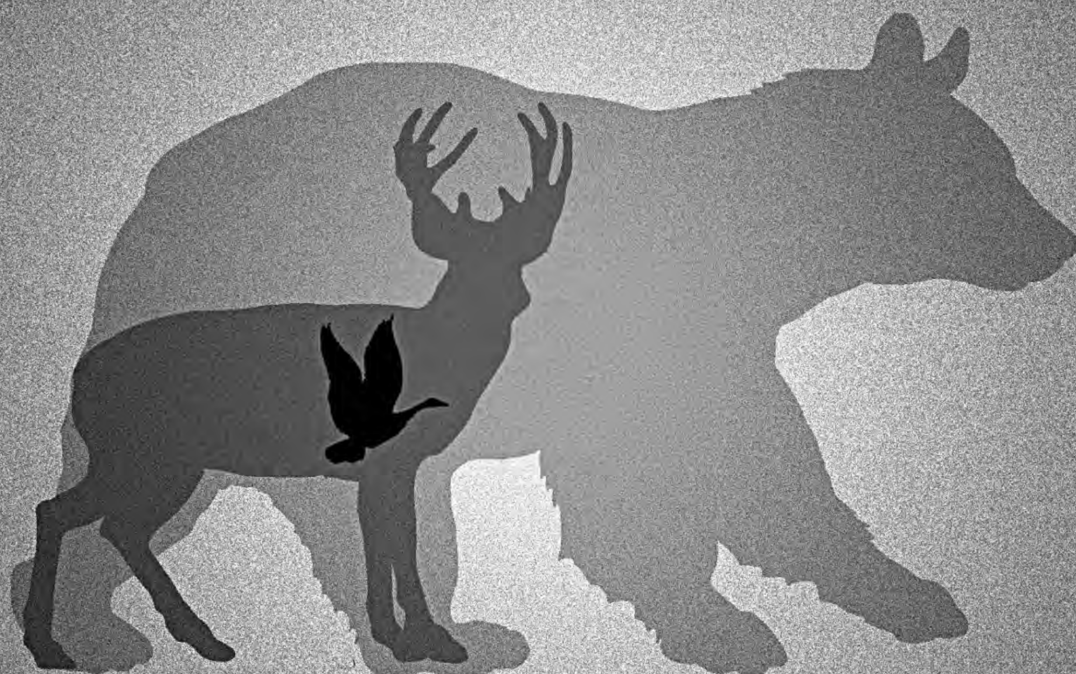

Status of Wildlife Populations

Fall 2022

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

mn DEPARTMENT OF NATURAL RESOURCES

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Status of Wildlife Populations, Fall 2022

(Including 2012-2022 Hunting and Trapping Harvest Statistics)

edited by
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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 2022

(Including 2012-2022 Hunting and Trapping Harvest Statistics)

This is the 46th 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.

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2022 MINNESOTA AUGUST ROADSIDE SURVEY

Timothy P. Lyons

SUMMARY OF FINDINGS

INTRODUCTION

Since 1955, the Minnesota Department of Natural Resources (MN DNR) wildlife and enforcement personnel have conducted the annual August Roadside Survey (ARS) during the first two weeks of August throughout Minnesota's farmland regions (Figure 1). Initially developed to provide indices of common upland game species (ring-necked pheasant, grey [Hungarian] partridge, eastern cottontail rabbits, white-tailed jackrabbits, and mourning doves), the survey now formally indexes white-tailed deer and sandhill cranes. The current ARS includes 172 survey routes in 70 counties throughout Minnesota. The results of the annual survey are made publicly available in the annual ARS report (e.g., Lyons 2022).

OBJECTIVES

1. Index game birds and other common game species within the historic "pheasant range" of Minnesota and throughout the farmland and transition zones of the state.
2. Analyze results to provide public information about population trends of focal species.
3. Summarize weather and habitat conditions that may impact population trends of pheasants or other focal species.

METHODS

Survey protocol

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, and sandhill cranes they observed. They also recorded information on sex and age of these species when applicable. Surveys were only performed on mornings with dew, cloud cover <60% and wind speeds <10mph. 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 with these conditions. 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 and range-wide; however, population indices for species with low detection rates (e.g., white-tailed jackrabbits) are imprecise and unreliable.

Observers recorded the number of male (rooster), female (hen), and juvenile pheasants, whether females were present with a brood, and the estimated age of chicks in each brood. The same measurements were recorded for gray partridge, but adult birds were not sexed because they are not sexually dimorphic. Age and sex were recorded for both white-tailed deer and sandhill cranes when observed. Observers only reported a total count (no sex or age information) for mourning doves and rabbits.

Habitat data collection

We queried the MN DNR GIS database files of Wildlife Management Areas (WMAs) and summed the total area of parcels by county to obtain an estimate of protected habitat. Due to difficulties in classifying vegetation types from remotely-sensed data products, this estimate includes areas that are unsuitable upland habitat (i.e. closed-canopy forest). Aquatic Management Areas and State Parks were not included in this tally as we assume they do not make a meaningful contribution to upland habitat within the state. We obtained information on additional public lands, primarily National Wildlife Refuges (NWRs) and Waterfowl Production Areas (WPAs) from the U.S. Fish and Wildlife Service (USFWS). Finally, we obtained estimates of potential upland habitat on private lands from the Minnesota Board of Water and Soil Resources (BWSR). These lands were enrolled in state or federal programs that retire cropland temporarily (e.g., Conservation Reserve Program [CRP]) or permanently (e.g. Conservation Reserve Enhancement Program [CREP], Reinvest in Minnesota [RIM]).

Weather data collection

We obtained precipitation and temperature data summaries from the Midwest Regional Climate Center ([MRCC]; 2022) for each of the agricultural regions covered by the ARS. We used weekly maps of interpolated snow depth, provided by the Minnesota State Climatology Office, to compute the mean snow depth for the winter season (December 1 through March 31) in each agricultural region.

Analysis

We computed averages and annual change, 10-yr, and long-term (since 1955) trend statistics for each of the focal species. We computed statistics at the state and regional scale, though results from regional analyses are more biased due to the smaller sample sizes. In the analysis, we treated each year and route combination as an independent sample when computing annual change and trend statistics. Thus, the average proportional change for the state or region is the mean of proportional changes at the route level. Confidence intervals were calculated using critical values from Student’s T-distribution.

We calculated additional statistics for pheasants, including the mean estimated hatch date and proportion of hens with a brood. We estimated the mean hatch date by back-calculating the hatch date for each brood based on its estimated age during the survey. We used the proportion of hens with broods as an index of breeding success among hens.

RESULTS

Habitat Conditions

Habitat acres on public and private lands in the primary pheasant range increased in 2022, with an approximately 5,000 acre increase in lands enrolled in CRP and a 7,000 acre increase in CREP (Table 1). Federally managed USFWSWPAs, NWRs, and conservation easements increased by almost 6,000 acres, and WMAs managed by the DNR increased approximately 3,000 acres. Protected lands accounted for 6.7% of lands within the pheasant range, up from 6.5% in 2021. The Southwest and West Central regions had the highest proportion of protected lands (public and private) in the region and together, accounted for nearly 50% of all protected lands considered (Table 1.)

Minnesota’s Walk-in Access (WIA) program continued to provide public hunting opportunities on private land already enrolled in existing conservation programs and/or with natural habitat. The program has grown each year since inception, and in 2022, featured more than 260 sites totaling more than 30,000 acres, primarily in the South Central, Southwest, and West Central regions but with additional sites within the Central, East Central and Southeast regions. Hunters were required to purchase a $3 WIA Validation that allowed access to all WIA lands statewide.

Weather Summary

Following National Oceanic and Atmospheric Administration conventions, the 30-year period used to calculate normal temperatures included the years ranging from 1991-2020. Weather conditions for pheasants were mixed in 2021-2022. Winter conditions across the state were generally cooler and snowier, but this varied among regions (Table 2). The southern regions all experienced cooler, but closer-to-normal winter temperatures and below-average snow depth (Table 2). Across the state, spring temperatures were 2-4 degrees below normal. As with snowfall, all regions outside of the southern tier of the state experienced above-average precipitation (range 1.2-2.4 inches above normal) while the Southwest, South Central, and Southeast experienced near-average amounts of rainfall (Table 2). Summer temperatures were 1-2.5 degrees above average and in most regions, rainfall during the summer was below average (Table 2).

Survey Conditions

Weather conditions during surveys were very good in 2022. Temperature, dew, wind and sky cover conditions were all similar to 10-year averages. Unlike 2021, which saw widespread smoke and drought throughout much of the surveyed area, weather conditions in 2022 were unlikely to have a substantial influence on survey results.

Species Reports

Ring-necked Pheasant

The total pheasant index increased 18.4% in 2022 (48.4 birds/100 mi) compared to 2021 (40.9 birds/100 mi; Table 3, Figure 2A). Indices of hens and broods remained similar to 2021 (Table 3). The indices for roosters, broods per 100 hens, and chicks per brood all increased by a small amount compared to 2021 (Table 3). All indices were at or near their 10-year averages (Table 3), though the index of chicks per brood (5.3) was 9.9% greater than in 2021 (4.8). Though most indices of pheasants remain below the long-term average (Table 3), the number of broods per 100 hens in 2022 (97.8) was approximately 15% greater than the long-term average (86.8; Table 3). Furthermore, the index of chicks per brood in 2022 (5.3) was nearly equal to the long-term average (5.8; Table 3). Collectively, this suggested good nesting and brood-rearing success in 2022.

The pheasant index exhibited double-digit increases in the Central, South Central, and Southeast regions where the index grew 47%, 29%, and 58%, respectively. Indices in other regions increased or decreased by insignificant amounts (Table 4). Though pheasant indices remain well below their long-term averages in all regions, they were near or above their ten-year averages (Table 4). The South Central (63.7 birds/100 mi), Southwest (58.1 birds/100mi), and the Central regions (52.8 birds/100 mi) had the highest indices and they, along with the West Central region (45.6 birds/100mi) likely provided the best hunting opportunities in the state.

Gray Partridge

The 2022 range-wide gray partridge index (3.9 birds/100 mi) was greater than 2021 (2.8 birds/100 mi) and the 10-year average (2.5 birds/100 mi) but remained below the long-term average (-69%; Table 3, Figure 2B). Partridge are generally rare throughout the state, but may be locally abundant. In 2022, the Central, South Central, and Southeast regions provided the best opportunities for harvesting gray partridge (Table 4).

Cottontail Rabbit and White-tailed Jackrabbit

Range-wide, the 2022 eastern cottontail rabbit index (6.5 rabbits/100 mi) increased slightly from 2021 (4.4 rabbits/100 mi), was above the 10-year average (5.5 rabbits/100 mi), and was similar to the long-term average (6.1 rabbits/100 mi; Table 3, Figure 3A). Most regions saw substantial increases in their cottontail index except for the East Central, South Central, and Northwest Regions, which had no substantive changes (Table 4). The greatest increase in the cottontail index was in the Southeast, where the cottontail population increased 150% to 18.7 rabbits/100 mi. The best rabbit hunting opportunities were in the Southwest, East Central, and Southeast regions (Table 4).

Single white-tailed jackrabbits were observed on four routes in the Southwest and West Central regions (Table 3). Jackrabbits are rarely detected, making annual or short-term trend comparisons difficult. Still, the jackrabbit index remained >90% below the long-term average (Table 3, Figure 3B). 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 (e.g., pasture, hayfields, and small grains).

White-tailed Deer

The 2022 white-tailed deer range-wide index (34.8 deer/100 mi) increased slightly compared to 2021 (31.4 deer/100 mi) and remained 40% above the 10-year average (24.6 deer/100 mi) and 162% above the long-term average (13.2 deer/100 mi; Table 3, Figure 4A). Regional indices for deer increased everywhere except the South Central and Southeast regions which were similar to last year and the Central region which declined slightly (-14%; Table 4).

Mourning Dove

The 2022 range-wide mourning dove index (123.5 doves/100 mi) increased 10% compared to the 2021 index (112.2 doves/100 mi) but remained 15% below the 10-year average (145.4 doves/100 mi) and 48% below the long-term average (241.8 doves/100 mi; Table 3, Figure 4B). The dove index showed large increases in the Central and East Central regions, while the Southwest, South Central, Southeast, and West Central regions saw more modest growth or were relatively constant (Table 3). The Northwest region saw a 43% decline in the mourning dove index (Table 4). The dove index was greatest in the Southwest, South Central, and West Central regions; opportunities for harvesting doves should have been the best there as well.

Sandhill Crane

The 2022 roadside index of sandhill cranes (12.9 cranes/100 mi) was similar to the 2021 index (12.2 cranes/100 mi; Table 3). Annual changes in regional indices varied greatly. The Northwest region saw a 56% decline (from 36.8 to 16.0 birds/100 mi) in crane numbers overall, whereas the East Central region index increased approximately 200% (from 30.3 to 91.3 birds/100 mi; Table 4), including a 122% increase in juvenile cranes. Other regions reported either no substantial changes or minor decreases, but the crane index was generally low in these regions (Table 4). Given the limited length of records, comparisons of 2022 indices with the 10-year averages showed similar patterns, albeit of a smaller magnitude (Table 4). Cranes were not detected on any surveys in the Southeast region in 2022 and have not yet been reported in roadside counts in the Southwest region.

Other Species

Notable incidental sightings recorded by observers included: peregrine falcon (Dakota county), red-headed woodpecker (Freeborn county), eastern meadowlark (Pine county), sharp-tailed grouse (Polk county), and red fox (Becker, Meeker, and Norman counties).

ACKNOWLEDGMENTS

We thank the many cooperators for completing the routes required for this survey; without their efforts, this survey would not be possible. Tonya Klinkner was invaluable in providing logistical assistance and entering route data. Dusty VanThuyne (Minnesota Board of Water and Soil Resources) provided enrollment data on cropland retirement programs in Minnesota and Lisa Rairdin (U.S. Fish and Wildlife Service) provided federal land acquisition data. John Giudice, Nicole Davros, and Mike Larson (MN DNR Wildlife Research) reviewed an earlier draft of this report. This work was funded in part through the Federal Aid in Wildlife Restoration Act.

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Table 1. Abundance (total acres) and density (acres/mi^2) of undisturbed grassland habitat within Minnesota's pheasant range, 2022, by agricultural region (AGREG).

	Cropland Retirement (private lands)[a]					Public Lands				
AGREG	CRP	CREP	RIM	RIM-WRP	WRP	USFWS[b]	MNDNR[c]	Total	% of landscape	Density ac/mi^2
WC	250,375	42,296	22,733	14,275	20,207	217,176	115,695	682,757	10.0%	64.3
SW	124,324	35,861	21,143	2,553	766	26,940	69,213	280,800	7.4%	47.5
C	127,199	20,941	48,736	7,265	3,158	93,765	55,540	356,604	5.9%	37.8
SC	105,182	35,186	13,664	10,779	9,107	12,315	38,905	225,138	5.6%	35.7
SE	77,943	3,780	7,294	1,070	1,577	37,136	58,714	187,514	5.1%	32.4
EC	2,373	0	1,257	0	4	4,994	97,178	105,806	3.3%	21.1
Total	687,396	138,064	114,827	35,942	34,819	392,326	435,245	1,838,619	6.7%	42.7

[a] Unpublished data, BWSR, 30 August 2022.
[b] Includes USFWS Waterfowl Production Areas (WPA), USFWS refuges, & USFWS conservation easements.
[c] MN DNR Wildlife Management Areas (WMA). Comparisons to 2020 and earlier years are not valid.

Table 2. Average temperature, snow depth, and precipitation by season and agricultural region in Minnesota, 2022.

	Agricultural Region							
	NW	WC	C	EC	SW	SC	SE	STATE
Winter (December 1 - March 31)								
Temperature (average °F)	9.2	15.1	16.0	14.2	20.3	19.9	19.9	16.4
Departure from normal (°F)[a]	-4.8	-3.0	-3.2	-4.1	-0.8	-1.6	-1.9	-2.8
Snow Depth (average inches)	12.4	8.3	5.3	6.8	1.5	2.2	2.6	3.8
Spring (April 1 - May 31)								
Temperature (average °F)	43.6	46.8	47.8	46.0	48.5	49.5	49.2	47.3
Departure from normal (°F)[a]	-3.8	-3.1	-2.4	-2.5	-2.5	-2.2	-2.0	-2.6
Precipitation (total inches)	4.6	4.6	4.2	4.4	3.9	3.8	4.2	4.2
Departure from normal (inches)[a]	2.4	1.9	1.1	1.2	0.4	0	0.1	1
Summer (June 1 - July 31)								
Temperature (average °F)	67.1	71.0	70.6	67.6	72.2	71.8	70.2	70.1
Departure from normal (°F)	0.9	2.4	1.9	0.8	2.5	1.8	1.1	1.6
Precipitation (total inches)	3	2.5	2.4	2.6	2	2.9	3.9	2.8
Departure from normal (inches)[a]	-0.9	-1.6	-1.9	-1.8	-2.2	-1.8	-1	-1.6

[a] Departures calculated using 30-year NOAA average (1991-2020) over respective time period.

Table 3. Range-wide trends (% change) in wildlife observed per 100 miles driven, Minnesota August roadside survey, 1955-2022.

Species / Subgroup	Change from 2021[a]					Change from 10-year average[b]				Change from long-term average (LTA)[c]			
	n	2021	2022	%	95% CI	*n*	2012-2021	%	95% CI	*n*	LTA	%	95% CI
Ring-necked pheasant													
Total pheasants	140	40.9	48.4	18.4	±22.3	143	39.5	19.8	±18.3	143	89.7	-47.2	±9.4
Cocks	140	5.1	7.0	36.8	±26.8	143	5.5	24.7	±20.8	143	11.7	-44.7	±10.2
Hens	140	6.5	6.6	2.3	±22.3	143	6.0	5.1	±17.6	143	13.0	-51.7	±9.4
Broods	140	6.4	6.9	6.6	±22.5	143	6.2	4.7	±17.9	143	10.4	-34.6	±13.7
Broods per 100 hens	227	93.8	97.8	4.3			99.9	-0.4			86.8	14.7	
Chicks per brood[d]	227	4.8	5.3	9.9			4.7	14.9			5.8	-8.0	
Median hatch date[d]	227	16-Jun	19-Jun				11-Jun				8-Jun		
Gray partridge	156	2.8	3.9	37.6	±70.0	159	2.5	50.7	±78.2	155	12.6	-69.1	±15.6
Eastern cottontail	156	4.4	6.5	46.6	±44.5	159	5.5	19.2	±35.6	155	6.1	11.0	±32.4
White-tailed jackrabbit[e]	156	0.1	0.1			159	0.1			155	1.5	-93.0	
White-tailed deer	156	31.4	34.8	11.0	±6.3	159	24.6	40.1	±8.0	159	13.2	161.9	±15.0
Mourning dove	156	112.2	123.5	10.1	±1.8	159	145.4	-15.4	±1.4	153	241.8	-48.2	±0.8
Sandhill crane[f]													
Total cranes	156	12.2	12.9	6.0	±16.1	159	12.2	11.0	±16.2				
Juveniles	156	1.8	1.5	-17.0	±107.1	163	1.5	12.0	±127.6				

[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 1955-2022, except for deer (1974-2022). Estimates for all species except deer based on routes (*n*) surveyed $\geq$40 years; estimates for deer based on routes surveyed $\geq$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 2022.
[e] White-tailed jackrabbits are too rare to make annual or 10-year comparisons.
[f] Sandhill cranes were added to the survey in 2009; thus, long-term averages are not calculated.

