	55	53	58	56	61	58	57	59	58	57	62	59	59	61	59	62	62	66[i]	61	63
Success rate (%)																				
Total harvest/hunters [g]	28	23	23	29	14	26	26	26	26	28	21	30	29	23	30	30	26	30	39	32
Quota harvest/licenses	25	20	20	28	14	25	26	25	25	28	21	30	30	24	33	37	33	39 [j]	50 [j]	46 [j]

[a] Includes area 99, a designation to increase preference but not to obtain a license (2008 = 528, 2009 = 835; 2010 = 1194; 2011 = 1626; 2012 = 1907; 2013 = 2129; 2014=2377; 2015=2455; 2016=2641; 2017=2803 (record high); additionally, in 2017, area 88 nuisance-only bear license applications counted in this total [n=3]).

[b] Permits reduced because of a new procedure in 2011 that ensures that all available licenses are purchased (see Table 2).

[c] Quota zone established in 1982. No-quota zone established in 1987. Surplus licenses from undersubscribed quota areas sold beginning in 2000; originally open only to unsuccessful permit applicants, but beginning in 2003, open to all. In 2011, surplus licenses offered for all lottery licenses not purchased by August 1. Free licenses for 10 and 11 year-olds were available beginning 2009.

[d] Quota licenses bought (including surplus)/permits available, or licenses bought (prior to surplus)/permits issued. Beginning in 2008, some permits were issued for area 99; these are no-hunt permits, just to increase preference, and are not included in this calculation. In 2011–17, all unpurchased licenses were put up for sale and were bought.

[e] Number of licensed hunters x percent of license-holders hunting. Percent hunting is based on data from bear hunter surveys conducted during 1981–91, 1998 (86.8%), 2001(93.9%) and 2009 (95.3%). Beginning in 2011 all unpurchased quota licenses were sold as “surplus” in August, and this process is quick and competitive; thus, for 2011–17 all Surplus and Military license-holders were considered to have hunted.

[f] Sex ratio as reported by hunters; hunters classify about 10% of female bears as males, so the actual harvest has a lower %M than shown here. In good food years, the harvest is more male-biased.

[g] Success rates in 2001–2012 were calculated as number of successful hunters/total hunters, rather than bears killed/total hunters, because no-quota hunters could take 2 bears. After 2012, hunters could take 2 bears only if they bought 2 licenses (1 quota + 1 no-quota). In both 2016 and 2017, 5 hunters legally killed 2 bears.

[h] Record high number of no-quota zone licenses purchased in 2016; record high % of licenses in no-quota zone in 2017 (nearly 50%; see Fig. 4).

[i] Record high % males in statewide harvest.

[j] 2015: highest success rate in quota zone since very poor food year of 1995; 2016: record high success rate; 2017: second-highest success rate.

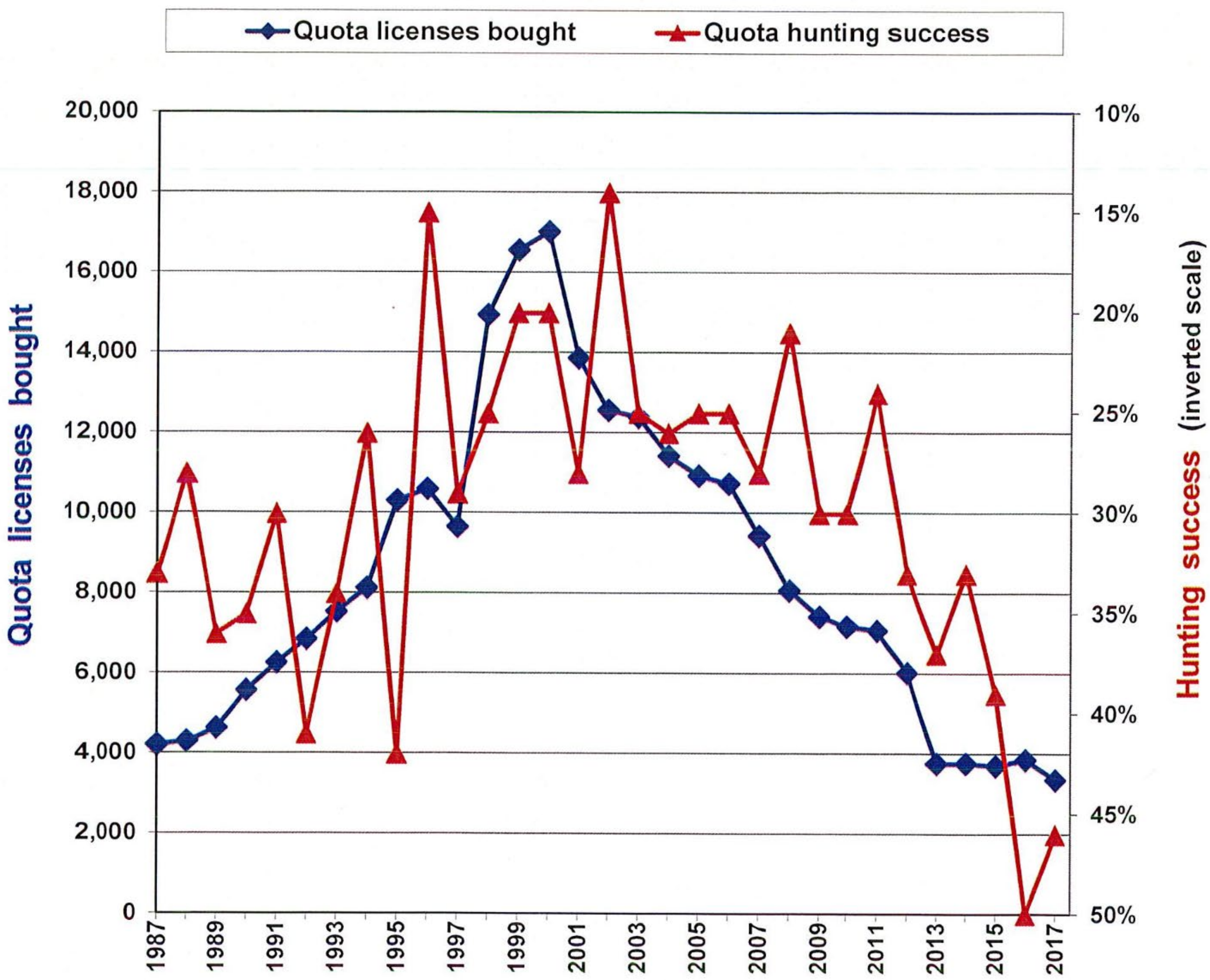


Figure 1. Relationship between licenses sold and hunting success (*note inverted scale*) in quota zone, 1987–2017 (no-quota zone first partitioned out in 1987). Number of licenses explains 48% of variation in hunting success during this period. Large variation in hunting success is also attributable to food conditions.

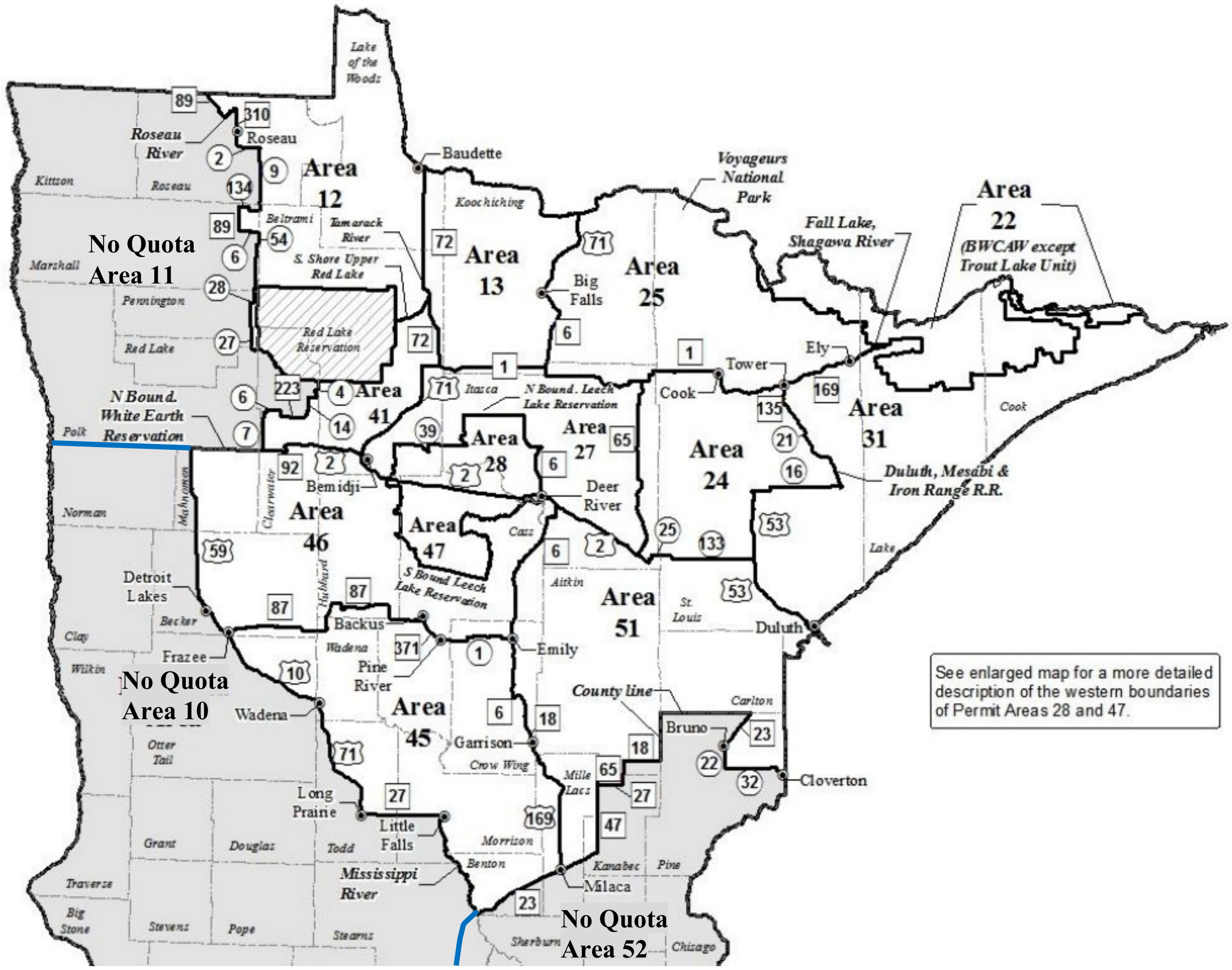


Figure 2. Bear management units (BMUs) within quota (white) and no-quota (gray) zones. Hunters in the quota zone are restricted to a single BMU. In 2016, BMU 26 was divided into 27 and 28, and BMU 44 was split into 46 and 47 (BMUs 28 and 47 comprise the Leech Lake Reservation). No-quota hunters can hunt anywhere within the gray-colored zone, including the southeast corner of Minnesota (not shown; designated area 60).

Table 2. Number of bear hunting quota area permits available, 2012–2017. Highlighted values show a change from the previous year. BMUs 26 and 44 were divided into 27/28 and 46/47, respectively, in 2016.

BMU		2012	2013	2014	2015	2016 Before BMU split [a]	2016 After BMU split	2017
12		300	200	200	150	150	150	125
13		400	250	250	250	250	250	225
22		100	50	50	50	50	50	50
24		300	200	200	200	200	200	175
25		850	500	500	500	500	500	400
26		550	350	350	350	325		
	27						250	225
	28						75	60
31		900	550	550	550	550	550	500
41		250	150	150	150	125	125	125
44		700	450	450	450	450		
	46						400	350
	47						50	40
45		200	150	150	150	250	250	175
51		1450	900	900	900	1000	1000	900
Total		**1650**	**3750**	**3750**	**3700**	3850	**3850**	**1465**

[a] In 2016, the Leech Lake Reservation was split from BMUs 26 and 44 to form BMUs 28 (north) and 47 (south), with the remaining area of BMU 26 renamed BMU 28 and remaining area of BMU 44 renamed BMU 46. The column shows permit allocation before the split in order to compare with previous years.

Table 3. Number of quota BMU permit applicants (Apps), licenses bought (after permits drawn) and surplus licenses bought, 2012–2017[a]. Shaded values indicate undersubscribed (applications less than permits available).

BMU	2012 Apps	2012 Bought license	2012 Surplus bought	2013 Apps	2013 Bought license	2013 Surplus bought	2014 Apps	2014 Bought license	2014 Surplus bought	2015 Apps	2015 Bought license	2015 Surplus bought	2016 Apps	2016 Bought license	2016 Surplus bought	2017 Apps	2017 Bought license	2017 Surplus bought
12	813	244	60	707	160	44	661	164	36	612	130	20	624	133	17	774	113	12
13	719	325	76	664	213	37	703	218	32	692	210	40	716	221	29	772	200	25
22	83	56	43	55	36	14	65	33	17	48	36	9[b]	52	37	13	47	34	16
24	888	253	47	763	170	30	875	174	26	771	171	29	884	173	27	945	158	17
25	1625	713	137	1575	432	69	1533	424	76	1396	433	67	1443	440	60	1651	354	46
26	1666	458	92	1695	303	47	1696	298	52	1650	309	42						
27													1224	219	31	1297	197	28
28													325	72	3	330	52	8
31	2406	758	146	2261	478	72	2257	468	82	2021	488	62	2180	489	62	2076	441	59
41	592	208	42	575	135	15	561	129	21	570	129	21	618	114	11	614	109	16
44	2619	612	88	2682	386	65	2751	393	57	2626	402	48						
46													2690	370	30	2774	319	31
47													194	45	5	214	33	7
45	1135	170	30	1205	141	9	1403	127	23	1703	139	11	2046	227	23	2323	161	14
51	3650	1154	296	3796	734	166	4003	748	152	3878	810	90	4321	880	121	4411	783	117
Total	4785	1324	326	15978	3188	568	5406	875	175	5581	949	101	17317	3420	432	9722	1296	169

[a] Beginning in 2011, all licenses not purchased by permittees were sold as “surplus”. In all cases but one (see footnote b), all of the surplus licenses were purchased. Surplus = Permits available (Table 2) minus Bought license (±4 to account for groups applying together).

[b] Even after purchase of surplus licenses, this BMU remained undersubscribed.

[c] Beginning in 2008, applicants could apply for area 99 in order to increase future preference, but not buy a license; these are not included in the total number of applications (unlike Table 1, where they are included).

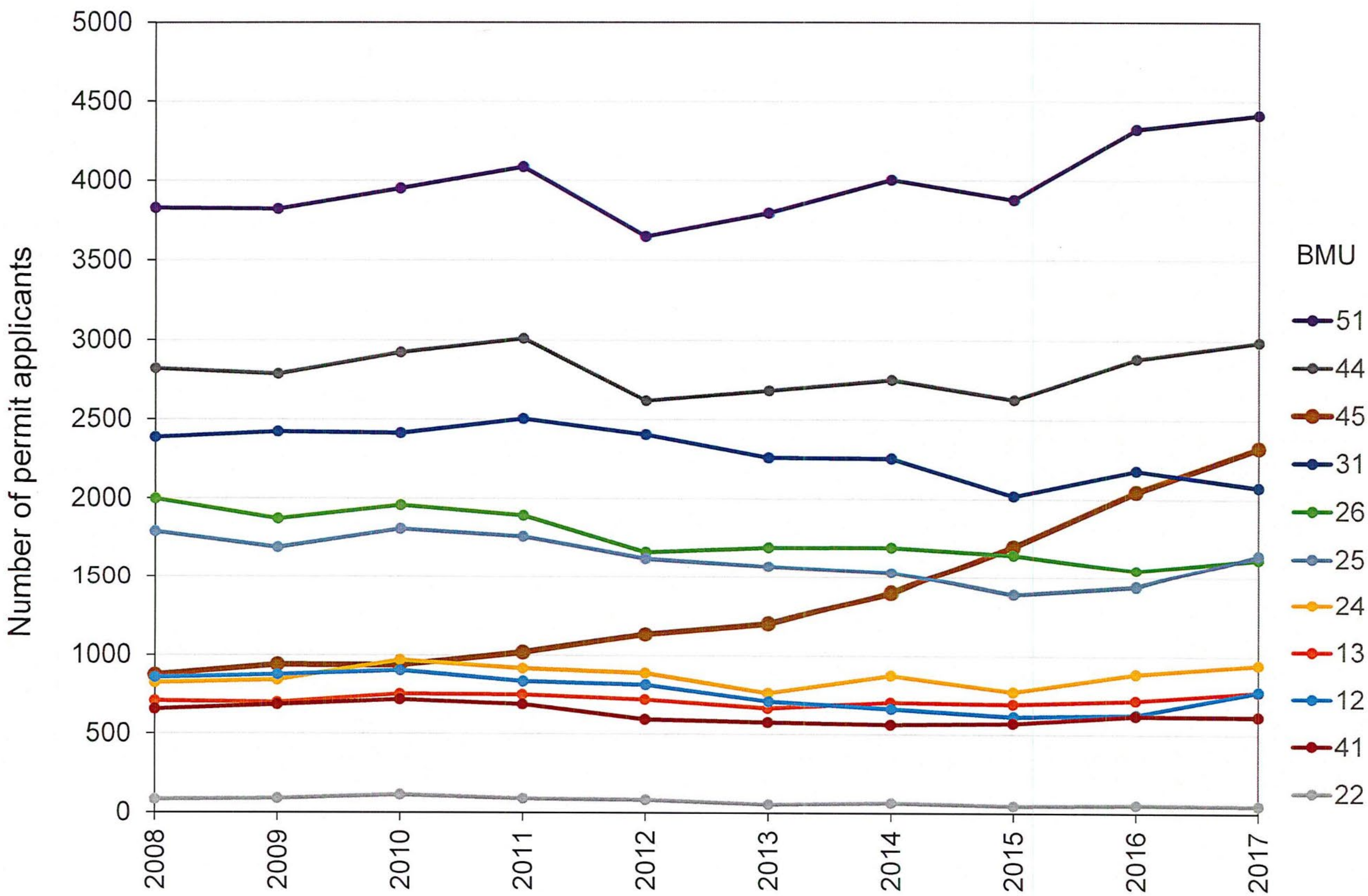


Figure 3. Trends in number of applicants for quota zone permits by BMU over past 10 years, 2008–2017. For 2016 and 2017, BMUs 27 and 28 were grouped into old BMU 26 and BMUs 46 and 47 were grouped into old BMU 44. BMU 45 is highlighted because applications there nearly tripled over this time period.

Table 4. Percent of quota BMU lottery applicants with preference levels 1 (1st-year applicants), 2, 3, and 4 who were drawn for a bear permit during 2012–2017. Blank spaces indicate 100% of applicants were drawn. All preference level 2 applicants were drawn, except where 0 preference level 1 applicants were drawn. Likewise, all preference level 3 applicants were drawn, except where 0 preference level 2 applicants were drawn[a].

	2012		2013			2014			2015				2016				2017			
BMU	Pref 1	Pref 2	Pref 1	Pref 2	Pref 3	Pref 1	Pref 2	Pref 3	Pref 1	Pref 2	Pref 3	Pref 4	Pref 1	Pref 2	Pref 3	Pref 4	Pref 1	Pref 2	Pref 3	Pref 4
12	0	80	0	46		0	40		0	17			0	0	98		0	0	57	
13	33		4			0	72		0	56			0	38			0	16		
22	100		89			72			100				98				100			
24	0	75	0	41		0	13		0	2			0	0	86		0	0	57	
25	28		0	81		0	57		0	44			0	42			0	6		
26[b]	0	49	0	7		0	0	80	0	0	51									
27													0	0	30		0	0	2	
28													0	0	0	99	0	0	0	76
31	0	84	0	45		0	15		0	0	87		0	0	75		0	0	67	
41	0	86	0	43		0	19		0	0	99		0	0	77		0	0	56	
44[b]	0	28	0	0	68	0	0	41	0	0	18									
46													0	0	0	85	0	0	0	51
47													0	0	10		0	0	0	49
45	0	29	0	0	75	0	0	30	0	0	0	81	0	0	0	63	0	0	0	16
51	1		0	53		0	22		0	0	89		0	0	72		0	0	54	

[a] As an example, in 2017: BMU 12: 0% of preference level 1 and 2 applicants were drawn, 57% of preference level 3, and 100% of preference level 4 and above were drawn for a permit; BMU 22: all preference level 1 applicants were selected; BMU 45: no preference level 1–3 applicants were drawn, 16% of hunters with preference 4 were drawn, and 100% of hunters with preference level 5 and above were drawn.

[b] BMU 26 was split into 27/28 and BMU 44 was split into 46/47 in 2016.

Table 5. Minnesota bear harvest tally for 2017 by Bear Management Unit (BMU)[a] and sex[b] compared to harvests during 2012–2016 and record high and low harvests (since establishment of each BMU).

BMU	2017 M	2017 (%M)	2017 F	2017 Total	2016	2015	2014	2013	2012	5-year mean	Record low harvest (yr)	Record high harvest (yr)
Quota												
12	36	(67)	18	54	78	60	38[d]	62	82	64	38 (14)	263 (01)
13	67	(67)	33	100	147	72[e]	91	95	112	103	71 (88)	258 (95)
22	4	(50)	4	8	5	7	5	9	8	7	3 (03)	41 (89)
24	45	(56)	36	81	96	97	50[f]	76	108	85	50 (14)	288 (95)
25	146	(69)[p]	66	212	287[p]	227	168[g]	197	254	227	149 (96)	584 (01)
26	[96]	[59]	[66]	[162]	[171][p]	121	117[h]	121	238	154	117 (14)	513 (95)
27	72	(60)	48	120	131							
28	24	(57)	18	42	40							
31	183	(70)[p]	79	262	312	307	221	197	363	280	157 (88)	697 (01)
41	34	(56)	27	61	57	35[i]	36	40	70	48	35 (15)	201 (01)
44	[99]	[63]	[59]	[158]	[215]	158	170	181	188	182	130 (11)	643 (95)
46	91	(65)	50	141	190							
47	8	(47)	9	17	25							
45	47	(61)	30	77	102[m]	55	54	48	67	65	32 (11)	178 (01)
51	191	(51)	181	372	463	302	291	349	471	375	247 (91)	895 (01)
Total	948	(61)	599	607	1933	357	345[j]	397	1961	1590	1192 (88)	4288 (01)
No-Quota[b]												
11	127	(71)	52	179	291	195	77[k]	136	224	185	38 (87)	351 (05)
10	14	(78)	4	18[n]	15	11	8	9	14	11		15 (16)
52	195	(66)	100	295	402	324	301	346	405	356	105 (02)	405 (12)
60	1[c]		0	1	0	0	0	0	0			
Total	337	(68)	156	296	708[n]	530	386	491	643	552	198 (87)	708 (16)
State	1285	(63)	755	**2040**	**2641**	1971	1627[j]	1866	2604	2142		4956 (95)

[a] Some tooth envelopes were received from hunters who did not register their bear. These were added to the harvest tally:

2012:7; 2013:6; 2014:3; 2015:6; 2016:7; 2017:4.

Some hunters with no-quota licenses hunted in the quota zone, and their kills were assigned to the BMU where they apparently hunted:

2012:8; 2013:11; 2014:4; 2015:12; 2016:9; 2017:2

Some quota area hunters also apparently hunted in the wrong BMU, based on the block where they said they killed a bear, but these were recorded in the BMU where they were assigned (presuming most were misreported kill locations).

[b] Sex recorded on tooth envelopes may differ from the registered sex. Sex shown on table is the registered sex.

[c] BMU 60 designates SE Minnesota, which is within No-quota zone. This is the first hunter-harvested bear in this area.

Notable harvests:

[d] Record low harvest since this area was established in 1987.

[e] Lowest harvest since 1988.

[f] Record low harvest since this area was established in 1989.

[g] Lowest harvest since 1996.

[h] Record low harvest since this area was established in 1991.

[i] Record low harvest since this area was established in 1990.

[j] Lowest harvest since 1988 (quota—no-quota split in 1987).

[k] Lowest harvest since 1999.

[m] Highest harvest since 2007.

[n] Record high harvest.

[p] Record high % males.

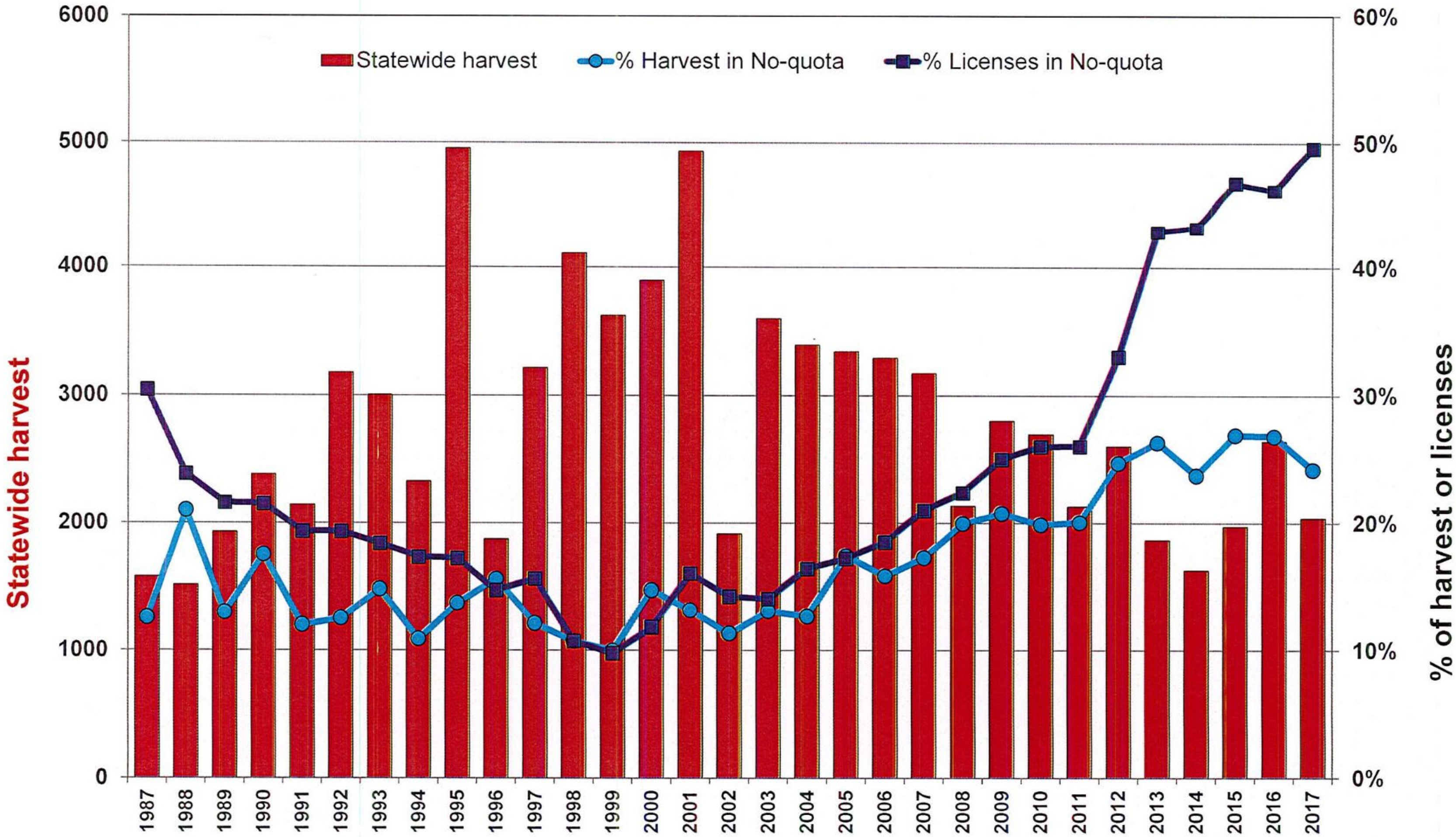


Figure 4. Trends in statewide bear harvest and proportions of harvest and licenses in the no-quota zones, 1987–2017.

Table 6. Bear hunting success (%) by BMU, measured as the registered harvest divided by the number of licenses sold[a], 2012–2017

BMU	Max success (yr) prior to 2016	Mean success 2012–2016	2017	2016	2015	2014	2013	2012
12	49 (95)	34	43	52[b]	40	19[e]	30	27
13	59 (95)	38	44[c]	59[b]	29	36	38	28
22	21 (92)	12	16	10	13	10	18[c]	8
24	45 (92)	39	46[c]	48[b]	48[b]	25	38	36
25	47 (92)	41	53[c]	57[b]	45	34	39	30
26	59 (95)	39	57[c]	52	34	33	34	43
27			53	52				
28			70[d]	53				
31	55 (92)	46	52	56[b]	56[b]	40	36	40
141	50 (95)	29	49[c]	46	23	24	26	28
44	43 (95)	37	41	48[b]	35	38	40	27
46			40	47				
47			43	50				
45	36 (14,15)	35	44[b]	40[c]	36	36	32	33
51	39 (13)	36	41[c]	46[b]	33	32	39	32
Quota	42 (95)	38	46[c]	50[b]	39	33	37	33
11[f]		18	17	28	20	9	15	
10[f]		9	8	9	7	7	12	
52[f]		17	14	19	15	16	19	
No Quota	32 (95)	18	15	21	16	13	17	20
Statewide	40 (95)	29	31	37[c]	28	25	28	28

a Registered harvest/licenses instead of harvest/hunters because BMU-year-specific estimates for the proportion of license-holders that hunted are unreliable. Statewide estimates of harvest/hunters are presented in Table 1.

b Record high (or tied record high) success.

c Second highest success.

d Highest success ever for any BMU.

e Tied record lowest success.

f Since 2013, an attempt was made to differentiate the number of no-quota (NQ) hunters by BMU in order to estimate success rates. When no-quota hunters bought licenses, they recorded the deer block where they anticipated hunting. A significant number chose blocks in the quota zone; those who did not harvest a bear in the quota zone were divided up into NQ-BMUs in proportion to those who chose blocks in or adjacent to NQ-BMUs. A few chose BMU 60 (SE Minnesota); the first bear was harvested there in 2017.

Table shows % indicating where they planned to hunt (number of hunters in parentheses for BMU 60 and Quota zone):

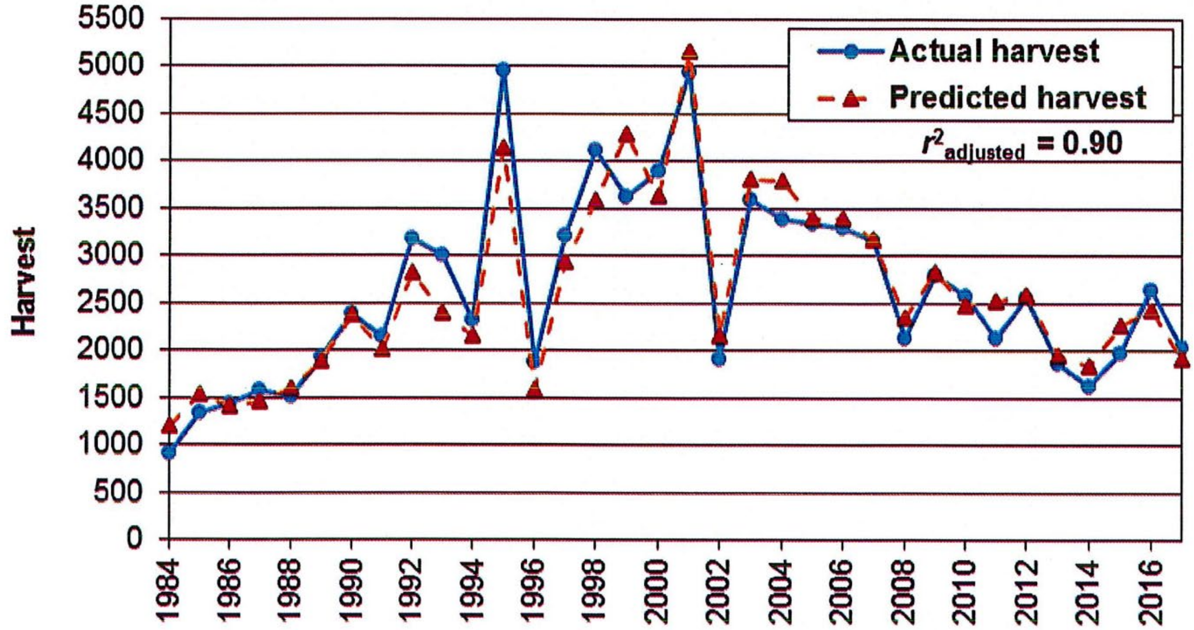
BMU	2017	2016	2015	2014	2013
11	29.8	30.3	29.3	28.5	30.0
10	6.6	4.9	4.4	4.1	2.6
52	59.2	61.2	63.9	64.7	62.6
60 (n)	0.1 (4)	0.4 (12)	0.2 (8)	0.6 (17)	0.4 (10)
Quota zone (n)	4.2 (137)	3.2 (105)	3.1 (101)	2.1 (60)	4.5 (127)

Table 7. Cumulative bear harvest (% of total harvest) by date, 1997–2017.