Table 4. Regional trends (% change) in number of wildlife observed per 100 miles driven, Minnesota August roadside survey, 1955-2022.

Region	Change from 2021[a]					Change from 10-year average[b]				Change from long-term average (LTA)[c]			
Species	*n*	2021	2022	%	95% CI	*n*	2012-2021	%	95% CI	*n*	LTA	%	95% CI
Northwest[d]													
Gray partridge	16	2.0	2.5	25.0	±106.6	16	1.0			16	2.8	-11.9	±75.1
Eastern cottontail	16	1.0	1.0	0		16	1.0			16	0.9		
White-tailed jackrabbit[e]	16	0	0			16	0.2			16	0.5		
White-tailed deer	16	56.9	67.0	17.8	±3.7	16	53.7	24.7	±4.0	16	36.9	81.4	±5.8
Mourning dove	16	74.4	42.4	-43.0	±2.9	16	82.1	-48.3	±2.6	16	114.4	-62.9	±1.9
Sandhill crane[f]	16	36.8	16.0	-56.6	±5.8	16	39.8	-59.9	±5.4				
West Central[g]													
Ring-necked pheasant	38	43.3	45.6	5.4	±4.7	37	44.2	-7.3	±4.6	37	91.6	-55.3	±2.2
Gray partridge	38	0.2	2.1			37	0.3			37	8.4	-74.3	±24.1
Eastern cottontail	38	1.6	2.4	53.8	±128.8	37	2.6	-8.1	±78.4	37	3.8	-37.3	±53.5
White-tailed jackrabbit[e]	38	0	0.1			37	0.1			37	2.0	-94.5	±102.7
White-tailed deer	38	29.6	37.6	26.8	±6.8	37	26.6	37.2	±7.6	37	13.2	176.2	±15.3
Mourning dove	38	126.7	138.2	9.0	±1.6	37	181.9	-24.3	±1.1	37	343.1	-59.9	±0.6
Sandhill crane[f]	38	4.4	4.6	4.7	±45.8	37	3.2	51.2	±63.1				
Central													
Ring-necked pheasant	28	36.0	52.8	46.5	±5.7	28	34.7	52.1	±5.9	28	68.0	-22.4	±3.0
Gray partridge	28	0.4	4.4			28	1.7			28	6.6	-32.8	±31.1
Eastern cottontail	28	5.0	6.7	34.4	±41.0	28	5.4	23.8	±37.8	28	6.3	6.4	±32.5
White-tailed jackrabbit[e]	28	0.4	0			28	0.1			28	1.0		
White-tailed deer	28	46.7	40.0	-14.4	±4.4	28	25.7	55.5	±8.0	28	9.9	304.6	±20.8
Mourning dove	28	86.9	118.5	36.5	±2.4	28	126.1	-6.0	±1.6	28	207.1	-42.7	±1.0
Sandhill crane[f]	28	28.6	30.9	8.0	±7.2	28	24.5	26.0	±8.4				
East Central													
Ring-necked pheasant	7	22.3	23.4	5.0	±11.0	10	32.2	12.9	±7.0	10	77.9	-53.3	±2.9
Gray partridge	7	0	0			10	0.2			10	0.1		
Eastern cottontail	7	7.4	6.9	-7.8	±32.9	10	11.3	-22.3	±20.0	10	8.3	5.4	±27.1
White-tailed jackrabbit[e]	7	0	0			10	0			10	0.2		
White-tailed deer	7	34.3	48.3	41.1	±7.1	10	27.4	70.3	±8.3	10	12.5	271.9	±18.0
Mourning dove	7	61.1	100.0	63.7	±4.0	10	68.1	38.0	±3.3	10	112.6	-16.5	±2.0
Sandhill crane[f]	7	30.3	91.3	201.6	±8.1	10	42.4	80.8	±5.3				

Table 4. Continued.

Region	Change from 2021[a]					Change from 10-year average[b]				Change from long-term average (LTA)[c]			
Species	*n*	2021	2022	%	95% CI	*n*	2012-2021	%	95% CI	*n*	LTA	%	95% CI
Southwest													
Ring-necked pheasant	19	63.2	58.1	-8.0	±3.3	19	63.4	-8.3	±3.3	19	108.6	-46.5	±1.9
Gray partridge	19	5.3	2.7	-48.0	±39.9	19	5.0	-45.4	±41.9	19	35.5	-92.3	±5.9
Eastern cottontail	19	4.4	7.6	71.3	±47.5	19	5.4	40.6	±39.0	19	7.7	-1.3	±27.4
White-tailed jackrabbit[e]	19	0	0.6			19	0.3			19	3.3	-80.6	±64.4
White-tailed deer	19	20.6	29.7	43.9	±10.2	19	20.8	42.6	±10.1	19	11.3	162.2	±18.6
Mourning dove	19	155.8	166.4	6.8	±1.3	19	197.5	-15.8	±1.1	19	293.0	-43.2	±0.7
Sandhill crane[f]	19	0	0			19	0						
South Central													
Ring-necked pheasant	29	49.2	63.7	29.4	±4.2	30	41.1	50.3	±5.0	30	117.4	-47.4	±1.7
Gray partridge	29	6.1	6.9	13.6	±33.8	30	5.2	27.6	±39.1	30	17.6	-62.1	±11.6
Eastern cottontail	29	6.9	5.9	-14.0	±29.7	30	7.5	-23.9	±27.2	30	7.6	-24.3	±27.0
White-tailed jackrabbit[e]	29	0	0			30	0.1			30	1.5		
White-tailed deer	29	12.3	13.2	7.8	±16.7	30	9.1	41.1	±22.6	30	4.9	161.7	±41.9
Mourning dove	29	134.9	152.5	13.1	±1.5	30	181.6	-15.1	±1.1	30	245.0	-37.0	±0.8
Sandhill crane[f]	29	3.3	2.8	-16.7	±61.9	30	2	32.5	±101.6				
Southeast													
Ring-necked pheasant	19	15.2	23.9	57.8	±18.0	19	14.9	60.5	±14.1	19	61.3	-61.0	±3.4
Gray partridge	19	5.9	5.8	-2.4	±50.0	19	3.8	51.6	±55.4	19	12.3	-53.4	±17.0
Eastern cottontail	19	7.4	18.7	153.1	±24.0	19	9.2	102.3	±22.8	19	8.4	122.5	±25.1
White-tailed jackrabbit[e]	19	0	0			19	0			19	0.5		
White-tailed deer	19	29.5	27.7	-6.0	±9.0	19	21.5	28.7	±9.8	19	13.1	110.8	±16.0
Mourning dove	19	93.3	91.6	-1.8	±3.0	19	87.0	5.2	±2.4	19	186.0	-50.8	±1.1
Sandhill crane[f]	19	2.3	0			19	0.5						

[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 1955-2022, except for Northwest region (1982-2022) and white-tailed deer (1974-2022). Estimates based on routes (*n*) surveyed ≥40 years (1955-202), 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] White-tailed jackrabbits are too rare to calculate regional trends.
[f] Sandhill cranes were added to the survey in 2009; thus, long-term averages are not calculated.
[g] Two routes were added to the West Central region in 2014.

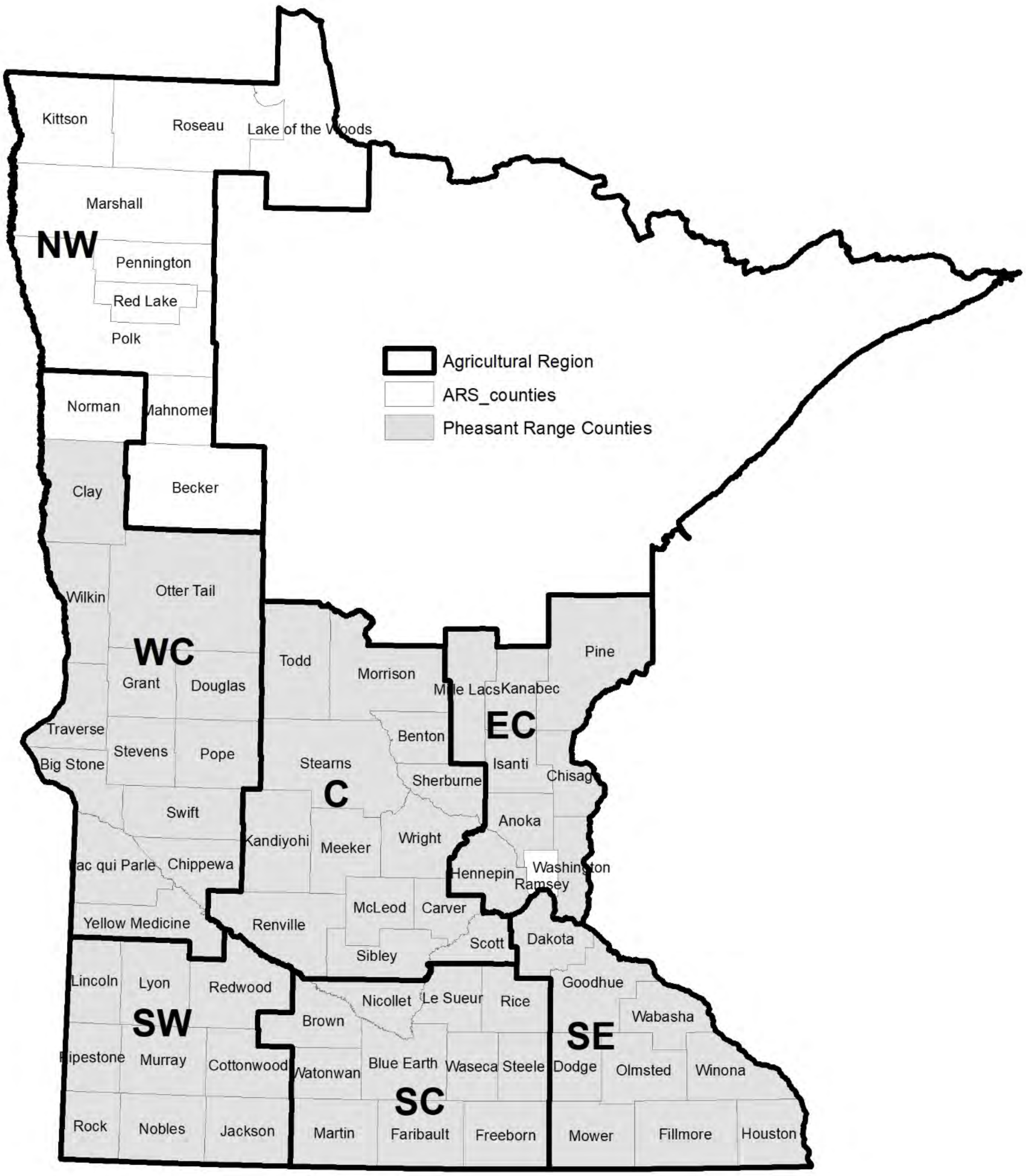

Figure 1. Survey regions and ring-necked pheasant range delineation for Minnesota's August roadside survey, 2022.

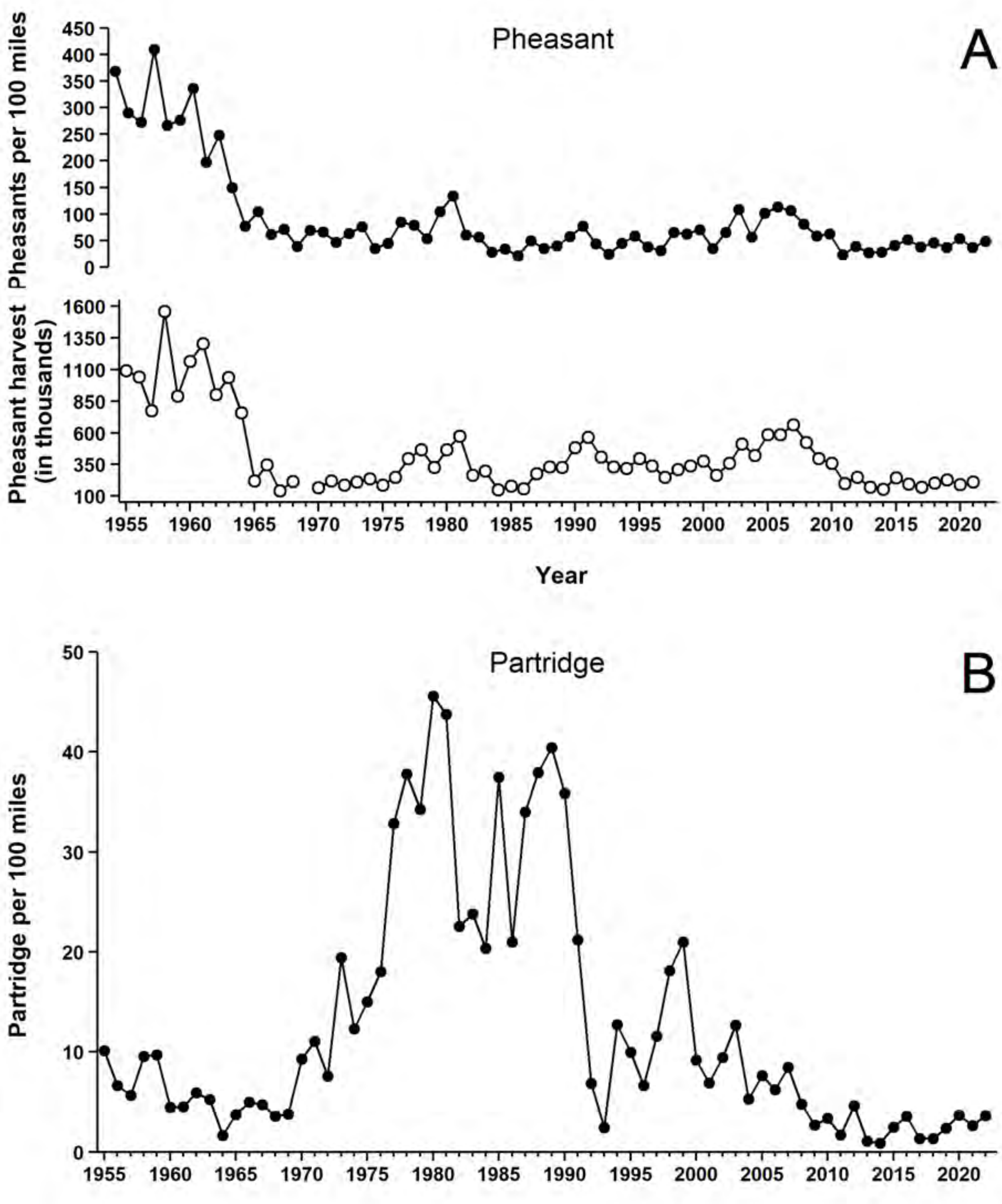

Figure 2. Range-wide index of ring-necked pheasants (A) and gray partridge (B) seen per 100 miles driven in Minnesota, 1955-2022. Based on all survey routes completed.

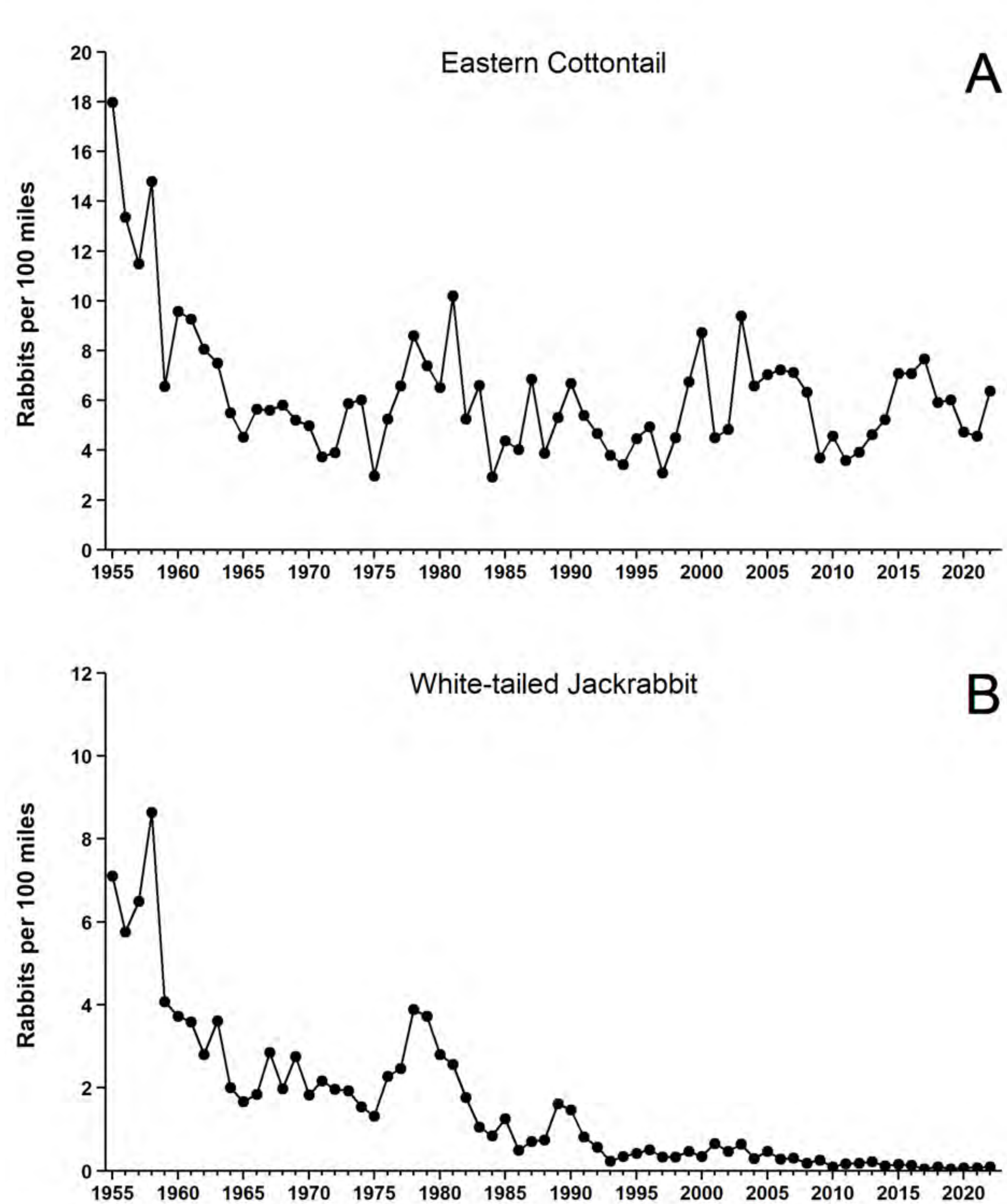

Figure 3. Range-wide index of eastern cottontail (A) and white-tailed jackrabbits (B) seen per 100 miles driven in Minnesota, 1955-2022. Based on all survey routes completed.

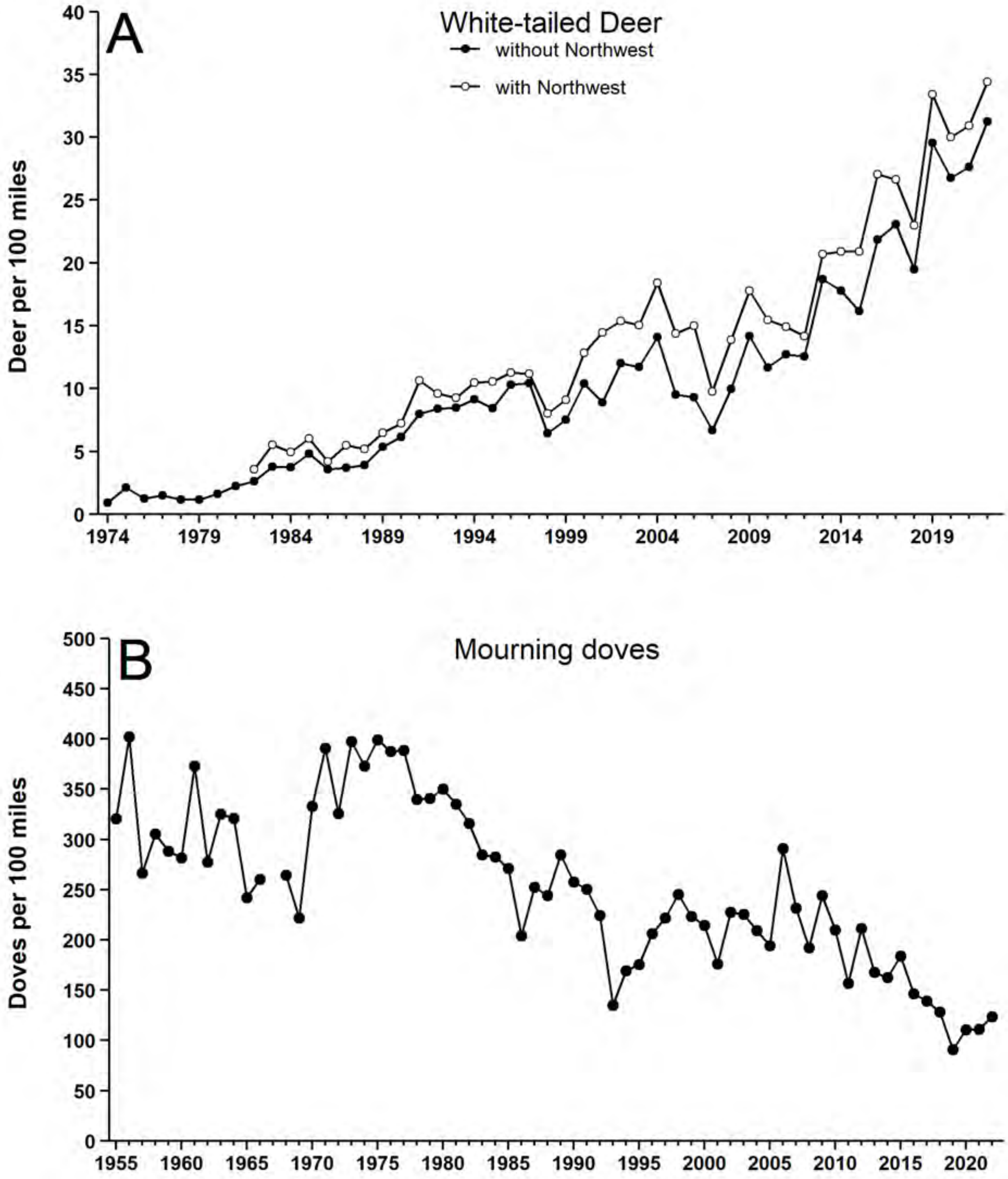

Figure 4. Range-wide index of: (A) white-tailed deer seen per 100 miles driven in Minnesota, 1974-2022, with and without the Northwest region included; and (B) mourning doves seen per 100 miles driven in Minnesota, 1955-2022. Doves were not counted in 1967. Based on all survey routes completed.

MONITORING POPULATION TRENDS OF WHITE-TAILED DEER IN MINNESOTA – 2022

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INTRODUCTION

Hunting is the primary method used to manage white-tailed deer (*Odocoileus virginianus*) populations in Minnesota. Minnesota Department of Natural Resources (MNDNR) sets annual hunting regulations to adjust deer harvest to meet management goals. MNDNR wildlife researchers conduct simulation modeling of deer populations to explore the impacts of various hunting regulations on populations, to understand historical deer herd dynamics, and to predict relative population sizes. To aid in decision-making, MNDNR Biologists consider output from population modeling 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 modeled density estimates and harvest recommendations.

METHODS

Prior to 2019, we modeled deer populations at the deer permit area (DPA) level. However, with over 130 DPAs, this was a major annual undertaking that limited the time the modeler could devote to each modeling unit, including exploring the sensitivity of the model in each case. Furthermore, we typically lacked empirical data on population vital rates (other than harvest) at the DPA scale and it would be cost prohibitive to collect such data. Conversely, collecting annual or periodic population data over larger modeling units might be feasible. Therefore, beginning in 2019, we consolidated DPAs into deer modeling units (DMUs; Figure 1). DMUs are generally consistent with goal-setting blocks (GSBs), except some DMUs may contain less than the full set of DPAs within a GSB if there were major boundary changes in the last 5 years (which makes it difficult to interpret harvest data and population trends).

We recognize that annual regulatory decisions still occur at the DPA level and we need to link DMU-level modeling results to DPA-level decision making. Therefore, we used the annual proportional buck harvest in each DPA to convert DMU population estimates to DPA-level density estimates, which we acknowledge is a simplification of factors that can influence variation in deer densities among DPAs and years. Thus, we advise caution when interpreting annual DPA-level estimates of absolute density and, in turn, encourage assessing the overall population trend.

Model Structure

We used the spring of the initial year before reproduction occurred (Figure 2) as the starting period for each multi-year simulation. We specified an initial population density (see Modeling Procedures section). The model then converted the initial population density into a total population size by multiplying the density by the total land area of the DMU. We set the proportion of adult deer by age- and sex-class in the initial population (adult females mean =

0.45 [SD = 0.02], adult males mean = 0.20 [SD = 0.02]). We allocated the remaining proportion approximately equally (with some small variation for primary sex ratio) to young-of-year (YOY) males and females.

Within each annual cycle, we applied age-specific fecundity rates to females to estimate reproduction. We subjected all age- and sex-classes to spring/summer mortality, and the result was the pre-hunt fall population. We also subtracted hunter-harvested deer from the pre-hunt population. We estimated winter mortality rates by age-class relative to winter severity, and we then applied winter mortality rates 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 DMU were equal.

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). We partitioned fecundity rates by 2 age-classes of breeding females (i.e., <1 year old [YOY] when bred and ≥1 years old [adult] when bred) and allowed rates to vary by 3 eco-geographic zones (northeast, farmland and transition areas, and southeast) that reflected relative differences in climate and habitat quality. We estimated fecundity rates to be lowest in the northeast (YOYs, mean = 0.06 [SD = 0.005]; adults, mean = 1.55 [SD = 0.001]), moderate in the farmland and transition zone (YOYs, mean = 0.07 [SD = 0.017]; adults, mean = 1.71 [SD = 0.022]), and greatest in the southeast (YOYs, mean = 0.13 [SD = 0.029]; adults, mean = 1.81 [SD = 0.055]). Sex ratio of fawns at birth in most deer populations is approximately 50:50 but may vary annually (Ditchkoff 2011). Therefore, we allowed the proportion of male fawns at birth to vary uniformly between 0.48-0.52.

Spring/Summer Survival

Winter survival rates of deer 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). Minnesota Information Technology (MNIT) Services/MNDNR staff calculate an annual winter severity index (WSI) in each DPA based on snow depth and minimum daily temperatures. From 1 November through 31 May, 1 point was added to the WSI for each day with snow depths ≥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 reported in the primary literature for deer in Minnesota and populations in similar habitats for fawn spring/summer survival (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). We adjusted fawn survival rates to estimate the effects of winter severity on the condition of adult females during the previous winter. Mean spring/summer fawn survival values 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≥180, respectively.

Spring/summer survival rates reported in the primary literature for adult deer ≥1 year old were relatively high and similar for both sexes (DeYoung 2011). We used similar 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 = 0.011], male = 0.98 [SD = 0.015]). 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

Hunter harvest represents the greatest source of mortality for deer populations in most DPAs in Minnesota during 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 were not registered during the hunting season or they were harvested illegally (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 with fawns being 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 et al. 2004, Grund and Woolf 2004, DelGiudice et al. 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 an equation to calculate survival to account for increased winter severity 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, we applied the same equation used to calculate adult survival. However, we subtracted an additional mortality rate of 0.05 to represent lower survival of fawns versus adults. For more severe winters (100≤WSI≤240), we adjusted the equation to represent increased mortality reported for fawns in field studies. When WSI exceeded 240, we set fawn survival at 0.033.

Modeling Procedures

Simulation models can be sensitive to the parameter for initial population size (e.g., Grund 2014). Therefore, we used density estimates from last year’s models as starting points for this year’s models. However, we explored alternative starting values in cases where the simulated population was growing or declining at an unrealistic rate (e.g., due to adding new harvest data and, possibly, removing harvest data that are now outside the modeling window). This can lead to some discrepancies with previously reported model estimates, which is not an ideal situation. However, it reflects an important limitation of simulation models. Thus, we advise caution when interpreting estimates of absolute density (vs. population trends).

We ran model simulations for 5 years (2017-2022) with the final population estimate occurring pre-fawning for the spring following the most recent deer hunting season (i.e., spring

2022). We performed all simulations with the R programming language (ver. 3.6.2, R Core Team 2019) and used 500 Monte Carlo simulations until we determined the most reasonable set of starting parameters. We then used 5,000 simulations for the final model run.

RESULTS

Deer Population Trends and Management Recommendations

Although we derived the model parameters from studies of deer in Minnesota or from studies from states that have similar habitats and environmental conditions, uncertainty is inherent in modeling wild deer populations. Our modeling allowed input parameters to vary stochastically to represent natural variation that occurs in wild populations, and model outputs 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 for 23 DMUs (Table 1) and derived subsequent density estimates in 99 of 130 DPAs in Minnesota to estimate deer densities before reproduction during spring 2022 (Table 2; Figure 3).

Deer populations in most DPAs increased through 2022. Management designations in 2022 were consistent in most DPAs compared to 2021 in an attempt to stabilize or reduce densities that had exceeded goals. Each ecogeographic zone observed some DPAs that were below goal (southwestern farmland zone, n = 2; farmland-forest transition zone, n = 1; northeastern forest region, n = 17). Total harvest slightly decreased in 2021 from 2020. Liberal antlerless seasons in 2022 will be required again to effectively manage deer populations in DPAs with average and above average productivity while more conservative strategies will be required for those units below goal.

In terms of management intensity, the 2022 designations afford more antlerless deer harvest opportunities to hunters in about 22% of the DPAs versus the 2021 season. About 9% of DPA designations afford less antlerless harvest opportunity in 2022 compared to 2021 with a majority (69%) of designations providing the same antlerless opportunity as 2020.

Farmland Zone

We produced density estimates for 28 of 36 total farmland zone DPAs. Of the 36 DPAs in the farmland zone, 19 were at goal, 2 were below goal, and 15 were 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 either stabilize densities for DPAs at goal or to decrease densities for DPAs above goal. We attempt to maintain consistent regulations across years whenever possible to improve model performance. For the 2022 season designations, most farmland DPAs (n = 20) were under an Antlerless Permit Lottery designation. Five DPAs required Either Sex, 7 were under a Two-deer Limit designation, 3 were under a Three-deer Limit designation, and 1 was designated as Three-deer Limit with an Early Antlerless season 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 compared to the forest zone. Historical harvests and modeled population trends suggested that Antlerless Permit Lottery designations were not sufficient to stabilize deer numbers in most transition zone DPAs as evidenced by few DPAs with Antlerless Permit Lottery recommendations. We produced density estimates for 39 of the 50 transition zone DPAs. Of those 49 DPAs in the farmland-forest transition zone, 19 were at goal, 1 was below goal, and 28 were above goal based on modeling or buck harvest trends. A goal density was not established for one DPA. We selected management designations to decrease densities for DPAs above goal while attempting to maintain consistent regulations across years whenever possible to improve model performance. For the 2022 season designations, Antlerless Permit Lottery will be used for 3 DPAs, Either Sex for 2 DPAs, and a Two-deer Limit designation will be used for 10 DPAs. In 27 DPAs, a Three-deer Limit designation will be necessary to continue reducing deer densities toward goal level, 18 of which have additional antlerless seasons. In the metro area (DPA 701) and the chronic wasting disease management zone (DPAs 605, 643, 645, 646, 647, 648, and 649), a Five Deer Limit with an Early Antlerless season 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. However, the most recent winter of 2021-22 was also severe and continued to decreased deer densities in some DPAs. We produced density estimates for 32 of 44 forest zone DPAs. Of the 44 DPAs in the forest zone, 22 were at goal, 17 were below goal, and 3 were above goal based on modeling or buck harvest trends. A goal density was not established for two DPAs. We selected management designations to increase densities for DPAs below goal while attempting to maintain consistent regulations across years whenever possible to improve model performance. For 2022 season designations, Bucks-only will be used in 5 DPAs, Antlerless Permit Lottery in 19 DPAs, Either Sex in 11 DPAs, a Two-deer Limit designation in 6 DPAs, and a Three-deer Limit designation in 3 DPAs (including one Early Antlerless designation).

ABRIDGED DESCRIPTIONS OF DEER HUNTING SEASON DESIGNATIONS (MNDNR 2021)

Bucks-only. All hunters, including youth and archery hunters, are restricted to harvesting only legal bucks. No antlerless deer may be harvested; limited exceptions for hunters ≥84 years of age or persons in veterans homes. The bag limit is **one** deer.

Antlerless Permit Lottery. A hunter may apply for authorization to harvest one either-sex deer during either the firearm or muzzleloader season. Archery hunters can take a deer of either sex. Under this scenario, archers, youth, and disabled hunters can kill a deer of either-sex. The bag limit is **one** deer.

Either Sex. The initial license is either-sex and bonus permits cannot be used. There is no antlerless permit lottery application and all hunters potentially could harvest an antlerless deer, regardless of season. The bag limit is **one** deer.

Two-deer Limit. The initial license is either-sex and a maximum of **two** deer (one buck) can be taken using any combination of licenses and permits.

Three-deer Limit. The initial license is either-sex and the maximum of **three** deer (one buck) can be taken using any combination of licenses and permits.

Five-deer Limit. The initial license is either-sex and the maximum of five deer (one buck, except the SE 600-series) can be taken using any combination of licenses and permits.

***Early Antlerless.** A hunter could harvest **three additional** deer in these permit areas during the early antlerless season (e.g. the annual limit in an intensive permit area with an early antlerless season would be eight deer).

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Table 1. Estimated mean pre-fawn deer densities (deer/mi^2) for deer management units (DMUs) derived from population model simulations in Minnesota, 2017-2022.

		Pre-fawn Deer Density					
Deer Modeling Unit	Land Area (mi^2)	2017	2018	2019	2020	2021	2022
1	1470	5	6	7	8	10	11
2	2026	12	13	13	15	17	18
3	2166	5	5	5	6	7	7
4	2467	5	5	5	4	5	5
5	2779	3	3	3	3	3	3
6	3750	10	11	12	13	16	18
7	3932	20	21	21	23	26	28
8	3573	13	14	13	13	15	16
9	3188	12	11	10	10	10	10
10	2348	28	29	30	34	38	42
11	2334	31	34	35	38	43	47
12	3331	23	26	27	29	33	35
13	2550	4	5	5	6	8	9
14	1456	15	18	20	24	30	35
15	3647	21	24	26	30	34	38
16	546	10	12	13	15	17	20
17	840	5	6	6	7	8	9
18	2822	6	7	7	7	8	8
19	2102	5	5	6	6	7	8
20	4314	4	5	5	6	7	8
21	3497	8	10	11	14	17	20
22	603	19	22	25	28	31	36
23	1677	24	28	29	32	35	40

Table 2. Estimated mean pre-fawn deer densities (deer/mi^2) for deer permit areas based on population model simulations in Minnesota deer management units, 2017-2022.

		Pre-fawn Deer Density[a]					
Deer Permit Area	Land Area (mi2)	2017	2018	2019	2020	2021	2022
101	496	12	11	11	12	13	15
[a]104	1414	-	-	-	-	-	-
[a]105	1199	-	-	-	-	-	-
[a]107	472	-	-	-	-	-	-
[a]109	1182	-	-	-	-	-	-
110	529	19	19	18	22	24	28
111	1384	4	4	4	4	5	6
[a]114	123	-	-	-	-	-	-
117	936	0	0	0	0	0	0
118	1239	6	5	5	5	6	6
119	782	6	6	8	8	10	10
126	942	7	6	6	6	8	7
130	747	4	4	3	2	3	3
131	901	1	2	2	2	1	2
132	481	5	6	6	5	6	7
133	352	13	7	7	8	7	7
152	60	15	13	14	17	20	20
[a]155	499	-	-	-	-	-	-
156	819	12	12	10	10	10	11
157	888	30	32	33	36	44	49
159	571	14	15	13	14	15	15
[a]169	939	-	-	-	-	-	-
[a]171	740	-	-	-	-	-	-
172	688	29	28	27	25	24	31
[a]173	471	-	-	-	-	-	-
176	917	13	12	10	10	12	11
177	491	12	14	14	14	15	16
178	1192	12	13	12	13	16	17
[a]179	1024	-	-	-	-	-	-
181	629	10	10	10	8	8	7
[a]182	278	-	-	-	-	-	-
183	664	12	13	11	11	11	11
184	1235	24	25	26	26	29	30
197	973	15	16	15	15	16	18
199	153	5	6	5	5	5	5
201	161	10	10	11	11	12	13
203	118	6	6	8	6	8	11
208	378	9	9	10	11	14	16

[a]Indicates deer permit area was not included in DMU population model.