Year	Day of week for opener	Aug 22/23 – Aug 31	Sep 1 – Sep 7	Sep 1 – Sep 14	Sep 1 – Sep 30
1997	Mon		76	88	97
1998	Tue		76	87	96
1999	Wed		69	81	95
2000	Wed	57	72	82	96
2001	Wed	67	82	88	98
2002	Sun		57[a]	69[a]	90
2003	Mon		72	84	96
2004	Wed		68	82	95
2005	Thu		72	81	94
2006	Fri		69	83	96
2007	Sat		69	82	96
2008	Mon		58[a]	71[a]	92
2009	Tue		74	86	96
2010	Wed		69	84	96
2011	Thu		65	78	93
2012	Sat		68	83	96
2013	Sun		61	76	94
2014	Mon		60	75	92
2015	Tue		58[b]	75	91
2016	Thu		68	83	95
2017	Fri		69	83	93

[a] The low proportion of total harvest taken during the opening week (<60%) reflects a high abundance of natural foods.

[b] The slow start the first week was likely due to especially warm weather.



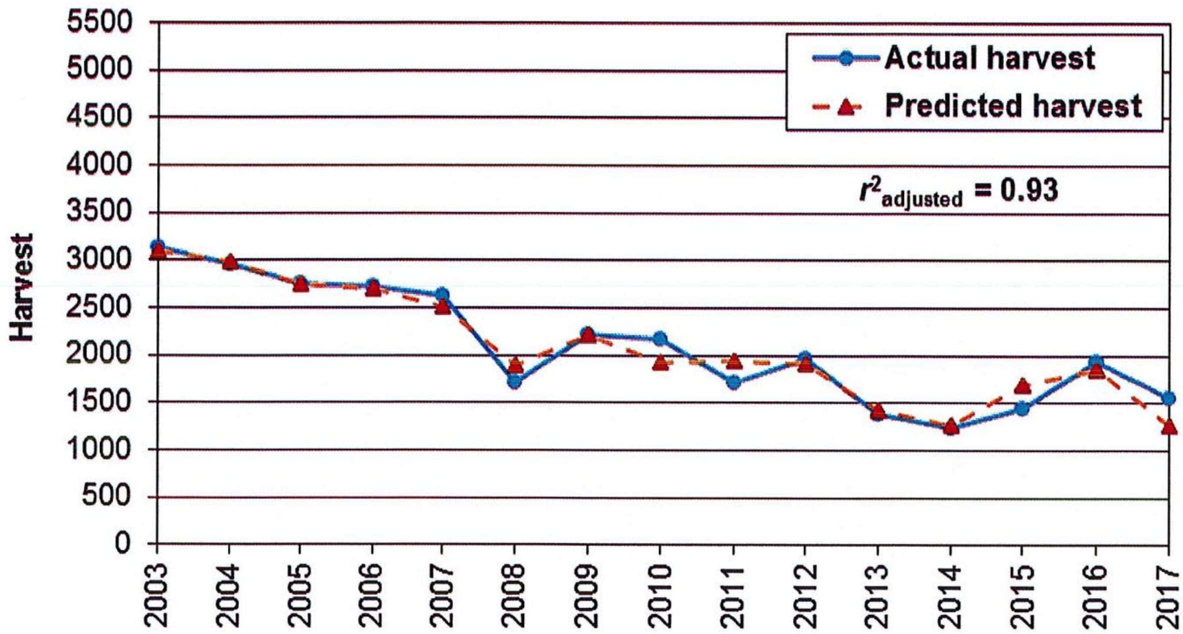


Figure 5. Number of bears harvested vs. number predicted to be harvested based on number of hunters and fall food production — top panel: statewide 1984–2017; bottom panel: quota zone only, most recent 15 years. Regression for the full dataset included an interaction term between food and hunters to better predict the drastic changes in harvest when fall foods were extremely high or low.

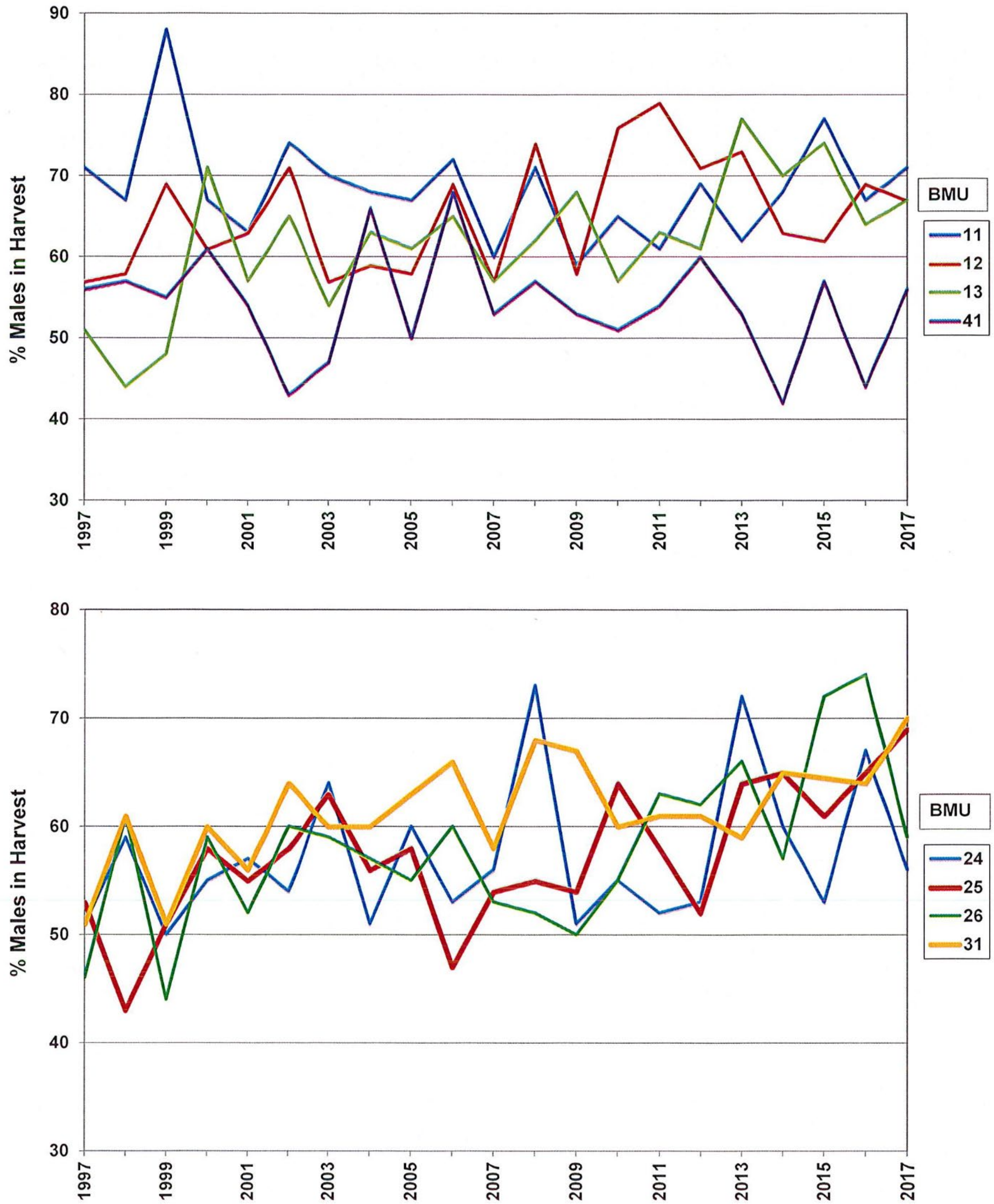


Figure 6. Sex ratios of harvested bears by bmu, 1997–2017. Thick lines show increasing trends continuing through 2017.

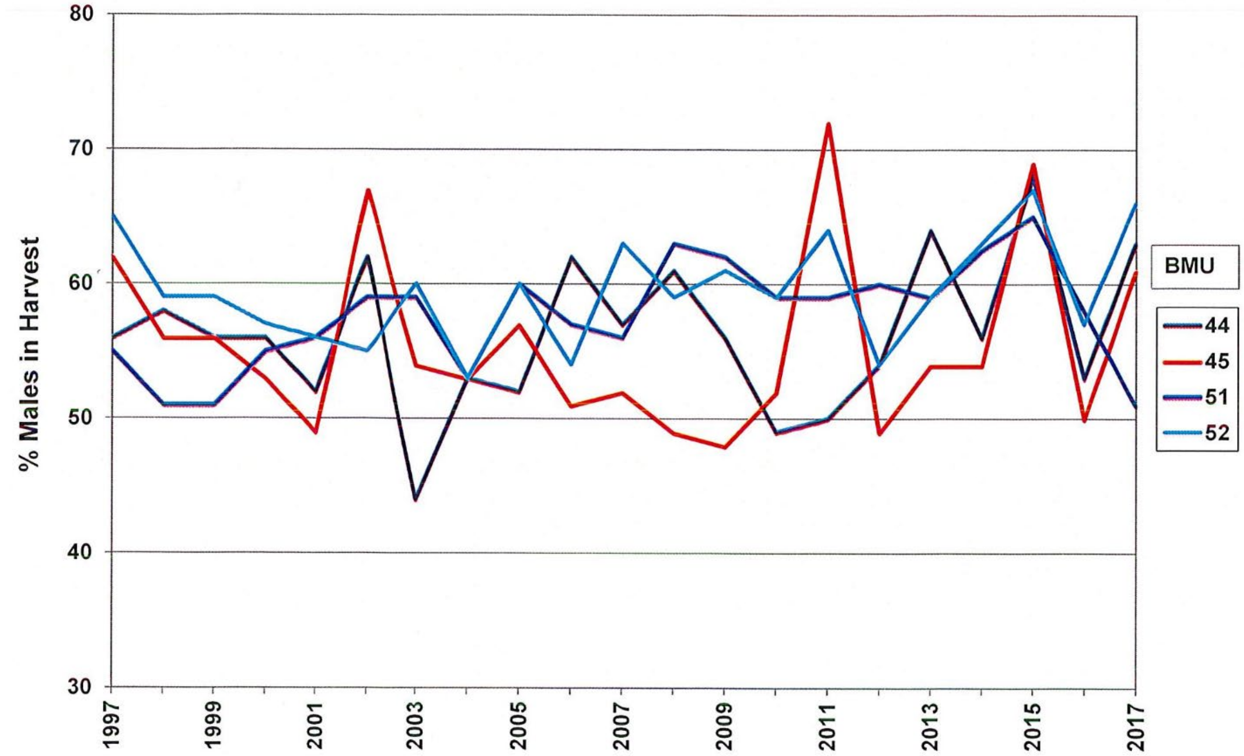
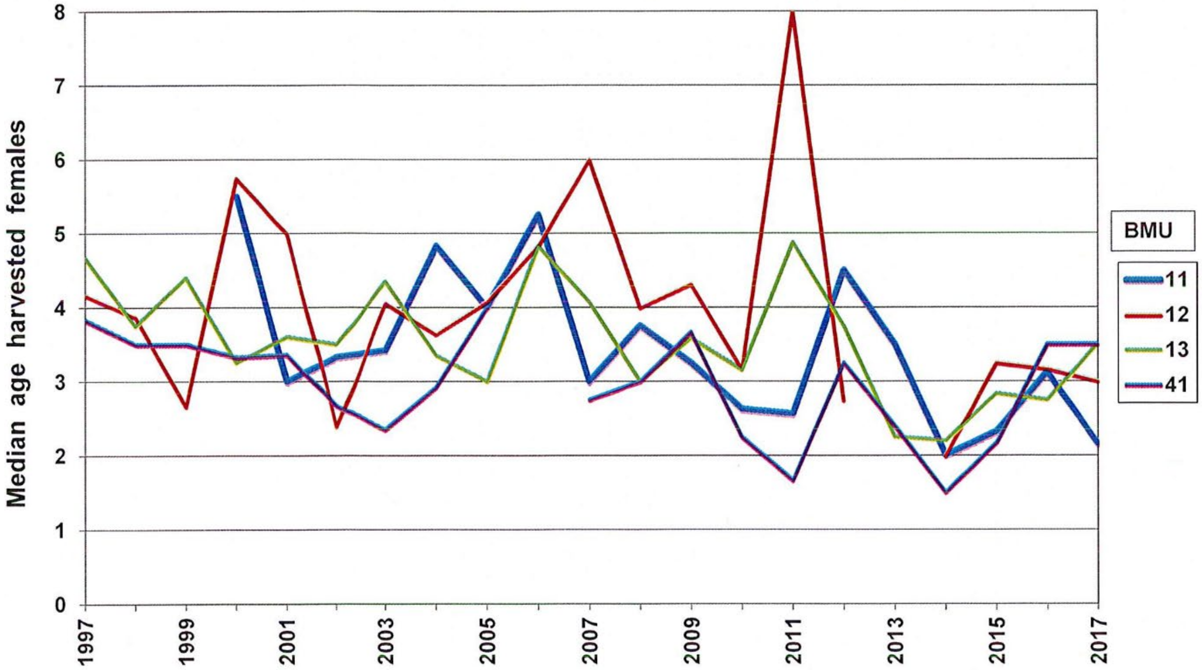


Figure 6 (continued)



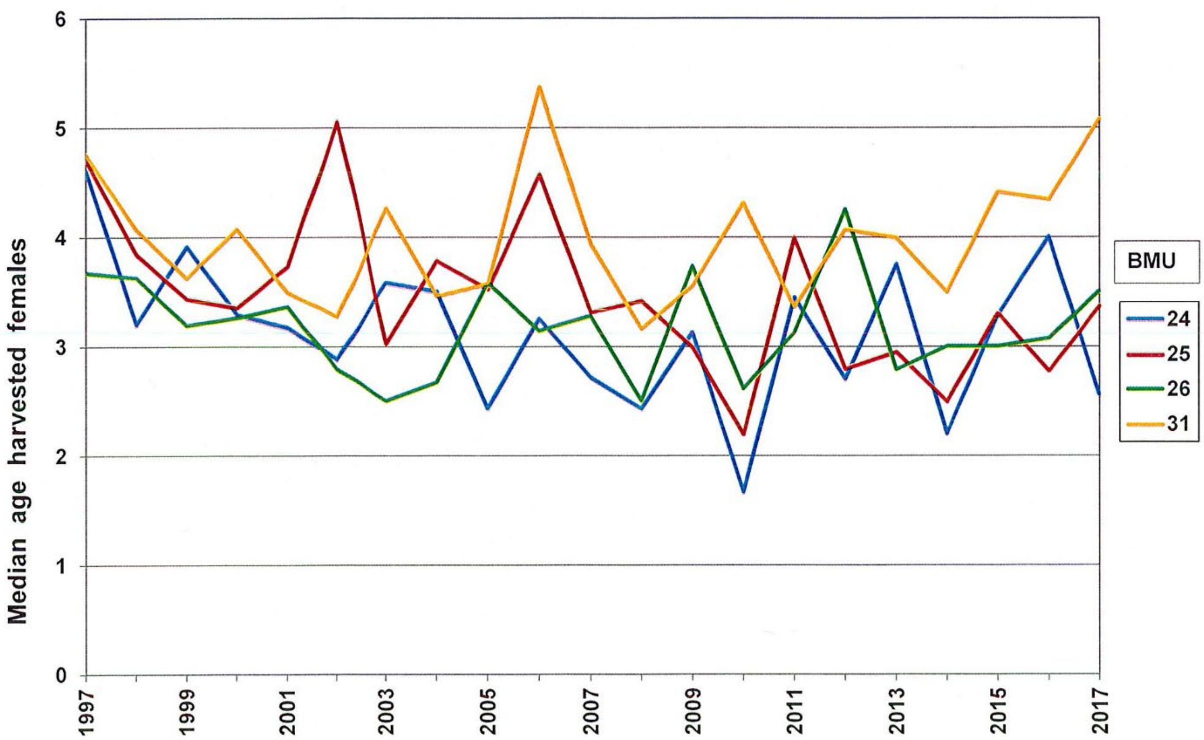


Figure 7. Median ages of harvested female bears by BMU, 1997–2017.

Thick lines show decreasing trends continuing through 2017. Breaks in line occur when sample sizes were too small to calculate a meaningful median.

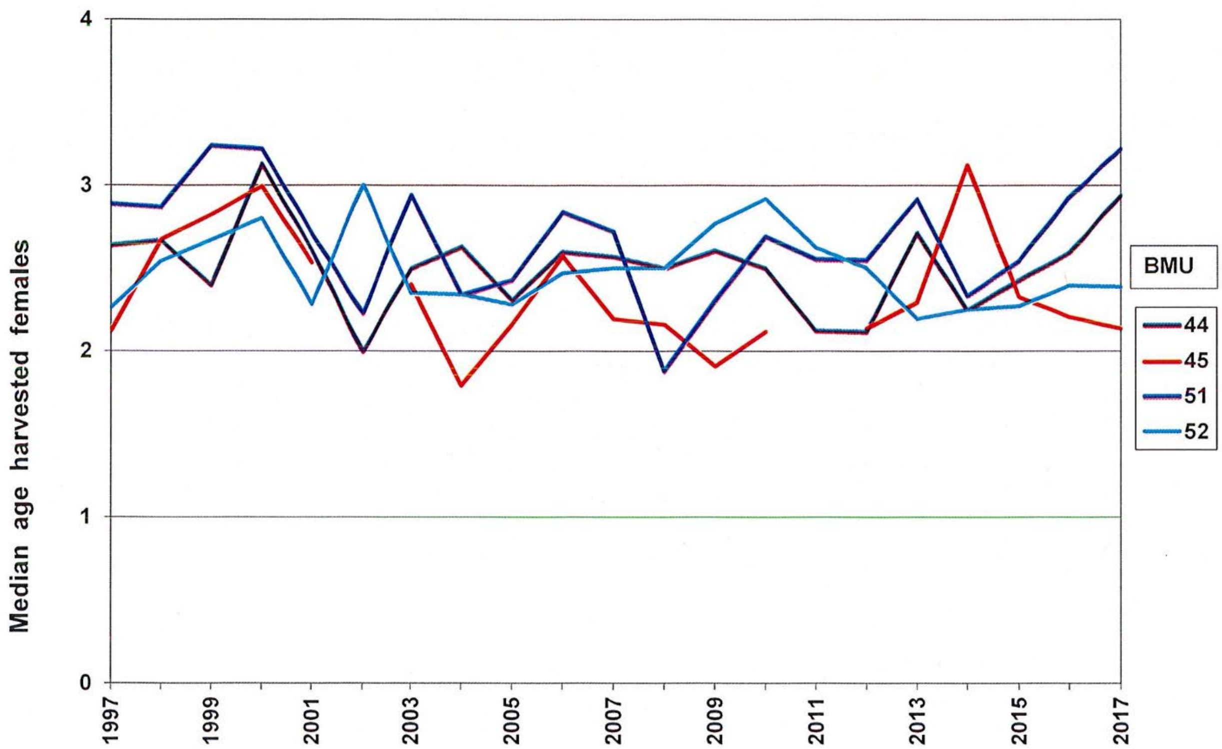


Figure 7. (continued)

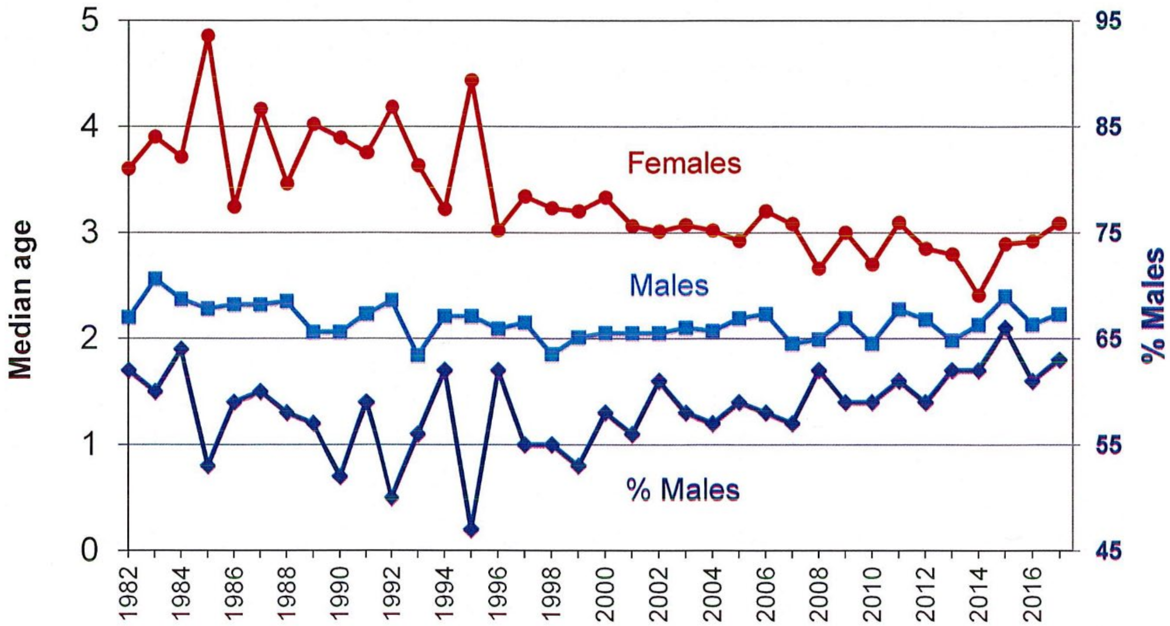


Figure 8. Statewide median ages (years) and sex ratio of harvested bears, 1982–2017.

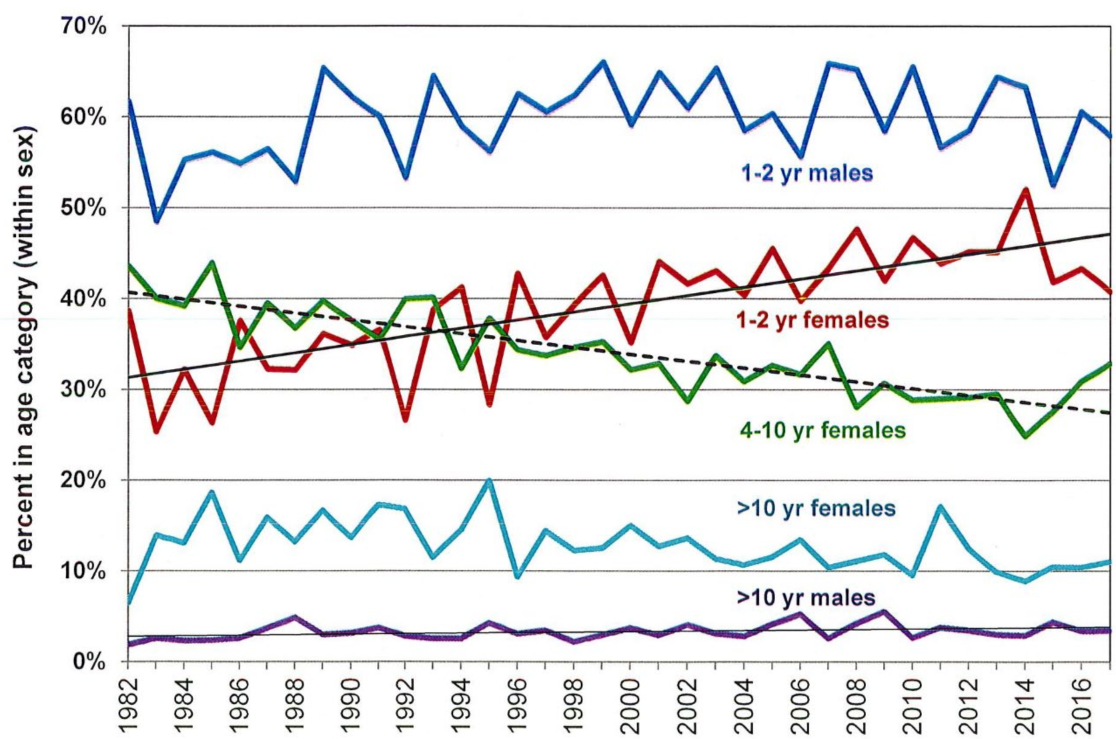


Figure 9. Statewide harvest structure: proportion of each sex in age category, 1982–2017. Trend lines are significant, but the last few years show a different trend.

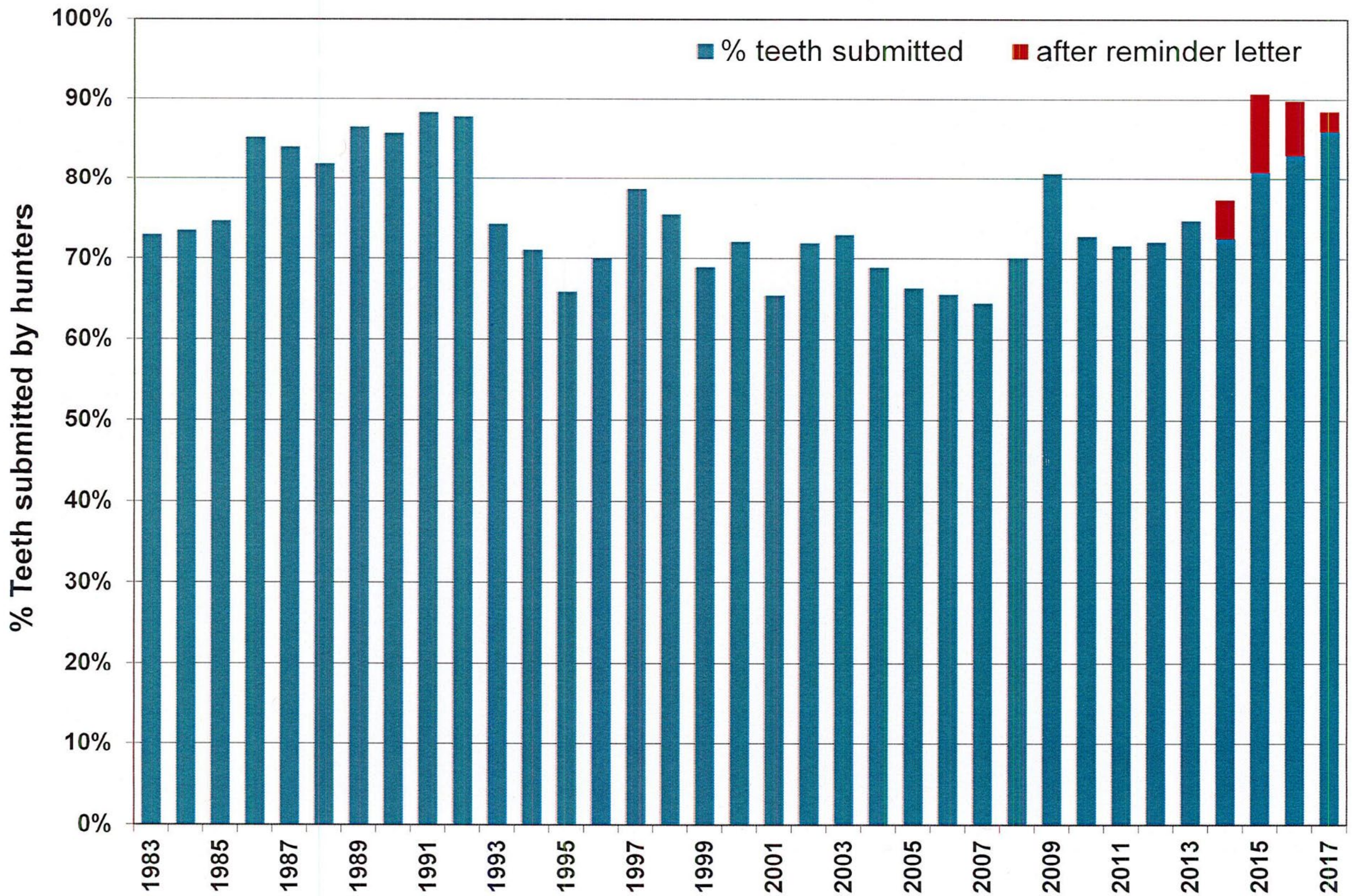


Figure 10. Percent of hunters submitting useable bear teeth for aging (vital for population monitoring, see Figs. 14–16). Cooperation levels exceeded 80% when registration stations were paid to extract teeth (this practice ended in 1993) and ~90% when non-compliant hunters were sent a reminder letter after the season.

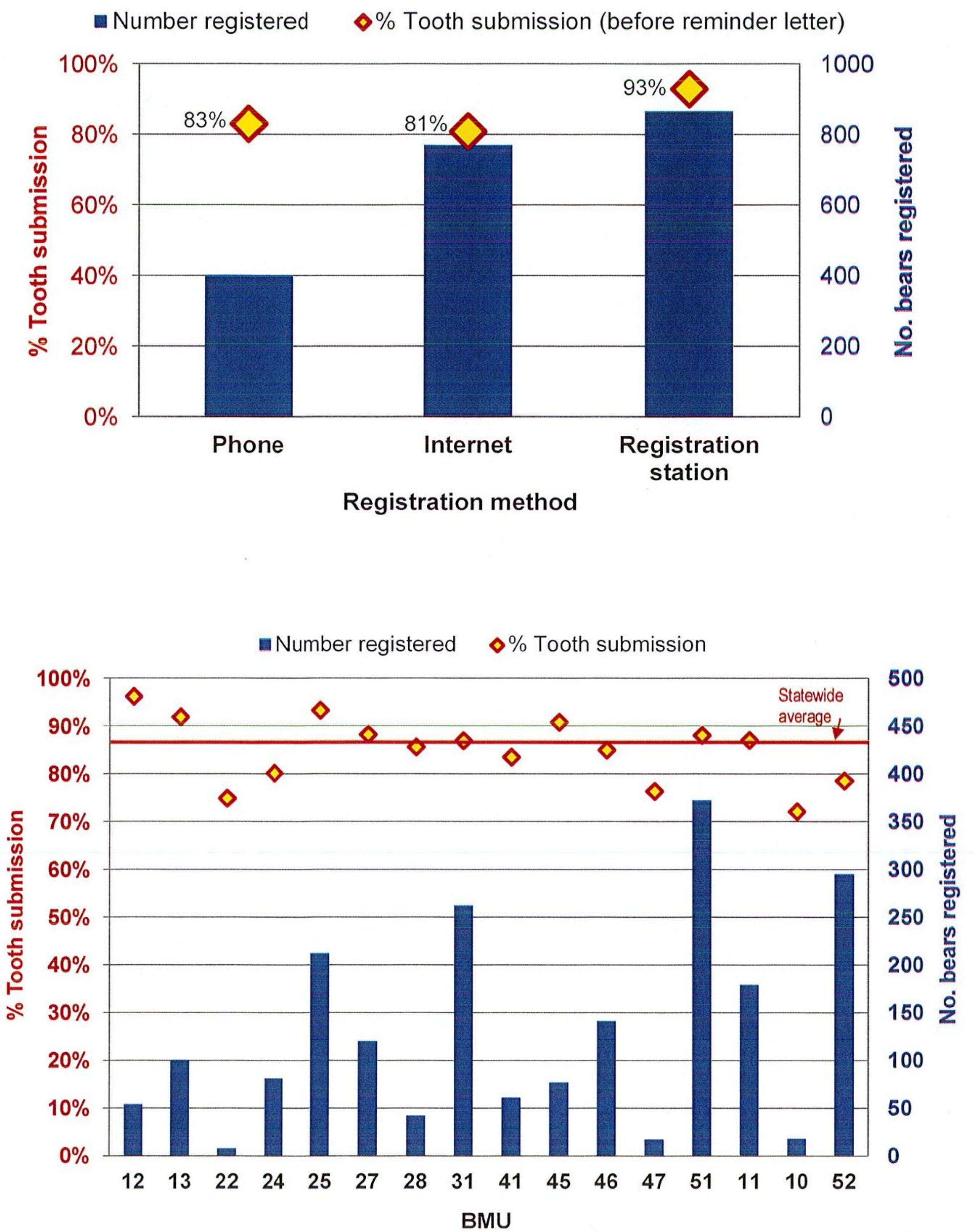


Figure 11. Percent of hunters who submitted a bear tooth in 2017 by method of registration (top panel) and by BMU (bottom panel). Beginning in 2013, hunters could register their bear by phone or internet, as well as in person at a station.