Table 2. Continued

Deer Permit Area	Land Area (mi^2)	Pre-fawn Deer Density[a]					
		2017	2018	2019	2020	2021	2022
209	639	11	14	14	16	18	22
210	615	14	15	16	18	24	25
213	1059	24	26	26	29	32	34
214	553	30	37	38	45	54	55
215	701	23	27	26	28	33	36
218	884	17	20	23	28	34	40
219	391	17	20	21	24	26	28
221	643	22	23	26	31	34	39
222	413	23	27	28	33	36	43
223	377	21	23	25	29	33	35
224	46	27	24	27	33	32	36
225	618	25	29	32	35	41	45
227	471	24	28	30	35	40	46
229	285	11	13	14	16	18	18
230	454	7	9	10	13	15	20
232	377	10	12	15	17	21	24
233	381	10	10	12	16	18	23
234	636	3	4	4	5	6	7
235	35	19	18	23	31	37	43
236	368	21	23	26	29	33	38
[a]237	608	-	-	-	-	-	-
238	95	9	11	11	13	15	16
239	928	18	21	22	24	26	28
240	643	30	33	34	38	42	47
241	997	36	37	40	45	49	54
246	784	27	29	26	28	31	37
248	216	25	30	32	40	46	50
249	496	26	28	29	42	48	47
250	712	5	6	7	7	8	9
251	55	14	13	14	14	18	23
252	716	4	5	6	7	8	9
253	974	6	8	8	10	12	14
254	924	8	9	12	13	17	21
[a]255	392	-	-	-	-	-	-
256	654	11	12	12	12	16	17
257	412	14	15	16	20	22	25
258	343	25	26	29	34	42	40
259	489	29	32	24	27	30	36

[a]Indicates deer permit area was not included in DMU population model.

Table 2. Continued

Deer Permit Area	Land Area (mi^2)	Pre-fawn Deer Density[a] 2017	2018	2019	2020	2021	2022
[a]260	1055	-	-	-	-	-	-
261	793	5	6	6	7	8	11
262	677	5	6	7	9	11	12
[a]263	706	-	-	-	-	-	-
264	669	14	16	16	18	21	22
265	494	13	15	15	18	22	23
266	617	8	9	10	12	14	14
267	472	7	9	9	11	14	12
268	228	19	21	19	25	26	28
269	650	4	6	6	8	9	10
270	736	3	4	4	6	7	7
271	632	4	5	6	6	8	10
272	532	4	5	5	6	7	11
273	572	12	13	15	19	22	27
274	355	5	6	5	6	7	7
[a]275	957	-	-	-	-	-	-
[a]277	1058	-	-	-	-	-	-
278	402	6	8	8	9	9	9
279	344	4	5	6	6	6	8
280	674	3	4	4	4	6	7
281	605	6	7	7	8	8	9
[a]282	1126	-	-	-	-	-	-
[a]283	337	-	-	-	-	-	-
284	840	5	6	6	7	8	9
285	546	10	12	13	15	17	20
286	447	6	6	6	7	8	8
287	47	23	18	14	11	16	14
288	624	6	6	6	6	8	8
289	816	3	3	3	4	4	5
290	661	5	6	5	6	6	7
291	799	7	7	8	8	8	8
[a]292	362	-	-	-	-	-	-
[a]293	278	-	-	-	-	-	-
294	687	5	4	5	6	6	6
[a]295	959	-	-	-	-	-	-
296	665	5	6	6	7	8	11
297	438	6	6	6	6	6	8
298	619	11	12	11	12	14	16
299	387	11	13	15	20	24	26

[a]Indicates deer permit area was not included in DMU population model.

Table 2. Continued

Deer Permit Area	Land Area (mi^2)	Pre-fawn Deer Density[a] 2017	2018	2019	2020	2021	2022
[a]338	316	-	-	-	-	-	-
341	603	19	22	25	28	32	36
342	350	22	24	24	23	31	35
[a]343	320	-	-	-	-	-	-
344	186	19	20	23	28	28	33
[a]604	673	-	-	-	-	-	-
[a]605	1192	-	-	-	-	-	-
[a]643	351	-	-	-	-	-	-
645	330	17	19	21	23	26	30
646	319	32	37	44	46	47	52
[a]647	434	-	-	-	-	-	-
[a]648	332	-	-	-	-	-	-
649	492	28	32	31	36	39	45
[a]655	387	-	-	-	-	-	-
[a]701	1324	-	-	-	-	-	-

[a]Indicates deer permit area was not included in DMU population model.

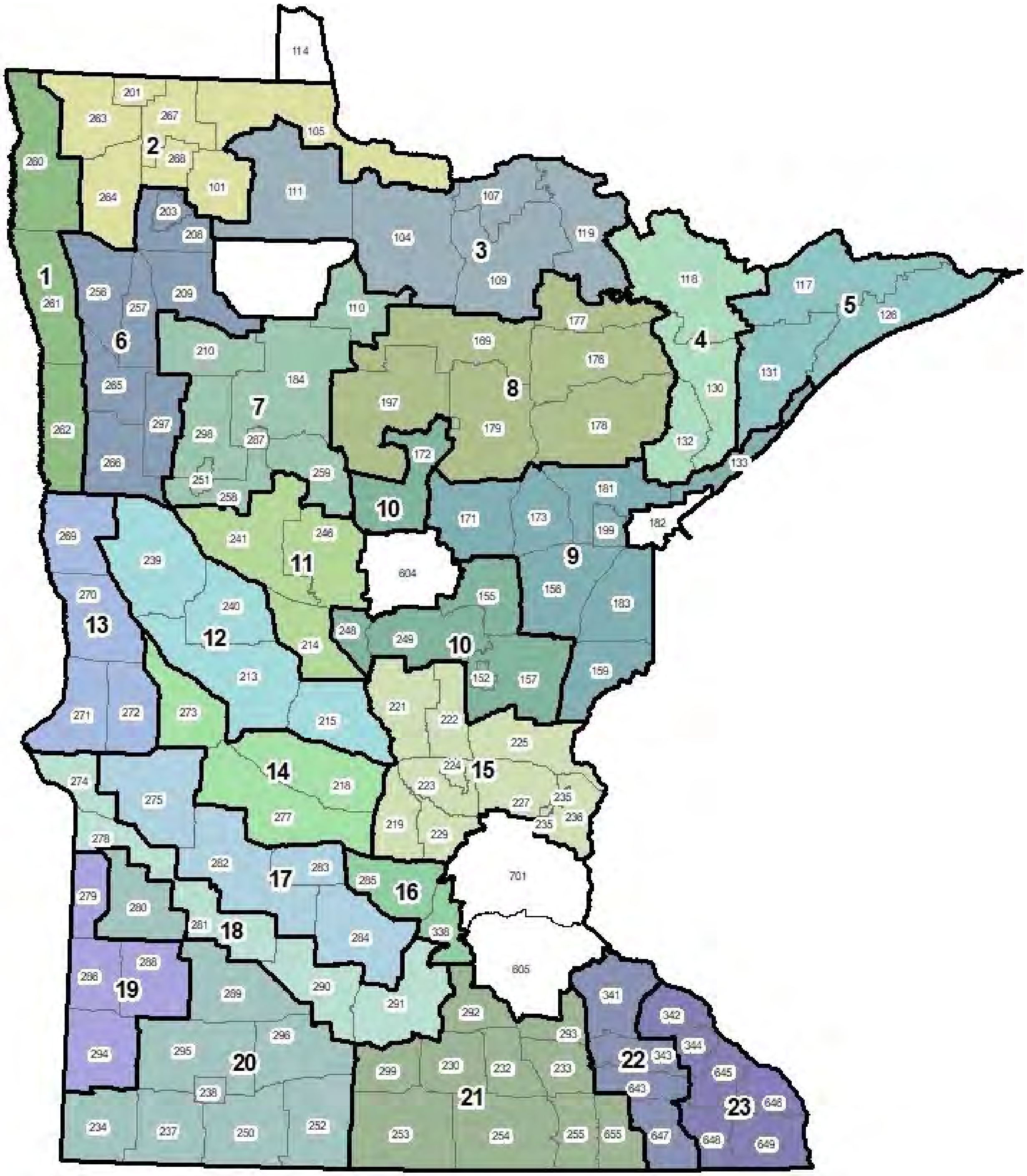

Figure 1. Deer permit areas (DPAs; 100 through 701) aggregated into deer modeling units (DMUs; 1 through 23). DPAs not colored were not included in aggregated units.

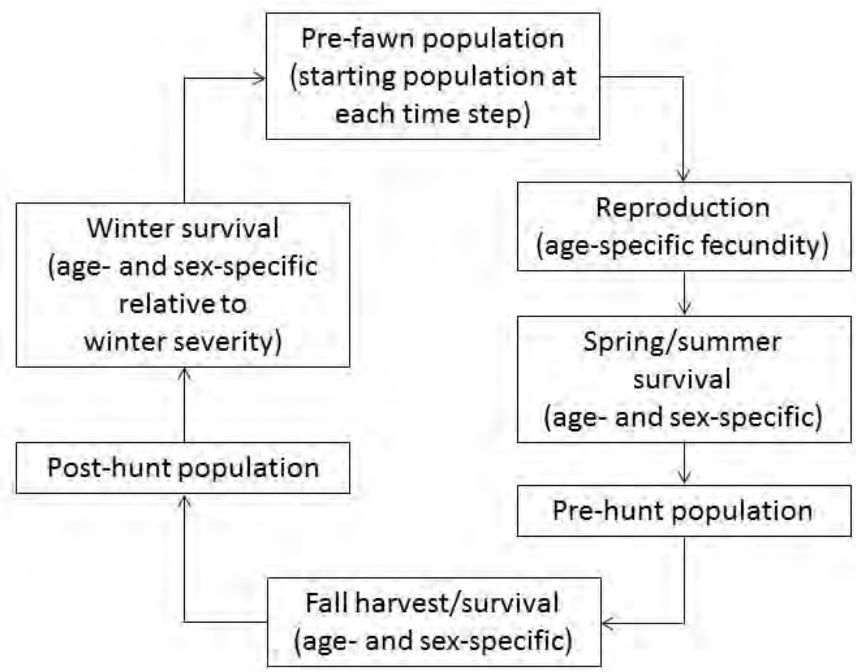

Figure 2. Model structure for simulations of white-tailed deer populations in Minnesota.

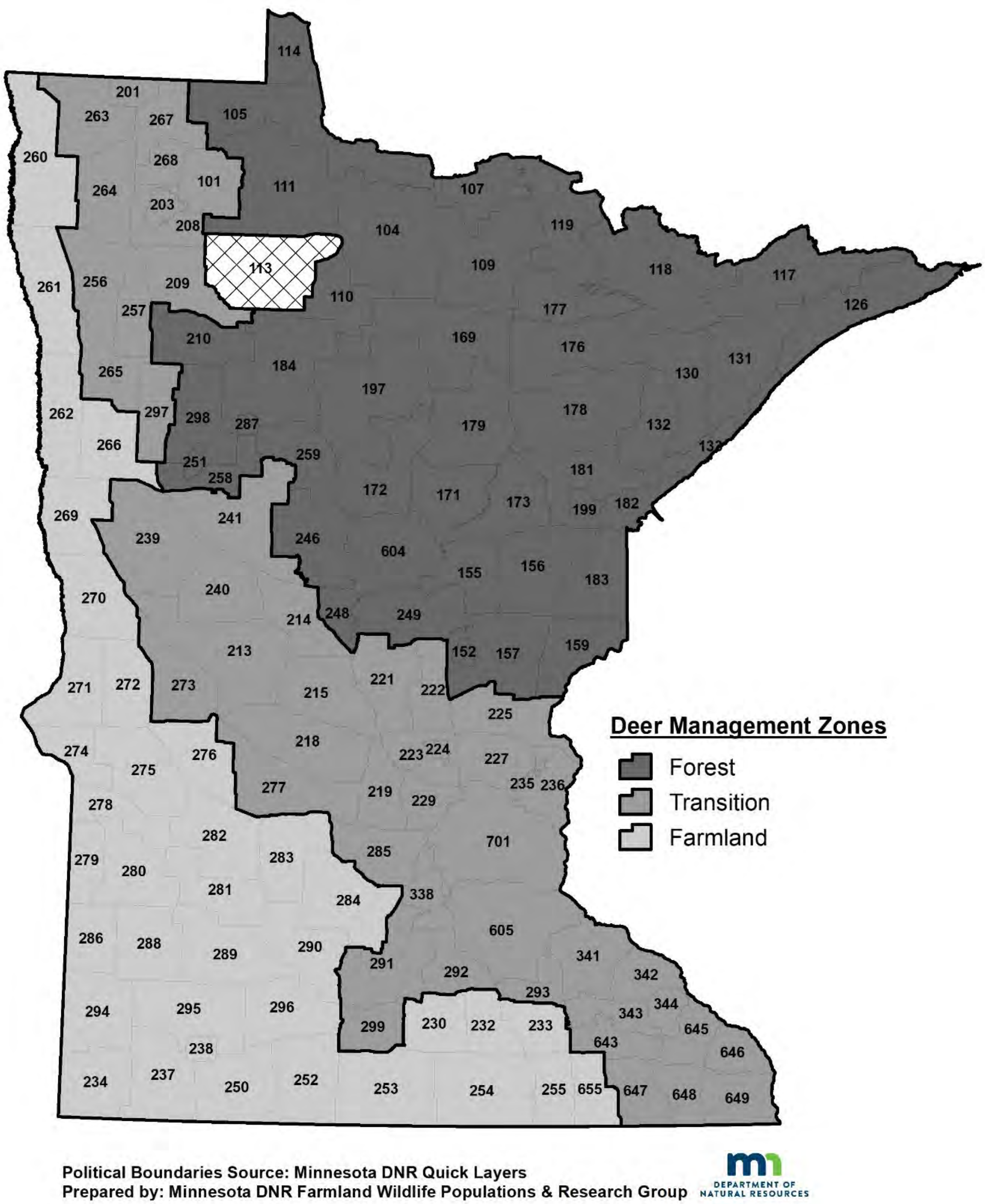

Figure 3. Deer permit areas (DPAs) in Minnesota and deer management zones used to describe deer population and harvest trends, 2022. DPAs were assigned to forest, transition, or farmland zones based on historical land cover and current woody cover. Generally, forested DPAs were composed of ≥60% woody cover, transition DPAs were composed of 6%-50% woody cover, and farmland DPAs were composed of ≤5% woody cover.

2021 MINNESOTA DEER HUNTER OBSERVATION SURVEY REPORT

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INTRODUCTION

White-tailed deer (*Odocoileus virginianus*; hereafter, deer) hunting season recommendations should incorporate objective and reliable information to move populations towards a desired density goal. Because the Minnesota Department of Natural Resources (MNDNR) adjusts regulatory decisions (seasons and bag limits) annually, agencies require current information. In Minnesota, deer densities are modeled at the larger deer modeling unit (DMU; N = 23) scale but are managed at the smaller deer permit area (DPA; N = 130) scale. Traditional firearm season lengths are 9 (200-series areas), 16 (100-series areas), or 18 (300-series areas; 2 seasons) days. Bag limits also vary by permit area and range from bucks only (1 antlered deer) to 3-deer limit (1 buck and up to 2 antlerless deer) management designations. Additionally, early antlerless seasons are used in limited situations and DPAs within disease management zones have allowable harvests of up to 5 deer, including one legal buck per each archery, firearm, and muzzleloader season per hunter (3 total bucks). To inform these annual decisions, MNDNR incorporates mandatory hunter-reported harvest, hunter effort, winter severity, and vital rate parameters (survival, fecundity, etc) into a population model to make population trend inferences (lambda [λ]; Michel and Giudice 2021). Population model indices are sensitive to varying hunting season regulations and changes in the relationship between winter severity and deer survival. Confidence in the population model is improved by collecting annually recurrent information to independently estimate the population trend. The Office of Legislative Auditors conducted an independent evaluation of the MNDNR deer population management program (OLA 2016) and recommended additional data collection to improve deer population estimates. Winter aerial surveys can provide an index, but logistical and environmental (e.g., adequate snow cover) constraints limit their use to every 5- to 10-years. Furthermore, aerial surveys are not considered reliable across much of northern Minnesota where predominant coniferous cover results in insufficient detection probability (Haroldson 2014) or across southwestern Minnesota where deer movements vary throughout the year (winter migrations).

Several Midwestern states have explored the use of annual hunter observation surveys for monitoring white-tailed deer population trends (Rolley et al. 2016) and trends of populations of other species of interest (Bauder et al. 2021). We conducted a pilot study from 2017 to 2019 to collect archery hunters' observations of deer using survey methods (mail and online versions). Although the information MNDNR biologists gained from this bowhunter survey was useful in developing age and sex ratios to use as indices to measure deer model performance, response rates were low statewide. Therefore, in attempt to increase hunter participation, we took a community science approach by allowing all deer hunters, regardless of the season they are hunting, to provide observational data in an online format. Our primary objective was to evaluate this community science approach for monitoring trends in white-tailed deer and other wildlife populations. Our secondary objective was to compare trends in fawn:adult female ratios from deer hunter observations to other recruitment metrics. In Minnesota, there is greater diversity in biogeography than other Midwestern states. Because of the variability of habitat, we chose to report results for three ecozones: 1) farmland, 2) transition, and 3) forest.

METHODS

We moved from a traditional mail survey to a community science approach by soliciting participation using a variety of methods. We solicited participation using agency social media (e.g., Facebook, Twitter, etc) and through agency newsletters such as the Deer Notes emails sent to subscribers. Hunters had the option to print off observation logs and mail in the logs once completed or they could document their observations online.

We asked deer hunters to document white-tailed deer, badger *(Taxidea taxus),* bear *(Ursus americanus),* bobcat *(Lynx rufus),* coyote *(Canis latrans),* fisher *(Martes pennanti),* gray fox *(Urocyon cinereoargenteus),* gray wolf *(Canis lupus),* and wild turkey *(Meleagris gallopavo)* observations and differentiate between antlered, adult female, fawn, and unknown deer age-sex classes while hunting. We also asked hunters to record DPA for hunting trip observations and provide a distance and direction from the nearest town. Finally, we collected locations (latitude and longitude), weather information, antler points of harvested deer, and inside antler spread of harvested deer.

We quantified dates of hunting trips, hunting trips per hunter, hours hunted per trip, and observation rates for the farmland, transition, and forest ecozones separately. We estimated variances using Taylor series linearization and constructed 95% confidence intervals using the normal approximation. We estimated hours hunted per hunting trip and observation rates per hour using Program R and the survey library (Lumley 2004, R Development Core Team 2016).

We did not compare hunter observation rates among ecozones because hunter distribution, similar to deer populations, is not randomly distributed. Thus, hunter observation rates among ecozones vary by hunter distribution and self-selected participation. For example, deer densities are highest in the transition ecozone (Michel and Giudice 2021), but hunter observation rates per 1,000 hours were greatest in the farmland ecozone (Norton et al. 2017). Therefore, we only compared the relative proportion of species hunters observed across ecozones.

RESULTS

There were 49 participants during the 2021 deer hunting season, down from 2,180 and 132 in 2019 and 2020, respectively. On average, participants completed 3.8 (SE = 0.73) observation logs each (Figure 1) and hunted about 4.4 hours per trip (SE = 0.38; Table 1). Mean hunting observation date responses occurred on 30 October (Figure 2). Mean hours hunted per observation log for the forest, transition, and farmland ecozone were 5.6 (SE = 0.57), 4.2 (SE = 0.42), and 3.6 (SE = 0.87), respectively (Figure 3; Appendix I).