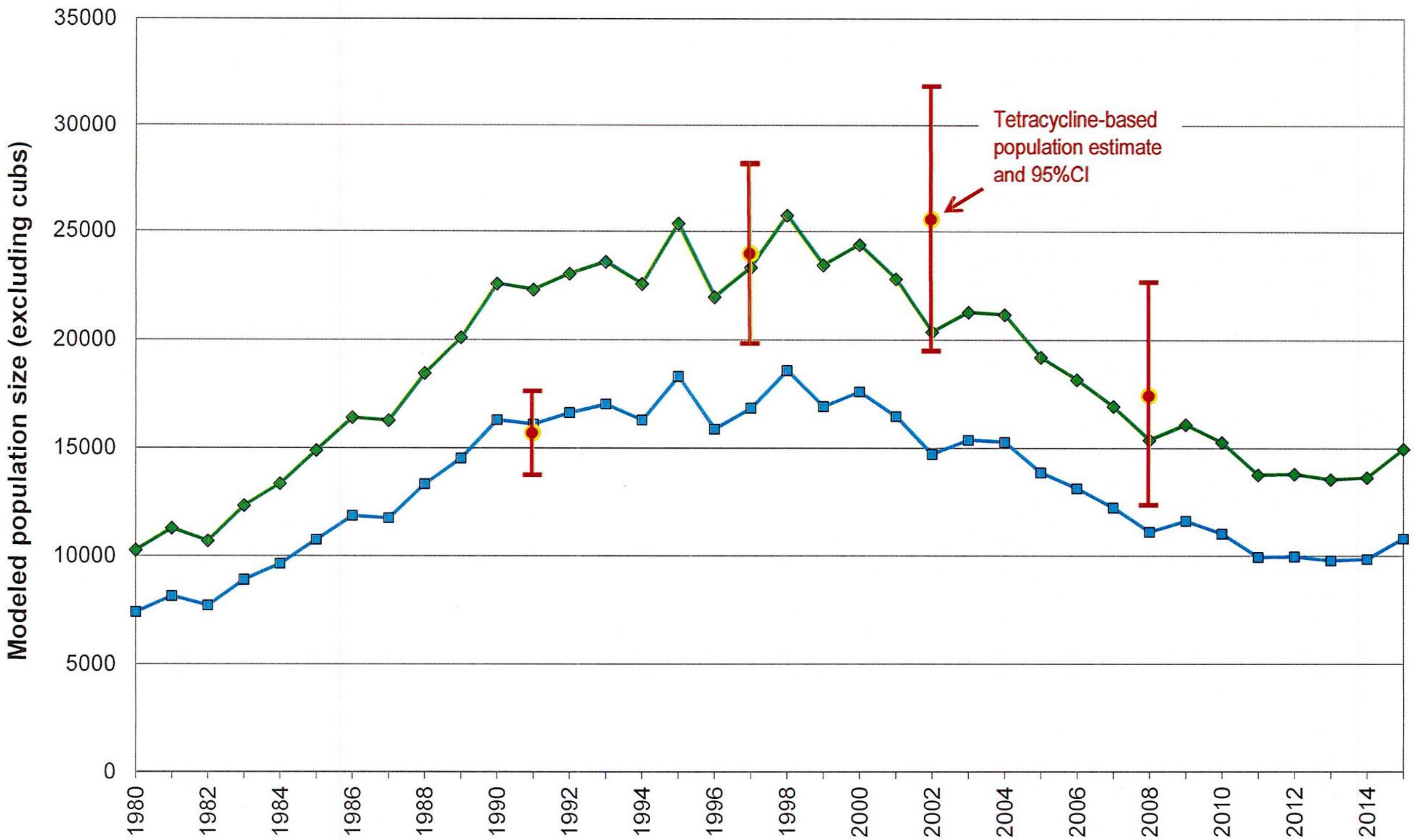


Figure 12. Statewide bear population trend (pre-hunt) derived from Downing reconstruction using harvest age structures, 1980–2017. Curves were scaled (elevated to account for non-harvest mortality) to various degrees to attempt to match the tetracycline-based mark–recapture estimates (2 such curves shown here). Estimates beyond 2015 are unreliable.

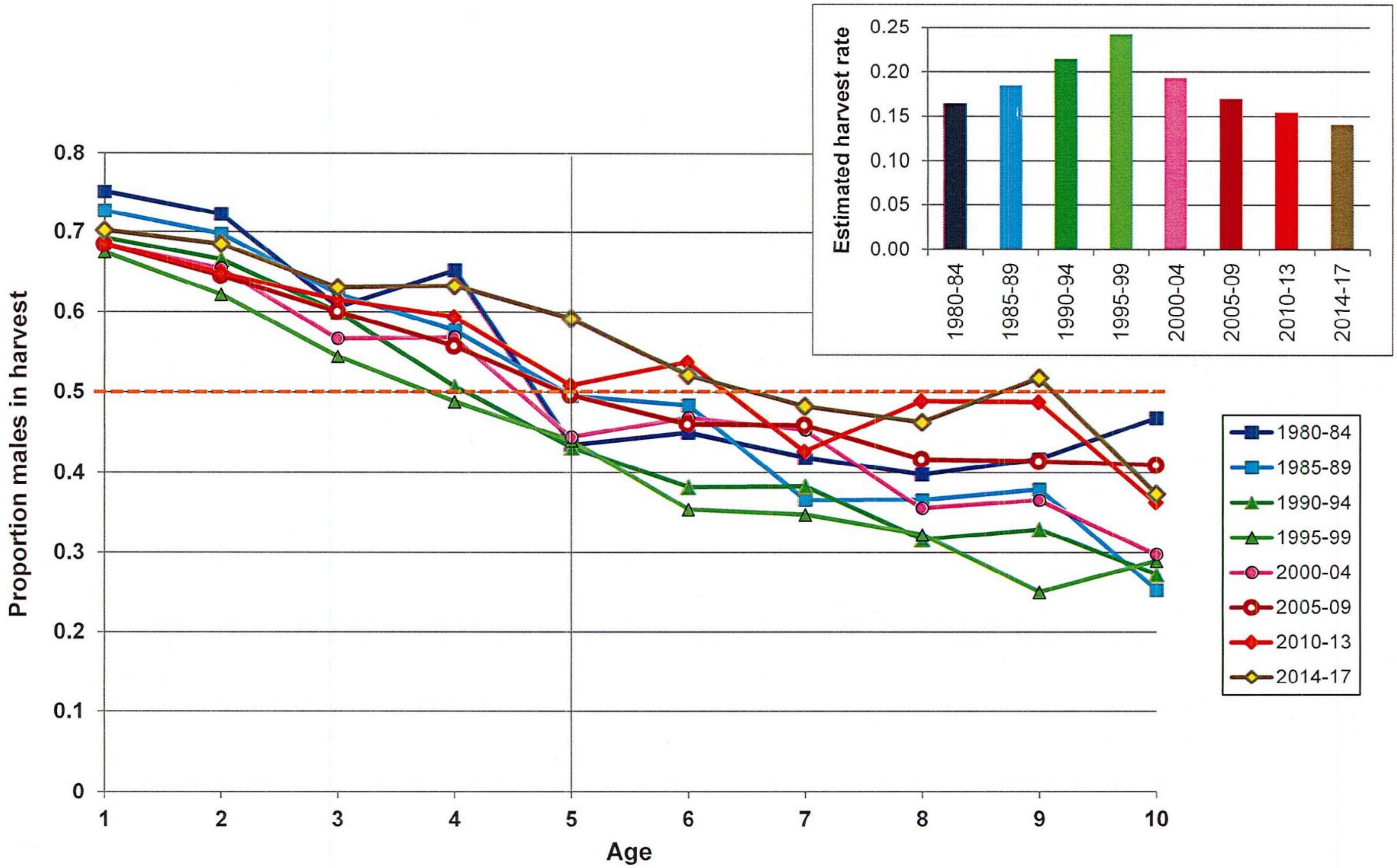


Figure 13. Trends in proportion of male bears in statewide harvest at each age, 1–10 years, grouped in 5-year time blocks, 1980–2017 (last 2 intervals are 4 years). Higher harvest rates result in steeper curves because males are reduced faster than females. Fitting a line to the data for each time block and predicting the age at which 50% of the harvest is male (dashed tan line) yields approximately the inverse of the harvest rate (derived rates are shown in inset).

2017 MINNESOTA DEER HARVEST REPORT

Erik Thorson, Big Game Program Leader, Division of Fish and Wildlife

INTRODUCTION

The white-tailed deer may be considered Minnesota's most popular wildlife species. In 2017, nearly 500,000 hunters participated in the season. 2017 was a generally liberal season designed to stabilize or reduce deer population growth across much of the state after they had mostly recovered from recent more severe winters. During the archery, firearms and muzzleloader seasons, hunters registered 197,768 deer.

METHODS

Every deer taken by hunting in Minnesota must be registered. Deer may be registered at any of the 825 to nearly 900 "Big Game Registration" stations available throughout the state. Starting in 2011, deer could also be registered using the internet and telephone. Implementation of electronic licensing (ELS) has improved the efficiency and accuracy of deer harvest estimates and provides a more timely release of harvest information. Registered deer are recorded as adult buck, fawn buck, adult doe, or fawn doe. Additional information gathered at the time of registration includes date of kill, deer permit area, and season. In 2016, carcass import restrictions were instituted to help prevent the spread of Chronic Wasting Disease (CWD). CWD was detected in three deer in Fillmore County during routine surveillance efforts. This prompted additional late season deer harvest for sample collection in southeast Minnesota around that area. Additionally, deer farms in Meeker and Crow Wing counties tested positive for CWD in the spring of 2017. For 2017 mandatory testing of all deer > 1 year old was instituted for the opening weekend of firearms season in three areas of the state and for the entire hunting season in the newly created CWD disease management zone 603.

RESULTS

Outcomes of the 2017 deer harvest are presented in the following tables.

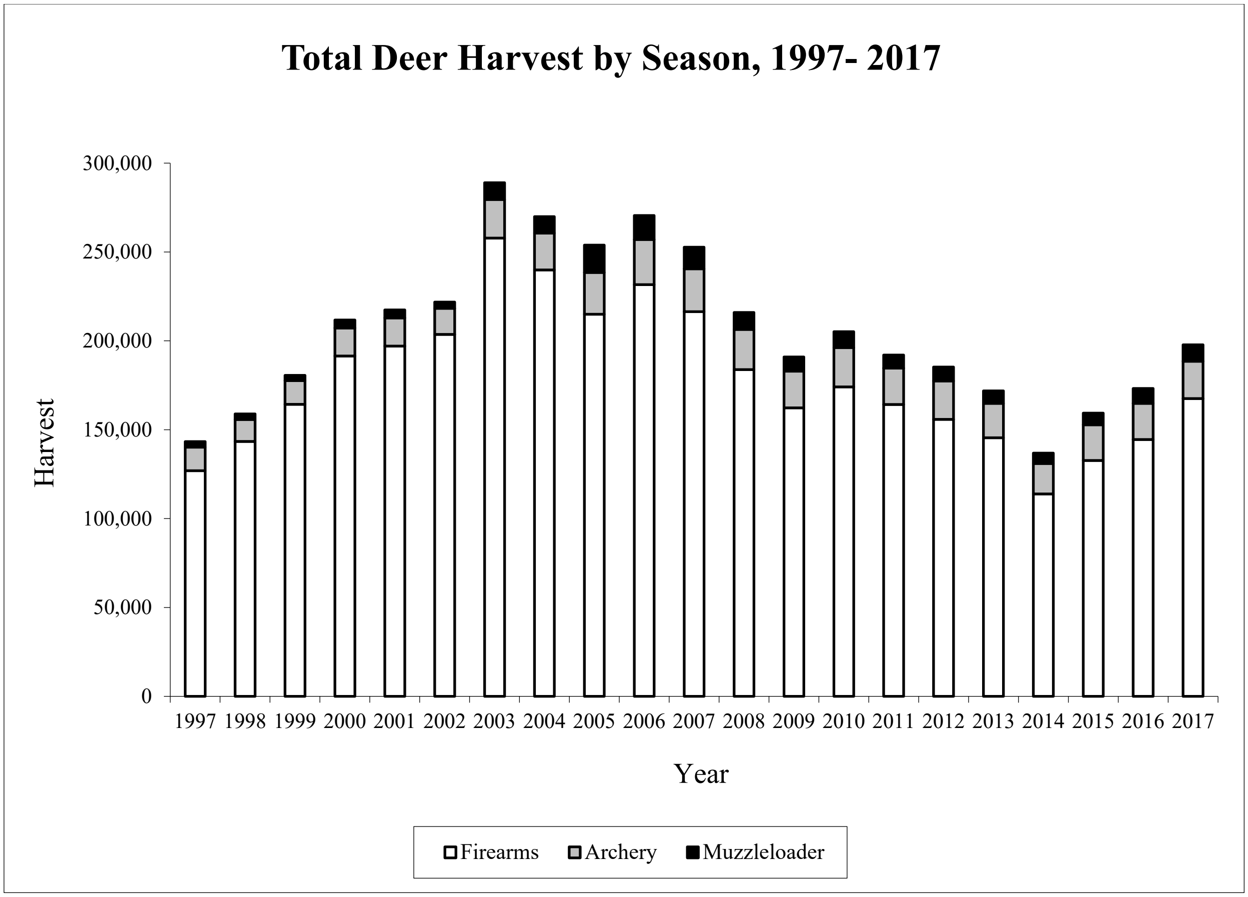


Figure 1. Total deer harvest by season, 1997-2017.

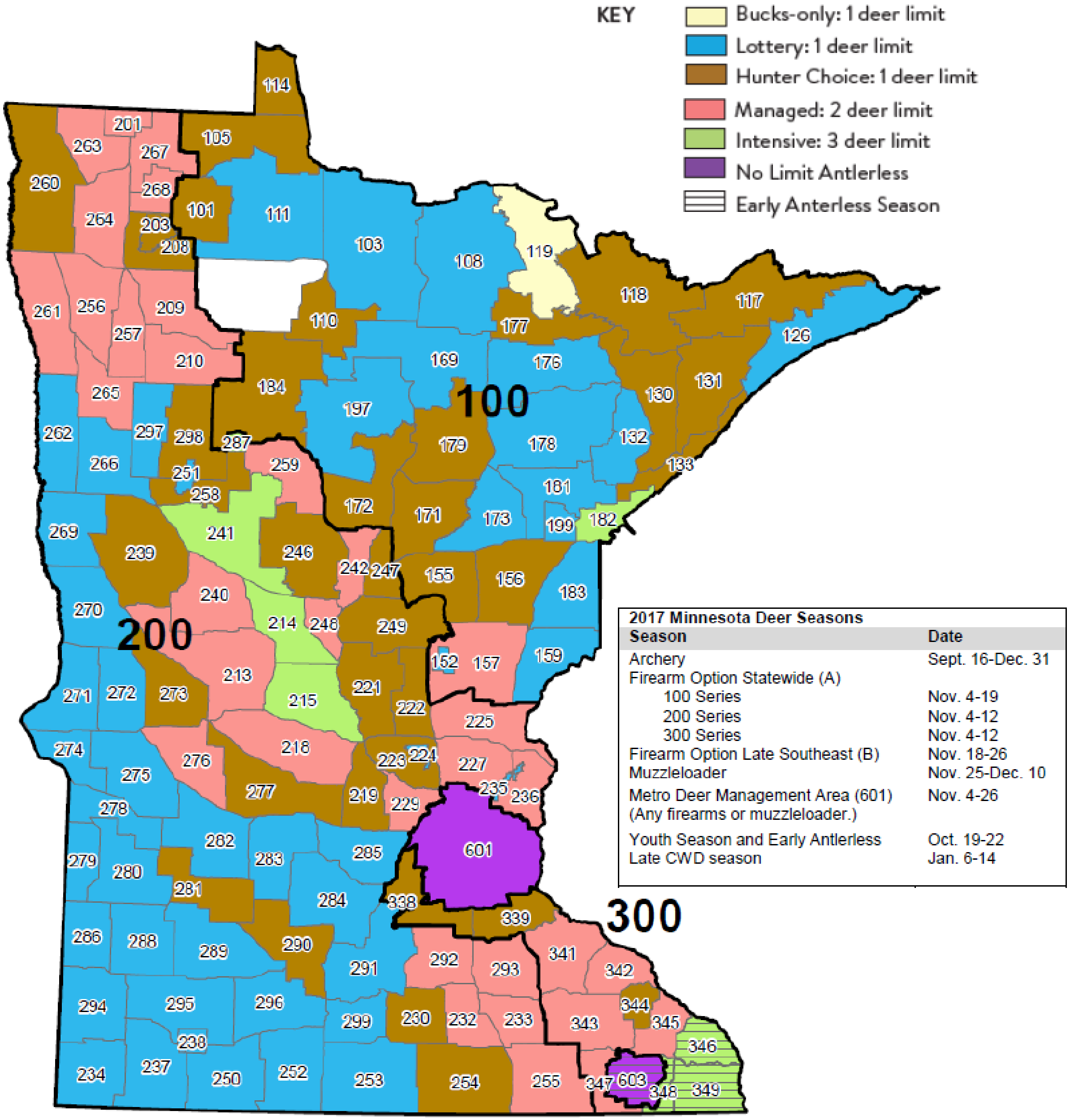


Figure 2. 2017 Deer Permit Areas, Seasons and Deer Management Designations.

Table 1. Statewide Firearms, Archery, and Muzzleloader Harvest, License Sales, and Success Rates, 2000-2017.

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
REGULAR FIREARMS																		
Resident License Sales	400,814	401,005	367,964	344,875	309,698	291,298	299,774	285,286	376,006	377,077	379,866	382,668	391,822	391,967	374,314	371,612	372,645	368,407
Non-Resident License Sales	10,595	10,972	10,835	11,334	12,036	12,523	12,520	12,520	11,883	11,759	11,908	11,955	12,483	12,496	11,674	13,501	12,540	12,923
Bonus Permit Sales	34,802	59,013	105,699	194,201	183,186	184,566	167,343	145,522	190,156	140,920	143,763	142,049	89,750	97,402	29,642	31,065	44,365	93,309
Multi-Zone Buck License Sales	42,669	41,921	35,658	32,929	32,359	28,233	15,984	15,051	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Youth License Sales	3,215	4,011	2,884	34,463	51,347	50,501	49,599	49,242	50,397	56,678	59,726	60,943	62,949	64,748	62,488	62,333	61,138	58,779
All Season Deer License Sales	2,384	3,986	22,125	30,998	46,008	59,090	75,511	76,385	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total License Sales	495,289	519,601	545,165	648,800	634,634	626,211	620,731	584,006	628,442	586,434	595,263	597,615	557,004	566,613	478,118	478,511	490,688	533,418
Registered Buck Harvest[1]	102,961	98,894	101,333	110,440	116,612	95,594	95,695	97,528	85,646	83,820	88,027	76,003	84,729	70,627	69,851	83,939	87,855	88,467
Antlerless Permits Offered	232,595	286,540	365,667	31,625	30,760	28,830	18,925	18,830	32,325	60,100	60,083	15,525	32,854	36,816	26,332	31,065	39,646	20,540
Antlerless Permits Issued	180,490	196,603	192,907	25,386	24,111	25,656	18,925	18,830	32,325	60,100	60,083	15,525	32,854	36,816	26,332	31,065	39,646	20,385
Antlerless Permits App.	237,571	225,341	202,086	30,253	28,454	31,403	31,403	31,403	31,403	90,882	86,783	21,071	67,308	68,811	96,580	95,656	97,056	45,001
Registered AL Harvest[1]	88,492	98,169	102,280	147,420	123,278	119,363	135,981	118,860	98,147	78,525	86,077	88,197	71,140	67,885	44,038	48,758	52,338	79,033
Registered Total Harvest[1]	191,453	197,063	203,613	257,860	239,890	214,957	231,676	216,388	183,793	162,345	174,104	164,200	155,869	145,449	113,889	132,697	144,470	167,500
Registered % Successful[2]	38.6	37.9	37.3	39.7	37.8	34.3	37.3	41.7	34.8	33.8	35.9	32.9	32.0	29.7	25.3	28.9	31.2	33.7
ARCHERY																		
Resident License Sales	68,947	69,608	57,532	59,339	50,601	50,293	49,595	52,780	87,872	88,707	91,156	90,252	95,259	92,717	92,301	93,462	92,076	91,875
Non-Resident License Sales	1,271	1,288	1,275	1,428	1,144	1,207	1,286	1,509	1,509	1,610	1,638	1,718	1,814	1,952	1,946	2,032	2,062	2,016
Youth Archery Sales	N/A	N/A	N/A	3,748	7,261	7,489	7,688	7,663	9,005	9,157	9,577	10,306	11,276	12,212	11,965	11,905	10,846	9,961
Mgmt Permit License Sales	20,393	22,141	18,126	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total License Sales	90,611	93,037	76,933	60,767	59,006	58,989	58,569	61,952	99,033	99,474	102,371	102,276	108,349	106,881	106,212	107,399	104,984	103,852
Total Harvest - All-Season License				2,356	3,489	4,563	8,284	6,900	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total Archery Harvest	15,776	15,884	14,744	21,691	20,726	23,538	25,360	24,161	22,632	20,629	22,057	20,444	21,605	19,388	17,119	20,074	20,360	21,058
Registered % Successful[2]	17.4	17.1	19.2	22.3	29.2	24.6	24.8	24.3	18.5	17.5	17.8	17.0	18.8	14.5	15.3	16.5	18.5	18.7
MUZZLELOADER																		
Total Muzzleloader License Sales	11,972	13,043	11,764	9,142	10,512	9,226	10,781	9,867	64,673	63,282	55,640	59,384	58,363	51,092	43,946	50,176	53,097	51,961
Estimated All-Season Hunters	--	--	--	12,020	14,168	23,293	23,293	26,813	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total Muzzleloader Harvest	4,548	4,494	3,505	9,466	9,289	15,421	13,507	12,138	9,572	7,929	9,023	7,416	7,779	7,045	5,847	6,572	8,383	9,210
Registered % Successful[2]	38.0	34.5	29.8	44.7	37.6	47.4	39.6	28.2	13.4	11.3	14.4	11.6	12.4	12.7	12.7	12.0	15.2	16.6
Antlerless Permits Offered											5,792	1,997	1,626	2,144	1,593	1,434	1,352	935
Antlerless Permits App.											7,260	2,615	3,743	3,544	4,588	3,393	2,930	1,902
TOTAL Registered Harvest	**211,777**	**217,452**	**222,050**	**290,525**	**260,604**	**255,736**	**270,778**	**260,434**	**221,837**	**194,186**	**207,313**	**192,331**	**186,634**	**172,781**	**139,442**	**159,343**	**173,213**	**197,768**

[1]Does not include free landowner licenses

[2]Based on total license sales - does not include all-season deer

Table 2. Deer Harvest by Season, 2017.

Season	Total Hunters	Buck Harvest	Antlerless Harvest	Total Harvest	Successful Hunters[2]	Overall Success
Archery	100,800	9,180	11,878	21,058	18,815	18.7%
100 Series A	161,512	32,130	25,779	57,909	57,027	35.3%
200 Series A	235,695	48,768	43,947	92,715	85,669	36.3%
300 Series A[1]	25,872	4,860	4,034	8,894	7,941	30.7%
300 Series B[1]	11,334	1,136	3,074	4,210	3,629	32.0%
Metro Firearms (601)	2,750	584	471	1,055	956	34.8%
Muzzleloader	50,993	3,557	5,428	8,985	8,429	16.5%
Youth	N/A	629	568	1,197	1,190	N/A
Early Antlerless	2,563	0	321	321	286	11.2%
Special Firearms Hunts[3]	3,868	317	733	1,050	894	23.1%
Late CWD	N/A	81	293	374	290	N/A
Total	**487,799**	**101,242**	**96,526**	**197,768**	**180,844**	**37.1%**

[1]Includes deer harvested in area 603
[2]Number of individuals who harvested at least one deer
[3]Includes deer harvested from both special firearm (825) and special muzzleloader (225) hunts

Table 3. Firearms Hunters, Harvest, and Harvest per Square Mile by Permit Area, 2017.
Includes regular, youth, and antlerless permits but no special hunts.

Permit Area	Land Area (Sq. Mile)	Firearms Hunters	Hunters/ Sq. Mile	Adult Male Harvest	Fawn Male Harvest	Adult Female Harvest	Fawn Female Harvest	Total Harvest	Bucks/ Sq. Mile	Antlerless/ Sq. Mile	Total/ Sq. Mile
101	496	1,867	3.8	418	31	186	30	665	0.84	0.50	1.34
103	1,820	2,990	1.6	798	26	223	17	1,064	0.44	0.15	0.58
105	740	4,133	5.6	1,004	85	688	77	1,854	1.36	1.15	2.51
108	1,651	4,414	2.7	968	34	166	18	1,186	0.59	0.13	0.72
110	529	4,029	7.6	978	112	628	112	1,830	1.85	1.61	3.46
111	1,438	2,260	1.6	443	23	122	21	609	0.31	0.12	0.42
114	116	153	1.3	24	1	7	1	33	0.21	0.08	0.28
117	927	145	0.2	23	5	17	7	52	0.02	0.03	0.06
118	1,220	3,281	2.7	565	63	431	47	1,106	0.46	0.44	0.91
119	770	2,237	2.9	333	2	12	1	348	0.43	0.02	0.45
126	942	1,626	1.7	290	13	81	7	391	0.31	0.11	0.42
130	746	2,135	2.9	310	35	220	21	586	0.42	0.37	0.79
131	899	1,029	1.1	93	11	64	12	180	0.10	0.10	0.20
132	482	1,885	3.9	277	13	77	16	383	0.57	0.22	0.79
133	352	2,305	6.5	432	40	253	30	755	1.23	0.92	2.14
152	61	627	10.3	77	13	30	9	129	1.26	0.85	2.11
155	593	7,139	12.0	1,423	283	1,128	213	3,047	2.40	2.74	5.14
156	825	8,760	10.6	1,733	252	1,310	213	3,508	2.10	2.15	4.25
157	888	13,072	14.7	2,706	577	2,015	449	5,747	3.05	3.43	6.48
159	571	6,518	11.4	1,411	103	515	49	2,078	2.47	1.17	3.64
169	1,124	8,359	7.4	1,526	136	682	91	2,435	1.36	0.81	2.17
171	701	6,442	9.2	1,116	227	1,044	197	2,584	1.59	2.09	3.69
172	687	10,125	14.7	1,836	411	1,646	357	4,250	2.67	3.52	6.19
173	584	4,534	7.8	817	59	415	63	1,354	1.40	0.92	2.32
176	921	5,753	6.2	1,144	89	527	65	1,825	1.24	0.74	1.98
177	480	3,922	8.2	699	100	601	71	1,471	1.46	1.61	3.07
178	1,195	8,684	7.3	1,681	92	593	73	2,439	1.41	0.63	2.04

Permit Area	Land Area (Sq. Mile)	Firearms Hunters	Hunters/ Sq. Mile	Adult Male Harvest	Fawn Male Harvest	Adult Female Harvest	Fawn Female Harvest	Total Harvest	Bucks/ Sq. Mile	Antlerless/ Sq. Mile	Total/ Sq. Mile
179	862	9,026	10.5	1,906	302	1,534	248	3,990	2.21	2.42	4.63
181	629	5,301	8.4	1,066	97	561	85	1,809	1.69	1.18	2.88
182	278	2,393	8.6	446	75	360	74	955	1.60	1.83	3.44
183	663	6,867	10.4	1,514	89	478	73	2,154	2.28	0.97	3.25
184	1,229	13,864	11.3	2,945	476	1,943	356	5,720	2.40	2.26	4.65
197	955	5,152	5.4	1,101	62	228	31	1,422	1.15	0.34	1.49
199	153	485	3.2	124	9	20	3	156	0.81	0.21	1.02
201	161	506	3.1	122	15	95	17	249	0.76	0.79	1.55
203	118	237	2.0	54	2	24	5	85	0.46	0.26	0.72
208	379	1,030	2.7	233	16	121	17	387	0.62	0.41	1.02
209	640	2,568	4.0	599	106	425	74	1,204	0.94	0.95	1.88
210	615	4,164	6.8	913	161	605	128	1,807	1.48	1.45	2.94
213	1,057	10,129	9.6	2,312	519	1,392	327	4,550	2.19	2.12	4.31
214	554	7,223	13.0	1,727	475	1,414	432	4,048	3.12	4.19	7.31
215	701	7,032	10.0	1,500	376	987	275	3,138	2.14	2.34	4.48
218	884	5,795	6.6	1,084	213	709	172	2,178	1.23	1.24	2.46
219	391	3,401	8.7	620	86	275	56	1,037	1.58	1.07	2.65
221	642	5,688	8.9	1,370	266	731	177	2,544	2.13	1.83	3.96
222	413	4,866	11.8	1,013	202	551	136	1,902	2.45	2.15	4.60
223	376	3,283	8.7	670	80	308	70	1,128	1.78	1.22	3.00
224	47	682	14.4	91	12	52	14	169	1.92	1.65	3.57
225	618	7,332	11.9	1,614	311	997	230	3,152	2.61	2.49	5.10
227	472	4,829	10.2	1,007	189	592	118	1,906	2.14	1.91	4.04
229	284	1,612	5.7	281	56	161	28	526	0.99	0.86	1.85
230	452	1,402	3.1	223	33	120	20	396	0.49	0.38	0.88
232	377	1,305	3.5	238	43	127	25	433	0.63	0.52	1.15
233	385	979	2.5	192	29	81	18	320	0.50	0.33	0.83
234	636	703	1.1	154	9	44	4	211	0.24	0.09	0.33
235	34	389	11.5	48	3	12	3	66	1.42	0.53	1.96
236	370	3,112	8.4	618	106	344	76	1,144	1.67	1.42	3.09

Permit Area	Land Area (Sq. Mile)	Firearms Hunters	Hunters/ Sq. Mile	Adult Male Harvest	Fawn Male Harvest	Adult Female Harvest	Fawn Female Harvest	Total Harvest	Bucks/ Sq. Mile	Antlerless/ Sq. Mile	Total/ Sq. Mile
237	728	1,087	1.5	215	12	50	4	281	0.30	0.09	0.39
238	95	308	3.2	75	2	20	3	100	0.79	0.26	1.05
239	919	7,758	8.4	1,636	263	833	184	2,916	1.78	1.39	3.17
240	643	7,571	11.8	1,810	394	1,222	314	3,740	2.82	3.00	5.82
241	996	14,277	14.3	3,149	860	2,781	734	7,524	3.16	4.39	7.56
242	214	2,951	13.8	728	141	569	149	1,587	3.40	4.02	7.42
246	840	10,719	12.8	2,143	478	1,593	364	4,578	2.55	2.90	5.45
247	228	3,492	15.3	742	143	530	98	1,513	3.25	3.38	6.63
248	214	1,982	9.2	418	89	285	65	857	1.95	2.05	4.00
249	502	6,004	12.0	1,300	278	907	208	2,693	2.59	2.78	5.37
250	713	1,455	2.0	284	12	97	10	403	0.40	0.17	0.57
251	55	484	8.8	69	7	38	8	122	1.25	0.96	2.22
252	715	1,267	1.8	258	15	90	10	373	0.36	0.16	0.52
253	974	1,987	2.0	404	20	87	14	525	0.41	0.12	0.54
254	929	2,440	2.6	440	53	156	31	680	0.47	0.26	0.73
255	774	1,908	2.5	440	76	201	42	759	0.57	0.41	0.98
256	654	2,242	3.4	536	64	404	64	1,068	0.82	0.81	1.63
257	412	1,882	4.6	430	64	323	56	873	1.04	1.07	2.12
258	343	4,122	12.0	882	185	527	135	1,729	2.57	2.47	5.05
259	490	7,272	14.9	1,542	378	1,513	330	3,763	3.15	4.54	7.69
260	1,249	1,712	1.4	392	27	193	27	639	0.31	0.20	0.51
261	795	845	1.1	221	23	148	15	407	0.28	0.23	0.51
262	677	956	1.4	236	20	64	14	334	0.35	0.14	0.49
263	512	1,972	3.9	422	57	295	40	814	0.82	0.77	1.59
264	669	3,639	5.4	798	126	605	121	1,650	1.19	1.27	2.47
265	494	2,137	4.3	499	93	387	88	1,067	1.01	1.15	2.16
266	617	1,939	3.1	367	31	102	23	523	0.60	0.25	0.85
267	472	1,283	2.7	313	47	265	32	657	0.66	0.73	1.39
268	228	1,375	6.0	351	51	278	53	733	1.54	1.67	3.21
269	650	1,274	2.0	241	9	51	5	306	0.37	0.10	0.47

Permit Area	Land Area (Sq. Mile)	Firearms Hunters	Hunters/ Sq. Mile	Adult Male Harvest	Fawn Male Harvest	Adult Female Harvest	Fawn Female Harvest	Total Harvest	Bucks/ Sq. Mile	Antlerless/ Sq. Mile	Total/ Sq. Mile
270	748	1,016	1.4	180	8	34	1	223	0.24	0.06	0.30
271	632	1,082	1.7	248	11	85	10	354	0.39	0.17	0.56
272	531	1,092	2.1	181	9	40	5	235	0.34	0.10	0.44
273	571	2,602	4.6	483	42	219	46	790	0.85	0.54	1.38
274	354	1,190	3.4	238	13	73	11	335	0.67	0.27	0.95
275	764	1,815	2.4	359	9	83	9	460	0.47	0.13	0.60
276	542	3,118	5.8	597	84	339	58	1,078	1.10	0.89	1.99
277	812	6,623	8.2	1,341	190	727	127	2,385	1.65	1.29	2.94
278	402	1,753	4.4	371	16	87	13	487	0.92	0.29	1.21
279	344	1,184	3.4	165	23	102	18	308	0.48	0.42	0.90
280	675	1,279	1.9	175	6	44	12	237	0.26	0.09	0.35
281	575	2,467	4.3	476	52	210	36	774	0.83	0.52	1.35
282	778	684	0.9	101	3	20	6	130	0.13	0.04	0.17
283	613	1,421	2.3	233	19	64	7	323	0.38	0.15	0.53
284	838	1,781	2.1	300	23	83	13	419	0.36	0.14	0.50
285	549	2,249	4.1	365	18	100	19	502	0.67	0.25	0.91
286	446	1,322	3.0	237	15	76	6	334	0.53	0.22	0.75
287	46	457	10.0	78	28	102	25	233	1.71	3.39	5.10
288	625	1,954	3.1	348	25	134	16	523	0.56	0.28	0.84
289	815	1,048	1.3	203	20	92	17	332	0.25	0.16	0.41
290	662	2,534	3.8	450	62	244	37	793	0.68	0.52	1.20
291	800	3,662	4.6	658	49	195	22	924	0.82	0.33	1.15
292	479	2,946	6.2	538	93	308	75	1,014	1.12	0.99	2.12
293	511	2,594	5.1	549	99	281	50	979	1.07	0.84	1.91
294	686	1,356	2.0	263	38	148	13	462	0.38	0.29	0.67
295	839	2,137	2.5	391	25	103	15	534	0.47	0.17	0.64
296	667	1,676	2.5	289	14	96	13	412	0.43	0.18	0.62
297	438	960	2.2	186	14	33	9	242	0.42	0.13	0.55
298	618	3,611	5.8	720	99	324	80	1,223	1.17	0.81	1.98
299	386	1,475	3.8	264	22	89	13	388	0.68	0.32	1.01

Permit Area	Land Area (Sq. Mile)	Firearms Hunters	Hunters/ Sq. Mile	Adult Male Harvest	Fawn Male Harvest	Adult Female Harvest	Fawn Female Harvest	Total Harvest	Bucks/ Sq. Mile	Antlerless/ Sq. Mile	Total/ Sq. Mile
338	454	1,933	4.3	230	44	171	30	475	0.51	0.54	1.05
339	394	1,729	4.4	263	44	146	33	486	0.67	0.57	1.24
341	612	5,031	8.2	810	201	685	130	1,826	1.32	1.66	2.98
342	349	3,672	10.5	607	127	487	108	1,329	1.74	2.07	3.81
343	663	3,975	6.0	603	157	455	96	1,311	0.91	1.07	1.98
344	190	2,558	13.5	273	47	211	59	590	1.44	1.67	3.11
345	323	2,643	8.2	445	127	352	69	993	1.38	1.70	3.08
346	318	4,276	13.5	801	246	772	221	2,040	2.52	3.90	6.42
347	272	1,616	5.9	291	68	166	50	575	1.07	1.04	2.11
348	123	1,440	11.7	236	54	182	38	510	1.92	2.23	4.15
349	490	5,675	11.6	1,102	300	928	276	2,606	2.25	3.07	5.31
601	1,625	2,750	1.7	602	94	330	53	1,079	0.37	0.29	0.66
603	372	2,658	7.1	606	115	321	97	1,139	1.63	1.43	3.06
TOTAL[1]	**78,854**	**437,163**	**5.5**	**88,107**	**14,025**	**53,327**	**10,842**	**166,301**	**1.12**	**0.99**	**2.11**

[1]Does not include figures from special firearm hunts (see Table 6)

Table 4. Archery Harvest by Permit Area, 2017.