Overall, the percent of antlered deer among total deer observations was similar to previous years and comparable among regions with the greatest observations occurring in the transition ecozone ($\bar{x}$ = 0.24), followed by the farmland ecozone ($\bar{x}$ = 0.13), then the forest ecozone ($\bar{x}$ = 0.11). The greatest observed fawn:doe ratio was in the forest ecozone ($\bar{x}$ = 0.78), followed by the transition ecozone ($\bar{x}$ = 0.74), and farmland ecozone ($\bar{x}$ = 0.63, Figures 4–6). We found the greatest buck:doe ratio in the transition ecozone ($\bar{x}$ = 0.60) followed by the farmland ($\bar{x}$ = 0.27) and forest ecozones ($\bar{x}$ = 0.26, Figures 4–6). Among other species surveyed, diversity was greater in the forest ecozone with relatively more bear, bobcat, wolf, fisher, and gray fox observations compared to the transition and farmland ecozones (Appendix I). Turkeys had the greatest proportion reported (compared to all other species) in the transition ecozone (Appendix I). There were 7 hunters that harvested 10 adult bucks. The adult bucks averaged 7.3 points (SE = 0.70, range = 4–10, *n* = 10) with an inside spread of 15.9 inches (SE = 2.01, range = 7–20, *n* = 6).

DISCUSSION

Using a community science approach does not allow for a direct comparison of response rates to prior data collection efforts. However, the total number of participants was 94% lower in 2020 than in 2019 and 73% lower in 2021 than in 2020. One of our main objectives for switching to a community science approach was to increase the total number of responses and increase coverage of responses throughout the state. We will need to incorporate various methods (e.g., sending out an increased number of reminders via social media platforms, directed emails, etc) to increase the total number of participants and increase coverage throughout Minnesota. Despite our low participation in the past 2 years, we believe re-incorporating the direct emails to hunters should allow for higher response rates in the future.

Total number of participants dramatically decreased from 2019 to 2021, and some the metrics changed between the former mail/online bowhunter survey and the new community science approach using all deer hunters, indicating a low sample with the most recent community science approach. We noticed differences (due to sample size) in fawn:doe and buck:doe ratios across ecozones and years. Increased sample size will improve precision of the estimates, which will also improve their use as independent indices for comparison to modeled deer densities.

We used the data collected from 2017 to 2021 to calculate total deer observed per hour (Figure 7) and sex and age composition (percent adult males, adult females, and fawns; Figure 8) for comparison to our modeled output in 2022. The total deer observed per hour metric serves as an independent index to assess population trends over time while the sex and age composition metric allows us to compare the compositions we obtain through the deer hunter survey to the compositions derived from the deer population model. These data will also potentially help inform an integrated population model, which we are developing. Although we are already using this information in our deer modeling reports (Figures 8, 9), trends will become more apparent and these indices will only become more useful once we increase sample sizes and have at least five years of data.

ACKNOWLEDGMENTS

We thank all deer hunters that participated in this survey and the MNDNR Farmland Wildlife Populations and Research Group staff that provided feedback on earlier versions of the survey and this report. We also thank Pete Takash, Barb Keller, Nyssa Gesch, and David Schueller for their help coordinating outreach and communication to solicit hunter participation.

Table 1. Statewide mean (± standard error) and 95% confidence intervals of responses for hours hunted per hunting trip and observation rates per 1,000 hours from the deer hunter observation survey in Minnesota, USA, 18 September – 31 December 2021.

Parameter	Mean (SE)	95% CI
Hours/Trip	4.42 (0.38)	3.68 – 5.16
Antlered Deer/1,000 Hours	161.9 (SE = 32.98)	97.27 – 226.53
Adult Female Deer/1,000 Hours	354.23 (SE = 78.75)	97.27 – 226.53
Fawn Deer/1,000 Hours	249.54 (SE = 63.23)	199.88 – 508.58
Unknown Deer/1,000 Hours	52.34 (SE = 14.81)	125.61 – 373.47
Total Deer/1,000 Hours	818.02 (SE = 161.31)	23.32 – 81.36
Turkeys/1,000 Hours	327.45 (SE = 124.4)	501.84 – 1134.19
Bears/1,000 Hours	1.22 (SE = 1.23)	83.62 – 571.28
Coyotes/1,000 Hours	12.17 (SE = 5.79)	0 – 3.63
Bobcats/1,000 Hours	2.43 (SE = 1.77)	0.82 – 23.53
Wolves/1,000 Hours	20.69 (SE = 10.26)	0 – 5.9
Fisher/1,000 Hours	2.43 (SE = 1.66)	0.58 – 40.81
Gray Foxes/1,000 Hours	0 (SE = 0)	0 – 5.68
Badgers/1,000 Hours	0 (SE = 0)	0 – 0

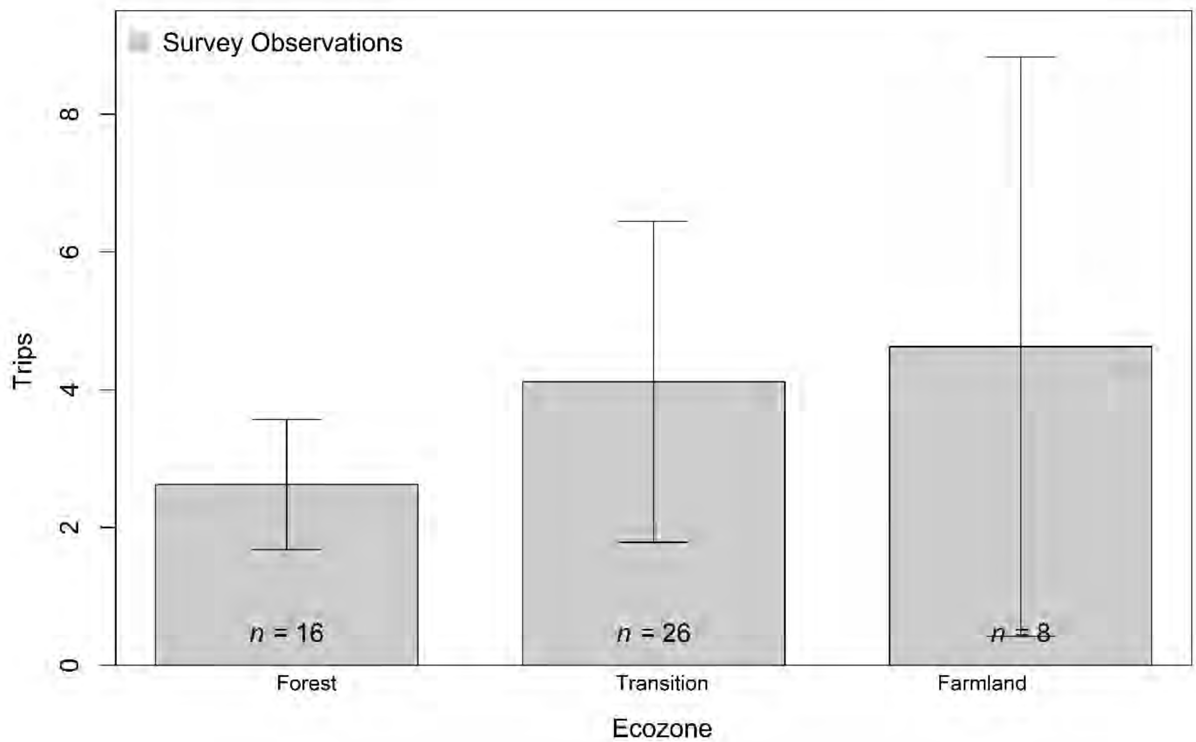

Figure 1. Mean hunting observation trips per deer hunter by ecozone with 95% confidence intervals during the deer hunting season (18 September – 31 December 2021) in Minnesota, USA.

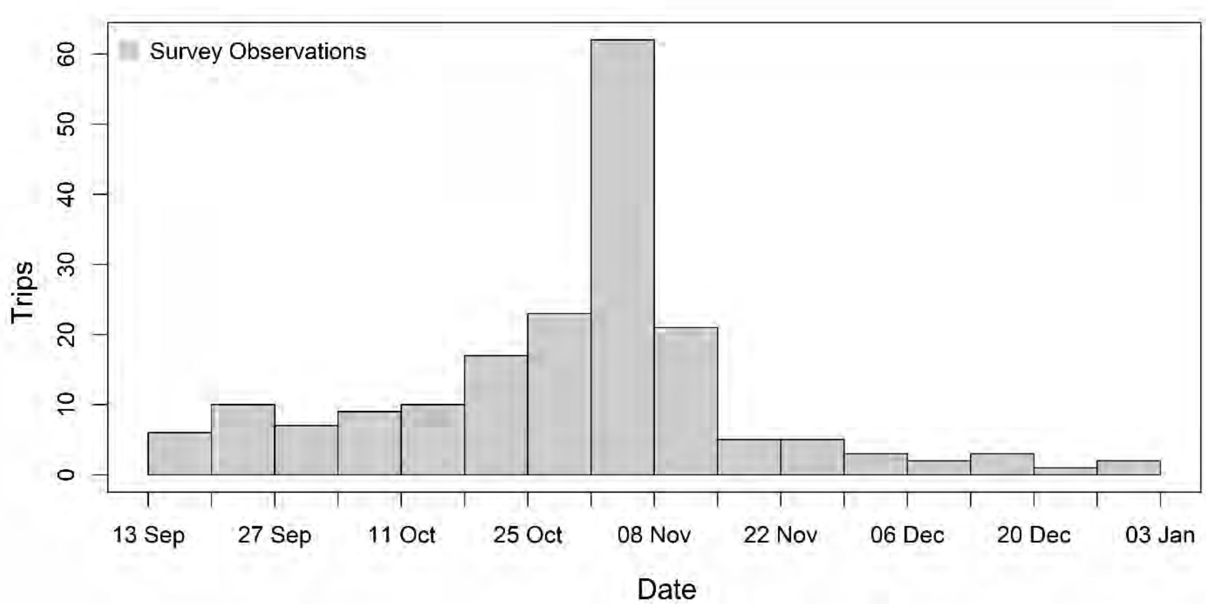

Figure 2. Date of hunting observation trips for respondents during the deer hunting season (18 September – 31 December 2021) in Minnesota, USA.

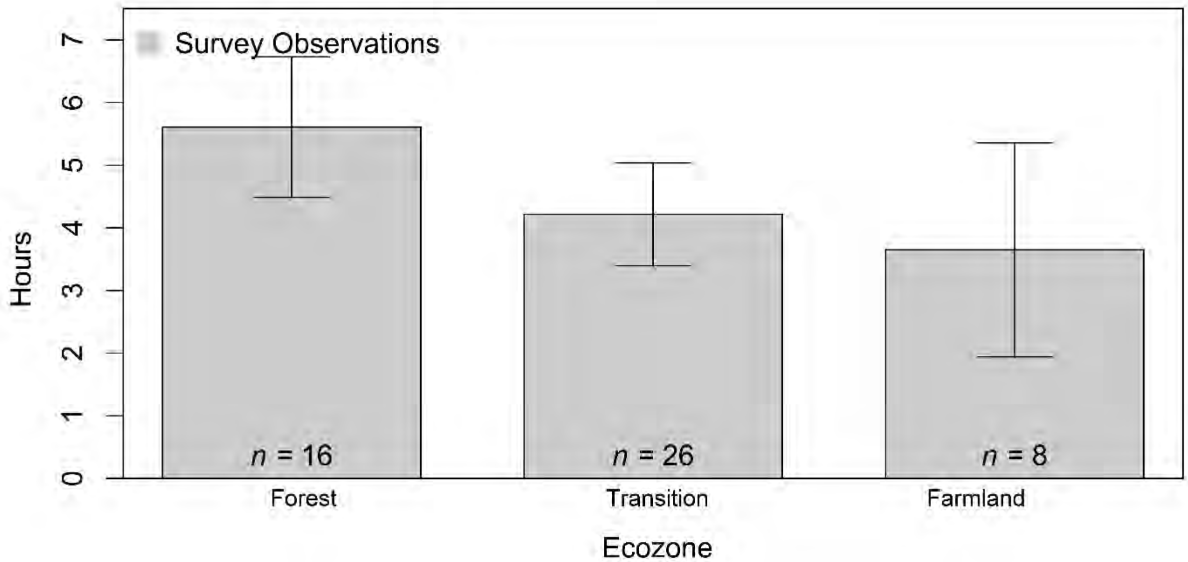

Figure 3. Mean hours hunted per trip with 95% confidence intervals during the deer hunting season (18 September – 31 December 2021) in Minnesota, USA.

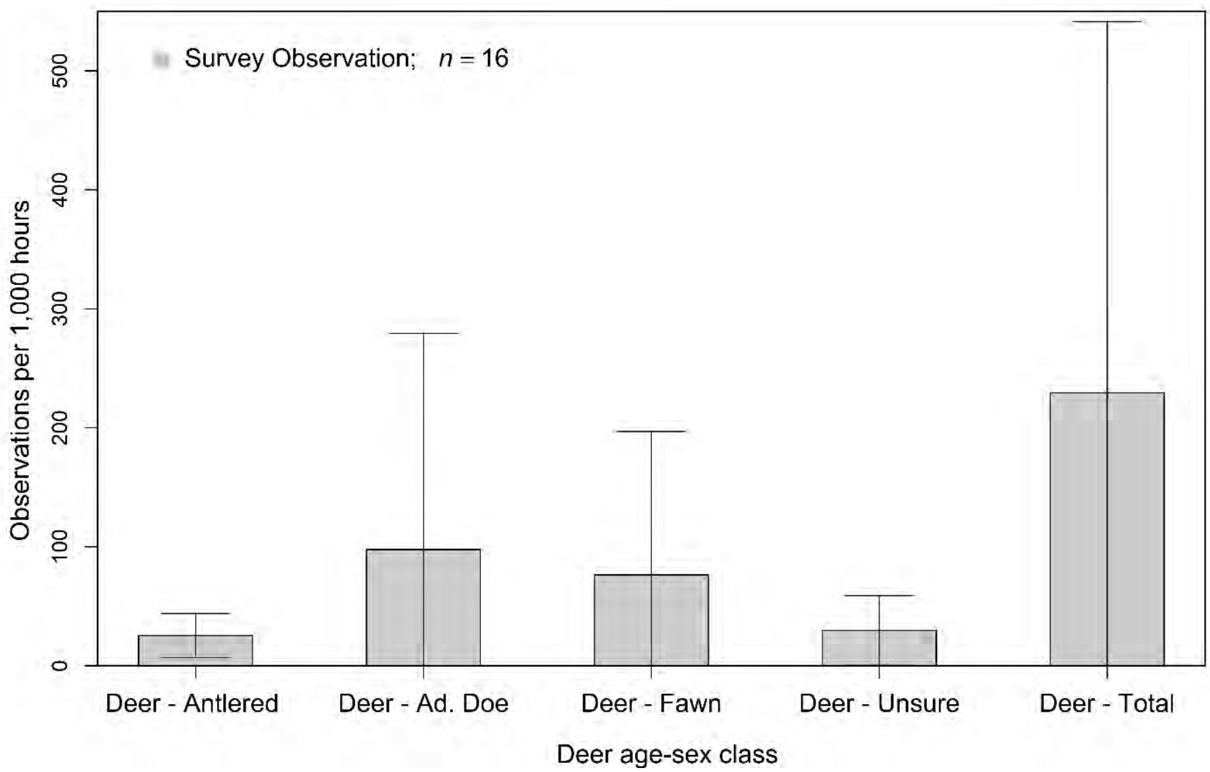

Figure 4. Mean deer observation rates per 1,000 hours with 95% confidence intervals in the forest ecozone during the deer hunting season (18 September – 31 December 2021) in Minnesota, USA.

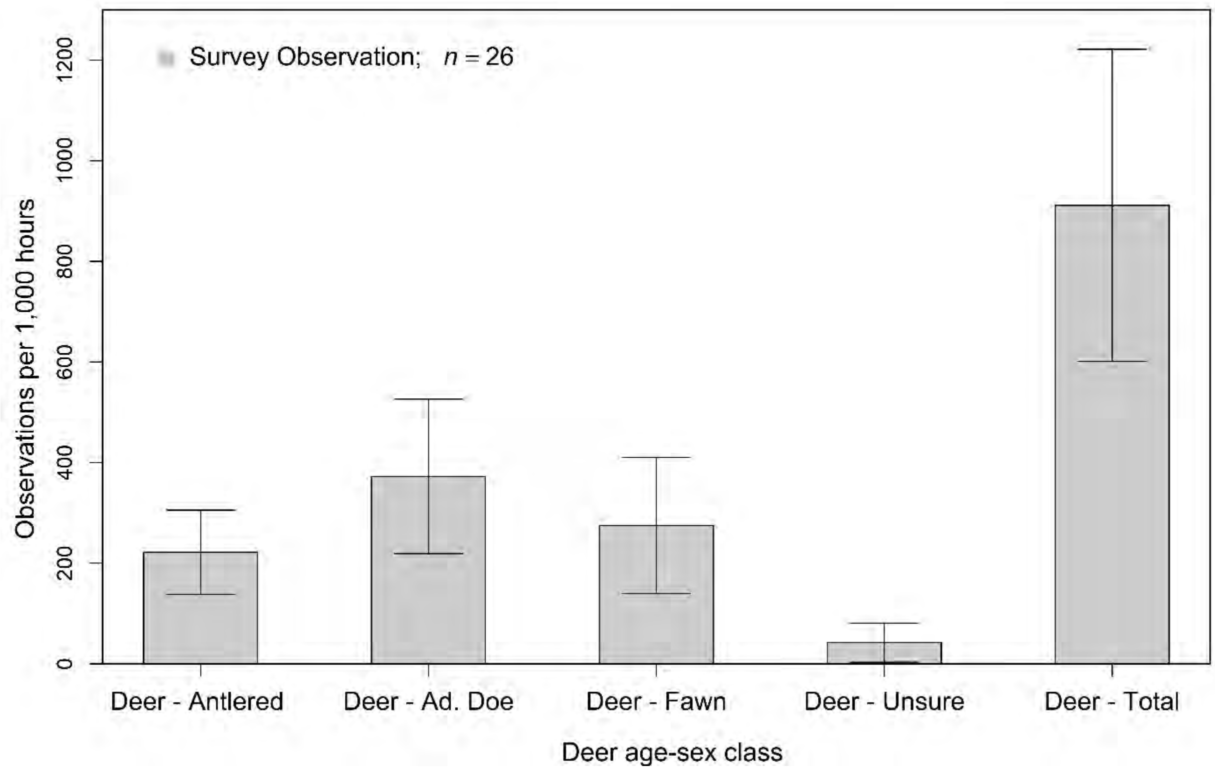

Figure 5. Mean deer observation rates per 1,000 hours with 95% confidence intervals in the transition ecozone during the deer hunting season (18 September – 31 December 2021) in Minnesota, USA.