Includes regular, youth, and antlerless permits but no special hunts.

Permit Area	Adult Male	Fawn Male	Adult Female	Fawn Female	Total
101	11	0	5	0	16
103	13	0	13	1	27
105	26	1	29	2	58
108	39	4	33	5	81
110	32	5	25	2	64
111	8	0	9	1	18
114	2	1	0	0	3
117	0	0	2	0	2
118	20	1	26	2	49
119	4	0	0	0	4
126	11	1	12	0	24
130	10	1	14	0	25
131	4	0	3	0	7
132	3	1	3	0	7
133	29	1	23	3	56
152	2	0	2	0	4
155	62	8	57	8	135
156	83	8	77	5	173
157	162	31	211	19	423
159	86	5	58	4	153
169	40	6	50	0	96
171	31	3	38	3	75
172	73	10	93	15	191
173	33	5	30	3	71
176	42	5	36	2	85
177	20	0	18	0	38
178	72	10	66	5	153
179	112	11	90	16	229
181	44	7	37	5	93
182	102	31	187	35	355
183	67	9	63	7	146
184	169	23	108	10	310
197	46	3	31	1	81
199	5	1	6	0	12
201	3	1	6	0	10
203	1	0	1	0	2
208	4	3	3	1	11
209	39	7	34	1	81
210	32	5	51	7	95
213	152	45	253	25	475
214	128	36	270	29	463

Permit Area	Adult Male	Fawn Male	Adult Female	Fawn Female	Total
249	90	9	58	8	165
250	38	5	18	4	65
251	2	0	2	0	4
252	46	4	14	3	67
253	89	8	40	1	138
254	87	5	41	2	135
255	98	19	97	15	229
256	35	5	24	2	66
257	27	6	28	2	63
258	44	2	29	7	82
259	62	9	94	11	176
260	20	1	10	0	31
261	26	1	19	1	47
262	24	5	19	4	52
263	19	1	12	3	35
264	37	1	40	2	80
265	37	3	40	6	86
266	20	2	18	0	40
267	16	2	19	1	38
268	18	2	27	3	50
269	33	2	17	4	56
270	25	2	11	0	38
271	25	1	11	1	38
272	15	1	3	1	20
273	45	4	19	1	69
274	33	1	16	4	54
275	30	3	25	3	61
276	57	4	70	10	141
277	190	17	119	15	341
278	43	2	19	0	64
279	12	0	1	0	13
280	22	2	14	1	39
281	55	5	37	2	99
282	23	2	5	1	31
283	51	2	26	1	80
284	39	1	19	3	62
285	81	3	36	2	122
286	23	2	17	1	43
287	3	1	3	1	8
288	37	5	32	1	75
289	24	2	16	2	44

Permit Area	Adult Male	Fawn Male	Adult Female	Fawn Female	Total
215	205	57	331	47	640
218	155	33	237	36	461
219	117	8	55	10	190
221	114	12	73	12	211
222	79	7	36	3	125
223	182	17	89	9	297
224	24	1	16	3	44
225	182	50	189	27	448
227	259	65	275	47	646
229	85	15	78	11	189
230	39	3	18	1	61
232	38	4	39	3	84
233	56	8	54	7	125
234	28	1	12	0	41
235	13	2	11	1	27
236	225	41	200	16	482
237	35	1	18	2	56
238	9	0	7	1	17
239	112	6	64	5	187
240	140	25	185	16	366
241	242	69	555	69	935
242	126	32	177	18	353
246	105	14	70	8	197
247	69	9	60	7	145
248	56	6	50	6	118

Permit Area	Adult Male	Fawn Male	Adult Female	Fawn Female	Total
290	54	5	33	3	95
291	146	14	83	4	247
292	103	12	110	10	235
293	113	17	94	12	236
294	22	4	18	2	46
295	49	5	45	1	100
296	26	2	15	2	45
297	12	0	3	0	15
298	15	3	13	3	34
299	56	2	37	2	97
338	65	6	36	0	107
339	63	4	31	3	101
341	193	34	198	23	448
342	111	23	116	20	270
343	240	34	256	35	565
344	51	8	13	7	79
345	82	10	50	7	149
346	176	30	192	19	417
347	57	7	41	2	107
348	42	7	39	6	94
349	222	29	201	21	473
601	757	186	905	113	1,961
603	81	19	83	18	201
Total[1]	**8,954**	**1,388**	**8,749**	**1,024**	**20,115**

[1]Does not include 943 deer from 900-series Archery Hunts, including Camp Ripley hunts (see Table 8)

Table 5. Muzzleloader Harvest by Permit Area, 2017.

Includes regular, youth, and antlerless permits but no special hunts.

Permit Area	Adult Male	Fawn Male	Adult Female	Fawn Female	Total
101	21	0	14	0	35
103	22	1	4	1	28
105	25	1	25	4	55
108	37	0	6	0	43
110	13	6	11	2	32
111	11	0	1	1	13
114	1	0	0	0	1
117	1	1	1	1	4
118	20	2	19	0	41
119	7	0	0	0	7
126	12	0	3	0	15
130	5	2	5	1	13
131	2	0	0	0	2
132	2	0	3	0	5
133	8	1	9	0	18
152	1	0	0	0	1
155	13	2	23	1	39
156	10	5	18	1	34
157	28	6	50	7	91
159	14	2	8	0	24
169	20	1	14	1	36
171	14	5	23	4	46
172	26	10	41	4	81
173	11	0	4	1	16
176	14	1	15	1	31
177	14	3	22	3	42
178	18	0	5	0	23
179	35	4	39	7	85
181	14	1	11	0	26
182	5	1	20	1	27
183	16	1	6	1	24
184	46	5	60	8	119
197	10	0	3	0	13
199	3	1	2	0	6
201	8	1	20	0	29
208	13	3	4	0	20
209	34	5	17	5	61
210	28	8	35	9	80
213	106	38	165	29	338
214	38	31	93	14	176

Permit Area	Adult Male	Fawn Male	Adult Female	Fawn Female	Total
249	24	10	33	3	70
250	39	2	13	0	54
251	5	0	1	1	7
252	23	1	9	0	33
253	56	6	23	2	87
254	57	11	44	8	120
255	34	8	58	7	107
256	34	6	32	4	76
257	14	9	26	3	52
258	12	2	19	0	33
259	34	14	70	11	129
260	41	1	14	0	56
261	28	0	24	0	52
262	14	1	6	1	22
263	25	2	39	2	68
264	48	10	68	12	138
265	39	8	43	6	96
266	29	3	12	1	45
267	30	4	18	4	56
268	33	4	29	3	69
269	47	0	5	1	53
270	25	0	1	0	26
271	28	1	17	1	47
272	20	0	3	0	23
273	28	3	20	3	54
274	21	4	12	1	38
275	28	3	5	0	36
276	59	10	73	13	155
277	95	23	111	11	240
278	48	2	13	1	64
279	19	3	16	4	42
280	23	0	8	0	31
281	42	6	64	6	118
282	20	0	1	0	21
283	31	0	5	0	36
284	34	0	11	1	46
285	18	4	9	1	32
286	39	3	13	0	55
287	3	0	5	0	8
288	34	4	27	4	69

Permit Area	Adult Male	Fawn Male	Adult Female	Fawn Female	Total
215	73	39	148	32	292
218	64	16	146	17	243
219	47	9	65	12	133
221	40	12	58	9	119
222	30	5	38	2	75
223	32	6	31	7	76
224	0	0	1	0	1
225	46	13	76	5	140
227	61	18	84	11	174
229	12	6	26	4	48
230	16	0	18	1	35
232	35	8	35	6	84
233	26	4	55	2	87
234	22	1	5	0	28
235	0	0	1	0	1
236	21	5	47	4	77
237	31	1	5	1	38
238	11	1	3	1	16
239	48	4	41	6	99
240	49	17	89	10	165
241	61	44	186	34	325
242	23	11	32	4	70
246	45	6	49	11	111
247	13	5	22	7	47
248	15	4	24	2	45

Permit Area	Adult Male	Fawn Male	Adult Female	Fawn Female	Total
289	28	0	11	0	39
290	45	6	54	5	110
291	54	8	33	5	100
292	38	13	59	10	120
293	36	13	64	8	121
294	58	1	15	3	77
295	75	4	25	2	106
296	31	4	17	3	55
297	4	0	1	0	5
298	15	4	11	0	30
299	33	2	15	2	52
338	16	5	25	2	48
339	12	5	19	6	42
341	40	26	81	13	160
342	30	15	75	11	131
343	41	15	68	8	132
344	10	5	22	0	37
345	18	8	34	8	68
346	45	24	130	9	208
347	15	8	29	3	55
348	6	3	11	1	21
349	47	27	185	23	282
601	21	8	35	2	66
603	11	8	22	6	47
TOTAL[1]	**3,557**	**763**	**4,125**	**540**	**8,985**

[1]Does not include special hunts (see Table 7)

Table 6. Summary of Special Firearm Hunts, 2017.

Includes regular, youth, and bonus permits.

Hunt Area	Dates	Permits Available	Adult Male Harvest	Fawn Male Harvest	Adult Female Harvest	Fawn Female Harvest	Total Harvest
900 - Cascade River State Park	11/4-11/19	100*	5	0	13	0	18
901 - Rice Lake NWR	11/11-11/19	40*	6	2	4	0	12
902 - St. Croix State Park	11/16-11/19	350*	64	17	54	10	145
904 - Gooseberry Falls State Park	11/4-11/19	30*	6	2	9	3	20
905 - Split Rock Lighthouse State Park	11/4-11/19	30*	4	3	5	0	12
906 - Tettegouche State Park	11/4-11/19	125*	9	4	18	2	33
907 - Scenic State Park	11/4-11/19	30*	3	1	2	0	6
908 - Hayes Lake State Park	11/4-11/19	75***	0	0	4	5	9
909 - Lake Bemidji State Park	11/4-11/7	30***	4	6	4	1	15
910 - Zippel Bay State Park	11/4-11/19	75***	10	7	31	9	57
911 - Judge CR Magney State Park	11/4-11/19	75*	5	1	7	0	13
912 - Schoolcraft State Park	11/4-11/19	NA†	1	2	1	0	4
913 - Lake Carlos State Park	11/4-11/7	20**	2	2	6	0	10
914 - William O'Brien State Park	11/11-11/12	50*	10	3	13	4	30
915 - Lake Bronson State Park	11/4-11/12	30***	10	2	12	3	27
916 - Maplewood State Park	11/4-11/7	100*	33	4	15	6	58
919 - Glacial Lakes State Park	11/9-11/12	30**	0	3	7	1	11
920 - Zumbro Falls Woods SNA	11/4-11/12	12**	0	4	4	0	8
922 - Old Mill State Park	11/4-11/7	10*	3	1	1	3	8
923 - Zumbro Falls Woods SNA	11/18-11/26	12**	0	5	3	1	9
924 - Franz Jevne State Park	11/4-11/19	NA†	0	0	0	0	0
925 - Vermillion Highlands WMA (A and B)	11/4-11/17	20*	7	1	0	2	10
927 - Whitewater State Park	11/18-11/19	50*	3	4	13	3	23
930 - Carver Park Reserve (A and B)	11/11-11/12	110*	17	4	24	7	52
931 - City of Grand Rapids	11/4-11/19	NA†*	9	9	20	7	45
933 - Forestville - Mystery Cave State Park	11/4-11/5	130*	22	6	10	6	44
934 - Whitewater State Game Refuge	11/18-11/26	75**	0	2	16	4	22
962 - Great Rivers Bluff State Park	11/18-11/19	50*	3	3	9	1	16
Firearms Special Hunt Totals			**236**	**98**	**305**	**78**	**717**

* Either Sex

** Antlerless Only

*** Earn-A-Buck

NA† Unlimited Permits

Table 7. Summary of Special Muzzleloader Hunts, 2017.

Includes regular, youth, and bonus permits.

Hunt Area	Dates	Permits Available	Adult Male Harvest	Fawn Male Harvest	Adult Female Harvest	Fawn Female Harvest	Total Harvest
921 - Minneopa State Park	12/1-12/3	12***	1	2	7	2	12
935 - Jay Cooke State Park	12/2-12/6	75*	3	4	15	2	24
936 - Crow Wing State Park	12/2-12/3	25*	0	0	5	2	7
937 - Soudan Underground Mine and Lake Vermilion State Park	11/25-12/10	25*	3	2	6	3	14
938 - City of Tower	11/25-12/10	20*	2	0	5	0	7
939 - Myre-Big Island State Park	12/1-12/3	50**	0	10	45	5	60
940 - Frontenac State Park	12/2-12/3	50*	6	3	8	3	20
942 - Sibley State Park	11/25-11/26	60**	1	0	14	0	15
944 - Vermillion Highlands WMA	11/25-12/10	20*	3	1	2	1	7
946 - City of Grand Rapids	11/25-12/10	NA†*	0	0	0	1	1
947 - Lake Bemidji State Park	12/1-12/3	30*	2	0	5	0	7
948 - Savanna Portage State Park	11/25-11/28	30*	0	0	0	0	0
949 - St. Croix State Park	11/30-12/3	100*	3	2	11	2	18
992 - Sakatah Lake State Park	12/1-12/3	15**	0	1	3	1	5
Muzzleloader Special Hunt Totals			**24**	**25**	**126**	**22**	**197**

* Either Sex
** Antlerless Only
*** Earn-A-Buck
NA† Unlimited Permits

Table 8. Summary of Special Youth and Camp Ripley Archery Hunts, 2017.

Includes regular, youth, and bonus permits.

Hunt Area	Dates	Permits Available	Adult Male Harvest	Fawn Male Harvest	Adult Female Harvest	Fawn Female Harvest	Total Harvest
950 - Camp Ripley Youth Archery	10/7-10/8	175*	1	0	1	0	2
951 - Afton State Park	11/4-11/5	25*	8	0	6	1	15
952 - Sibley State Park	10/28-10/29	10*	3	0	2	0	5
953 - Zippel Bay State Park	10/21-10/22	20*	1	0	1	1	3
954 - Lake Bemidji State Park	10/20-10/22	20*	1	0	2	0	3
955 - Lake Alexander PreserveArchery	10/7-10/8	20*	0	0	0	1	1
956 - St. Croix State Park	10/28-10/29	90*	7	4	9	3	23
957 - Rydell National Wildlife Refuge	10/28-10/29	15*	3	1	1	0	5
958 - Savanna Portage State Park	10/28-10/29	25*	4	0	5	1	10
959 - Buffalo River State Park	11/4-11/5	14***	0	1	2	2	5
960 - Tettegouche State Park	10/28-10/29	10*	0	0	1	0	1
961 - Itasca State Park	10/14-10/15	75*	1	0	1	0	2
963 - Kilen Woods State Park	10/28-10/29	6*	1	0	1	0	2
965 - Banning State Park	10/28-10/29	6*	1	0	1	0	2
966 - Blue Mounds State Park	11/18-11/19	10*	2	0	2	0	4
967 - Camden State Park	10/28-10/29	12***	2	1	3	1	7
968 - Lake Shetek State Park	11/18-11/19	12***	3	1	6	1	11
Youth Special Hunt Totals			**38**	**8**	**44**	**11**	**101**
970 – Camp Ripley First Hunt	10/19-10/20	2,000*	25	4	26	3	58
971 - Camp Ripley First Hunt	11/28-10/29	2,000*	111	16	67	10	204
Camp Ripley Archery Hunt Totals			**136**	**20**	**93**	**13**	**262**

* Either Sex

** Antlerless Only

*** Earn-A-Buck

NA† Unlimited Permits

Table 9. Total Deer Harvest by Permit Area, 2017. Includes all seasons, license types, and permits with special hunts harvest reallocated to original permit area.

Permit Area	Adult Male Harvest	Fawn Male Harvest	Adult Female Harvest	Fawn Female Harvest	Total Harvest	Land Area (Sq. Mile)	Bucks/ Sq. Mile	Antlerless/ Sq. Mile	Total/ Sq. Mile	Rank
101	450	31	209	35	725	496	0.91	0.55	1.46	82
103	833	27	240	19	1,119	1,820	0.46	0.16	0.62	114
105	1,066	95	778	94	2,033	740	1.44	1.31	2.75	52
108	1,044	38	205	23	1,310	1,651	0.63	0.16	0.79	102
110	1,023	123	664	116	1,926	529	1.94	1.71	3.64	40
111	462	23	132	23	640	1,438	0.32	0.12	0.45	125
114	27	2	7	1	37	116	0.23	0.09	0.32	127
117	24	6	20	8	58	927	0.03	0.04	0.06	130
118	605	66	476	49	1,196	1,220	0.50	0.48	0.98	96
119	344	2	12	1	359	770	0.45	0.02	0.47	122
126	323	15	116	7	461	942	0.34	0.15	0.49	121
130	327	39	248	24	638	746	0.44	0.42	0.86	99
131	99	11	67	12	189	899	0.11	0.10	0.21	129
132	282	14	83	16	395	482	0.59	0.23	0.82	101
133	488	51	318	38	895	352	1.39	1.16	2.54	57
152	80	13	32	9	134	61	1.31	0.88	2.19	64
155	1,504	295	1,212	222	3,233	593	2.54	2.92	5.45	19
156	1,826	265	1,405	219	3,715	825	2.21	2.29	4.50	30
157	2,896	614	2,276	475	6,261	888	3.26	3.79	7.05	7
159	1,586	133	655	68	2,442	571	2.78	1.50	4.28	32
169	1,589	144	748	92	2,573	1,124	1.41	0.88	2.29	62
171	1,161	235	1,105	204	2,705	701	1.66	2.20	3.86	36
172	1,935	431	1,780	376	4,522	687	2.82	3.77	6.59	10
173	865	64	454	68	1,451	584	1.48	1.00	2.48	59
176	1,200	95	578	68	1,941	921	1.30	0.80	2.11	65
177	736	104	658	78	1,576	480	1.53	1.75	3.29	44
178	1,772	103	693	82	2,650	1,195	1.48	0.73	2.22	63
179	2,067	336	1,717	287	4,407	862	2.40	2.71	5.11	21
181	1,124	105	609	90	1,928	629	1.79	1.28	3.07	47
182	606	144	736	143	1,629	278	2.18	3.68	5.86	13
183	1,600	101	556	82	2,339	663	2.41	1.11	3.53	42
184	3,174	512	2,147	376	6,209	1,229	2.58	2.47	5.05	25
197	1,157	65	262	32	1,516	955	1.21	0.38	1.59	78
199	132	11	28	3	174	153	0.86	0.28	1.14	89
201	133	17	121	17	288	161	0.83	0.96	1.79	71
203	55	2	25	5	87	118	0.47	0.27	0.74	105
208	250	22	128	18	418	379	0.66	0.44	1.10	90
209	672	118	476	80	1,346	640	1.05	1.05	2.10	66

Permit Area	Adult Male Harvest	Fawn Male Harvest	Adult Female Harvest	Fawn Female Harvest	Total Harvest	Land Area (Sq. Mile)	Bucks/ Sq. Mile	Antlerless/ Sq. Mile	Total/ Sq. Mile	Rank
210	973	174	691	144	1,982	615	1.58	1.64	3.22	46
213	2,572	604	1,816	381	5,373	1,057	2.43	2.65	5.08	23
214	1,893	542	1,777	475	4,687	554	3.42	5.04	8.46	3
215	1,778	472	1,466	354	4,070	701	2.54	3.27	5.80	16
218	1,303	262	1,092	225	2,882	884	1.47	1.79	3.26	45
219	784	103	395	78	1,360	391	2.00	1.47	3.47	43
221	1,524	290	862	198	2,874	642	2.37	2.10	4.48	31
222	1,122	214	625	141	2,102	413	2.71	2.37	5.08	22
223	884	103	428	86	1,501	376	2.35	1.64	4.00	34
224	115	13	69	17	214	47	2.43	2.09	4.52	29
225	1,842	374	1,262	262	3,740	618	2.98	3.07	6.05	12
227	1,327	272	951	176	2,726	472	2.81	2.97	5.78	17
229	378	77	265	43	763	284	1.33	1.35	2.68	54
230	278	36	156	22	492	452	0.62	0.47	1.09	91
232	311	55	201	34	601	377	0.83	0.77	1.60	76
233	274	41	190	27	532	385	0.71	0.67	1.38	86
234	206	11	63	4	284	636	0.32	0.12	0.45	124
235	61	5	24	4	94	34	1.81	0.98	2.79	51
236	874	155	604	100	1,733	370	2.36	2.32	4.69	28
237	281	14	73	7	375	728	0.39	0.13	0.51	119
238	95	3	30	5	133	95	1.00	0.40	1.40	84
239	1,831	278	956	203	3,268	919	1.99	1.56	3.56	41
240	1,999	436	1,496	340	4,271	643	3.11	3.54	6.65	9
241	3,452	973	3,522	837	8,784	996	3.47	5.35	8.82	2
242	877	184	781	172	2,014	214	4.10	5.32	9.42	1
246	2,293	498	1,712	383	4,886	840	2.73	3.09	5.82	15
247	824	157	612	112	1,705	228	3.61	3.86	7.47	6
248	639	119	462	89	1,309	214	2.98	3.13	6.11	11
249	1,414	297	1,000	220	2,931	502	2.82	3.02	5.84	14
250	363	19	129	14	525	713	0.51	0.23	0.74	106
251	76	7	41	9	133	55	1.38	1.04	2.42	60
252	327	20	113	13	473	715	0.46	0.20	0.66	110
253	549	34	150	17	750	974	0.56	0.21	0.77	103
254	584	79	286	46	995	929	0.63	0.44	1.07	93
255	573	106	387	70	1,136	774	0.74	0.73	1.47	81
256	605	75	461	70	1,211	654	0.93	0.93	1.85	69
257	474	80	379	61	994	412	1.15	1.26	2.41	61
258	938	189	575	142	1,844	343	2.74	2.64	5.38	20
259	1,638	401	1,677	352	4,068	490	3.35	4.96	8.31	5
260	453	29	217	27	726	1,249	0.36	0.22	0.58	117

Permit Area	Adult Male Harvest	Fawn Male Harvest	Adult Female Harvest	Fawn Female Harvest	Total Harvest	Land Area (Sq. Mile)	Bucks/ Sq. Mile	Antlerless/ Sq. Mile	Total/ Sq. Mile	Rank
261	275	24	191	16	506	795	0.35	0.29	0.64	112
262	274	26	89	19	408	677	0.40	0.20	0.60	115
263	476	62	358	48	944	512	0.93	0.91	1.84	70
264	886	138	714	138	1,876	669	1.32	1.48	2.80	50
265	575	104	470	100	1,249	494	1.16	1.36	2.53	58
266	416	36	132	24	608	617	0.67	0.31	0.99	95
267	359	53	302	37	751	472	0.76	0.83	1.59	77
268	402	57	334	59	852	228	1.76	1.97	3.73	38
269	321	12	75	12	420	650	0.49	0.15	0.65	111
270	230	10	46	1	287	748	0.31	0.08	0.38	126
271	301	13	113	12	439	632	0.48	0.22	0.69	109
272	216	10	46	6	278	531	0.41	0.12	0.52	118
273	556	49	258	50	913	571	0.97	0.62	1.60	75
274	293	18	114	16	441	354	0.83	0.42	1.24	87
275	417	15	113	12	557	764	0.55	0.18	0.73	107
276	713	101	489	82	1,385	542	1.32	1.24	2.56	56
277	1,630	230	973	153	2,986	812	2.01	1.67	3.68	39
278	464	20	122	15	621	402	1.15	0.39	1.55	80
279	196	26	120	22	364	344	0.57	0.49	1.06	94
280	220	8	67	13	308	675	0.33	0.13	0.46	123
281	573	63	320	47	1,003	575	1.00	0.75	1.75	72
282	144	5	26	7	182	778	0.19	0.05	0.23	128
283	315	21	95	8	439	613	0.51	0.20	0.72	108
284	373	24	113	17	527	838	0.45	0.18	0.63	113
285	464	25	145	22	656	549	0.85	0.35	1.20	88
286	299	20	106	7	432	446	0.67	0.30	0.97	97
287	85	29	111	26	251	46	1.86	3.63	5.49	18
288	421	35	196	22	674	625	0.67	0.41	1.08	92
289	255	22	119	19	415	815	0.31	0.20	0.51	120
290	551	77	355	52	1,035	662	0.83	0.73	1.56	79
291	868	79	369	41	1,357	800	1.08	0.61	1.70	73
292	679	119	480	96	1,374	479	1.42	1.45	2.87	49
293	701	130	443	71	1,345	511	1.37	1.26	2.63	55
294	343	43	181	18	585	686	0.50	0.35	0.85	100
295	518	35	179	19	751	839	0.62	0.28	0.90	98
296	346	20	128	18	512	667	0.52	0.25	0.77	104
297	202	14	37	9	262	438	0.46	0.14	0.60	116
298	750	106	348	83	1,287	618	1.21	0.87	2.08	67
299	354	28	152	18	552	386	0.92	0.51	1.43	83
338	311	55	232	32	630	454	0.69	0.70	1.39	85

Permit Area	Adult Male Harvest	Fawn Male Harvest	Adult Female Harvest	Fawn Female Harvest	Total Harvest	Land Area (Sq. Mile)	Bucks/ Sq. Mile	Antlerless/ Sq. Mile	Total/ Sq. Mile	Rank
339	340	53	199	43	635	394	0.86	0.75	1.61	74
341	1,054	267	991	173	2,485	612	1.72	2.34	4.06	33
342	748	174	685	140	1,747	349	2.14	2.86	5.01	26
343	884	206	779	139	2,008	663	1.33	1.70	3.03	48
344	337	66	275	73	751	190	1.78	2.18	3.96	35
345	545	145	436	84	1,210	323	1.69	2.06	3.75	37
346	1,025	303	1,103	250	2,681	318	3.23	5.21	8.44	4
347	363	83	236	55	737	272	1.33	1.37	2.71	53
348	284	64	232	45	625	123	2.31	2.77	5.08	24
349	1,371	356	1,314	320	3,361	490	2.80	4.06	6.85	8
601	1,417	294	1,305	179	3,195	1,625	0.87	1.09	1.97	68
603	801	205	602	197	1,805	372	2.15	2.70	4.85	27
TOTAL	**101,242**	**16,451**	**67,390**	**12,685**	**197,768**	**78,854**	**1.28**	**1.22**	**2.51**	

Table 10. Youth Deer Season Harvest (Oct. 19-22) by Permit Area, 2017.

Permit Area	Adult Male	Fawn Male	Adult Female	Fawn Female	Total
101	22	1	10	0	33
105	60	6	51	11	128
111	13	5	14	2	34
114	1	0	1	0	2
201	9	1	8	0	18
203	0	0	2	0	2
208	19	2	8	1	30
209	29	5	15	3	52
256	33	2	24	0	59
257	21	4	11	6	42
260	23	1	24	5	53
263	19	3	24	2	48
264	39	3	38	6	86
267	28	2	24	5	59
268	17	3	13	4	37
338	11	2	6	0	19
339	10	1	2	0	13
341	28	6	24	6	64
342	26	7	15	2	50
343	27	8	16	2	53
344	16	6	11	1	34
345	28	6	12	2	48
346	39	6	11	4	60
347	15	6	5	1	27
348	12	1	6	0	19
349	43	9	9	2	63
601	18	2	3	1	24
603	16	1	4	1	22
Total	**622**	**99**	**391**	**67**	**1,179**

Table 11. Early Antlerless Deer Season Harvest (Oct. 19-22) by Permit Area, 2017.

Permit Area	Fawn Male	Adult Female	Fawn Female	Total
346	24	78	25	127
348	3	13	4	20
349	28	66	27	121
603	11	15	5	31
Total	**66**	**172**	**61**	**299**

Table 12. 300 Series A and B Seasons Firearms Harvest by Permit Area, 2017.

Permit Area	Zone	Adult Male	Fawn Male	Adult Female	Fawn Female	Total
338	3A	193	34	122	20	369
	3B	26	8	43	10	87
339	3A	210	28	101	22	361
	3B	43	14	43	11	111
341	3A	635	127	382	72	1,216
	3B	147	68	277	52	544
342	3A	452	60	288	58	858
	3B	129	60	183	48	420
343	3A	491	95	279	59	924
	3B	85	54	160	35	334
344	3A	212	24	125	38	399
	3B	45	17	75	20	157
345	3A	326	59	169	37	591
	3B	91	62	171	29	353
346	3A	633	126	360	109	1,228
	3B	129	90	323	83	625
347	3A	227	33	103	24	387
	3B	49	29	58	25	161
348	3A	195	33	111	27	366
	3B	29	17	52	7	105
349	3A	832	125	391	117	1,465
	3B	227	138	462	130	957
603	3A	454	49	174	53	730
	3B	136	54	128	38	356
Total		**5,996**	**1,404**	**4,580**	**1,124**	**13,104**

Table 13. Free Landowner License Harvest by Permit Area, 2017.

Permit Area	Fawn Male	Adult Female	Fawn Female	Total
101	0	3	1	4
105	0	15	0	15
110	2	13	3	18
133	0	0	1	1
155	1	8	3	12
156	1	10	2	13
157	9	35	5	49
171	1	1	0	2
172	0	6	0	6
177	0	8	1	9
179	5	9	1	15
182	0	1	0	1
184	6	37	4	47
201	0	1	1	2
208	0	6	1	7
209	4	18	0	22
210	6	18	4	28
213	35	77	16	128
214	22	94	20	136
215	11	46	7	64
218	1	10	3	14
219	1	2	2	5
221	18	48	4	70
222	3	15	1	19
223	0	5	3	8
225	10	16	5	31
227	4	7	1	12
229	1	4	1	6
230	1	1	0	2
232	1	0	0	1
233	1	1	0	2
236	1	4	0	5
239	12	36	6	54
240	19	60	18	97
241	26	112	24	162
242	0	1	0	1
246	6	39	6	51
247	1	3	1	5
248	3	3	1	7
249	8	52	11	71
254	1	9	0	10
255	1	8	2	11
256	2	21	1	24
257	5	19	2	26
258	6	5	1	12
259	1	11	1	13
260	1	3	0	4
261	0	1	0	1
263	0	3	0	3
264	6	22	6	34
265	2	14	4	20
267	2	5	1	8
268	0	6	1	7
273	0	1	0	1
276	0	1	0	1
277	0	16	0	16
281	0	1	0	1
290	0	3	0	3
292	1	12	1	14
293	2	1	2	5
298	2	4	1	7
338	0	9	1	10
339	0	6	1	7
341	13	24	6	43
342	5	21	8	34
343	5	14	6	25
344	3	15	4	22
345	4	20	2	26
346	4	28	9	41
347	0	9	1	10
348	1	2	0	3
349	7	47	13	67
601	0	1	0	1
603	1	10	2	13
Total	**295**	**1,197**	**233**	**1,725**

Table 14. 2017 Firearm Lottery Distribution Report.

Permit Area Number	Preference Level	Applications Total	Applications Rejected	Unsuccessful	Winners	Permits Available
103	1	365	1	365	0	**496**
	2	300	0	300	0	
	3	289	3	70	219	
	4	272	1	0	272	
	5	5	0	0	5	
		1,231	**5**	**735**	**496**	
108	1	334	2	334	0	**98**
	2	330	2	330	0	
	3	228	1	228	0	
	4	197	1	197	0	
	5	178	0	177	1	
	6	97	0	0	97	
	7	0	1	0	0	
		1,364	**7**	**1,266**	**98**	
111	1	215	1	215	0	**348**
	2	202	3	161	41	
	3	186	4	0	186	
	4	121	0	0	121	
		724	**8**	**376**	**348**	
126	1	415	2	104	311	**394**
	2	76	0	0	76	
	3	5	0	0	5	
	4	2	0	0	2	
		498	**2**	**104**	**394**	
132	1	591	0	546	45	**249**
	2	192	0	0	192	
	3	11	0	0	11	
	5	1	0	0	1	
		795	**0**	**546**	**249**	
152	1	168	0	66	102	**193**
	2	86	0	0	86	
	3	4	0	0	4	
	5	1	0	0	1	
		259	**0**	**66**	**193**	

Permit Area Number	Preference Level	Applications		Unsuccessful	Winners	Permits Available
		Total	Rejected			
159	1	927	3	927	0	**1,473**
	2	682	3	61	621	
	3	681	5	0	681	
	4	170	2	0	170	
	7	1	0	0	1	
		2,461	**13**	**988**	**1,473**	
169	1	2,477	12	2,354	123	**1,981**
	2	1,419	7	0	1,419	
	3	375	2	0	375	
	4	58	0	0	58	
	5	5	0	0	5	
	9	1	0	0	1	
		4,335	**21**	**2,354**	**1,981**	
173	1	596	2	596	0	**980**
	2	516	3	418	98	
	3	553	2	0	553	
	4	327	1	0	327	
	5	2	0	0	2	
		1,994	**8**	**1,014**	**980**	
176	1	821	2	821	0	**1,484**
	2	1,023	4	160	863	
	3	607	1	0	607	
	5	12	0	0	12	
	6	1	0	0	1	
	9	1	0	0	1	
		2,465	**7**	**981**	**1,484**	
178	1	1,178	2	1,178	0	**987**
	2	1,968	6	1,040	928	
	3	47	0	0	47	
	4	9	0	0	9	
	5	2	0	0	2	
	9	1	0	0	1	
		3,205	**8**	**2,218**	**987**	
181	1	823	1	0	823	**1,977**
	2	1,022	3	0	1,022	
	3	26	0	0	26	
	4	9	0	0	9	
		1,880	**4**	**0**	**1,880**	

Permit Area Number	Preference Level	Applications Total	Applications Rejected	Unsuccessful	Winners	Permits Available
183	1	1,197	4	1,197	0	**983**
	2	1,367	7	839	528	
	3	416	1	0	416	
	4	34	2	0	34	
	5	1	0	0	1	
	6	1	0	0	1	
	9	3	0	0	3	
		3,019	**14**	**2,036**	**983**	
197	1	744	2	744	0	**492**
	2	490	0	490	0	
	3	490	2	490	0	
	4	533	7	41	492	
	5	0	1	0	0	
		2,257	**12**	**1,765**	**492**	
199	1	110	0	50	60	**100**
	2	32	0	0	32	
	3	6	0	0	6	
	4	2	0	0	2	
		150	**0**	**50**	**100**	
224	1	145	1	0	145	**296**
	2	90	0	0	90	
	3	2	0	0	2	
	4	1	0	0	1	
		238	**1**	**0**	**238**	
234	1	109	1	109	0	**93**
	2	112	1	20	92	
	3	1	0	0	1	
		222	**2**	**129**	**93**	
235	1	62	0	26	36	**63**
	2	20	0	0	20	
	3	5	0	0	5	
	4	2	0	0	2	
		89	**0**	**26**	**63**	
237	1	92	0	92	0	**47**
	2	151	1	151	0	
	3	71	2	25	46	
	4	1	0	0	1	
		315	**3**	**268**	**47**	

Permit Area Number	Preference Level	Applications Total	Applications Rejected	Unsuccessful	Winners	Permits Available
238	1	54	0	54	0	**49**
	2	44	0	12	32	
	3	17	0	0	17	
		115	**0**	**66**	**49**	
250	1	300	1	300	0	**274**
	2	253	0	48	205	
	3	69	0	0	69	
		622	**1**	**348**	**274**	
251	1	184	1	76	108	**192**
	2	76	0	0	76	
	3	8	0	0	8	
		268	**1**	**76**	**192**	
252	1	360	1	164	196	**375**
	2	169	2	0	169	
	3	9	0	0	9	
	5	1	0	0	1	
		539	**3**	**164**	**375**	
253	1	344	0	344	0	**345**
	2	281	1	135	146	
	3	197	1	0	197	
	4	2	0	0	2	
		824	**2**	**479**	**345**	
262	1	180	3	64	116	**274**
	2	131	1	0	131	
	3	27	0	0	27	
		338	**4**	**64**	**274**	
266	1	423	0	202	221	**473**
	2	213	2	0	213	
	3	38	1	0	38	
	4	1	0	0	1	
		675	**3**	**202**	**473**	
269	1	163	1	163	0	**136**
	2	207	0	191	16	
	3	120	0	0	120	
	4	0	1	0	0	
		490	**2**	**354**	**136**	

Permit Area Number	Preference Level	Applications Total	Applications Rejected	Unsuccessful	Winners	Permits Available
270	1	89	0	89	0	**23**
	2	103	0	103	0	
	3	84	0	84	0	
	4	59	0	36	23	
		335	**0**	**312**	**23**	
271	1	258	0	124	134	**323**
	2	180	1	0	180	
	3	6	1	0	6	
	4	3	0	0	3	
		447	**2**	**124**	**323**	
272	1	149	0	149	0	**194**
	2	155	1	101	54	
	3	109	0	0	109	
	4	30	1	0	30	
	9	1	0	0	1	
		444	**2**	**250**	**194**	
274	1	276	1	276	0	**218**
	2	216	1	24	192	
	3	23	0	0	23	
	4	2	0	0	2	
	9	1	0	0	1	
		518	**2**	**300**	**218**	
275	1	266	0	266	0	**235**
	2	257	2	243	14	
	3	217	0	0	217	
	4	4	1	0	4	
		744	**3**	**509**	**235**	
278	1	268	1	268	0	**175**
	2	247	0	247	0	
	3	239	1	176	63	
	4	111	0	0	111	
	7	1	1	0	1	
		866	**3**	**691**	**175**	
279	1	427	1	45	382	**517**
	2	124	1	0	124	
	3	10	0	0	10	
	4	1	0	0	1	
		562	**2**	**45**	**517**	

Permit Area Number	Preference Level	Applications Total	Applications Rejected	Unsuccessful	Winners	Permits Available
280	1	216	1	216	0	**93**
	2	180	0	172	8	
	3	82	0	0	82	
	4	2	0	0	2	
	5	0	1	0	0	
	9	1	0	0	1	
		481	**2**	**388**	**93**	
282	1	62	0	62	0	**24**
	2	60	0	60	0	
	3	41	0	40	1	
	4	23	0	0	23	
		186	**0**	**162**	**24**	
283	1	211	0	211	0	**185**
	2	194	0	157	37	
	3	147	0	0	147	
	6	1	0	0	1	
		553	**0**	**368**	**185**	
284	1	308	1	308	0	**190**
	2	316	2	313	3	
	3	181	1	0	181	
	4	4	0	0	4	
	5	2	0	0	2	
		811	**4**	**621**	**190**	
285	1	361	1	361	0	**280**
	2	378	3	378	0	
	3	338	0	61	277	
	4	3	0	0	3	
	5	0	1	0	0	
		1,080	**5**	**800**	**280**	
286	1	185	0	185	0	**181**
	2	257	0	131	126	
	3	53	0	0	53	
	4	2	0	0	2	
		497	**0**	**316**	**181**	
288	1	470	0	371	99	**462**
	2	348	0	0	348	
	3	13	2	0	13	
	4	2	0	0	2	
		833	**2**	**371**	**462**	

Permit Area Number	Preference Level	Applications Total	Applications Rejected	Unsuccessful	Winners	Permits Available
289	1	295	0	7	288	**407**
	2	108	0	0	108	
	3	9	1	0	9	
	4	1	0	0	1	
	9	1	0	0	1	
		414	**1**	**7**	**407**	
291	1	745	2	745	0	**735**
	2	704	2	242	462	
	3	271	1	0	271	
	4	2	2	0	2	
		1,722	**7**	**987**	**735**	
294	1	409	1	96	313	**458**
	2	135	1	0	135	
	3	8	0	0	8	
	4	1	1	0	1	
	5	1	0	0	1	
		554	**3**	**96**	**458**	
295	1	344	2	344	0	**269**
	2	296	0	253	43	
	3	224	1	0	224	
	4	1	2	0	1	
	5	1	0	0	1	
		866	**5**	**597**	**269**	
296	1	305	1	305	0	**269**
	2	263	0	172	91	
	3	175	1	0	175	
	4	3	0	0	3	
		746	**2**	**477**	**269**	
297	1	131	0	131	0	**98**
	2	95	0	46	49	
	3	49	0	0	49	
		275	**0**	**177**	**98**	
299	1	358	1	343	15	**352**
	2	302	1	0	302	
	3	32	1	0	32	
	4	2	1	0	2	
	5	1	0	0	1	
		695	**4**	**343**	**352**	
TOTAL		**45,001**	**180**	**24,616**	**20,385**	**20,540**

Table 15. 2017 Muzzleloader Lottery Distribution Report.

Permit Area Number	**Preference Level**	**Applications**		**Unsuccessful**	**Winners**	**Permits Available**
		Total	**Rejected**			
103	1	3	0	3	0	**4**
	2	6	0	3	3	
	3	1	0	0	1	
		10	**0**	**6**	**4**	
108	1	11	0	11	0	**2**
	2	6	0	6	0	
	3	4	0	4	0	
	4	2	0	1	1	
	5	1	0	0	1	
		24	**0**	**22**	**2**	
111	1	1	0	1	0	**2**
	2	2	0	1	1	
	3	1	0	0	1	
		4	**0**	**2**	**2**	
126	1	7	0	2	5	**6**
	2	1	0	0	1	
		8	**0**	**2**	**6**	
132	1	4	0	3	1	**1**
		4	**0**	**3**	**1**	
152	1	7	0	2	5	**7**
	2	1	0	0	1	
	4	1	0	0	1	
		9	**0**	**2**	**7**	
159	1	28	0	18	10	**27**
	2	10	0	0	10	
	3	7	0	0	7	
		45	**0**	**18**	**27**	
169	1	27	0	23	4	**19**
	2	14	0	0	14	
	3	1	0	0	1	
		42	**0**	**23**	**19**	
173	1	23	0	20	3	**20**
	2	10	0	0	10	
	3	7	0	0	7	
		40	**0**	**20**	**20**	

Permit Area Number	Preference Level	Applications Total	Applications Rejected	Unsuccessful	Winners	Permits Available
176	1	13	0	10	3	**16**
	2	13	0	0	13	
		26	**0**	**10**	**16**	
178	1	27	0	27	0	**13**
	2	16	0	3	13	
		43	**0**	**30**	**13**	
181	1	11	0	0	11	**23**
	2	11	0	0	11	
		22	**0**	**0**	**22**	
183	1	26	0	26	0	**17**
	2	20	0	8	12	
	3	4	0	0	4	
	4	1	0	0	1	
		51	**0**	**34**	**17**	
197	1	21	0	21	0	**8**
	2	7	0	6	1	
	3	5	0	0	5	
	4	2	0	0	2	
		35	**0**	**27**	**8**	
224	1	2	0	0	2	**4**
	2	1	0	0	1	
		3	**0**	**0**	**3**	
234	1	7	1	7	0	**7**
	2	8	0	1	7	
		15	**1**	**8**	**7**	
235	1	12	0	2	10	**12**
	2	2	0	0	2	
		14	**0**	**2**	**12**	
237	1	6	0	6	0	**3**
	2	12	0	10	2	
	3	1	0	0	1	
		19	**0**	**16**	**3**	
238	1	2	0	1	1	**1**
		2	**0**	**1**	**1**	
250	1	31	0	27	4	**26**
	2	22	0	0	22	
		53	**0**	**27**	**26**	

Permit Area Number	Preference Level	Applications		Unsuccessful	Winners	Permits Available
		Total	Rejected			
251	1 2 3	7 3 1 **11**	0 0 0 **0**	3 0 0 **3**	4 3 1 **8**	**8**
252	1 2 3	20 13 1 **34**	0 0 0 **0**	9 0 0 **9**	11 13 1 **25**	**25**
253	1 2 3	54 50 9 **113**	0 0 0 **0**	54 4 0 **58**	0 46 9 **55**	**55**
262	1 2 3	19 9 1 **29**	0 0 0 **0**	3 0 0 **3**	16 9 1 **26**	**26**
266	1 2	26 11 **37**	0 0 **0**	10 0 **10**	16 11 **27**	**27**
269	1 2 3	18 25 2 **45**	0 0 0 **0**	18 13 0 **31**	0 12 2 **14**	**14**
270	1 2 3 4	9 7 4 3 **23**	0 0 0 0 **0**	9 7 4 1 **21**	0 0 0 2 **2**	**2**
271	1 2	25 10 **35**	0 0 **0**	8 0 **8**	17 10 **27**	**27**
272	1 2 3	7 5 2 **14**	0 0 0 **0**	7 1 0 **8**	0 4 2 **6**	**6**
274	1 2 3	38 26 2 **66**	0 0 0 **0**	34 0 0 **34**	4 26 2 **32**	**32**

Permit Area Number	Preference Level	Applications		Unsuccessful	Winners	Permits Available
		Total	Rejected			
275	1	16	0	16	0	**15**
	2	20	1	15	5	
	3	9	0	0	9	
	9	1	0	0	1	
		46	**1**	**31**	**15**	
278	1	46	0	46	0	**25**
	2	30	0	30	0	
	3	30	0	6	24	
	4	1	0	0	1	
		107	**0**	**82**	**25**	
279	1	67	0	0	67	**83**
	2	10	0	0	10	
	3	1	0	0	1	
		78	**0**	**0**	**78**	
280	1	17	0	17	0	**7**
	2	19	0	12	7	
		36	**0**	**29**	**7**	
282	1	5	0	5	0	**1**
	2	2	0	2	0	
	3	2	0	1	1	
		9	**0**	**8**	**1**	
283	1	22	1	22	0	**15**
	2	13	0	5	8	
	3	7	0	0	7	
		42	**1**	**27**	**15**	
284	1	28	0	28	0	**10**
	2	10	0	4	6	
	3	4	0	0	4	
		42	**0**	**32**	**10**	
285	1	38	0	38	0	**20**
	2	25	0	15	10	
	3	10	0	0	10	
		73	**0**	**53**	**20**	
286	1	24	0	24	0	**19**
	2	24	0	5	19	
		48	**0**	**29**	**19**	
288	1	40	0	25	15	**38**
	2	23	0	0	23	
		63	**0**	**25**	**38**	

Permit Area Number	Preference Level	Applications		Unsuccessful	Winners	Permits Available
		Total	Rejected			
289	1 2 3	30 9 1 **40**	0 0 0 **0**	0 0 0 **0**	30 9 1 **40**	**43**
291	1 2 3	74 59 7 **140**	0 0 0 **0**	74 1 0 **75**	0 58 7 **65**	**65**
294	1 2	41 6 **47**	0 0 **0**	5 0 **5**	36 6 **42**	**42**
295	1 2 3	44 30 16 **90**	0 0 0 **0**	44 15 0 **59**	0 15 16 **31**	**31**
296	1 2 3	38 30 9 **77**	0 0 0 **0**	38 8 0 **46**	0 22 9 **31**	**31**
297	1 2	3 2 **5**	0 0 **0**	3 0 **3**	0 2 **2**	**2**
299	1 2 3	48 33 2 **83**	0 0 0 **0**	35 0 0 **35**	13 33 2 **48**	**48**
TOTAL		**1,902**	**3**	**977**	**925**	**935**

Table 16. 2017 Special Firearms Hunt Lottery Distribution Report.

Special Hunt	Preference Level	Applications Total	Applications Rejected	Unsuccessful	Winners	Permits Available
900 - Cascade River SP	1 2 3	21 1 1 **23**	0 0 0 **0**	0 0 0 **0**	21 1 1 **23**	**100**
901 - Rice Lake NWR	1 2	43 20 **63**	0 0 **0**	21 0 **21**	22 20 **42**	**40**
902 - St. Croix SP	1 2 3	333 162 7 **502**	0 0 0 **0**	151 0 0 **151**	182 162 7 **351**	**350**
904 - Gooseberry Falls SP	1 2	43 11 **54**	0 0 **0**	24 0 **24**	19 11 **30**	**30**
905 - Split Rock Lighthouse SP	1 2	30 8 **38**	0 0 **0**	5 0 **5**	25 8 **33**	**30**
906 - Tettegouche SP	1 2	95 5 **100**	0 0 **0**	0 0 **0**	95 5 **100**	**125**
907 - Scenic SP	1 2 3	20 7 1 **28**	0 0 0 **0**	0 0 0 **0**	20 7 1 **28**	**30**
908 - Hayes Lake SP	1 2 3	46 3 1 **50**	0 0 0 **0**	0 0 0 **0**	46 3 1 **50**	**75**
909 - Lake Bemidji SP	1 2	25 14 **39**	0 0 **0**	8 0 **8**	17 14 **31**	**30**
910 - Zippel Bay SP	1 2 3 4	66 15 1 1 **83**	0 0 0 0 **0**	8 0 0 0 **8**	58 15 1 1 **75**	**75**
911 - Judge CR Magney SP	1 3 9	21 1 1 **23**	0 0 0 **0**	0 0 0 **0**	21 1 1 **23**	**75**
913 - Lake Carlos SP	1 2	22 2 **24**	0 0 **0**	2 0 **2**	20 2 **22**	**20**

Special Hunt	Preference Level	Applications		Unsuccessful	Winners	Permits Available
		Total	Rejected			
914 - William O'Brien SP	1	102	0	102	0	**50**
	2	79	0	49	30	
	3	13	0	0	13	
	4	4	0	0	4	
	9	4	0	0	4	
		202	**0**	**151**	**51**	
915 - Lake Bronson SP	1	49	0	41	8	**30**
	2	20	0	0	20	
	3	2	0	0	2	
		71	**0**	**41**	**30**	
916 - Maplewood SP	1	164	0	164	0	**100**
	2	144	0	144	0	
	3	95	0	8	87	
	4	13	0	0	13	
	9	2	0	0	2	
		418	**0**	**316**	**102**	
919 - Glacial Lakes SP	1	42	0	16	26	**30**
	2	5	0	0	5	
		47	**0**	**16**	**31**	
920 - Zumbro Falls Woods SNA	1	18	0	13	5	**12**
	2	7	0	0	7	
		25	**0**	**13**	**12**	
922 - Old Mill SP	1	19	0	19	0	**10**
	2	22	0	11	11	
	3	1	0	0	1	
	4	1	0	0	1	
		43	**0**	**30**	**13**	
923 - Zumbro Falls Woods SNA	1	12	0	0	12	**12**
		12	**0**	**0**	**12**	
925A - Vermillion Highlands WMA	1	26	0	26	0	**18**
	2	29	0	29	0	
	3	21	0	4	17	
	9	1	0	0	1	
		77	**0**	**59**	**18**	
925B - Vermillion Highlands WMA	1	7	0	7	0	**2**
	2	2	0	0	2	
		9	**0**	**7**	**2**	
927 - Whitewater SP	1	65	0	55	10	**50**
	2	36	0	0	36	
	3	4	0	0	4	
		105	**0**	**55**	**50**	

Special Hunt	Preference Level	Applications Total	Applications Rejected	Unsuccessful	Winners	Permits Available
930A - Carver Park Reserve	1 2 3 4 9	179 135 75 4 1 **394**	0 0 0 0 0 **0**	179 109 0 0 0 **288**	0 26 75 4 1 **106**	**104**
930B - Carver Park Reserve	1 2 3	12 4 5 **21**	0 0 0 **0**	12 3 0 **15**	0 1 5 **6**	**6**
931 - City of Grand Rapids	1 2 3	47 2 3 **52**	0 0 0 **0**	0 0 0 **0**	47 2 3 **52**	**52**
933 - Forestville - Mystery Cave SP	1 2 3	68 53 2 **123**	0 0 0 **0**	0 0 0 **0**	68 53 2 **123**	**130**
934 - Whitewater State Game Refuge	1 2	61 33 **94**	0 0 **0**	17 0 **17**	44 33 **77**	**75**
962- Great River Bluffs SP	1 2 3	50 11 3 **64**	0 0 0 **0**	14 0 0 **14**	36 11 3 **50**	**50**
TOTAL		**2,784**	**0**	**1,241**	**1,543**	**1,711**

Table 17. 2017 Special Muzzleloader Hunt Lottery Distribution Report.

Special Hunt	Preference Level	Applications Total	Applications Rejected	Unsuccessful	Winners	Permits Available
921 - Minneopa SP	1 2 3	28 16 11 **55**	0 0 0 **0**	28 12 0 **40**	0 4 11 **15**	**12**
935 - Jay Cooke SP	1 2 3 9	107 52 10 1 **170**	0 0 0 0 **0**	95 0 0 0 **95**	12 52 10 1 **75**	**75**
936 - Crow Wing SP	1 2 3 9	45 24 7 1 **77**	0 0 0 0 **0**	45 6 0 0 **51**	0 18 7 1 **26**	**25**
937 - Soudan Underground Mine and Lake Vermillion SP	1 2 3	13 14 1 **28**	0 0 0 **0**	3 0 0 **3**	10 14 1 **25**	**25**
938 - City of Tower	1	11 **11**	0 **0**	0 **0**	11 **11**	**20**
939 - Myre-Big Island SP	1 2 3 9	50 51 11 1 **113**	0 0 0 0 **0**	50 13 0 0 **63**	0 38 11 1 **50**	**50**
940 - Frontenac SP	1 2 3	112 37 7 **156**	0 0 0 **0**	106 0 0 **106**	6 37 7 **50**	**50**
942 - Sibley SP	1 2 3 4 9	72 52 3 1 1 **129**	0 0 0 0 0 **0**	69 0 0 0 0 **69**	3 52 3 1 1 **60**	**60**
944 - Vermillion Highlands WMA	1 2 3	36 10 2 **48**	0 0 0 **0**	28 0 0 **28**	8 10 2 **20**	**20**
946 - City of Grand Rapids	1	10 **10**	0 **0**	0 **0**	10 **10**	**10**
947 - Lake Bemidji SP	1 2	25 4	0 0	0 0	25 4	**30**

Special Hunt	**Preference Level**	**Applications Total**	**Applications Rejected**	**Unsuccessful**	**Winners**	**Permits Available**
		29	**0**	**0**	**29**	
948 - Savanna Portage SP	1	15	0	0	15	**30**
		15	**0**	**0**	**15**	
949 - St. Croix SP	1	79	0	0	79	**100**
	2	7	0	0	7	
	3	1	0	0	1	
		87	**0**	**0**	**87**	
992 - Sakatah Lake SP	1	17	0	17	0	**15**
	2	10	0	5	5	
	3	5	0	0	5	
	4	4	0	0	4	
	5	1	0	0	1	
		37	**0**	**22**	**15**	
TOTAL		**965**	**0**	**477**	**488**	**522**
GRAND TOTAL		**50,652**	**183**	**27,311**	**23,341**	**23,708**

2017 MINNESOTA ELK HARVEST REPORT

Erik Thorson, Acting Big Game Program Leader

Ruth Anne Franke, Area Wildlife Supervisor (Karlstad)

Jason Wollin, Asst. Area Wildlife Manager (Karlstad)

Kyle Arola, Acting Wildlife Area Supervisor (Thief Lake)

INTRODUCTION

A limited number of licenses are offered to Minnesota residents to hunt elk. In 2017, there were two established zones open for elk hunting: 1) Zone 20 - Kittson County Central and 2) Zone 30 - Kittson County Northeast (Figure 1). Elk hunting in Zone 10, near Grygla, Minnesota, has been closed since 2013 because the population is below goal (Figure 2). In 2017, there were two regular season hunts held in both open zones: 1) Season A - September 9 through September 17 and 2) Season B - October 7 through October 15. The hunts were structured to fall within the breeding season when bull elk are most vulnerable and elk can be located by vocalizations.

METHODS

All elk hunters are required to attend a mandatory orientation session the day before their respective hunts begin. At this session, DNR staff provide hunters with their license and a kit to collect biological samples from their harvested animal. Field samples collected by the hunter include blood, hair with skin, muscle tissue, ticks (if found), and the whole liver. Hunters must register their animal in person within 24 hours at the local DNR office. DNR staff help map the harvest location, provide a possession tag, and take the hunter-collected biological samples. DNR staff also collect lymph nodes, the obex (brain stem), the whole brain (with consent), and a tooth so an accurate age can be determined at a later date. Alternative arrangements are made for the collection of some samples, if immediate collection would interfere with a hunter's planned taxidermy mount. DNR staff submit all biological samples to Wildlife Health for disease testing and other monitoring projects.

RESULTS

A total of 13 licenses (including one landowner permit each for Zones 20 and 30) were available and 1,695 individuals or parties (up to two hunters) applied for the opportunity to hunt elk for both zones and seasons (Table 1). Applicants were given the opportunity to select both zone and season in which to hunt. First, random drawings were held for landowners in their respective zones. Once landowner licenses were drawn and selected, two more drawings were held in the second round for applicants that had applied for 10 years or more and one elk license was drawn for each zone. All remaining landowners were then placed into the general drawing with all the other applicants for the remaining elk licenses available in the zone and season they had selected on their application. These licenses were distributed through a third random drawing conducted per zone.

In 2017, a total of 10 elk were harvested in zones 20 and 30 (Table 2). Long-term elk harvest for all zones is depicted in Tables 3 and 4.

Table 1. License allocation and application numbers of the 2017 Minnesota elk seasons

KITTSON COUNTY SEASON A

Zone	Either-Sex	Antlerless	Bull-only	Total	Total Applicants
Zone 20 – Kittson Central	0	1	3	4	595
Zone 30 – Kittson Northeast	0	0	2	2	463
Total	**0**	**1**	**5**	**6**	**1,058**

KITTSON COUNTY SEASON B

Zone	Either-Sex	Antlerless	Bull-only	Total	Total Applicants
Zone 20 – Kittson Central	0	1	3	4	303
Zone 30 – Kittson Northeast	0	0	3	3	334
Total	**0**	**1**	**6**	**7**	**637**

Table 2. Distribution of the 2017 Minnesota elk harvest.

KITTSON COUNTY CENTRAL HUNT ZONE (20)

Season	Bulls-only Licenses	Antlerless Licenses	Bulls taken	Antlerless taken	Total elk taken
Season A (Sept 9 – 17)	3	1	3	1	4
Season B (Oct 7 – 15)	3	1	2	0	2
Total	**6**	**2**	**5**	**1**	**6**

KITTSON COUNTY NORTHEAST HUNT ZONE (30)

Season	Bulls-only Licenses	Antlerless Licenses	Bulls taken	Antlerless taken	Total elk taken
Season A (Sept 9 – 17)	2	0	2	0	2
Season B (Oct 7 – 15)	3	0	2	0	2
Total	**5**	**0**	**4**	**0**	**4**

Table 3. Grygla elk harvests, 1987-2017

	Grygla Elk Harvests			
	Bulls (or Either-Sex)		**Antlerless**	
Year	**Permits**	**Harvest**	**Permits**	**Harvest**
1987	2	1	2	1
1996	2	2	7 (1 alternate)	6
1997	5 (2 alternate)	1	5 (2 alternate)	2
1998	4 (2 alternate)	2	0	0
2004	1	1	4	2
2005	1	0	4	0
2006	2	2	6	2
2007	0	0	6	6
2008	2	2	10	6
2009	2	3*	12	11
2010	2	1	5	3
2011	2	2	3	0
2012	2	1	3	0
2013	Closed	0	Closed	0
2014	Closed	0	Closed	0
2015	Closed	0	Closed	0
2016	Closed	0	Closed	0
2017	Closed	0	Closed	0
Total	**27**	**18**	**67**	**39**

*One bull was a sub-legal spike and was legally tagged as an antlerless animal.

Table 4. Kittson County elk harvests, 2008-2017

	Kittson County (Combined Zone 20 & 30)			
	Bulls (or Either-Sex)		Antlerless	
Year	**Permits**	**Harvest**	**Permits**	**Harvest**
2008	1	1	10	10
2009	12	9[a]	4	5
2010	1	1	3	3
2011	2	3[b]	8[c]	4
2012	5	4[d]	13	3
2013	8	6	15	6
2014	9	6	0	0
2015	7	5	0	0
2016	7	5	0	0
2017	11	9	2	1
Total	**63**	**49**	**55**	**32**

[a] One additional bull (6x7) was wounded but not retrieved in 2009. It was found dead later and is counted in the total.

[b] One bull was a male calf and was legally tagged as an antlerless animal.

[c] Three unsuccessful hunters from t8.5

he Grygla zone were invited to participate in the January extended season in Kittson County, however only 2 participated and were included in the number of antlerless permits issued.

[d] One bull was a sub-legal spike and was confiscated.

Figure 1. Kittson County Elk Hunt Zones.

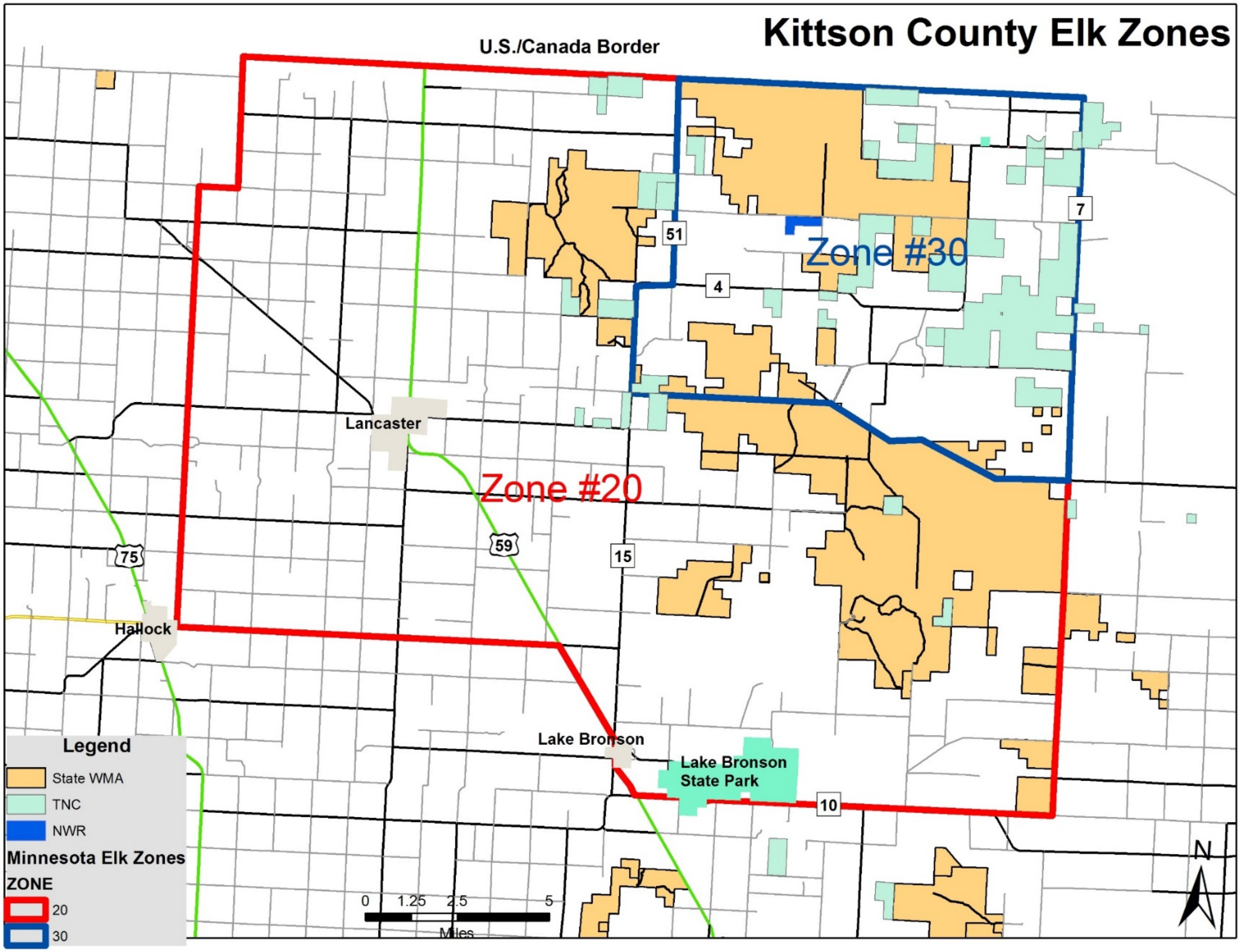
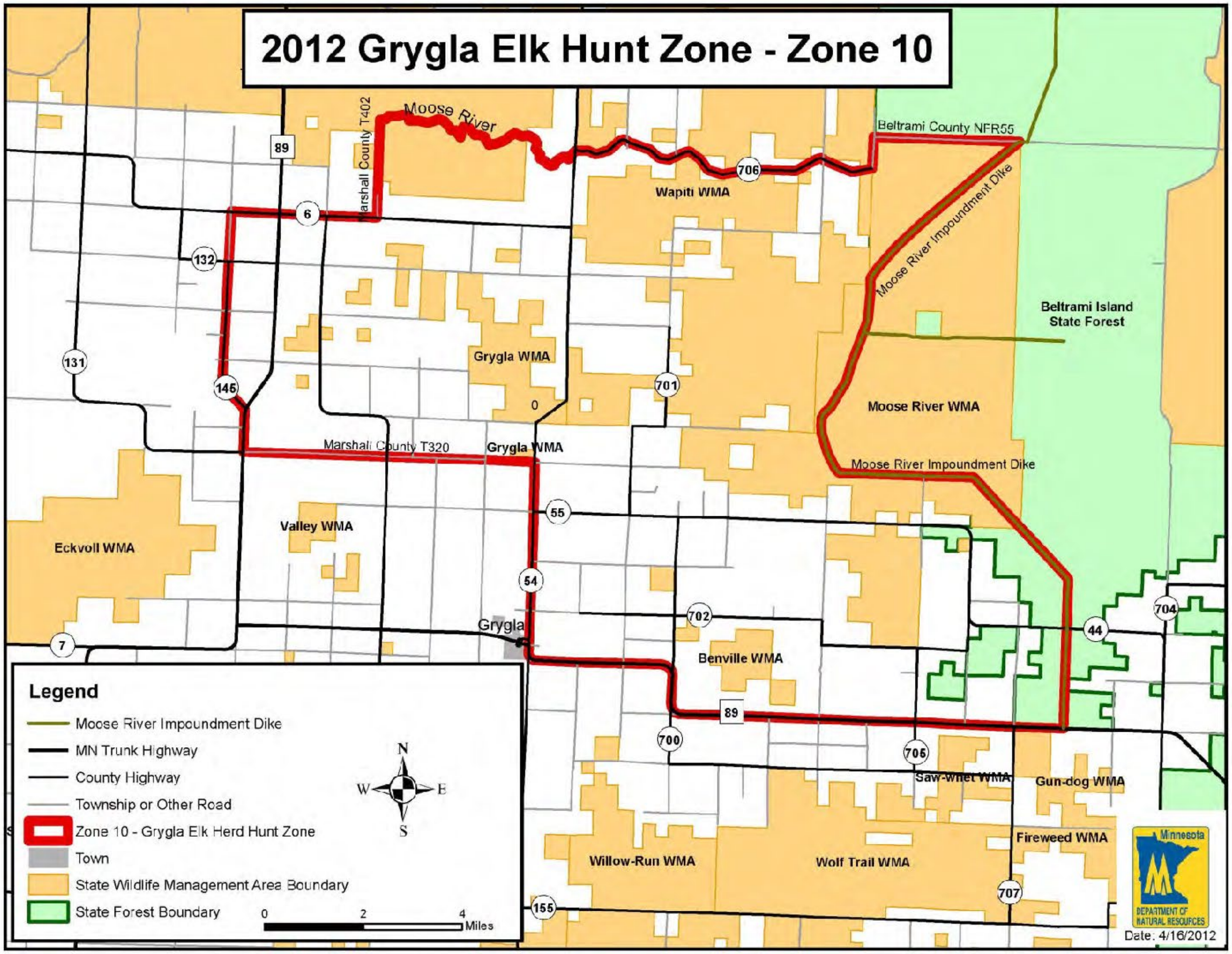


Figure 2. Grygla Elk Hunt Zone



MINNESOTA SANDHILL CRANE HARVEST REPORT, 2017

Margaret Dexter, Wildlife Research Unit

Two distinct populations of sandhill cranes (*Grus Canadensis*) occur in Minnesota. Sandhill cranes that breed and stage during fall in NW Minnesota are part of the Mid-continent population whereas sandhill cranes in the remainder of the state are part of the Eastern population. The Mid-continent population, including cranes in NW Minnesota is managed via a cooperative management plan with the U.S. Fish and Wildlife Service, Mississippi, Central, and Pacific Flyway Councils.