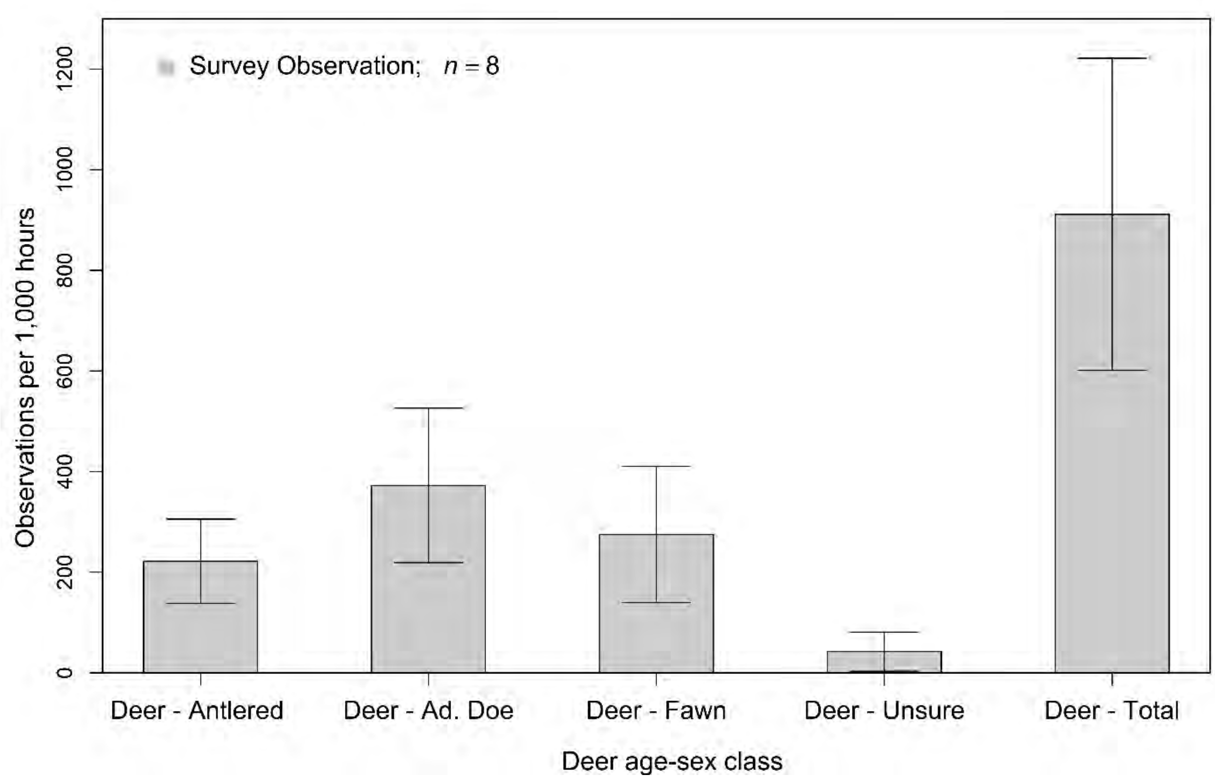

Figure 6. Mean deer observation rates per 1,000 hours with 95% confidence intervals in the farmland ecozone during the deer hunting season (18 September – 31 December 2021) in Minnesota, USA.

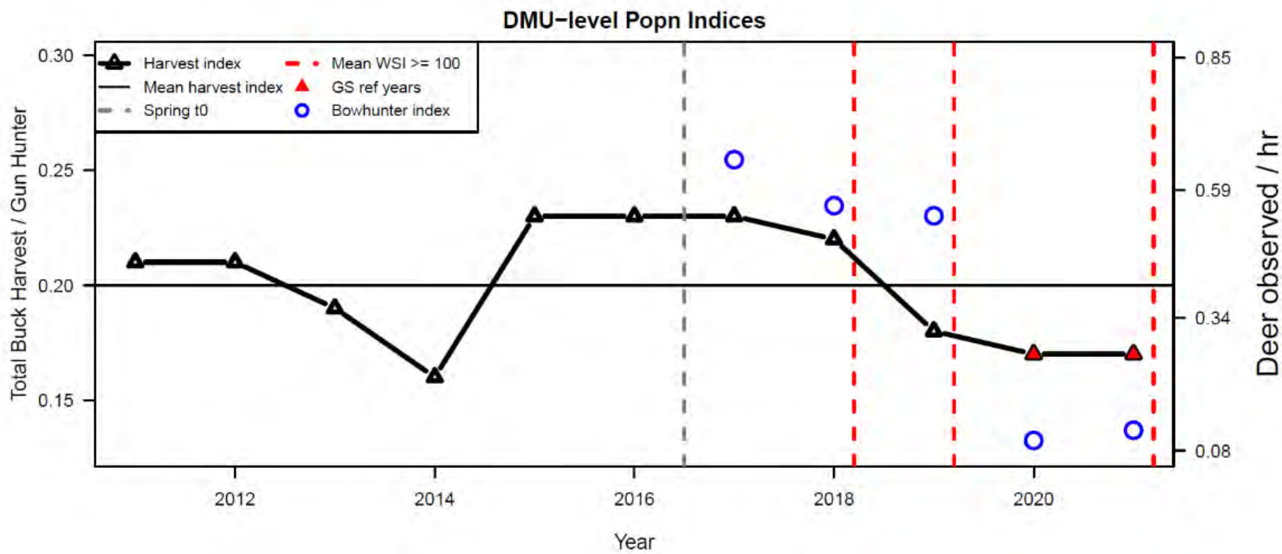

Figure 7. The number of bucks harvested per gun hunter (triangles) and total deer observed per hour (circles) to assess deer population trends over time per deer permit area. Spring t0 indicates the starting year used the deer population model (e.g., spring 2017). GS ref years indicates the year goal setting occurred.

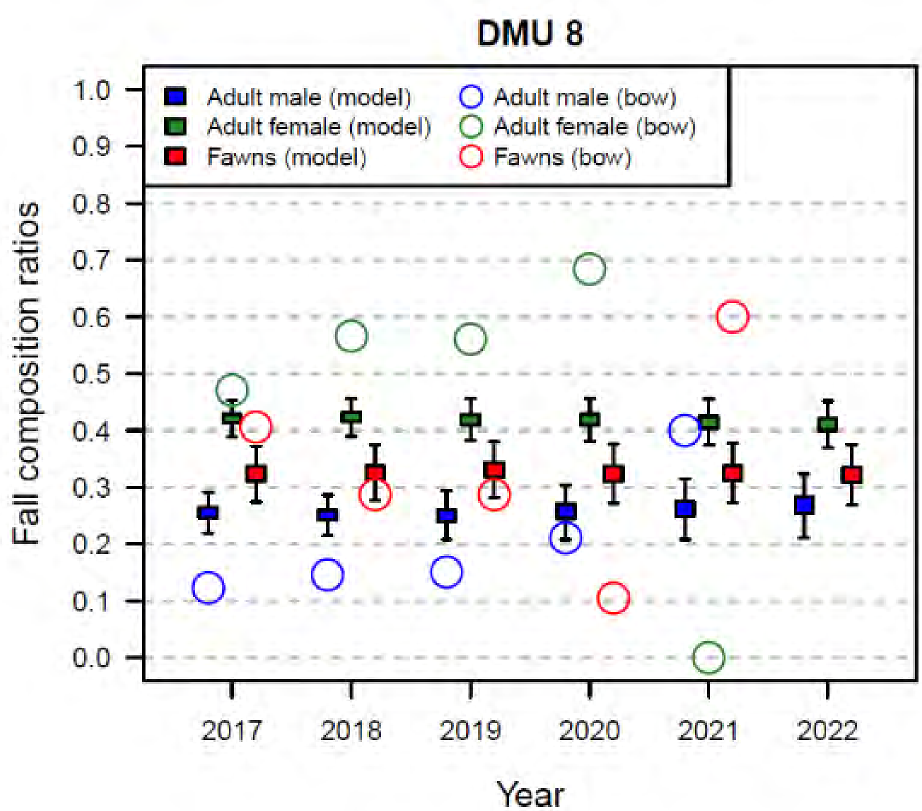

Figure 8. Age and sex proportions derived from the deer population model (squares) and from the deer hunter survey (circles). Age and sex proportions are used in the deer population model to estimate deer density for each deer permit area.

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APPENDIX I. Mean observation rates of other species per 1,000 hours and hours per trip with 95% confidence intervals by ecozone during the deer hunting season (19 September – 31 December 2020) in Minnesota, USA.

Parameter	Ecozone	Mean	95% CI
Hours/Trip	Forest	5.61 (SE = 0.57)	4.49 – 6.73
Antlered Deer/1,000 Hours	Forest	25.48 (SE = 9.4)	7.05 – 43.9
Adult Female Deer/1,000 Hours	Forest	97.66 (SE = 92.66)	0 – 279.28
Fawn Deer/1,000 Hours	Forest	76.43 (SE = 61.46)	0 – 196.89
Not Sure Deer/1,000 Hours	Forest	29.72 (SE = 14.88)	0.55 – 58.9
Total Deer/1,000 Hours	Forest	229.3 (SE = 159.16)	0 – 541.25
Turkeys/1,000 Hours	Forest	271.76 (SE = 222.59)	0 – 708.03
Bears/1,000 Hours	Forest	0 (SE = 0)	0 – 0
Coyotes/1,000 Hours	Forest	4.25 (SE = 4.36)	0– 12.79
Bobcats/1,000 Hours	Forest	4.25 (SE = 4.2)	0 – 12.47
Wolves/1,000 Hours	Forest	72.19 (SE = 29.27)	14.82 – 129.56
Fisher/1,000 Hours	Forest	0 (SE = 0)	0 – 0
Gray Foxes/1,000 Hours	Forest	0 (SE = 0)	0 – 0
Badgers/1,000 Hours	Forest	0 (SE = 0)	0 – 0
Hours/Trip	Transition	4.21 (SE = 0.42)	3.39 – 5.04
Antlered Deer/1,000 Hours	Transition	221.73 (SE = 42.73)	137.99 – 305.47
Adult Female Deer/1,000 Hours	Transition	372.51 (SE = 78.37)	218.91 – 526.1
Fawn Deer/1,000 Hours	Transition	274.94 (SE = 69.04)	139.62 – 410.27
Not Sure Deer/1,000 Hours	Transition	42.13 (SE = 19.88)	3.16 – 81.1
Total Deer/1,000 Hours	Transition	911.31 (SE = 158.28)	601.09 – 1221.52
Turkeys/1,000 Hours	Transition	339.25 (SE = 188.16)	0 – 708.04
Bears/1,000 Hours	Transition	2.22 (SE = 2.28)	0 – 6.68
Coyotes/1,000 Hours	Transition	17.74 (SE = 10.44)	0 – 38.21
Bobcats/1,000 Hours	Transition	2.22 (SE = 2.34)	0 – 6.8
Wolves/1,000 Hours	Transition	0 (SE = 0)	0 – 0
Fisher/1,000 Hours	Transition	4.43 (SE = 3.03)	0 – 10.38
Gray Foxes/1,000 Hours	Transition	0 (SE = 0)	0 – 0
Badgers/1,000 Hours	Transition	0 (SE = 0)	0 – 0

Appendix I continued.

Parameter	Ecozone	Mean	95% CI
Hours/Trip	Farmland	3.65 (SE = 0.87)	1.94 – 5.36
Antlered Deer/1,000 Hours	Farmland	200 (SE = 88.53)	26.49 – 373.51
Adult Female Deer/1,000 Hours	Farmland	740.74 (SE = 290.34)	171.68 – 1309.8
Fawn Deer/1,000 Hours	Farmland	466.67 (SE = 245.45)	0 – 947.75
Not Sure Deer/1,000 Hours	Farmland	125.93 (SE = 49.08)	29.73 – 222.12
Total Deer/1,000 Hours	Farmland	1533.33 (SE = 622.93)	312.42 – 2754.25
Turkeys/1,000 Hours	Farmland	385.19 (SE = 173.73)	44.68 – 725.69
Bears/1,000 Hours	Farmland	0 (SE = 0)	0 – 0
Coyotes/1,000 Hours	Farmland	7.41 (SE = 5.98)	0 – 19.12
Bobcats/1,000 Hours	Farmland	0 (SE = 0)	0 – 0
Wolves/1,000 Hours	Farmland	0 (SE = 0)	0 – 0
Fisher/1,000 Hours	Farmland	0 (SE = 0)	0 – 0
Gray Foxes/1,000 Hours	Farmland	0 (SE = 0)	0 – 0
Badgers/1,000 Hours	Farmland	0 (SE = 0)	0 – 0

FOREST WILDLIFE POPULATIONS

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CARNIVORE SCENT STATION SURVEY SUMMARY, 2021

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 47th 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 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 or 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 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 198 routes and 1,769 stations were surveyed this year, the third fewest since the survey became fully operational in the early 1980's. Route density varied from 1 route per 754 km^2 in the Forest Zone to 1 route per 1,945 km^2 in the Farmland Zone (Figure 1).

Statewide, route visitation rates (% of routes with detection), in order of increasing magnitude, were opossums (6%), wolves (9%), bobcats (11%), domestic dogs (16%), domestic cats (27%), skunks (30%), red foxes and raccoons (34%), and coyotes (35%). Regionally, species-specific route visitation rates were as follows: red fox – FA 17%, TR 28%, FO 42%; coyote – FO 27%, TR 34%, FA 63%; skunk – TR 26%, FO 27%, FA 43%; raccoon – FO 15%, TR 42%, FA 80%; domestic cat – FO 15%, TR 42%, FA 46%; domestic dog – FO 11%, FA 17%, TR 26%; opossum - FO 0%, TR 6%, FA 17%; wolf - FA 0%, TR 2%, FO 15%; and bobcat - FA 0%, TR 9%, FO 15%.

Figures 2-5 show station visitation indices (% of stations visited) from the survey's inception through the current year. Although the survey is intended to document long-term trends in populations, confidence intervals (CI) improve interpretation of the significance of any annual changes. However, I refrain from formal significance testing (e.g., determination of whether a CI on the difference between means overlaps 0) and instead use more informal methods (i.e., degree of CI overlap; Cumming and Finch 2005) to highlight changes from last year that likely represent significant differences. Using this approach, the only notable changes this year were significant declines in striped skunk detections in the Farmland zone (Figure 2) and in wolf indices in the Forest Zone (Figure 5).

In the Farmland Zone (Figure 2), red fox indices continue to remain stable but well below their long-term average as they have been for nearly 20 years. Conversely, coyote and raccoon indices remain at or near record levels. Low red fox numbers are likely related, in part, to increased coyote abundance (Levi and Wilmers 2012). No consistent long-term trends are evident for other species in the Farmland Zone, though domestic dog detections have remained below the long-term average for over a decade.

As in the Farmland, red fox and coyote indices have generally exhibited inverse patterns in the Transition Zone, with red fox indices remaining below average for nearly 2 decades and coyote indices steadily increasing during that same time (Figure 3). No consistent long-term trends are evident for other species in the Transition Zone. Wolves and bobcats continue to occur in the Transition Zone (Figure 5), but at low and sometimes erratic levels of detection compared to the Forest Zone.

Unlike in the Farmland and Transition Zones, the Forest Zone coyote index has not increased over time and, except for the past 3 years, has been below the long-term average for 2 decades (Figure 4), likely due to the presence and long-term increase of wolves in the Forest Zone (Levi and Wilmers 2012). Coyote point indices, however, have been above the long-term average the previous 3 years, as have wolf indices, but there was a significant decline in the Forest Zone wolf index this year. Red foxes, raccoons, and striped skunks have not exhibited consistent or notable trends over the past 20 years, and all are currently near their long-term averages. After remaining low for an extended period (1976 – 2000), bobcat indices increased for over a decade (~ 2000 – 2012) and have since fluctuated but remained well above average (Figure 4).

ACKNOWLEDGMENTS

I wish to thank all of the cooperators who participated in the 2021 survey: DNR Division of Wildlife staff; Superior National Forest Aurora District; Rydell Rice Lake, and Sherburne National Wildlife Refuges; 1854 Treaty Authority, White Earth, Red Lake, and Leech Lake Tribal Natural Resource Departments; Ryan Miller, Rita Koch, and Vermillion Community College; Peter Jacobson and Faribault High School; 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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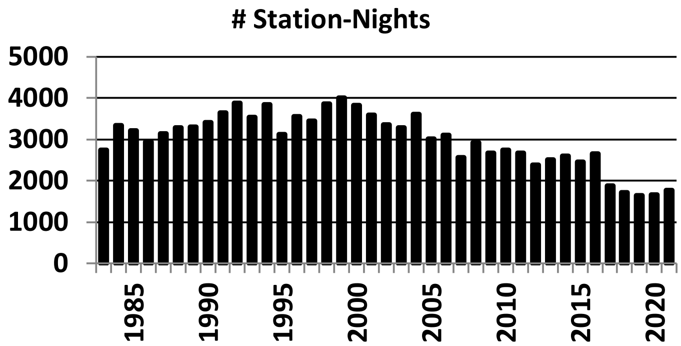

2021 SCENT STATION SPECIFICS

Zone	Routes Completed	Route Density	Station Nights
Farmland	**35**	**1/1,945 km^2**	**332**
Transition	**53**	**1/1,240 km^2**	**474**
Forest	**110**	**1/754 km^2**	**963**
Totals	**198**	**1/1,095 km^2**	**1,769**

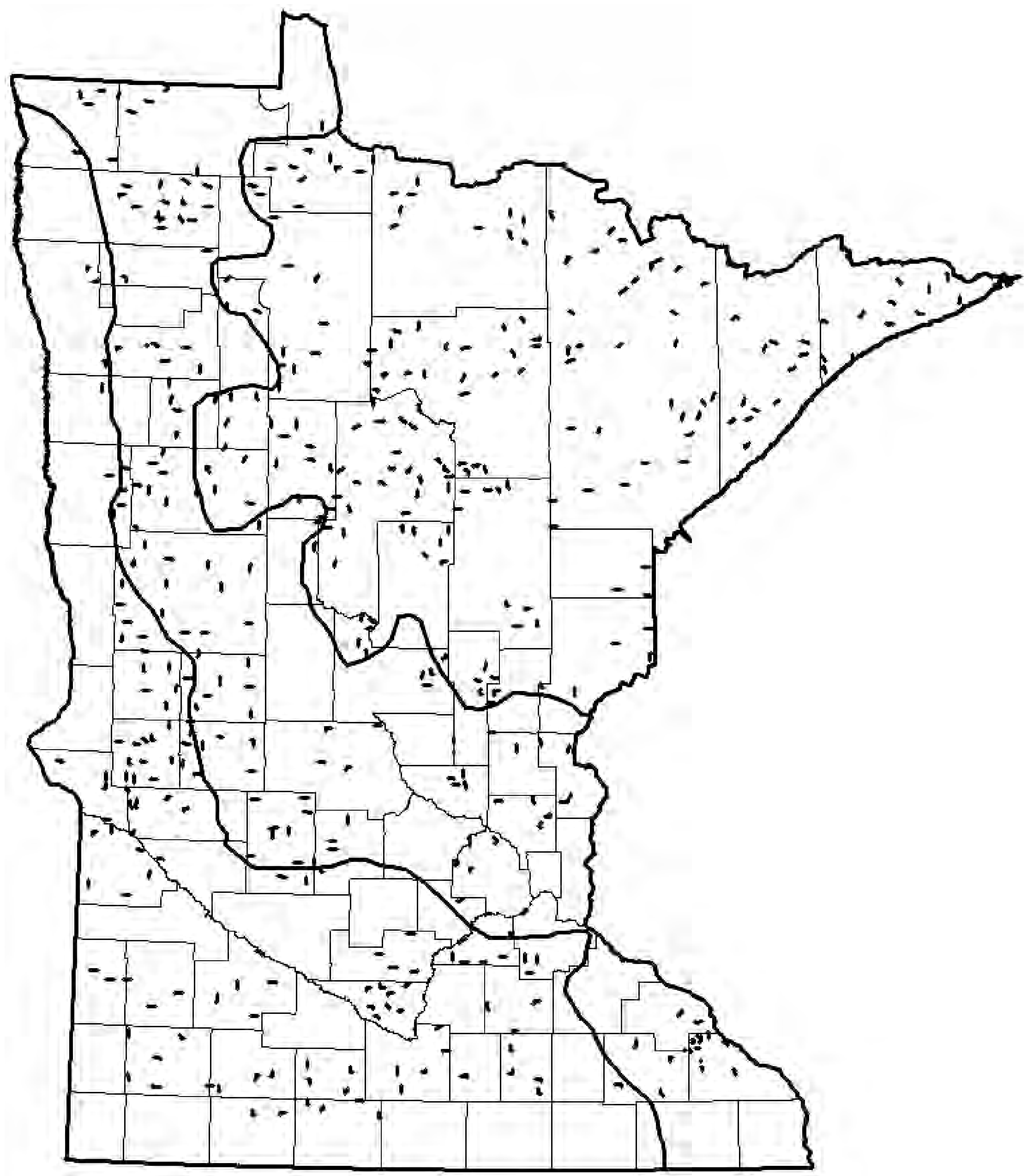

Figure 1. Locations of existing scent station routes (not all completed every year). Insets show 2021 route specifics and the number of station-nights per year since 1983.