A limited season for Mid-continent sandhill cranes was opened in Minnesota's Northwest Goose Zone (Figure 1) beginning in 2010. The season was open from the first Saturday in September through the second Sunday in October for the first two years with a daily limit of 2 and a possession limit of 4 (Table 1). In 2012 the season was shifted to a week later but the limits remained the same. The possession limit increased from 4 to 6 in 2013. In 2014 limits were reduce to 1 daily and 3 in possession. The season was shifted to open the third Saturday in September and close the fourth Sunday in October in 2017 with no changes to the daily and possession limits. Hunters were required to purchase a $3.00 sandhill crane permit. A sample of sandhill crane permit holders were selected to receive a harvest survey from the U.S. Fish and Wildlife Service after the season. This survey is used to monitor harvest levels and hunting activity (Table 2).

LITERATURE CITED

Central Flyway Webless Migratory Bird Technical Committee. 2006. Management Guidelines for the Mid-Continent Population of Sandhill Cranes. Special Report in files of the Central Flyway Representative. Denver, Colorado.

Dubovsky, J.A. 2016. Status and harvests of sandhill cranes:Mid-Continent, Rocky Mountain, Lower Colorado River Valley and Eastern Populations. Administrative Report, U.S. Fish and Wildlife Service, Denver, Colorado. 15pp.) http://www.fws.gov/migratorybirds/NewReportsPublications/PopulationStatus.html

Table 1. Sandhill Crane season dates and limits in Minnesota, 2010 – 2017.

Year	Dates	Daily limit	Possession limit
2010	4 Sept – 10 Oct	2	4
2011	3 Sept – 9 Oct	2	4
2012	15 Sept – 21 Oct	2	4
2013	14 Sept – 20 Oct	2	6
2014	13 Sept – 19 Oct	1	3
2015	12 Sept – 18 Oct	1	3
2016	10 Sept – 16 Oct	1	3
2017	16 Sept – 22 Oct	1	3

Table 2. Sandhill crane permit sales, estimated number of active hunters and harvest for NW Minnesota, 2010-2017. (Kruse, K.L. et al. 2015).

Year	Number of Permits	Active Hunters	Harvest
2010	1,954	964	830
2011	1,342	643	765
2012	1,032	410	407
2013	1,086	485	378
2014	1,216	401	247
2015	1,199	424	212
2016	1,139	471	287
2017	1,125	397	196

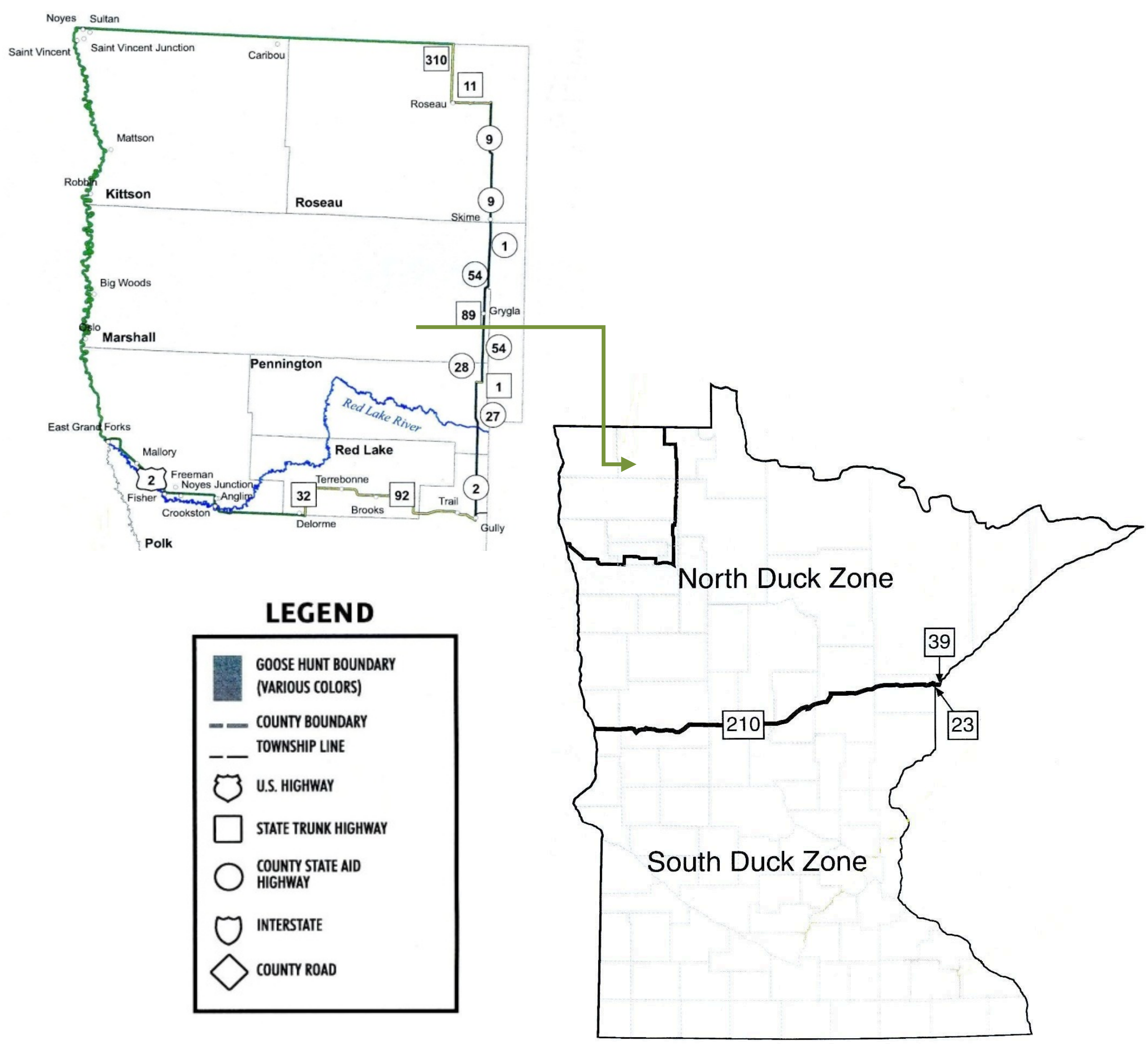


Figure 1. Sandhill crane hunting zone in Minnesota, 2010-2017.

TRAPPING HARVEST STATISTICS

Division of Fish and Wildlife
500 Lafayette Road, Box 20
Saint Paul, MN 55155-4020
(651) 259-5207

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2017 TRAPPER HARVEST SURVEY

Margaret Dexter, Wildlife Research Unit

INTRODUCTION

The Minnesota Department of Natural Resources (MNDNR) annually conducts a mail survey of licensed trappers. Annual harvest estimates from the survey data are used to help assess and set trapping regulations and season structure. Beginning in 2000, survey cards were sent to all trappers with a valid mailing address. Beginning in 2017, due to data privacy rules we excluded license holders <18 years old at the time of the survey. Information concerning registered harvest (fisher, marten, bobcat, and otter) is obtained from mandatory registration of these animals. Details regarding methods and results can be found in the Registered Furbearer Harvest report on the DNR website.

METHODS

The sampling frame consisted of all individuals with active MNDNR trapping licenses (all types) except for youth <18 years old who were excluded from the survey, listed in the Electronic License System (ELS) database in late February 2018. There were 7,163 active trapping licenses in the ELS database, which consisted of 5,192 Resident Regular Trappers, 22 age - eligible (of 225) Resident Junior Trappers, 1,160 Resident Senior Trappers, 555 "active" Lifetime Trappers, and 12 Nonresident (MN landowners) license holders. License type was reclassified as "adult" (regular, lifetime, and non-resident) or "youth" for analysis purposes.

The MNDNR Trapper Harvest Survey is a census but the response rate is <100% (mean = 69%, range: 56–79%). Thus, uncertainty in harvest estimates is strictly a function of non-response (missing data) rather than random sampling. However, if non-response (unit and item) is completely random then data from respondents can be treated as a random sample, which is how the Trapper Harvest Survey has been analyzed historically. The critical assumption is that non-response is completely random (e.g., if you repeated the survey, non-respondents would be a random subset of licensed trappers). For consistency with previous analyses, the response data was treated as a random sample.

A postcard survey (Figure 1) was sent to all trapping license holders with a valid mailing address at the close of the license year. Trappers that returned the survey questionnaire within three weeks were marked returned and eliminated from follow-up mailings. A single follow-up mailing was sent to non-respondents. Returned questionnaires were checked for completeness, consistency, and biological practicability. Cards were marked with numeric county codes corresponding to the trapper's written information. Data from each usable card was converted to an electronic database. Duel key-entry and quality control checks were used to minimize transcription errors. Data was tabulated using Viking Data Entry VDE+ software and statistically analyzed using R programming language (R version 3.5.0 (2018-04-23); R Development Core Team 2018) to summarize responses.

RESULTS

We mailed out 6,941 surveys, 88 surveys were undeliverable and 3,926 were returned for an adjusted response rate of 57.3%. Sixty eight percent of respondents reported setting traps for at least one species (Table 1, Figure 2). Historic trapper estimates are presented in Table 2, Table 3, and Table 4.

ACKNOWLEDGMENTS

This project was funded in part by the Wildlife Restoration Program. Special thanks to John Giudice for continued statistical support and critical review.

DEPARTMENT OF NATURAL RESOURCES
500 Lafayette Road Box 20
St Paul MN 55155

RETURN SERVICE REQUESTED

Presorted
First-Class Mail
US Postage
PAID
Twin Cities MN
Permit No 171

Dear Trapper:

You are being asked as a trapping license buyer to assist us in evaluating the 2017-2018 trapping season **(March 2017-February 2018)**. For Spring Beaver, please report only animals taken between March 2017 and May 15, 2017. We need this information to estimate the season's harvest and to help set future furbearer trapping seasons. Similar to past years we are also asking for the **average number of traps you checked per day** for each species. If a trap is set for multiple species, count the trap for both species when answering the question. For example, if you ran 20 mink/coon traps each day, enter 20 traps/day for both mink and coon.

YOUR RESPONSE IS NEEDED
EVEN IF YOU DID NOT SET TRAPS THIS YEAR.

Please fill out the attached questionnaire and mail as soon as possible. A reminder will be sent to individuals not returning the questionnaire within three weeks. No envelope or stamp is necessary; just tear along the perforation and drop into a mailbox.

THANK YOU FOR YOUR COOPERATION

Lou Cornicelli, Wildlife Research Program Manager
Division of Fish and Wildlife
Department of Natural Resources

2017 Trapper Report

1. Did you set traps / snares in Minnesota during the 2017-2018 trapping season?
☐ No ☐ Yes (Please check one)
2. Indicate your harvest, the number of days you trapped for each species, the average number of traps you checked PER DAY for each species, and the county in which you trapped **most** for each species. Report only animals **YOU personally** trapped in Minnesota. Animals taken by hunting should **NOT** be reported here.

Species Trapped		*Number YOU Trapped All Season*	*# Days Trapped All Season*	*Average # Traps/Snares Checked Per Day*	*County You Trapped In Most*
Muskrat	80				
Mink	32				
Gray Fox	96				
Striped skunk	34				
Coyote (brush wolf)	97				
Beaver (Mar-May '17)	81				
Beaver (Oct '17-Feb '18)	82				
Pine marten	37				
Otter	38				
Fisher	36				
Badger	35				
Long-tailed weasel	31				
Short-tailed weasel	30				
Opossum	10				
Bobcat	98				
Raccoon	94				
Red Fox	95				

DEPARTMENT OF NATURAL RESOURCES
500 Lafayette Road Box 20
St Paul MN 55155

NO POSTAGE NECESSARY IF MAILED IN THE UNITED STATES

BUSINESS REPLY MAIL
FIRST-CLASS MAIL PERMIT NO. 171 ST. PAUL, MN
POSTAGE WILL BE PAID BY ADDRESSEE

Department of Natural Resources - Wildlife
STATE OF MINNESOTA
395 JOHN IRELAND BLVD
SAINT PAUL, MN 55101-9798

Figure 1. Trapper survey card 2017.

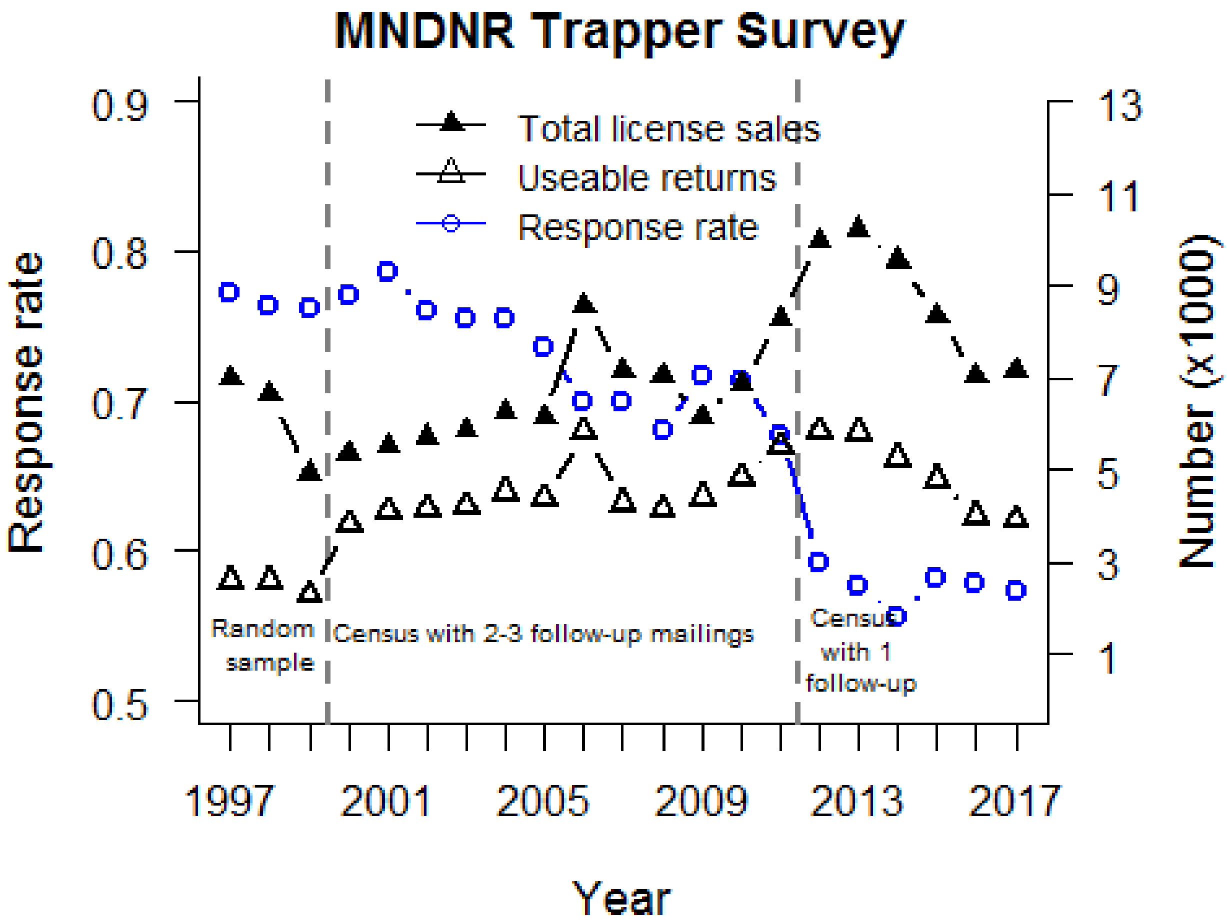

Figure 2. Trapper annual license sales and mail survey response, 1997-98 through 2017-18.

Table 1. Use of trapper licenses, 2006-07 through 2017-18.

Year		Returns from mail survey	Projections from license sales
2006-07	Trapped Did not trap	4,782 (81.9%) 1,053 (18.1%) 5,835 (100.0%)	7,008 1,549 8,557[a]
2007-08	Trapped Did not trap	3,322 (77.2%) 980 (22.8%) 4,302 (100.0%)	5,533 1,634 7,167[a]
2008-09	Trapped Did not trap	3,154 (75.7%) 1,012 (24.3%) 4,166 (100.0%)	5,319 1,708 7,027[a]
2009-10	Trapped Did not trap	3,202 (72.7%) 1,202 (27.3%) 4,404 (100.0%)	4,467 1,677 6,144[a]
2010-11	Trapped Did not trap	3,546 (73.2%) 1,298 (26.8%) 4,844 (100.0%)	5,032 1,843 6,875[a]
2011-12	Trapped Did not trap	4,498 (81.5%) 1,019 (18.5%) 5,517 (100.0%)	6,748 1,532 8,280[a]
2012-13	Trapped Did not trap	4,537 (77.6%) 1,307 (22.4%) 5,844 (100.0%)	7,747 2,236 9,983[a]
2013-14	Trapped Did not trap	4,342 (74.6%) 1,480 (25.4%) 5,822 (100.0%)	7,627 2,597 10,224[a]
2014-15	Trapped Did not trap	3,786 (72.2%) 1,459 (27.8%) 5,245 (100.0%)	6,888 2,652 9,540[a]
2015-16	Trapped Did not trap	3,296 (68.8%) 1,496 (31.2%) 4,792 (100.0%)	5,734 2,600 8,334[a]
2016-17	Trapped Did not trap	2,558 (63.7%) 1,458 (36.3%) 4,016 (100.0%)	4,487 2,557 7,044[a]
2017-18	Trapped Did not trap	2,654 (67.6%) 1,272 (32.4%) 3,926 (100.0%)	4,692 2,249 6,941[a]

[a] excludes duplicates.

Table 2. Estimated number of trappers of various furbearers, 2006-07 through 2017-18.

	Estimated number of trappers											
	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
Muskrat	4228	2371	2393	2088	2760	4,320	4,110	3,410	2,902	2,218	1,797	1,882
Mink	3033	2168	2044	1541	1847	2,470	3,110	2,780	2,158	1,587	1,049	1,084
Short-tailed weasel	864	595	511	417	546	800	690	510	666	289	195	283
Long-tailed weasel	694	434	345	254	333	560	540	480	519	265	174	190
Raccoon	3766	3189	3150	2320	2567	4,060	4,680	4,660	4,182	2,781	2,032	2,168
Striped skunk	1644	1485	1488	949	1130	1,800	1,940	1,610	1,541	1,234	907	840
Badger	347	330	293	206	229	310	360	390	284	247	193	167
Opossum	1511	1392	1169	701	645	830	1,100	1,110	575	463	469	785
Red fox	1608	1320	1232	1006	1068	1,900	2,240	2,080	2,012	1,434	1,048	1,258
Gray fox	806	654	657	529	555	970	1,180	1,060	1,035	684	446	458
Coyote	1379	1203	1141	888	998	1,720	2,360	2,200	2,396	1,981	1,479	1,781
Beaver (Oct - Feb)	2659	2008	1877	1650	1722	2,360	2,620	2,710	2,189	1,894	1,642	1,495
Beaver (previous Spring)	1710	1408	1257	1260	1367	1,510	1,810	1,150	1,305	1,145	1,130	1,194

Note: Estimates prior to 2009 may differ from values published in previous reports because of rounding and more recent estimates were recomputed using a standardized historic dataset (vs. being carried forward from previous reports).

Table 3. Estimated take per trapper of various furbearers, 2006-07 through 2017-2018.

	Estimated take per successful trapper reporting that species											
	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
Muskrat	58	32	34	48	66	82	59	36	39	51	49	45
Mink	9	9	9	9	8	7	6	6	5	5	6	5
Short-tailed weasel	10	7	7	8	10	10	7	5	8	4	5	5
Long-tailed weasel	6	5	3	4	6	6	4	3	5	3	3	3
Raccoon	21	24	23	20	23	25	18	16	15	11	12	14
Striped skunk	7	8	7	7	8	7	7	6	6	6	7	6
Badger	2	2	2	2	2	2	2	2	2	2	2	2
Opossum	14	13	10	8	7	6	7	7	7	4	5	8
Red fox	5	4	3	3	4	4	4	3	4	3	3	4
Gray fox	3	3	3	3	2	3	3	2	2	2	2	2
Coyote	4	5	4	5	5	6	5	5	5	6	5	7
Beaver (Oct –Feb)	13	11	12	12	10	12	10	9	8	8	8	8
Beaver (previous Spring)	25	19	23	20	22	20	20	9	16	14	17	19

Note: Estimates may differ from values published in previous reports because of rounding and they were recomputed using a ratio of estimated totals (estimated harvest / estimated trappers), which were computed from the standardized, historic harvest dataset.

Table 4. Minnesota trapper license sales and estimated annual harvest, 2006-07 through 2017-2018[a]

	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
Trapper license sales [b]	8,557	7,167	7,027	6,158	6,885	8,280	9,998	10,224	9,540	8,334	7,044	7,163
Estimated harvest [c]												
Muskrat	243,360	75,439	80,157	98,524	180,505	352,030	242,120	120,500	111,998	112,219	87,958	83,844
Mink	26,084	18,626	16,647	13,207	13,853	15,770	18,460	14,710	10,211	7,745	5,439	5,218
Short-tailed weasel	8,145	4,155	3,515	3,128	4,914	7,300	4,500	2,360	4,806	1,083	930	1,305
Long-tailed weasel	3,494	2,013	1,118	838	1,732	3,020	2,030	1,410	2,568	734	466	554
Raccoon	78,571	73,498	71,893	45,118	57,245	98,240	79,800	70,380	58,868	29,963	22,874	28,899
Striped skunk	10,773	10,811	10,354	6,194	8,023	12,250	12,620	9,430	7,956	6,349	5,458	4,476
Badger	461	499	424	316	344	490	570	600	347	376	286	278
Opossum	20,442	17,332	11,296	4,963	4,193	4,400	6,780	6,720	3,524	1,814	2,124	6,160
Red fox	6,783	4,060	3,500	2,984	3,311	7,250	7,540	5,710	6,040	4,061	2,707	4,500
Gray fox	1,703	1,360	1,320	1,084	1,110	2,100	2,550	1,940	1,902	1,161	715	736
Coyote	5,315	5,355	4,532	3,797	4,292	8,780	11,130	9,010	11,703	10,084	7,308	12,303
Beaver (Oct- Feb)	33,966	21,813	21,075	18,178	17,048	26,620	24,590	23,220	15,671	14,181	13,070	11,223
Beaver (previous Spring)	41,652	26,286	27,815	25,008	29,118	29,500	34,600	10,110	20,820	15,966	19,004	22,293
Registered harvest [d]												
Otter	2,720	1,861	1,938	1,544	1,814	2,294	3,171	2,824	2,148	1,955	1195	1,295
Lynx [e]	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed
Bobcat [g]	890	702	853	884	1,012	1,711	1,875	1,038	1,380	766	485	731
Fisher	3,251	1,682	1,712	1,259	903	1,473	1,293	1,146	919	756	399	477
Marten	3,788	2,221	1,823	2,073	1,842	2,525	1,472	1,014	1,055	877	551	979

[a] Includes data for all seasons from October through April of years indicated.
[b] Separate licenses were issued for juveniles (13-17 years old) and adults (18 and older), beginning in 1982. Nonresident (MN Landowner) licenses started in 2004. Senior trapping licenses were first issued in 2007. Lifetime Licenses became available for free when renewing lifetime sports or small game licenses in 2007. As of April, 2018- 7,163 trapping licenses were sold in 2017: 225 (3.1%) were junior licenses, 5,196 (72.5%) were Regular adult licenses, 1,160 (16.2%) were Senior licenses, 570 (7.9%) were Lifetime licenses, and 12 (<1%) were Nonresident (MN Landowner) licenses. Duplicate licenses excluded.
[c] Based upon trappers' responses to mail surveys. [d] Raccoon and red fox season continuous May 1994 thru March 15, 2006.
[e] Lynx (1984) and Eastern spotted skunk (1996) listed as Special Concern and threatened species (respectively) and are fully protected.
[f.] Registered harvest information as reported from annual, mandatory registration. [g] Registered harvest for bobcat includes animals taken by hunting.

MINNESOTA FUR BUYERS SURVEY FOR THE 2017-2018 HUNTING AND TRAPPING SEASON

Jason Abraham, Season Setting/Furbearer Specialist
Margaret Dexter, Policy and Research Unit

INTRODUCTION

Fur buyers are individuals licensed by the State of Minnesota to buy and sell raw fur. They are required to keep complete records of all transactions and activities related to buying, selling, and disposing of raw furs. Each year buyers are sent a questionnaire asking them to submit information regarding the "average" price they paid to trappers for various furbearers the previous season.

METHODS

In September 2018, questionnaires were mailed to the 33 licensed fur buyers in Minnesota. The survey asked them to report the number and type of fur purchased from Minnesota trappers and hunters and the "average price" paid to those hunters and trappers based on all furs purchased. A total of 30 usable surveys were received, for a return rate of 90 percent.

Calculations of average pelt price for each species were weighted according to the number of pelts purchased by each buyer. Average pelt prices for the past 15 years are summarized in the table below. Total estimated value of the furbearer harvest to trappers and hunters in 2017-18 was $642,882.60, a 126 percent increase from the previous season.

Table 1. Minnesota fur prices as reported by licensed fur dealers, 2017-18.

Species	Number Pelts	Minimum Price	Maximum Price	Weighted Mean
Muskrat	22958	1.00	3.25	2.59
Mink Female	1245	3.00	8.00	5.80
Mink male	1467	5.00	10.00	7.29
Raccoon	13262	2.00	8.50	5.76
Red Fox	1361	7.00	20.00	13.30
Gray Fox	212	10.00	20.00	11.32
Coyote	5421	10.00	40.00	25.15
Bobcat	91	11.25	139.29	63.52
River Otter	330	18.00	30.00	21.98
Beaver 10-12	3962	4.76	11.00	8.32
Beaver 3-4	9490	5.00	13.49	10.39
L.T. Weasel	10	2.00	2.00	0.00
S.T. Weasel	230	1.00	5.00	2.79
Striped Skunk	274	0.00	8.00	7.12
Badger	97	0.00	20.00	9.09
Opossum	175	0.00	1.47	1.34
Fisher Male	86	12.30	42.00	29.87
Fisher Female	83	25.00	45.00	36.75
Marten Male	42	30.00	40.00	36.90
Marten Female	49	25.00	40.00	33.96
Deer Hides	38305	2.75	5.09	4.14
Bear Hides	22	20.00	40.00	25.91

Table 2. Average price per pelt paid to hunters and trappers in Minnesota, 2007-08 through 2017-18

	Average pelt prices paid hunters and trappers in Minnesota (dollars)										
Species	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
Muskrat	2.96	1.85	4.43	5.33	5.86	7.91	8.72	4.85	2.28	2.65	2.59
Mink (female)	9.05	7.45	8.02	9.33	11.54	17.53	13.72	7.45	4.99	6.20	5.80
Mink (male)	12.32	9.14	9.37	13.66	14.68	18.27	18.11	10.50	6.18	7.47	7.29
Raccoon	14.32	9.34	9.18	10.87	12.57	16.60	16.58	8.64	5.11	4.92	5.76
Red Fox	14.69	11.79	10.85	13.35	22.87	33.52	30.90	20.41	11.86	10.52	13.30
Gray Fox	30.09	14.08	11.55	14.64	15.11	19.20	21.27	14.17	10.64	10.33	11.32
Coyote	13.51	7.12	8.62	9.47	17.99	22.04	21.30	25.10	21.48	17.39	25.15
Bobcat	93.41	74.74	42.77	71.44	98.18	144.79	88.63	66.67	57.46	35.88	63.52
Otter	29.49	24.33	35.65	34.53	51.40	72.12	61.32	34.57	30.03	21.05	21.98
Beaver (fall-winter)	14.6	14.63	12.49	11.95	14.29	18.47	16.52	12.40	8.77	8.14	8.32
Beaver (spring)	17.77	9.36	14.47	14.50	19.96	12.80	14.77	10.69	8.24	7.33	10.39
L.T. Weasel	5	2.21	3.12	2.87	4.02	4.10	2.35	1.78	1.46	1.41	0.00
S.T. Weasel	3.18	3.57	3.02	1.50	2.10	2.51	0.00	2.00	1.41	0.00	2.79
Striped Skunk	5.27	2.56	3.66	3.29	3.55	5.00	4.14	3.86	3.65	4.00	7.12
Badger	13.92	7.70	8.81	10.43	13.47	14.54	13.72	9.52	9.57	7.86	9.09
Opossum	1.76	1.21	1.30	2.64	5.80	1.52	1.52	1.17	1.98	1.32	1.34
Fisher (male)	63.09	22.27	34.45	38.19	47.69	62.38	61.32	41.76	34.88	28.00	29.87
Fisher (female)	48.24	37.22	34.90	37.31	39.59	63.02	67.73	50.87	34.39	37.07	36.75
Marten (male)	58.72	30.61	26.76	39.80	42.32	56.57	74.10	38.92	30.83	29.94	36.90
Marten (female)	50.05	28.19	29.95	36.57	39.49	54.29	70.94	32.20	28.89	30.41	33.96
Deer Hides	3.92	3.53	4.44	4.41	3.95	5.18	6.09	5.59	5.62	4.00	4.14
Bear Hides	36.57	29.81	43.00	33.38	28.79	30.28	42.63	32.94	46.03	32.97	25.91

REGISTERED FURBEARER HARVEST STATISTICS

Forest Wildlife Populations and Research Group
1201 East Highway 2
Grand Rapids, MN 55744
(218) 327-4432

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REGISTERED FURBEARER HARVEST STATISTICS 2017-18

John Erb, Minnesota Department of Natural Resources, Forest Wildlife Research Group

INTRODUCTION

Monitoring harvest is an important component of population management for some wildlife populations. For many species, harvest represents a large proportion of overall mortality. Obtaining harvest information can be useful for documenting changes in the distribution and abundance of animals, as well as the effects of changes in harvest seasons, harvest techniques, and habitat. The level of detail or accuracy necessary in harvest information may vary across species, depending on such factors as population density, harvest pressure, habitat 'sensitivity' of the species, and reproductive potential.

In Minnesota, detailed harvest information is collected on 4 carnivores – fishers, martens, bobcats, and river otters. These species have lower reproductive potential, naturally occur at low to moderate densities, have comparatively restricted distributions, or may be more influenced by habitat change. Hence, detailed harvest information is desirable to help ensure sustainable populations. For the past 41 years, detailed harvest data has been collected for these species.

METHODS

Hunters and trappers are required to bring pelts from harvested animals (fishers, martens, bobcats, and otters) in to fur registration stations usually within 48 hours of the close of the season. Upon registration, information is collected on the sex, date, method of take, and harvest location (township), and the pelt is tagged to verify it has been registered.

RESULTS

Currently, harvest of fishers, martens, and bobcats is allowed in approximately the northern 60% of the state, while otter harvest is allowed statewide (Figure 1). There were no changes to season structures this year compared to the 2016 season. All harvest summaries are provided in the following tables and graphs. Data for years prior to those presented in this report is available (back to 1977) by contacting the Minnesota DNR.

ACKNOWLEDGMENTS

I thank the many individuals from the Minnesota Department of Natural Resources for their assistance with collection of data contained in this report. This project was funded in part by the Wildlife Restoration Program (Pittman-Robertson).

NOTE: This report does not include tribal harvests, or any confiscations.

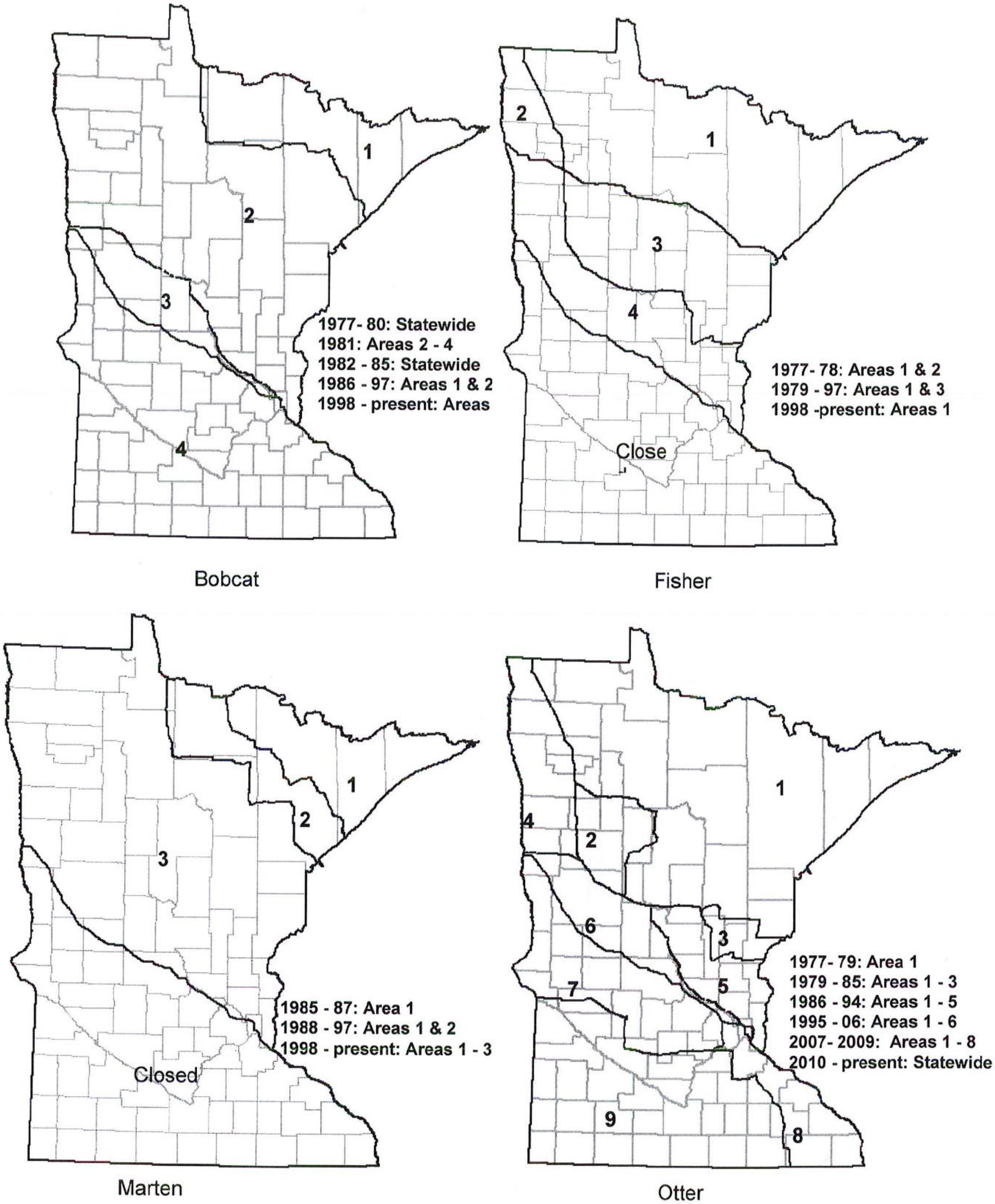

Figure 1. Open trapping areas for fisher, marten, bobcat, and otter, 1977- present.

Table 1. Registered furbearer seasons and harvests, 1987-2017.

	Bobcat				Fisher				Marten				Otter			
Year	Season	Days	Limit	Harvest	Season	Days	Limit[a]	Harvest	Season	Days	Limit[a]	Harvest	Season[b]	Days	Limit[c]	Harvest
1987-88	11/28-1/3	37	5	212	11/28-12/13	16	1	1641	11/28-12/13	16	1	1363	10/24-11/29	37	3	1386
1988-89	11/26-1/1	37	5	141	11/26-12/11	16	1	1025	11/26-12/11	16	2	2072	10/29-11/27	30	3	922
1989-90	12/2-1/7	37	5	129	12/2-12/17	16	1	1243	12/2-12/17	16	2	2119	10/28-12/17	51	3	1294
1990-91	12/1-1/6	37	5	84	12/1-12/16	16	1	746	12/1-12/16	16	2	1349	10/27-1/6	71	3	888
1991-92	11/30-1/5	37	5	106	11/30-12/15	16	1	528	11/30-12/15	16	1	686	10/26-1/5	71	3	855
1992-93	11/28-1/3	37	5	168	11/28-12/13	16	1	778	11/28-12/13	16	2	1602	10/24-1/3	71	4	1368
1993-94	12/4-1/9	37	5	201	12/4-12/19	16	2	1159	12/4-12/19	16	2	1438	10/23-1/9	78	4	1459
1994-95	12/3-1/8	37	5	238	12/3-12/18	16	2	1772	12/3-12/18	16	2	1527	10/29-1/8	71	4	2445
1995-96	12/2-1/7	37	5	134	12/2-12/17	16	2	942	12/2-12/17	16	2	1500	10/28-1/7	71	4	1435
1996-97	11/30 -1/5	37	5	223	11/30-12/15	16	2	1773	11/30-12/15	16	2	1625	10/26-1/5	71	4	2219
1997-98	11/29-1/4	37	5	359	11/29-12/14	16	2	2761	11/29-12/14	16	2	2261	10/25-1/4	71	4	2145
1998-99	11/28-12/13	16	5	103	11/28-12/13	16	2	2695	11/28-12/13	16	2	2299	10/24-1/3	71	4	1946
1999-00	12/4-1/9	37	5	206	12/4-12/19	16	2	1725	12/4-12/19	16	4	2423	10/23-1/9	78	4	1635
2000-01	12/2-1/7	37	5	231	12/2-12/17	16	4	1674	12/2-12/17	16	4	1629	10/28-1/7	71	4	1578
2001-02	11/24-1/6	44	5	250	11/24-12/9	16	4	2119	11/24-12/9	16	4	1928	10/27-1/6	71	4	2301
2002-03	11/30-1/5	37	5	544	11/30-12/15	16	5	2660	11/30-12/15	16	5	2839	10/26-1/5	71	4	2145
2003-04	11/29-1/4	37	5	483	11/29-12/14	16	5	2521	11/29-12/14	16	5	3214	10/25-1/4	71	4	2766
2004-05	11/27-1/9	44	5	631	11/27-12/12	16	5	2552	11/27-12/12	16	5	3241	10/23-1/9	78	4	3450
2005-06	11/26-1/8	44	5	590	11/26-12/11	16	5	2388	11/26-12/11	16	5	2653	10/29-1/8	71	4	2846
2006-07	11/25-1/7	44	5	890	11/25-12/10	16	5	3251	11/25-12/10	16	5	3788	10/28-1/7	71	4	2720
2007-08	11/24-1/6	44	5	702	11/24-12/2	9	5	1682	11/24-12/2	9	5	2221	10/27-1/6	71	2/4	1861
2008-09	11/29-1/4	37	5	853	11/29-12/7	9	5	1712	11/29-12/7	9	5	1823	10/25-1/4	71	2/4	1938
2009-10	11/28-1/3	37	5	884	11/28-12/6	9	5	1259	11/28-12/6	9	5	2073	10/24-1/3	71	2/4	1544
2010-11	11/27-1/9	44	5	1012	11/27-12/5	9	2	903	11/27-12/5	9	5	1842	10/23-1/9	78	4	1814
2011-12	11/26-1/8	44	5	1711	11/26-12/4	9	2	1473	11/26-12/4	9	5	2525	10/22-1/8	78	4	2294
2012-13	11/24-1/6	44	5	1875	11/24-11/29	6	2	1293	11/24-11/29	6	5	1472	10/27-1/6	71	4	3171
2013-14	11/30-1/5	37	5	1038	11/30-12/5	6	2	1146	11/30-12/5	6	2	1014	10/26-1/5	71	4	2824
2014-15	11/29-1/4	37	5	1384	11/29-12/4	6	2	943	11/29-12/4	6	2	1059	10/25-1/4	71	4	2154
2015-16	11/28-1/3	37	5	766	11/28-12/3	6	2	756	11/28-12/3	6	2	877	10/24-1/3	71	4	1955
2016-17	11/26-1/8	44	5	485	11/26-12/1	6	2	399	11/26-12/1	6	2	551	10/29-1/8	78	4	1195
2017-18	11/25-1/7	44	5	731	11/25-11/30	6	2	477	11/25-11/30	6	2	979	10/28-1/7	78	4	1295

[a] Starting in 1997, the limit on fisher/marten became a combined limit. In years after, the combined limit for a given year is the higher of the 2 reported above (if different).
[b] In some years, otter season opens 1 week earlier in a north zone as compared to a south zone. Otter season dates in this table reflect the start of the north zone.
[c] From 2007-2009, otter limits differ between a southeast zone (limit=2; Area 8, Fig. 1) and the remainder of the open area (limit=4).

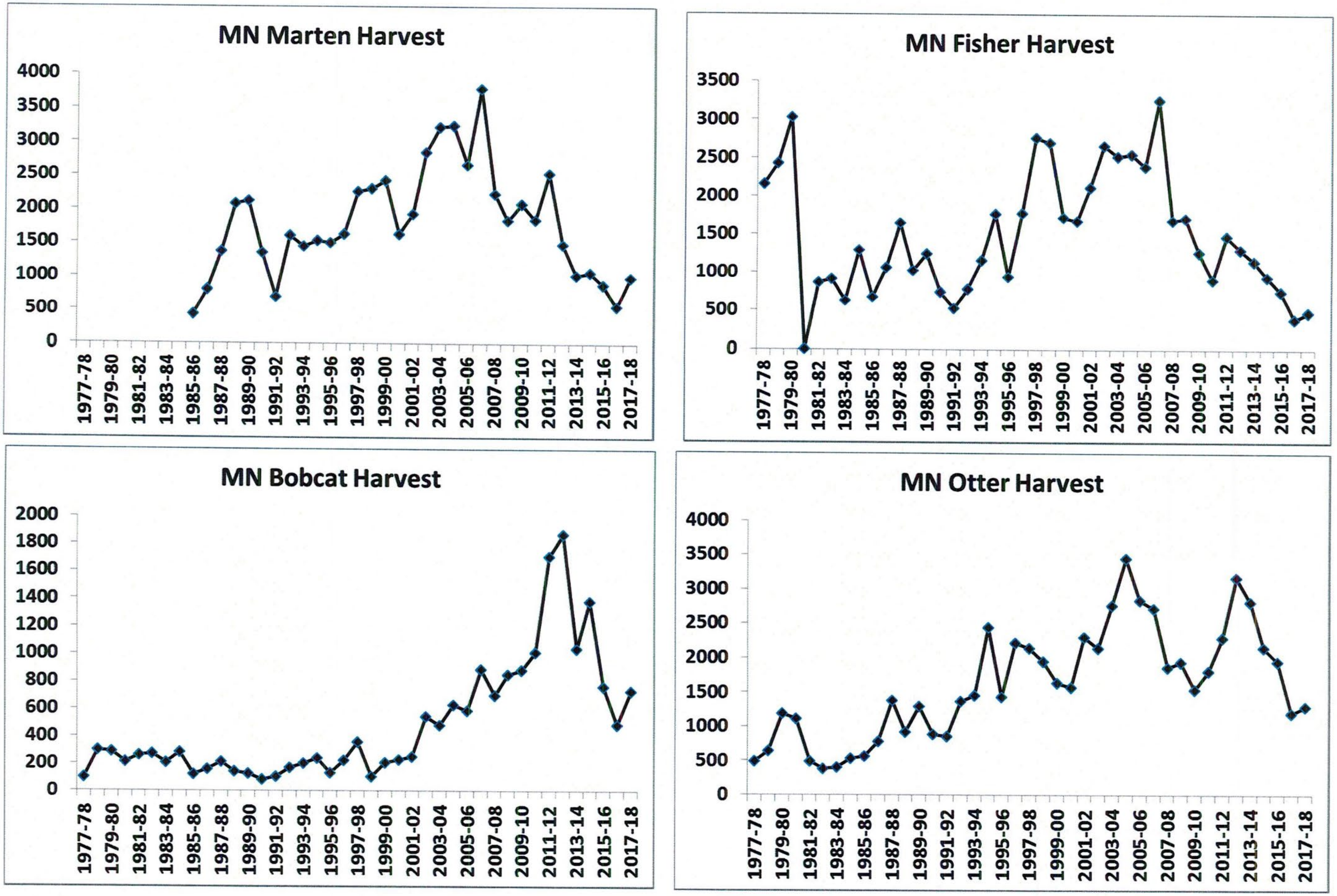

Figure 2. Harvest of registered furbearers in Minnesota, 1977-present.

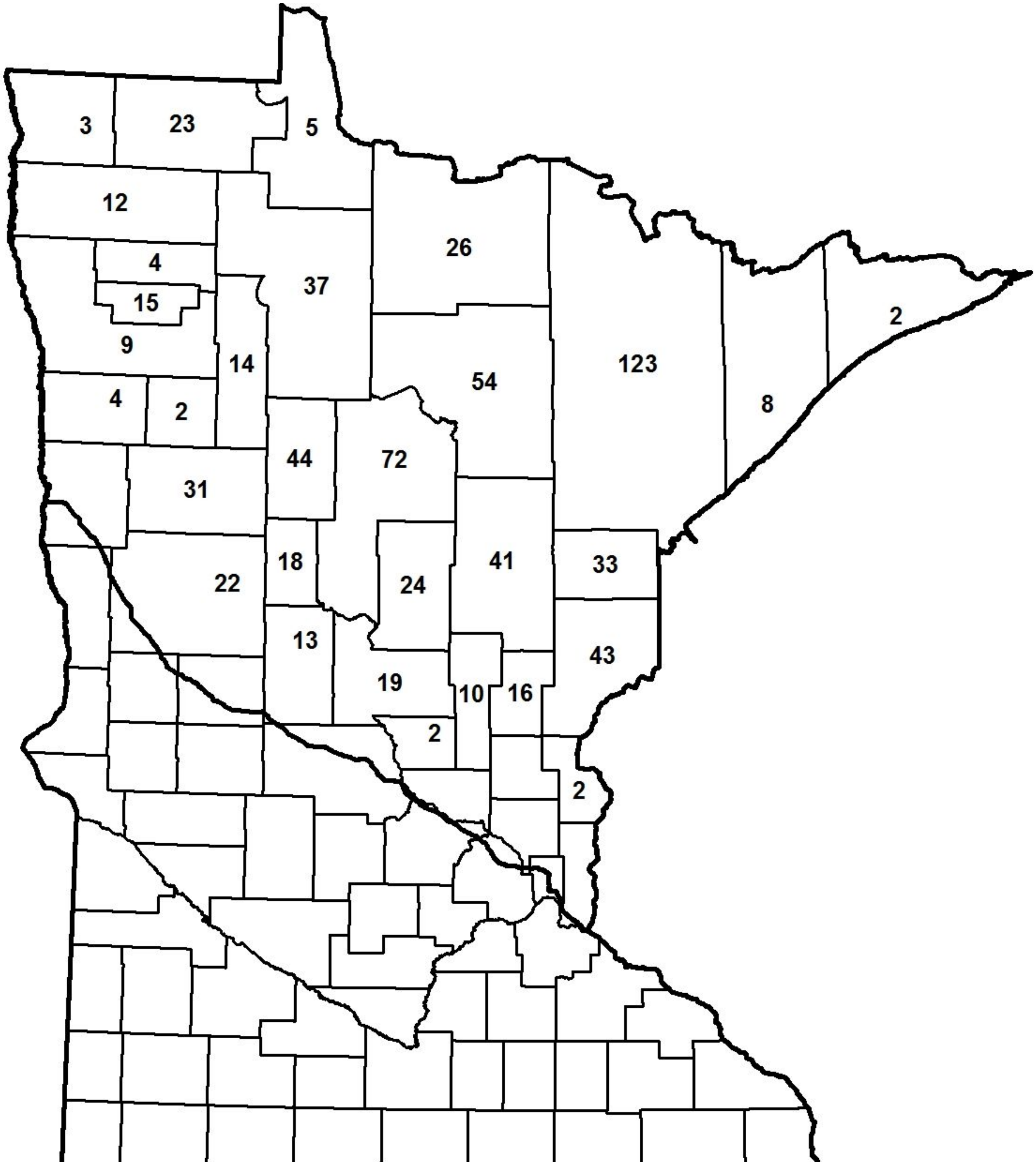

Figure 3. Bobcat harvest by county, 2017-18.

Table 2. Bobcat harvest by county and sex, 2017-18.

County	Sex* Male	Female	Unknown	Total	Harvest/ 100 Mile²
Aitkin	21	20		41	2.06
Anoka	0	0		0	0.00
Becker	19	12		31	2.14
Beltrami	18	19		37	1.21
Benton	1	1		2	0.48
Carlton	18	15		33	3.77
Cass	32	40		72	2.98
Chisago	1	1		2	0.45
Clay	0	0		0	0.00
Clearwater	8	6		14	1.36
Cook	1	1		2	0.12
Crow Wing	10	14		24	2.08
Douglas	0	0		0	0.00
Hubbard	21	23		44	4.40
Isanti	0	0		0	0.00
Itasca	20	34		54	1.85
Kanabec	11	5		16	3.00
Kittson	1	2		3	0.27
Koochiching	10	16		26	0.82
Lake	2	6		8	0.35
Lake of the Woods	3	2		5	0.28
Mahnomen	0	2		2	0.34
Marshall	6	6		12	0.66
Mille Lacs	7	3		10	1.47
Morrison	6	13		19	1.65
Norman	3	1		4	0.46
Otter Tail	10	12		22	0.99
Pennington	3	1		4	0.65
Pine	24	19		43	3.00
Polk	2	7		9	0.45
Red Lake	9	6		15	3.46
Roseau	12	11		23	1.37
Sherburne	0	0		0	0.00
St. Louis	50	73		123	1.83
Stearns	0	0		0	0.00
Todd	8	5		13	1.33
Wadena	10	8		18	3.31
Unknown	0	0		0	
Total	347	384	0	731	

* Trapper/hunter reported sex ratios in this table are **NOT** adjusted according to results from DNR carcass analyses

Table 3. Comparison of bobcat harvest by county, 2007-2017.

County	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
Aitkin	56	64	82	73	121	142	65	105	39	22	41
Anoka	0	0	0	0	1	0	0	1	0	0	0
Becker	24	37	25	39	70	58	36	48	36	10	31
Beltrami	33	49	70	108	139	139	59	73	49	30	37
Benton	1	5	2	0	4	3	3	0	0	1	2
Carlton	25	45	44	37	94	63	42	88	25	16	33
Cass	50	98	115	117	164	150	76	126	73	44	72
Chisago	3	0	0	1	0	3	1	1	3	4	2
Clay	0	0	1	3	1	3	2	3	1	0	0
Clearwater	25	43	27	30	58	40	19	29	15	13	14
Cook	0	1	0	1	3	3	9	17	1	0	2
Crow Wing	21	36	38	29	64	65	19	32	21	7	24
Douglas	0	0	0	0	0	1	1	0	0	0	0
Hubbard	40	49	81	59	129	105	51	50	45	21	44
Isanti	0	0	0	0	0	0	1	0	1	1	0
Itasca	86	72	106	132	186	194	93	110	50	19	54
Kanabec	16	23	11	16	21	46	16	46	12	11	16
Kittson	4	9	4	9	10	7	5	5	7	6	3
Koochiching	37	31	25	54	66	82	50	40	22	25	26
Lake	0	1	2	7	15	21	13	15	8	4	8
Lake of the Woods	9	12	16	10	28	13	20	26	10	7	5
Mahnomen	8	0	4	2	9	7	4	4	3	5	2
Marshall	32	18	15	31	42	44	15	21	19	14	12
Mille Lacs	13	11	10	10	13	23	7	14	5	2	10
Morrison	23	28	13	23	25	35	15	25	16	17	19
Norman	0	0	1	0	3	6	3	8	4	1	4
Otter Tail	9	7	7	14	21	38	18	17	16	15	22
Pennington	11	9	6	5	4	13	7	3	4	1	4
Pine	87	101	49	50	94	135	54	87	56	37	43
Polk	0	4	9	9	17	20	10	16	15	10	9
Red Lake	0	0	7	16	20	25	6	11	3	1	15
Roseau	32	18	19	26	46	60	38	27	20	23	23
Sherburne	0	0	1	0	3	0	0	0	0	0	0
St. Louis	39	58	56	81	202	283	255	307	156	91	123
Stearns	1	0	0	0	0	0	2	0	1	0	0
Todd	6	14	10	9	14	16	5	8	8	9	13
Wadena	9	7	21	9	17	23	18	18	10	18	18
Unknown	2	3	7	2	7	9	0	3	12	0	0
Total	702	853	884	1012	1711	1875	1038	1384	766	485	731

Table 4. Bobcat harvest by sex and week, 2017-18 season.

Date	Sex*			Total	% of Total	Cumulative %
	Male	Female	Unknown			
Nov.25 - Dec.1	47	78		125	17.10	17.10
Dec.2 - Dec.8	61	49		110	15.05	32.15
Dec.9 - Dec.15	54	71		125	17.10	49.25
Dec.16 - Dec.22	78	72		150	20.52	69.77
Dec.23 - Dec.29	53	55		108	14.77	84.54
Dec.30 - Jan.7**	47	54		101	13.82	98.36
Unknown	7	5		12	1.64	100%
Total	347	384	0	731	100%	

* Trapper/hunter reported sex ratios in this table are **NOT** adjusted according to results from DNR carcass analyses

** 9-day interval

Table 5. Distribution of bobcat harvest* among takers, 1992-2017.

Number (%) of Takers	Number Taken					
	1	2	3	4	5	Total Takers
1992-93	69 (64)	21 (20)	9 (9)	5 (5)	2 (2)	106
1993-94	90 (70)	17 (13)	13 (10)	7 (5)	2 (2)	201
1994-95	103 (68)	25 (17)	12 (8)	6 (4)	5 (3)	151
1995-96	67 (74)	13 (14)	5 (6)	4 (4)	2 (2)	91
1996-97	115 (73)	28 (18)	85 (5)	2 (1)	4 (3)	157
1997-98	129 (61)	43 (20)	17 (8)	12 (6)	9 (5)	210
1998-99	59 (77)	11 (14)	2 (3)	3 (4)	1 (2)	76
1999-00	113 (76)	21 (14)	10 (6)	4 (3)	1(1)	149
2000-01	99 (69)	23 (16)	7 (5)	5 (4)	9 (6)	143
2001-02	101 (71)	23 (16)	12 (8)	1 (1)	5 (4)	142
2002-03	185 (60)	64 (21)	33 (10)	15 (5)	12 (4)	309
2003-04	171 (64)	40 (15)	25 (10)	20 (7)	11 (4)	267
2004-05	193 (59)	55 (17)	32 (10)	25 (7)	24 (7)	329
2005-06	198 (60)	67 (20)	33 (10)	15 (5)	18 (5)	331
2006-07	265 (57)	90 (19)	44 (9)	25 (5)	42 (9)	466
2007-08	212 (58)	71 (19)	30 (8)	16 (4)	38 (10)	367
2008-09	236 (55)	88 (21)	43 (10)	25 (6)	37 (9)	429
2009-10	223 (53)	80 (19)	40 (9)	30 (7)	51 (12)	424
2010-11	242 (50)	103 (21)	58 (12)	35 (7)	49 (10)	487
2011-12	351 (47)	126 (17)	86 (12)	62 (8)	118 (16)	743
2012-13	380 (45)	167 (20)	108 (13)	82 (10)	100 (12)	837
2013-14	350 (60)	112 (19)	51 (9)	44 (8)	26 (4)	583
2014-15	383 (54)	131 (19)	84 (12)	49 (7)	58 (8)	705
2015-16	248 (59)	87 (21)	33 (8)	29 (7)	25 (6)	422
2016-17	126 (58)	47 (22)	26 (12)	6 (3)	11 (5)	216
2017-18	257 (61)	95 (22)	31 (7)	16 (4)	25 (6)	424

* Product of categories above may not equal total harvest due to some missing names/license numbers

Table 6. Bobcat harvest by method of take, 1990-2017.

	Total	Trapping					Hunting				
Year	Harvest[a]	Harvest	% of Total	# Takers	Ave. Take	% Males[b]	Harvest	% of Total	# Takers	Ave. Take	% Males[b]
1990-91	83	61	73	43	1.4		22	27	17	1.3	
1991-92	102	59	58	31	1.9		43	42	33	1.3	
1992-93	168	133	79	85	1.6		35	21	23	1.5	
1993-94	201	147	73	88	1.7		54	27	41	1.3	
1994-95	238	189	79	120	1.6		49	21	31	1.6	
1995-96	134	73	54	53	1.4		61	46	38	1.6	
1996-97	203	133	66	91	1.5		70	34	53	1.3	
1997-98	357	313	88	176	1.8		44	12	34	1.3	
1998-99	103	95	92	67	1.4		8	8	8	1.0	
1999-00	206	155	75	114	1.4		51	25	36	1.4	
2000-01	231	140	61	85	1.6		91	39	58	1.6	
2001-02	250	208	83	116	1.8	41	42	17	27	1.6	68
2002-03	544	500	92	279	1.8	38	44	8	32	1.4	57
2003-04	483	415	86	230	1.8	46	68	14	40	1.7	65
2004-05	631	542	86	279	1.9	43	89	14	53	1.7	60
2005-06	583	435	75	250	1.7	37	148	25	85	1.7	65
2006-07	890	779	88	391	2.0	45	111	12	81	1.4	57
2007-08	702	524	75	266	2.0	40	178	25	110	1.6	48
2008-09	853	689	81	334	2.1	42	164	19	99	1.7	59
2009-10	884	736	83	340	2.2	43	148	17	91	1.6	58
2010-11	1012	817	81	372	2.2	40	195	19	123	1.6	50
2011-12	1708	1606	94	670	2.4	47	102	6	74	1.4	60
2012-13	1875	1681	90	721	2.3	46	194	10	130	1.5	52
2013-14	1038	879	85	490	1.8	40	159	15	107	1.5	55
2014-15	1384	1260	91	622	2.0	44	124	9	86	1.4	56
2015-16	766	657	86	355	1.9	49	109	14	68	1.6	70
2016-17	485	377	78	215	1.8	41	108	22	69	1.6	54
2017-18	731	606	83	335	1.8	45	125	17	93	1.3	59

[a] Total harvest reported here may not be equal to total harvest in other tables due to incomplete method-of-take data.

[b] Trapper/hunter reported sex ratios in this table are **NOT** adjusted according to results from DNR carcass analyses

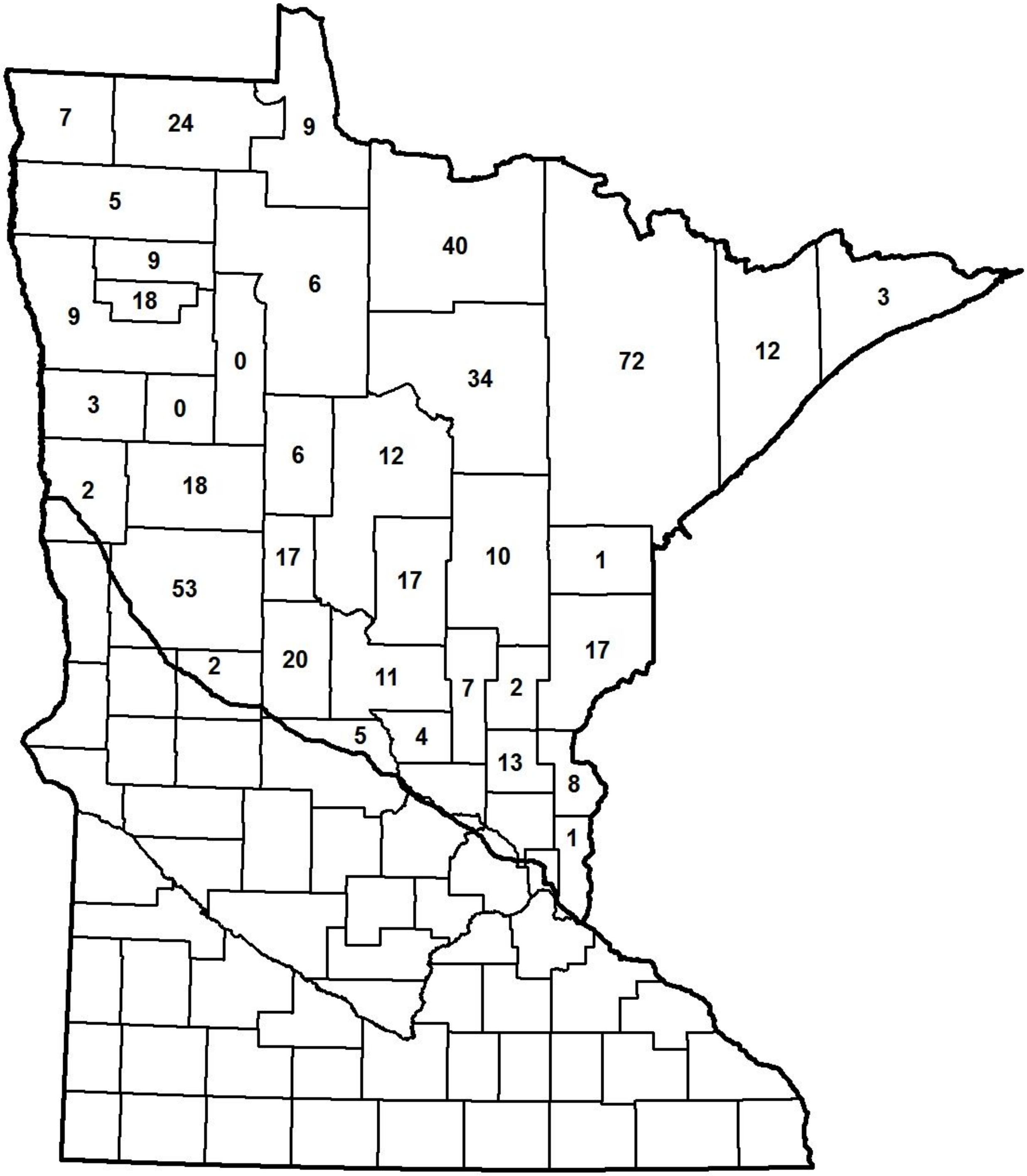

Figure 4. Fisher harvest by county, 2017.

Table 7. Fisher harvest by county and sex, 2017 season.

County	Sex			Total	Harvest/
	Male	Female	Unknown		100 Mile^2
Aitkin	7	3		10	0.50
Anoka	0	0		0	0.00
Becker	11	7		18	1.25
Beltrami	5	1		6	0.20
Benton	3	1		4	0.97
Carlton	1	0		1	0.11
Cass	10	2		12	0.50
Chisago	7	1		8	1.81
Clay	2	0		2	0.19
Clearwater	0	0		0	0.00
Cook	1	2		3	0.19
Crow Wing	9	8		17	1.47
Douglas	0	2		2	0.28
Grant	0	0		0	0.00
Hubbard	4	2		6	0.60
Isanti	5	7	1	13	2.88
Itasca	19	15		34	1.16
Kanabec	1	1		2	0.38
Kittson	3	4		7	0.63
Koochiching	23	17		40	1.27
Lake	6	6		12	0.52
Lake of the Woods	5	4		9	0.51
Mahnomen	0	0		0	0.00
Marshall	4	1		5	0.28
Mille Lacs	5	2		7	1.03
Morrison	4	7		11	0.95
Norman	3	0		3	0.34
Otter Tail	32	21		53	2.38
Pennington	3	6		9	1.46
Pine	11	6		17	1.19
Polk	7	2		9	0.45
Red Lake	11	7		18	4.16
Roseau	13	11		24	1.43
Sherburne	0	0		0	0.00
St. Louis	37	35		72	1.07
Stearns	2	3		5	0.36
Todd	14	6		20	2.04
Wadena	9	8		17	3.13
Washington	0	1		1	0.24
Wilkin	0	0		0	0.00
Unknown	0	0		0	
Total	277	199	1	477	

Table 8. Comparison of fisher harvest by county, 2006-2017.