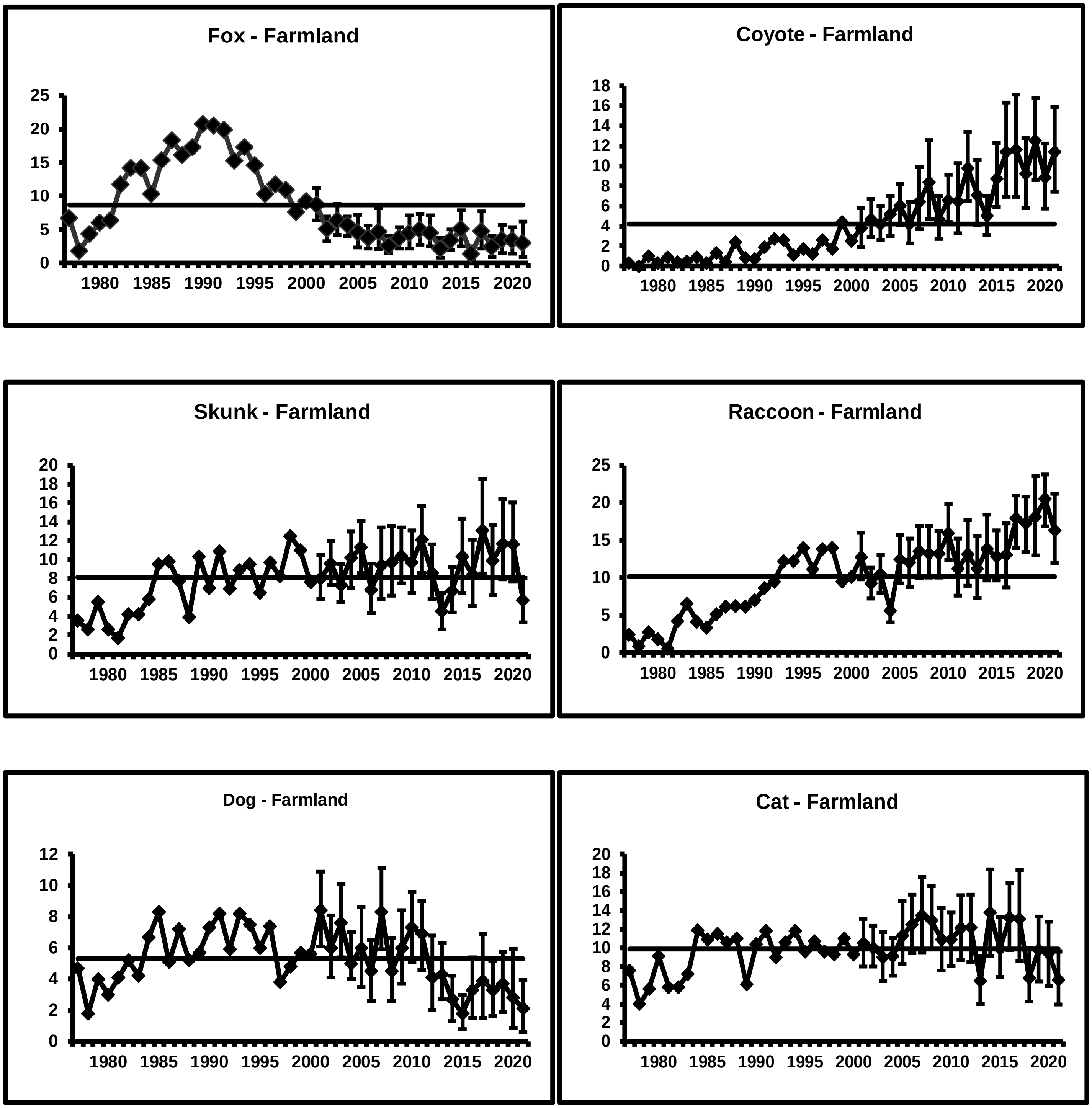

Figure 2. Percentage of scent stations visited by selected species in the Farmland Zone of Minnesota, 1977-2021. Horizontal lines represent long-term means.

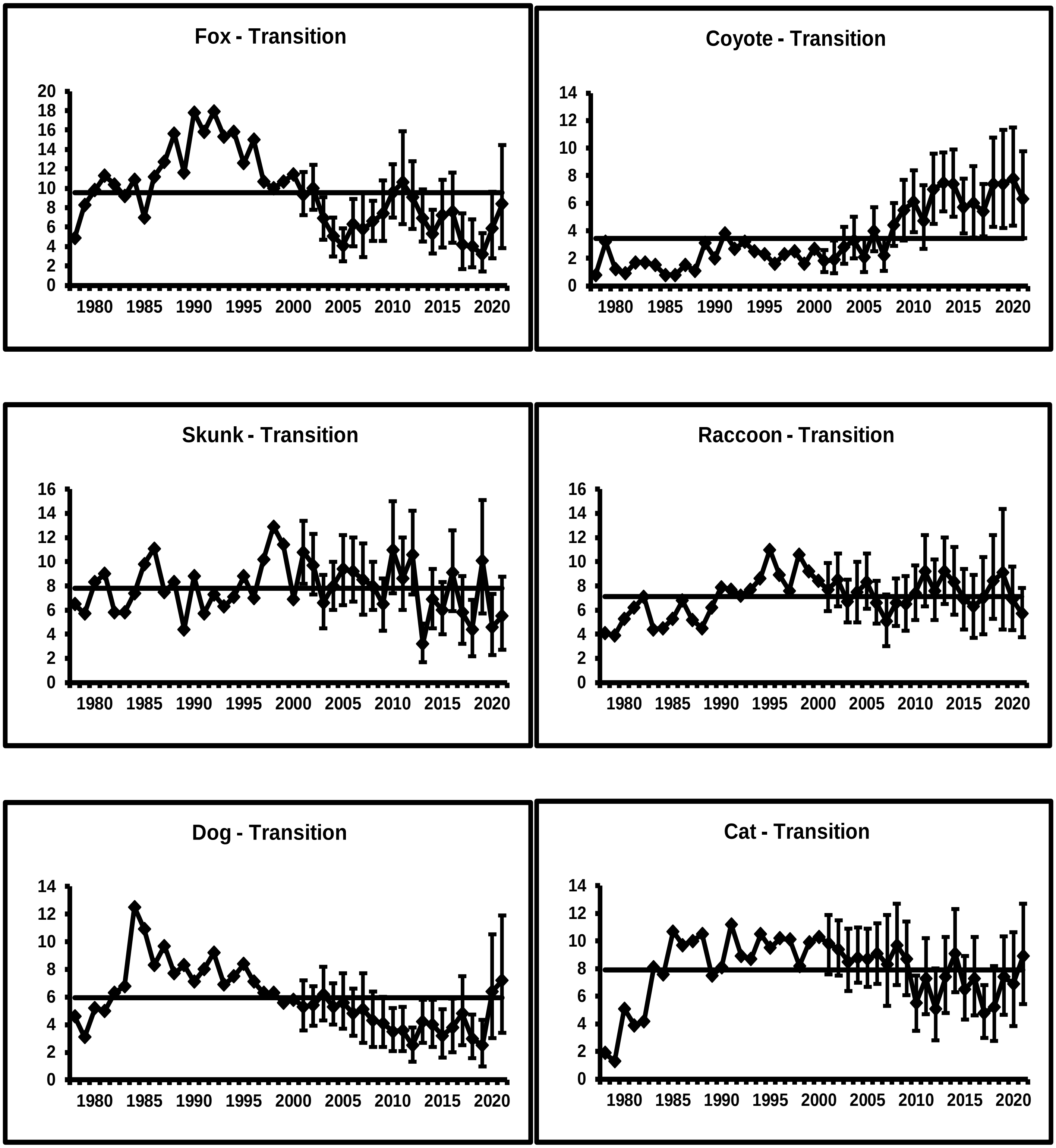

Figure 3. Percentage of scent stations visited by selected species in the Transition Zone of Minnesota, 1978-2021. Horizontal lines represent long-term means.

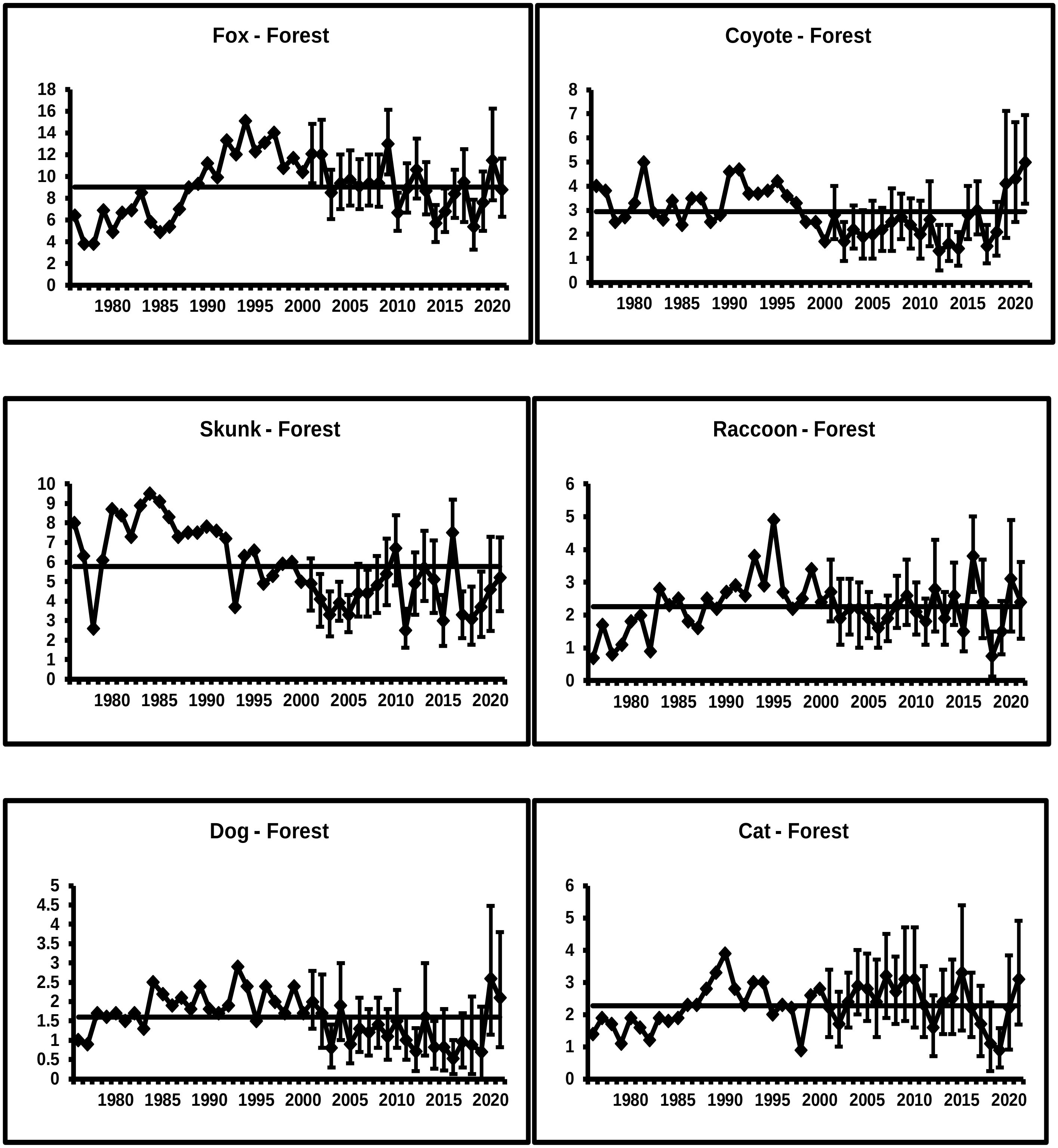

Figure 4. Percentage of scent stations visited by selected species in the Forest Zone of Minnesota, 1976-2021. Horizontal lines represent long-term means.

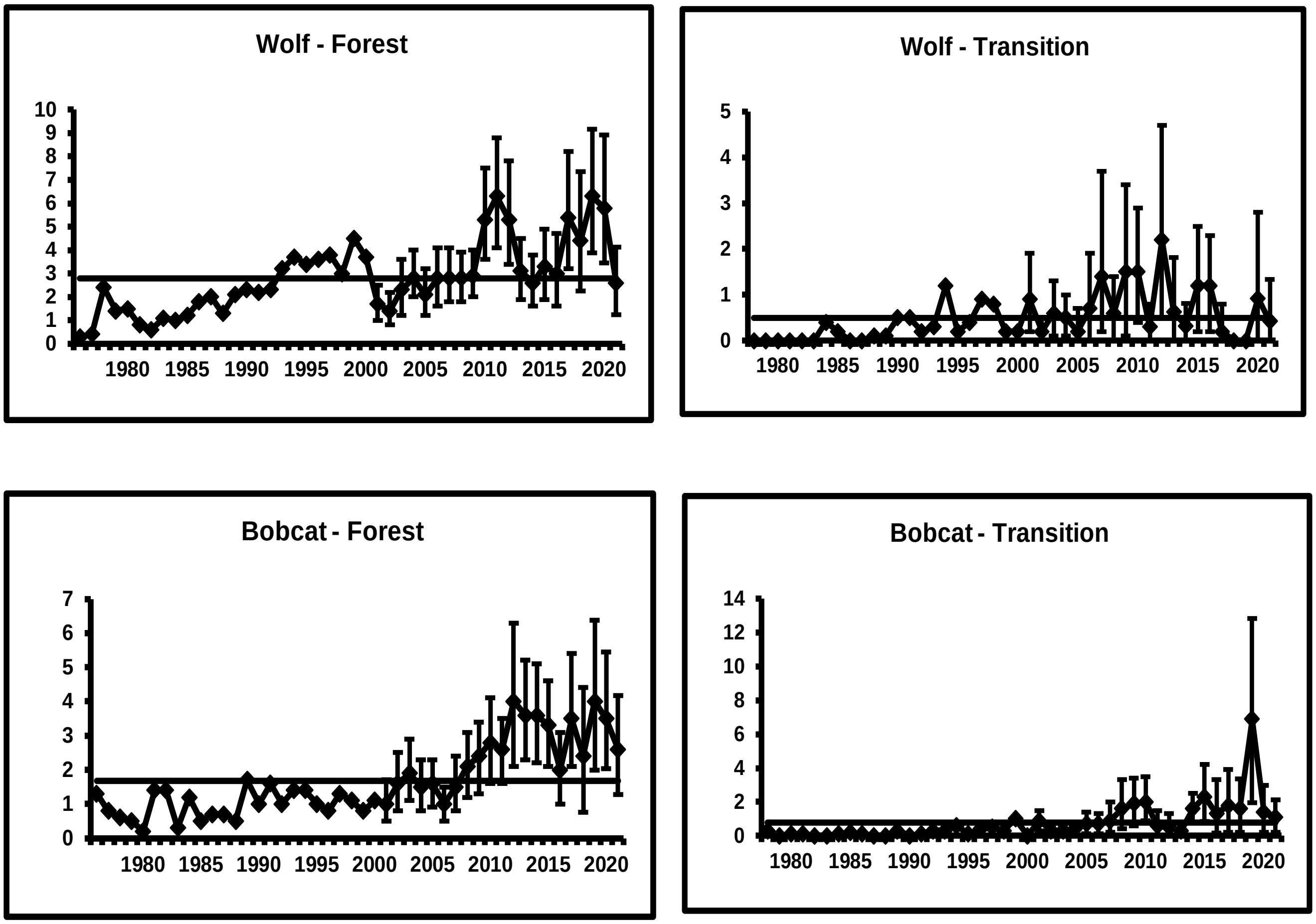

Figure 5. Percentage of scent stations visited by wolves and bobcat in the Forest and Transition Zones of Minnesota, 1976-2021. Horizontal lines represent long-term means.

FURBEARER WINTER TRACK SURVEY SUMMARY, 2021

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 their 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 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 fishers (*Pekania pennanti*) and martens (*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 (*Urocyon cinereoargenteus*) detections did not commence until 2008.

METHODS

Presently, 57 track survey routes are operational across the northern portion of the state (Figure 1); for various reasons, not all are surveyed each year. Each route is 10 miles long and follows secondary roads or trails. Most routes are continuous 10-mile stretches of road or trail, but a few are composed of multiple discontinuous segments. Route locations were subjectively determined based on availability of suitable roads or trails, but were chosen when 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 recorded only 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 these 'duplicate' tracks are excluded 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. For standardization, routes are to be surveyed one day after the conclusion of a snowfall (ending by ~ 6:00 pm). However, in most years a few routes are completed two nights following snowfall; track counts on those routes are divided by the number of nights since snowfall.

Because most species of interest occur throughout the area where survey routes are located, calculated indices for all species in reports 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 (hereafter, the 'marten zone'). However, in general there were minimal differences in temporal patterns observed in this subset versus the full sample of routes.