County	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Aitkin	156	67	75	50	35	55	52	47	24	38	16	10
Anoka	0	0	2	0	0	1	2	1	2	7	4	0
Becker	87	57	36	44	30	32	45	38	21	23	3	18
Beltrami	54	40	15	22	10	25	21	17	4	8	9	6
Benton	1	0	3	2	0	5	5	2	4	3	7	4
Carlton	49	13	19	15	12	12	14	8	14	13	6	1
Cass	209	80	77	57	43	41	37	23	30	24	11	12
Chisago	18	7	4	10	6	10	3	4	16	18	11	8
Clay	1	0	3	0	6	10	6	5	6	4	4	2
Clearwater	54	19	37	13	6	8	5	12	3	2	3	0
Cook	35	29	10	11	17	28	11	13	11	5	4	3
Crow Wing	140	81	116	42	48	64	55	51	34	31	13	17
Douglas	6	2	5	2	6	15	24	8	20	12	6	2
Grant	0	0	0	0	1	0	0	0	0	0	0	0
Hubbard	51	20	38	18	13	10	11	10	8	6	5	6
Isanti	5	1	5	9	1	4	6	11	11	12	3	13
Itasca	405	195	195	166	88	142	105	116	78	47	13	34
Kanabec	26	11	26	20	13	21	27	30	9	10	6	2
Kittson	2	5	8	5	7	5	9	11	2	3	5	7
Koochiching	221	105	115	96	51	116	80	51	67	45	23	40
Lake	87	49	54	49	45	56	53	35	28	14	14	12
Lake of the Woods	74	17	42	21	9	33	21	13	12	15	6	9
Mahnomen	27	25	6	3	0	3	0	4	2	0	0	0
Marshall	26	19	26	6	7	13	14	17	22	22	6	5
Mille Lacs	20	15	17	18	18	17	20	17	12	6	13	7
Morrison	23	21	14	10	8	10	24	25	23	15	16	11
Norman	4	9	12	7	4	10	19	21	12	5	9	3
Otter Tail	158	110	152	67	100	138	121	117	102	77	41	53
Pennington	22	16	8	2	4	8	8	11	19	11	4	9
Pine	82	39	74	30	26	22	42	46	44	35	18	17
Polk	72	61	49	31	25	54	58	45	32	22	11	9
Red Lake	32	29	23	23	10	17	16	24	18	6	8	18
Roseau	127	84	89	58	20	79	61	42	32	26	15	24
Sherburne	0	0	0	3	1	6	2	2	2	2	0	0
St. Louis	898	407	283	296	186	350	233	220	171	125	61	72
Stearns	0	0	1	1	0	4	1	4	2	3	3	5
Todd	21	13	33	22	18	15	29	22	15	19	12	20
Wadena	44	27	37	23	23	31	25	23	21	26	9	17
Washington	0	1	0	0	0	1	1	0	2	2	1	1
Wilkin	0	0	0	0	0	1	0	0	0	0	0	0
Unknown	14	8	3	7	6	1	27	0	8	14	0	0
Total	3,251	1,682	1,712	1,259	903	1,473	1,293	1,146	943	756	399	477

Table 9. Fisher harvest by date and sex, 2017 season.

	Sex				% of Known	Cumulative
Date	Male	Female	Unknown	Total	Total	%
Nov. 25	11	0		11	2.31	2.31
Nov. 26	60	48		108	22.64	24.95
Nov. 27	66	48	1	115	24.11	49.06
Nov. 28	61	40		101	21.17	70.23
Nov. 29	43	35		78	16.35	86.58
Nov. 30	33	25		58	12.16	98.74
Unknown	3	3		6	1.26	100%
Total	277	199	1	477	100%	

Table 10. Distribution of fisher harvest* among trappers, 1993-2017.

Number (%) of Takers	Number Taken						
	1	2	3	4	5	Total Takers	Ave. Take
1993	239 (34)	460 (66)	----	----	----	699	1.7
1994	321 (31)	725 (69)	----	----	----	1046	1.7
1995	232 (40)	355 (60)	----	----	----	587	1.6
1996	321 (31)	726 (69)	----	----	----	1047	1.7
1997	351 (23)	1205 (77)	----	----	----	1556	1.8
1998	443 (28)	1141 (72)	----	----	----	1584	1.7
1999	397 (37)	664 (63)	----	----	----	1061	1.6
2000	301(38)	251 (31)	129 (16)	121 (15)	----	802	2.1
2001	294 (33)	271 (31)	146 (17)	168 (19)	----	879	2.2
2002	336 (35)	234 (25)	138 (15)	117 (12)	123 (13)	948	1.8
2003	403 (39)	249 (24)	150 (15)	107 (11)	115 (11)	1024	1.7
2004	390 (37)	260 (25)	184 (17)	95 (9)	132 (12)	1061	1.7
2005	407 (40)	251 (24)	150 (15)	102 (10)	118 (11)	1028	1.7
2006	510 (37)	328 (24)	208 (15)	150 (11)	171 (13)	1367	1.7
2007	416 (50)	193 (23)	104 (12)	68 (8)	57 (7)	838	1.7
2008	382 (48)	182 (23)	91 (11)	65 (8)	79 (10)	799	1.6
2009	372 (55)	156 (23)	69 (10)	42 (6)	38 (6)	677	1.6
2010	330 (54)	279 (46)	----	----	----	609	1.5
2011	553 (55)	451 (45)	----	----	----	1004	1.4
2012	453 (52)	415 (48)	----	----	----	868	1.5
2013	501 (61)	316 (39)	----	----	----	817	1.4
2014	434 (63)	254 (37)	----	----	----	688	1.4
2015	346 (63)	203 (37)	----	----	----	549	1.4
2016	177 (61)	111 (39)	----	----	----	288	1.4
2017	246 (68)	114 (32)	----	----	----	360	1.3

* Product of categories above may not equal total harvest due to some missing name/license numbers

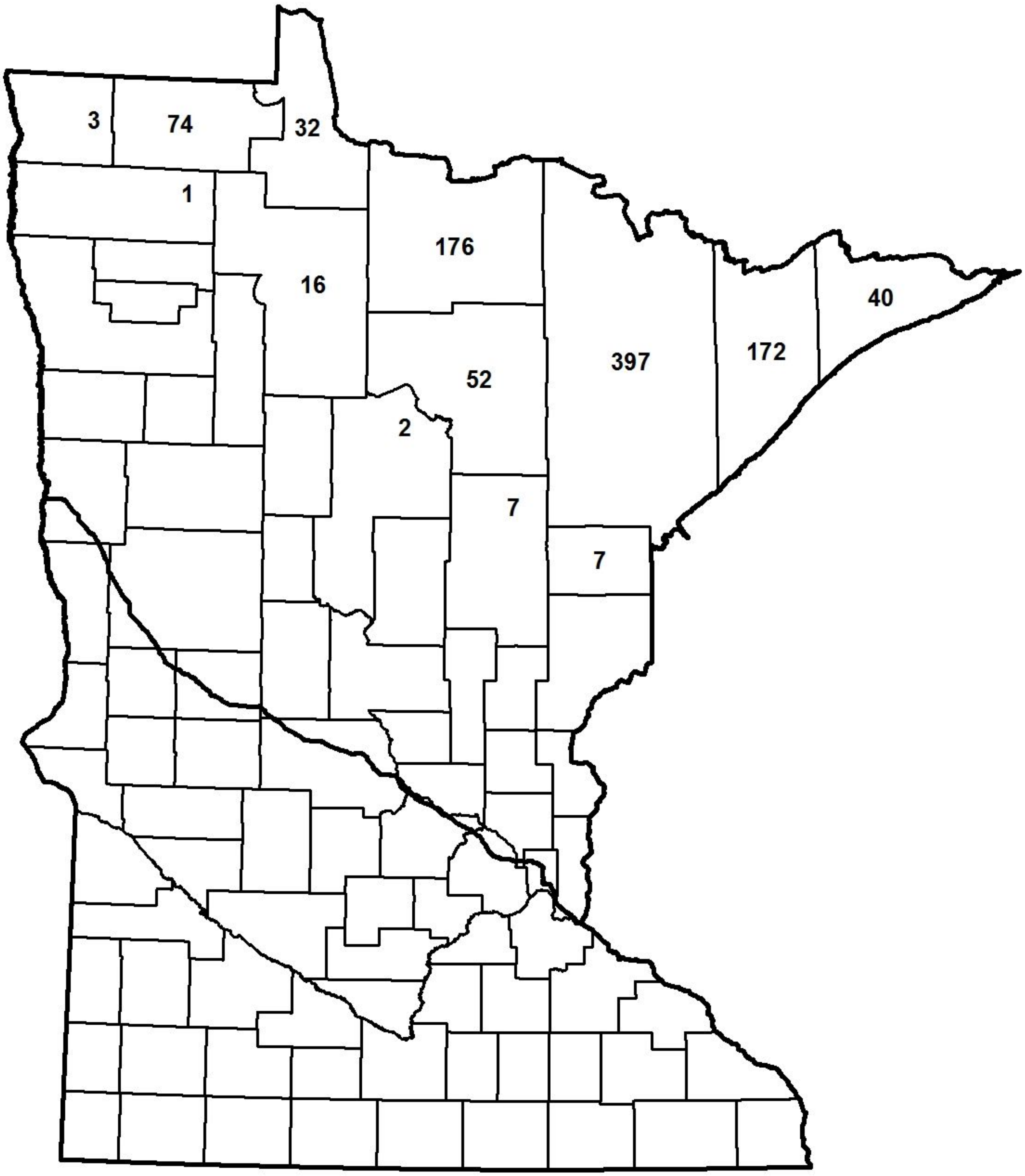

Figure 5. Marten harvest by county, 2017.

Table 11. Marten harvest by county and sex, 2017 season.

County	Sex: Male	Female	Unknown	Total	Harvest/ 100 Mile^2
Aitkin	3	3	1	7	0.35
Becker	0	0		0	0.00
Beltrami	8	8		16	0.52
Carlton	3	4		7	0.80
Cass	1	1		2	0.08
Clearwater	0	0		0	0.00
Cook	29	11		40	2.49
Crow Wing	0	0		0	0.00
Hubbard	0	0		0	0.00
Itasca	26	25	1	52	1.78
Kanabec	0	0		0	0.00
Kittson	2	1		3	0.27
Koochiching	126	50		176	5.58
Lake	120	52		172	7.52
Lake of the Woods	25	7		32	1.80
Mahnomen	0	0		0	0.00
Marshall	1	0		1	0.06
Otter Tail	0	0		0	0.00
Pennington	0	0		0	0.00
Pine	0	0		0	0.00
Red Lake	0	0		0	0.00
Roseau	52	22		74	4.41
St. Louis	237	160		397	5.89
Unknown	0	0		0	
Total	633	344	2	979	

Table 12. Comparison of marten harvest by county in Minnesota, 2006-2017.

County	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Aitkin	13	4	12	5	4	13	10	8	12	4	1	7
Becker	0	0	0	0	0	0	0	0	0	1	0	0
Beltrami	19	8	6	10	2	11	20	15	7	15	7	16
Carlton	6	1	4	8	5	6	3	1	1	0	0	7
Cass	4	0	1	2	1	2	0	0	3	2	2	2
Clearwater	0	0	0	0	0	0	0	0	0	0	0	0
Cook	446	269	151	244	191	205	148	78	43	39	23	40
Crow Wing	0	0	0	1	0	1	0	0	1	0	2	0
Hubbard	0	0	0	0	0	0	0	0	0	1	0	0
Itasca	155	74	72	91	73	118	46	62	79	64	28	52
Kanabec	2	0	0	0	0	0	0	0	0	0	0	0
Kittson	0	0	0	0	1	0	4	0	1	0	0	3
Koochiching	592	348	300	354	336	516	276	218	265	169	107	176
Lake	892	520	438	496	491	577	290	185	149	138	109	172
Lake of the Woods	46	31	17	17	13	49	32	18	23	25	21	32
Mahnomen	0	0	0	0	0	0	0	0	0	0	0	0
Marshall	0	1	0	4	0	3	3	5	5	3	1	1
Otter Tail	0	0	0	0	0	0	0	0	1	0	0	0
Pennington	0	1	0	0	0	0	0	0	0	1	0	0
Pine	1	1	0	0	1	0	0	0	1	0	0	0
Red Lake	0	0	0	0	0	0	1	1	0	0	0	0
Roseau	31	69	46	32	13	98	77	37	40	33	31	74
St. Louis	1,579	885	769	803	709	926	562	386	421	377	219	397
Unknown	2	9	7	6	2	0	0	0	7	5	0	0
Total	3,788	2,221	1,823	2,073	1,842	2,525	1,472	1,014	1,059	877	551	979

Table 13. Marten harvest by date and sex, 2017 season.

Date	Sex: Male	Sex: Female	Sex: Unknown	Total	% of Known Total	Cumulative %
Nov. 25	1	0		1	0.10	0.10
Nov. 26	218	95		313	31.97	32.07
Nov. 27	155	77	1	233	23.80	55.87
Nov. 28	95	73	1	169	17.26	73.14
Nov. 29	89	55		144	14.71	87.84
Nov. 30	73	44		117	11.95	99.80
Unknown	2	0		2	0.20	100%
Total	633	344	2	979	100%	

Table 14. Distribution of marten harvest* among trappers, 1993-2017.

Number (%) of Takers	Number Taken						
	1	2	3	4	5	Total Takers	Ave. Take
1993	76 (10)	681 (90)	----	----	----	757	1.9
1994	165 (20)	681 (80)	----	----	----	846	1.8
1995	78 (10)	711 (90)	----	----	----	789	1.9
1996	157 (18)	734 (82)	----	----	----	891	1.8
1997	161 (13)	1050 (87)	----	----	----	1211	1.9
1998	187 (15)	1056 (85)	----	----	----	1243	1.8
1999	164 (17)	318 (34)	213 (23)	246 (26)	----	941	2.6
2000	188 (28)	190 (28)	123 (18)	173 (26)	----	674	2.4
2001	147 (23)	175 (27)	138 (21)	187 (29)	----	647	2.6
2002	149 (21)	138 (19)	147 (21)	123 (17)	160 (22)	717	1.9
2003	126 (15)	135 (16)	159 (19)	170 (20)	265 (31)	855	1.8
2004	165 (17)	153 (16)	171 (18)	164 (18)	282 (30)	935	1.8
2005	191 (22)	158 (18)	139 (16)	156 (18)	215 (25)	859	1.8
2006	206 (18)	201 (17)	226 (19)	203 (17)	335 (29)	1171	1.8
2007	176 (23)	160 (21)	147 (19)	141 (18)	142 (19)	766	2.0
2008	153 (24)	139 (22)	108 (17)	110 (17)	122 (19)	632	1.9
2009	121 (19)	105 (16)	106 (17)	134 (21)	173 (27)	639	1.9
2010	95 (17)	77 (14)	120 (22)	92 (17)	170 (31)	554	1.8
2011	154 (19)	131 (16)	179 (22)	166 (20)	181 (22)	811	2.0
2012	198 (33)	134 (22)	131 (22)	73 (12)	64 (11)	600	1.9
2013	341 (51)	332 (49)	----	----	----	673	1.5
2014	307 (45)	376 (55)	----	----	----	683	1.6
2015	247 (44)	309 (56)	----	----	----	556	1.6
2016	142 (41)	202 (59)	----	----	----	344	1.6
2017	233 (39)	365 (61)	----	----	----	598	1.6

* Product of categories above may not equal total harvest due to some unknown name/license numbers

Table 15. Number of trappers with different fisher/marten combinations, 2017.
(Combined limit = 2)

Number of Takers		Number of Marten					
		0	1	2	3	4	5
Number of Fisher	0		134	365			
	1	149	97				
	2	114					
	3						
	4						
	5				Total takers of at least 1 fisher or marten		859

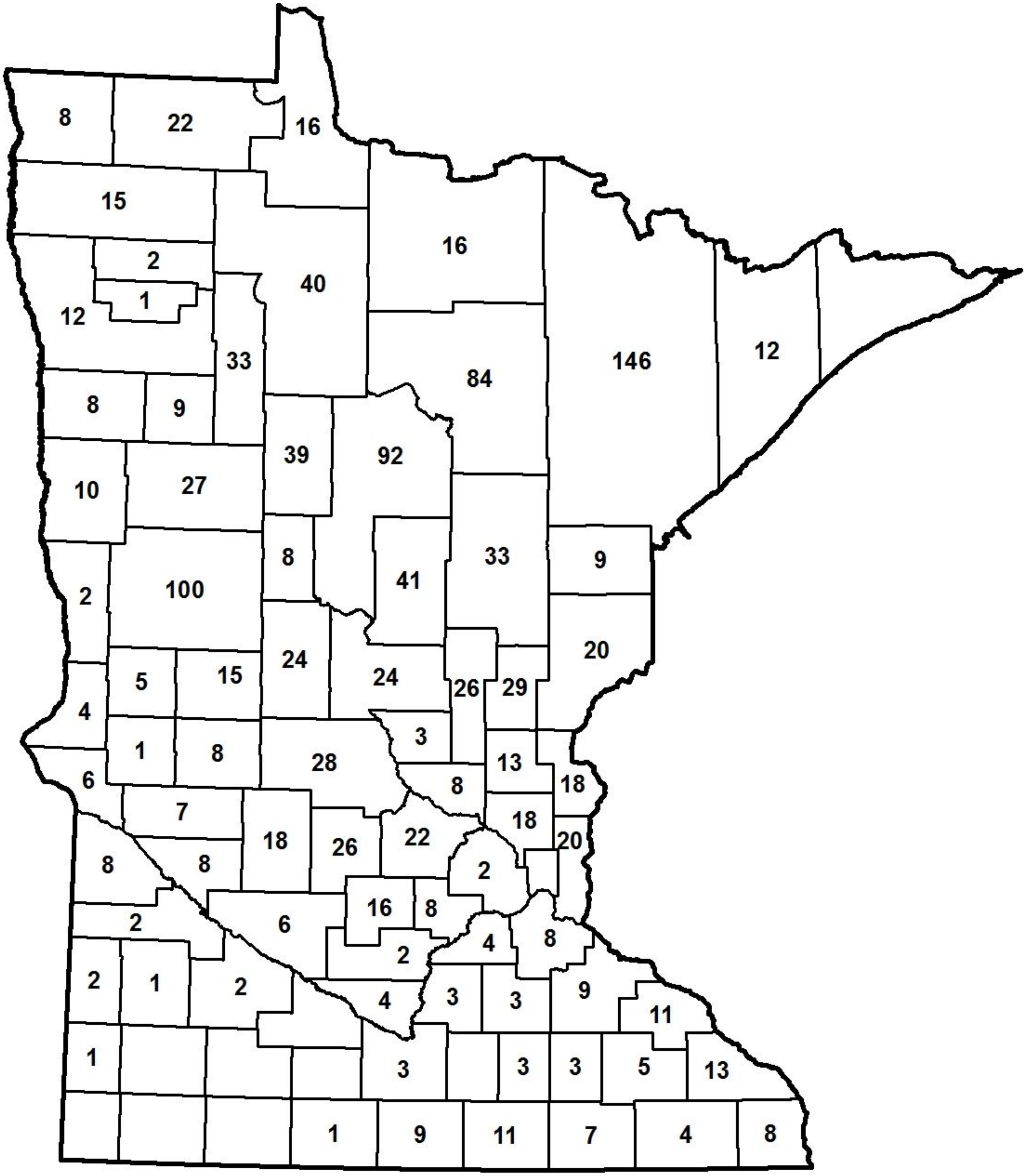

Figure 6. Otter harvest by county, 2017-18.

Table 16. Otter harvest by county and sex, 2017-18 season.

County	Sex: Male	Female	Unknown	Total	Harvest/ 100 Mile[2]
Aitkin	16	17		33	1.66
Anoka	11	7		18	4.04
Becker	19	8		27	1.87
Beltrami	20	20		40	1.31
Benton	2	1		3	0.73
Big Stone	4	2		6	1.14
Blue Earth	3	0		3	0.39
Brown	0	0		0	0.00
Carlton	6	3		9	1.03
Carver	5	3		8	2.13
Cass	60	32		92	3.81
Chippewa	5	3		8	1.36
Chisago	13	3	2	18	4.07
Clay	4	6		10	0.95
Clearwater	21	12		33	3.20
Cook	0	0		0	0.00
Crow Wing	26	15		41	3.55
Dakota	5	3		8	1.37
Dodge	2	1		3	0.68
Douglas	11	4		15	2.08
Faribault	7	2		9	1.25
Fillmore	2	2		4	0.46
Freeborn	6	5		11	1.52
Goodhue	3	6		9	1.15
Grant	2	3		5	0.87
Hennepin	2	0		2	0.33
Houston	5	3		8	1.41
Hubbard	21	18		39	3.90
Isanti	9	4		13	2.88
Itasca	53	30	1	84	2.87
Jackson	0	0		0	0.00
Kanabec	16	13		29	5.44
Kandiyohi	13	5		18	2.09
Kittson	4	4		8	0.72
Koochiching	8	8		16	0.51
Lac Qui Parle	4	3	1	8	1.03
Lake	6	6		12	0.52
Lake of the Woods	9	7		16	0.90
Le Sueur	2	1		3	0.63
Lincoln	1	1		2	0.36
Lyon	0	0	1	1	0.14
Mahnomen	5	4		9	1.54
Marshall	11	4		15	0.83
Martin	1	0		1	0.14
McLeod	10	6		16	3.17
Meeker	13	13		26	4.03
Mille Lacs	18	8		26	3.82
Morrison	13	11		24	2.08
Mower	6	1		7	0.98
Murray	0	0		0	0.00
Nicollet	2	2		4	0.86
Nobles	0	0		0	0.00
Norman	3	5		8	0.91

Table 16 (continued). Otter harvest by county and sex, 2017-18 season.

County	Sex: Male	Female	Unknown	Total	Harvest/ 100 Mile^2
Olmsted	2	3		5	0.76
Otter Tail	60	38	2	100	4.49
Pennington	2	0		2	0.32
Pine	12	8		20	1.40
Pipestone	1	0		1	0.21
Polk	5	7		12	0.60
Pope	5	3		8	1.12
Ramsey	0	0		0	0.00
Red Lake	1	0		1	0.23
Redwood	1	1		2	0.23
Renville	4	2		6	0.61
Rice	1	2		3	0.58
Rock	0	0		0	0.00
Roseau	13	7	2	22	1.31
Scott	1	3		4	1.09
Sherburne	5	3		8	1.78
Sibley	1	1		2	0.33
St. Louis	86	60		146	2.17
Stearns	15	13		28	2.02
Steele	0	3		3	0.69
Stevens	0	0	1	1	0.17
Swift	2	3	2	7	0.93
Todd	15	9		24	2.45
Traverse	2	2		4	0.68
Wabasha	8	3		11	2.00
Wadena	4	4		8	1.47
Waseca	0	0		0	0.00
Washington	12	8		20	4.72
Watonwan	0	0		0	0.00
Wilkin	2	0		2	0.27
Winona	5	8		13	2.03
Wright	12	10		22	3.08
Yellow Medicine	0	1	1	2	0.26
Unknown	0	0	0	0	
Total	765	517	13	1,295	

Table 17. Comparison of otter harvest by county, 2006-2017.

County	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
Aitkin	124	53	65	54	59	107	111	90	67	74	61	33
Anoka	16	26	18	26	8	13	31	25	23	20	12	18
Becker	117	54	55	39	53	95	127	87	77	83	21	27
Beltrami	154	105	80	74	77	112	120	98	74	76	43	40
Benton	16	9	11	3	13	13	21	17	8	1	3	3
Big Stone	0	0	2	1	0	3	3	9	8	3	1	6
Blue Earth	0	0	0	0	0	2	3	1	2	1	3	3
Brown	0	0	0	0	0	0	0	0	0	2	2	0
Carlton	39	36	29	30	35	29	38	37	26	42	32	9
Carver	0	2	5	6	5	15	8	9	17	11	8	8
Cass	236	124	160	90	135	140	183	161	193	172	74	92
Chippewa	0	0	0	0	5	7	8	12	6	4	3	8
Chisago	33	16	15	18	23	19	24	32	26	20	12	18
Clay	35	8	14	7	23	42	23	16	14	18	10	10
Clearwater	41	39	35	19	38	41	46	47	23	38	21	33
Cook	39	13	12	16	19	36	55	57	28	9	4	0
Crow Wing	111	63	99	76	66	107	117	96	83	59	35	41
Dakota	0	0	5	7	1	0	11	10	6	13	3	8
Dodge	0	0	0	0	3	1	1	3	4	2	0	3
Douglas	30	18	28	11	14	34	37	23	33	22	21	15
Faribault	0	0	0	0	0	1	12	3	1	3	5	9
Fillmore	0	6	1	1	5	5	10	6	13	3	3	4
Freeborn	0	0	0	0	5	10	10	1	7	6	2	11
Goodhue	0	3	3	7	11	7	18	2	2	11	4	9
Grant	0	3	3	6	1	8	12	6	13	4	3	5
Hennepin	0	1	3	6	2	3	4	5	6	3	2	2
Houston	0	9	15	11	11	10	26	22	14	9	2	8
Hubbard	72	59	72	41	52	42	67	61	36	32	26	39
Isanti	30	30	17	18	14	9	18	28	23	13	17	13
Itasca	334	205	201	191	247	281	346	345	184	159	67	84
Jackson	0	0	0	0	0	0	0	0	0	1	0	0
Kanabec	62	44	29	23	17	22	52	45	34	26	20	29
Kandiyohi	0	2	6	6	8	8	10	20	20	23	17	18
Kittson	5	11	2	3	8	2	9	7	4	0	8	8
Koochiching	118	70	95	61	81	62	127	115	55	68	19	16
Lac Qui Parle	0	0	0	0	2	6	15	6	1	7	0	8
Lake	60	35	34	45	28	36	66	67	45	26	23	12
Lake of the Woods	24	30	17	8	15	27	27	27	31	31	8	16

Table 17 (continued). Comparison of otter harvest by county, 2006-2017.

County	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
Le Sueur	0	0	0	0	3	0	9	5	2	2	4	3
Lincoln	0	0	0	0	0	0	4	0	0	0	0	2
Lyon	0	0	0	0	0	0	0	0	0	0	0	1
Mahnomen	26	24	7	7	9	20	15	25	7	6	3	9
Marshall	7	6	2	0	13	13	15	15	4	9	12	15
Martin	0	0	0	0	0	0	1	0	0	1	1	1
McLeod	0	6	6	8	12	18	19	22	18	16	14	16
Meeker	0	13	13	16	12	28	19	32	35	23	11	26
Mille Lacs	21	33	26	28	19	15	30	39	28	16	13	26
Morrison	60	45	43	31	29	29	52	52	50	31	22	24
Mower	0	0	0	0	8	20	14	9	8	2	13	7
Murray	0	0	0	0	0	0	0	0	0	1	0	0
Nicollet	0	0	0	0	2	1	5	7	1	0	0	4
Nobles	0	0	0	0	0	0	0	0	4	0	0	0
Norman	11	9	17	11	12	21	45	27	19	13	9	8
Olmsted	0	0	2	3	2	3	0	7	7	5	3	5
Otter Tail	81	50	82	32	65	109	173	154	97	87	92	100
Pennington	15	9	0	1	4	2	12	5	8	8	11	2
Pine	111	50	74	37	38	44	66	98	59	86	48	20
Pipestone	0	0	0	0	0	0	0	0	0	0	1	1
Polk	47	32	25	19	36	49	83	71	47	37	20	12
Pope	0	11	12	12	11	20	22	14	19	8	19	8
Ramsey	0	0	0	0	0	0	3	1	1	1	0	0
Red Lake	30	19	8	20	22	19	26	11	10	14	13	1
Redwood	0	0	0	0	0	2	4	6	8	3	0	2
Renville	0	0	0	0	0	1	6	0	3	1	1	6
Rice	0	0	0	0	1	9	4	8	1	2	6	3
Rock	0	0	0	0	0	0	2	0	0	0	2	0
Roseau	53	32	53	23	32	33	64	48	44	23	24	22
Scott	0	3	3	1	4	2	4	3	2	4	5	4
Sherburne	29	26	10	17	7	19	12	9	10	10	11	8
Sibley	0	0	0	0	6	6	6	3	2	3	2	2
St. Louis	344	290	251	233	253	239	363	293	258	260	109	146
Stearns	33	9	38	24	13	41	53	53	41	50	45	28
Steele	0	0	0	0	1	0	3	1	0	1	3	3
Stevens	0	1	3	1	6	1	3	12	4	2	1	1
Swift	0	9	4	5	2	11	10	10	9	3	7	7
Todd	81	35	37	32	41	63	55	55	19	28	22	24

Table 17 (continued). Comparison of otter harvest by county, 2006-2017.

County	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
Traverse	0	1	0	2	0	1	4	1	0	3	7	4
Wabasha	0	15	7	18	7	8	20	21	19	9	11	11
Wadena	32	15	19	15	16	20	43	30	30	19	5	8
Waseca	0	0	0	0	0	0	0	0	2	2	0	0
Washington	16	18	19	11	16	18	12	24	27	9	12	20
Watonwan	0	0	0	0	0	0	0	1	0	0	0	0
Wilkin	0	2	0	0	0	0	3	2	0	3	1	2
Winona	0	11	19	13	15	20	21	17	5	17	6	13
Wright	5	7	9	8	11	17	23	26	21	21	11	22
Yellow Medicine	0	0	0	0	0	0	7	9	0	3	0	2
Unknown	22	6	18	12	2	17	40	2	18	18	0	0
Totals	2,720	1,861	1,938	1,544	1,814	2,294	3,171	2,824	2,154	1,955	1,195	1,295

Table 18. Otter harvest by sex and week, 2017-18 season.

Date	Sex			Total Harvest	% of Total	Cumulative %
	Male	Female	Unknown			
Oct.28 - Nov.3	158	111	5	274	21.16	21.16
Nov.4 - Nov.10	118	79		197	15.21	36.37
Nov.11 - Nov.17	86	54		140	10.81	47.18
Nov.18 - Nov.24	77	50	2	129	9.96	57.14
Nov.25 - Dec.1	112	62	1	175	13.51	70.66
Dec.2 - Dec.8	79	47	1	127	9.81	80.46
Dec.9 - Dec.15	47	43	1	91	7.03	87.49
Dec.16 - Dec.22	51	25		76	5.87	93.36
Dec.23 - Dec.29	24	26	1	51	3.94	97.30
Dec.30 - Jan.7*	10	15	2	27	2.08	99.38
Unknown	3	5		8	0.62	100.00
Total	765	517	13	1,295	100%	

* 9-day interval.

Table 19. Distribution of otter harvest* among trappers, 1993-2017.

Number (%) of Takers	Number Taken					
	1	2	3	4	Total Takers	Ave. Take
1993-94	193 (33)	115 (19)	100 (17)	184 (31)	592	2.5
1994-95	250 (27)	185 (20)	143 (15)	349 (38)	927	2.6
1995-96	183 (31)	134 (23)	88 (15)	180 (31)	585	2.5
1996-97	257 (29)	205 (23)	140 (16)	283 (32)	885	2.5
1997-98	304 (33)	235 (26)	117 (13)	255 (28)	911	2.4
1998-99	263 (32)	183 (23)	139 (17)	226 (28)	811	2.4
1999-00	222 (33)	124 (19)	99 (15)	217 (33)	662	2.5
2000-01	206 (32)	122 (19)	108 (17)	201 (32)	637	2.5
2001-02	147 (23)	175 (27)	138 (21)	187 (29)	647	2.6
2002-03	253 (33)	147 (19)	122 (16)	241 (32)	763	2.5
2003-04	269 (27)	201 (20)	152 (16)	361 (37)	983	2.6
2004-05	302 (25)	235 (19)	182 (15)	498 (41)	1217	2.7
2005-06	291 (27)	213 (20)	186 (17)	386 (36)	1076	2.6
2006-07	372 (34)	216 (19)	194 (17)	328 (30)	1110	2.4
2007-08	308 (39)	153 (19)	119 (15)	207 (26)	787	2.3
2008-09	293 (37)	157 (20)	121 (15)	216 (27)	787	2.3
2009-10	237 (38)	131 (21)	93 (15)	171 (27)	632	2.3
2010-11	263 (34)	166 (22)	130 (17)	206 (27)	765	2.4
2011-12	438 (42)	227 (22)	149 (14)	236 (22)	1050	2.2
2012-13	468 (35)	330 (24)	175 (13)	376 (28)	1349	2.3
2013-14	561 (43)	291 (22)	196 (15)	271 (21)	1319	2.1
2014-15	424 (42)	231 (23)	154 (15)	200 (20)	1009	2.1
2015-16	337 (39)	183 (21)	142 (16)	203 (23)	865	2.2
2016-17	270 (46)	135 (23)	80 (14)	101 (17)	586	2.0
2017-18	243 (41)	139 (23)	77 (13)	135 (23)	594	2.2

* Product of categories above may not equal total harvest due to some unknown name/license numbers