Currently, I present three summary statistics for each species. First, I compute the percentage of 0.5-mile segments with species presence, hereafter the 'track index', after removing any duplicates (e.g., if the same red fox (*Vulpes vulpes*) clearly traverses two adjacent 0.5-mile segments of the road, and it was the only 'new' red fox 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 computed after removing any obvious duplicate tracks across segments. For wolves (*Canis lupus*) traveling through adjacent segments, I use the maximum number of pack members recorded in any one of those segments 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 (percent of segments occupied and number of 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 foxes 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, I include both indices on the same graph. Because snowshoe hares are tallied only as present or absent, the two indices are 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'). I compute this measure to help assess whether any notable changes in the above-described track indices are a result of larger-scale changes in distribution (i.e., more/fewer routes with presence) or finer-scale changes in density along routes.

Using a bootstrapping approach (percentile method; Thompson et al. 1998), 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. Although the survey is intended to document long-term trends in populations, confidence intervals (CI) improve interpretation of the significance of any annual changes. However, I refrain from formal significance testing (e.g., determination of whether a CI on the difference between means overlaps 0) and instead use an informal approach (i.e., degree of CI overlap; Cumming and Finch 2005) to highlight changes from last year that likely represent significant differences.

RESULTS AND DISCUSSION

This winter, 36 of the 57 routes were completed (Figures 1 and 2). Survey routes took an average of 2.1 hours to complete. Snow depths averaged 14" along completed routes, 4" above the long-term mean (Figure 3). Mean overnight low temperature the night preceding the surveys was -7°F, the third coldest since the survey began (Figure 3). Survey routes were completed between December 7th and March 24th, with the mean survey date of January 11th (Figure 3).

Reliable interpretation of changes in 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. Based on degree of confidence interval overlap, the only significant changes this winter were declines in the gray fox track and distribution indices, and a decline in the bobcat track index (Figure 4).

Fishers were detected on 4.6% of the route segments and along 61% of the routes (Figure 4), both non-significant changes from last winter. 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 indicative of population trends in only the northern 'core' of fisher range. Although there had been some slight increase in fisher indices the last couple years, they have remained below their long-term average for the past 14 years, and far below their high in 2002; at their peak, fishers were detected on 14% of survey route segments.

Within the 'marten zone', martens were detected on 7.7% of the route segments and 59% of the survey routes (Figure 4), both non-significant changes from the previous winter. At their peak in 1999, martens were detected on 13% of the 'marten zone' route segments and 83% of the 'marten zone' survey routes. Like but preceding the fisher decline by a few years, marten indices had also declined over a 13-year period (through 2008). Although low and without trend since that time, marten indices show indications of 3 - 5-year cycles, consistent in timing with cyclic fluctuations of some of their rodent prey species in Minnesota (e.g., Berg et al. 2017, Swingen 2020).

Bobcat indices had increased for approximately 14 years through 2012 (Figure 4). Since then, indices have fluctuated erratically and generally remained above, sometimes well above, the long-term average. The percentage of route segments with bobcat detection had significantly increased last year (highest index on record), but this year exhibited a significant decline to near the long-term average. Bobcats were detected on 3.7% of the segments and 44% of the routes (Figure 4).

Wolves were detected on 9.9% of the route segments and 86% of the survey routes, both the 4th highest since the survey began, but neither representing a significant change from the previous winter (Figure 4). The average number of wolves detected per route was 3.3, the third largest since the survey began. Coyotes were detected on 3.6% of the route segments and 39% of the routes, similar to last winter. The long-term trend in coyote indices has been stable, but as with martens and weasels (see below), coyote track indices show indications of 3 - 5-year cycles consistent in timing with fluctuations in some rodent populations in MN. Long-term, red fox indices display a 'stair-step' decline over time, being lowest and comparatively stable from 2013 – 2018. Over the last 3 years, indices have slowly climbed to near the long-term average. Red foxes were detected on approximately 5% of the segments and 89% of the routes (Figure 4), neither representing a significant increase from last winter. Although no long-term trend is evident in gray fox indices, data from the past 13 years suggests that, similar to coyotes, martens, and weasels, they may fluctuate in concert with cyclic rodent populations. Gray foxes were detected on <1% of the route segments and on 6% of the routes, both significant declines from last winter.

Weasel (*Mustela* spp.) fluctuations continue to be characterized by 3 - 5-year cycles or 'irruptions' superimposed on a long-term declining trend, though the declining trend appears to have leveled off since 2013 (Figure 4). Weasels were detected on 10% of the route segments (peak of 31% in 1995) and on 79% of the routes (peak of 88% in 1999).

Both spring and winter hare indices steadily increased from 1994 – 2010. Since then, there has been less consistency between the 2 indices but both had generally declined for five years and were near their post-1994 averages in 2020 (Figure 4). This winter, hare indices exhibited minimal change, whereas the separate spring 2021 hare index exhibited a notable decline.

Historic data (pre-1994; not presented here) for the spring snowshoe hare index clearly exhibited 10-year cycles, with peaks and rapid declines often occurring in the first few years of each decade, and somewhat synchronous with the ruffed grouse cycle (which is also in the decline phase now). Although recent data suggests hare cycling has dampened, we may be entering a cyclic decline phase for hares as well.

ACKNOWLEDGEMENTS

I wish to thank all those who participated in this year's survey, including staff with the Minnesota DNR, Superior National Forest, Fond-du-Lac 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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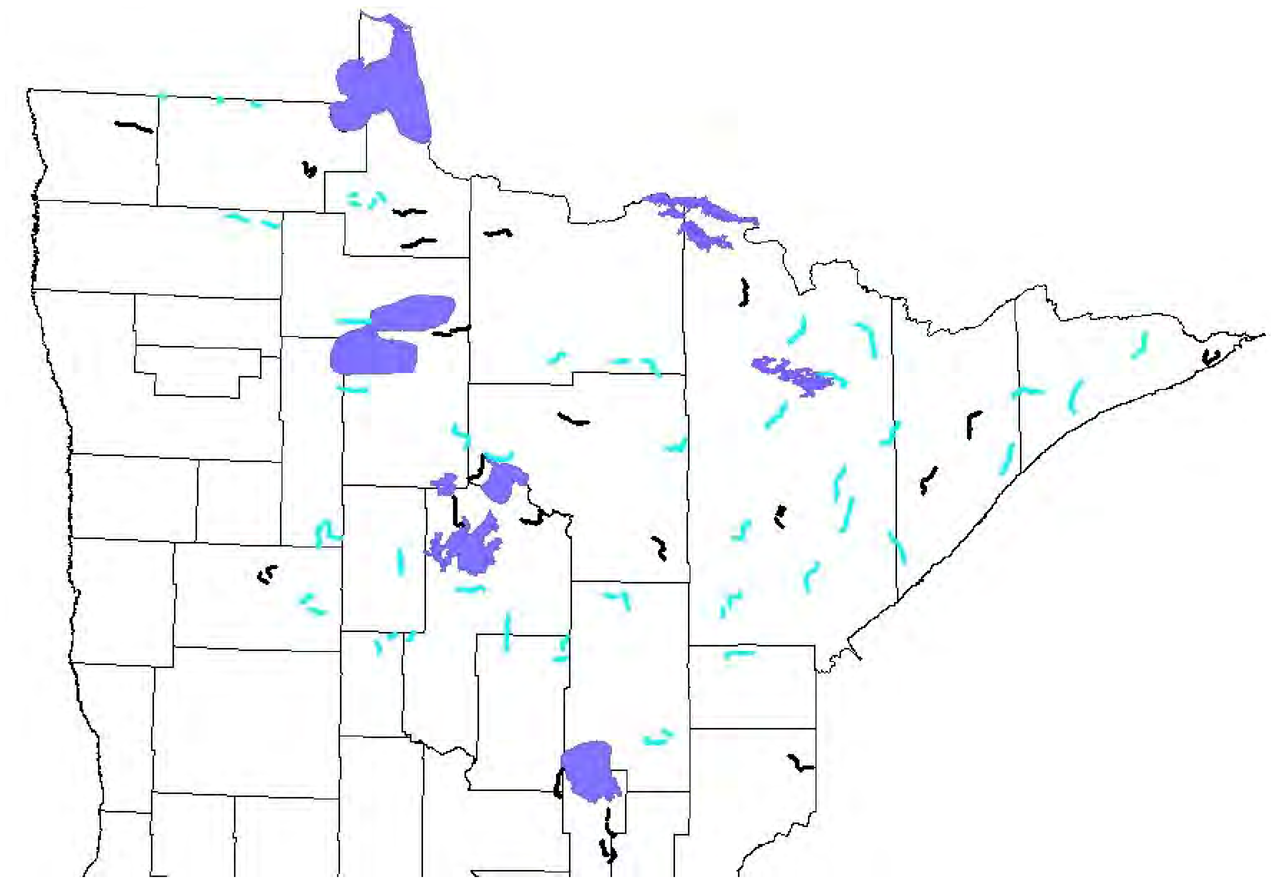


Figure 1. Locations of furbearer winter track survey routes in northern Minnesota. Blue routes are those completed during winter 2021-22.

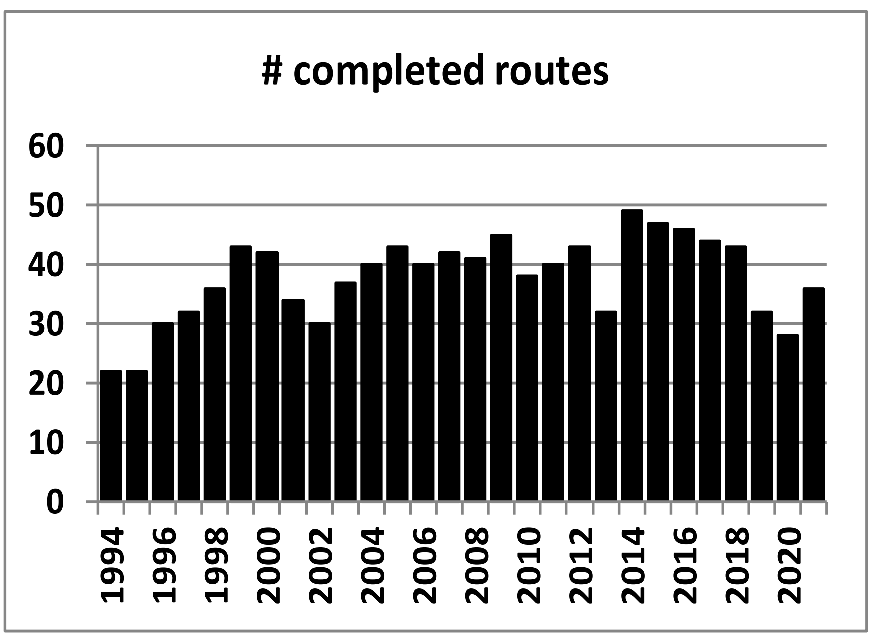
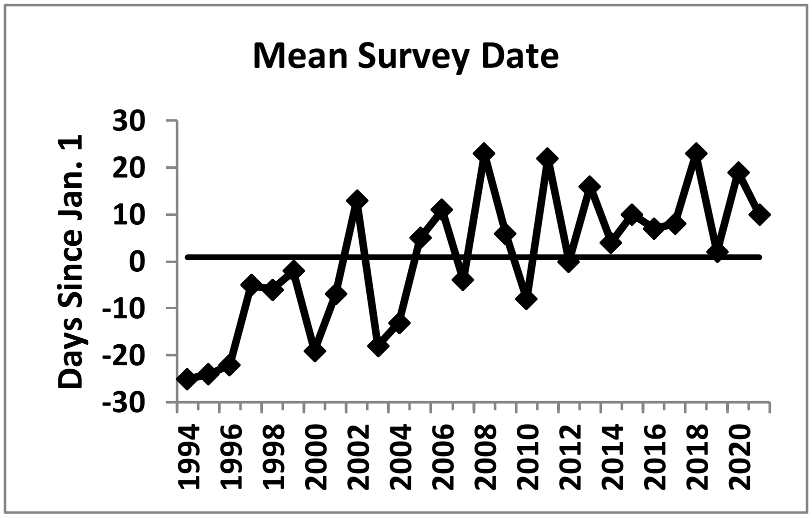
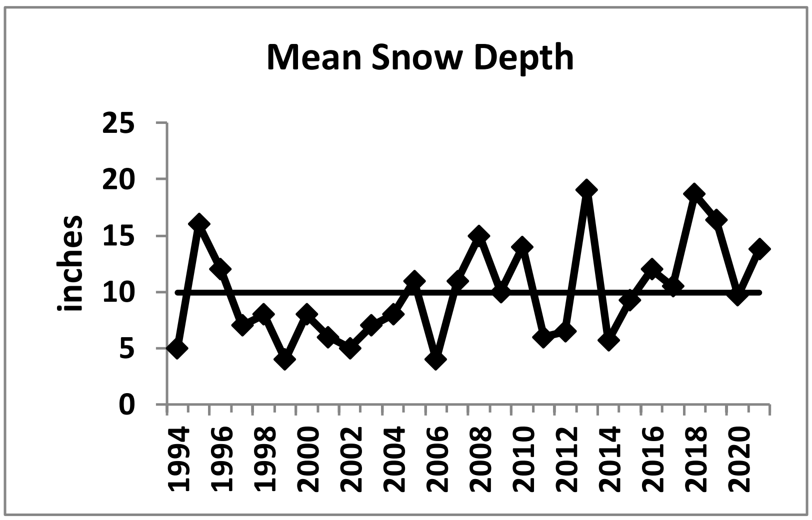


Figure 2. Number of snow track routes surveyed in Minnesota, 1994-2021.





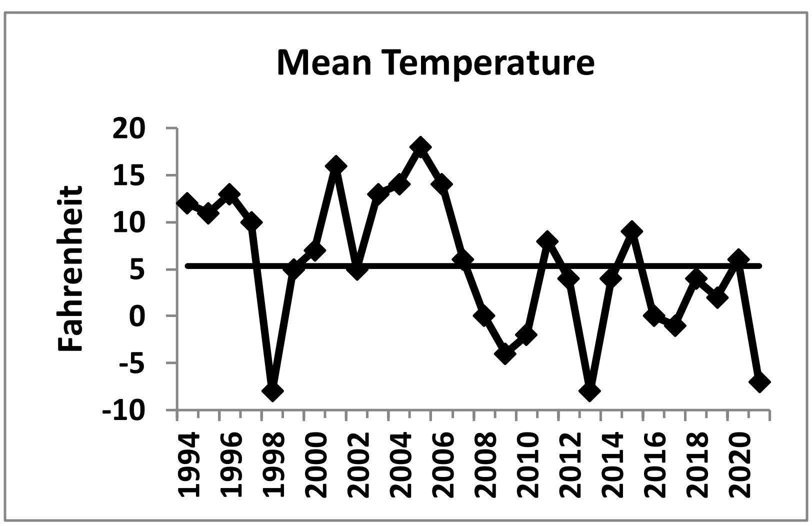


Figure 3. Average survey date, snow depth, and temperature for snow track routes completed in Minnesota, 1994-2021. Horizontal line represents long-term mean.

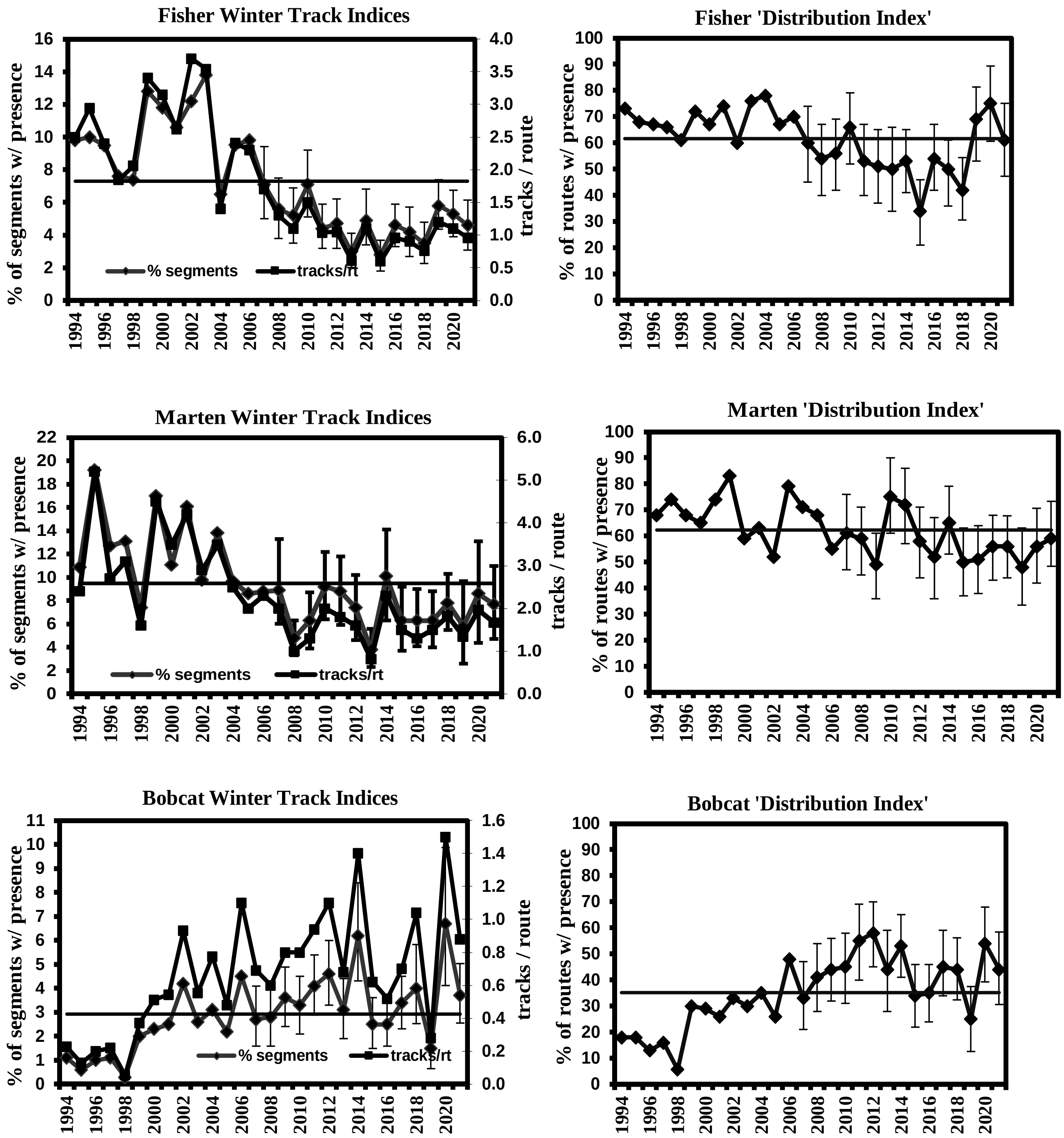


Figure 4. Winter track indices for selected species in Minnesota, 1994-2021. Confidence intervals are presented only for % segments and % routes with track presence; horizontal lines represent their long-term averages.

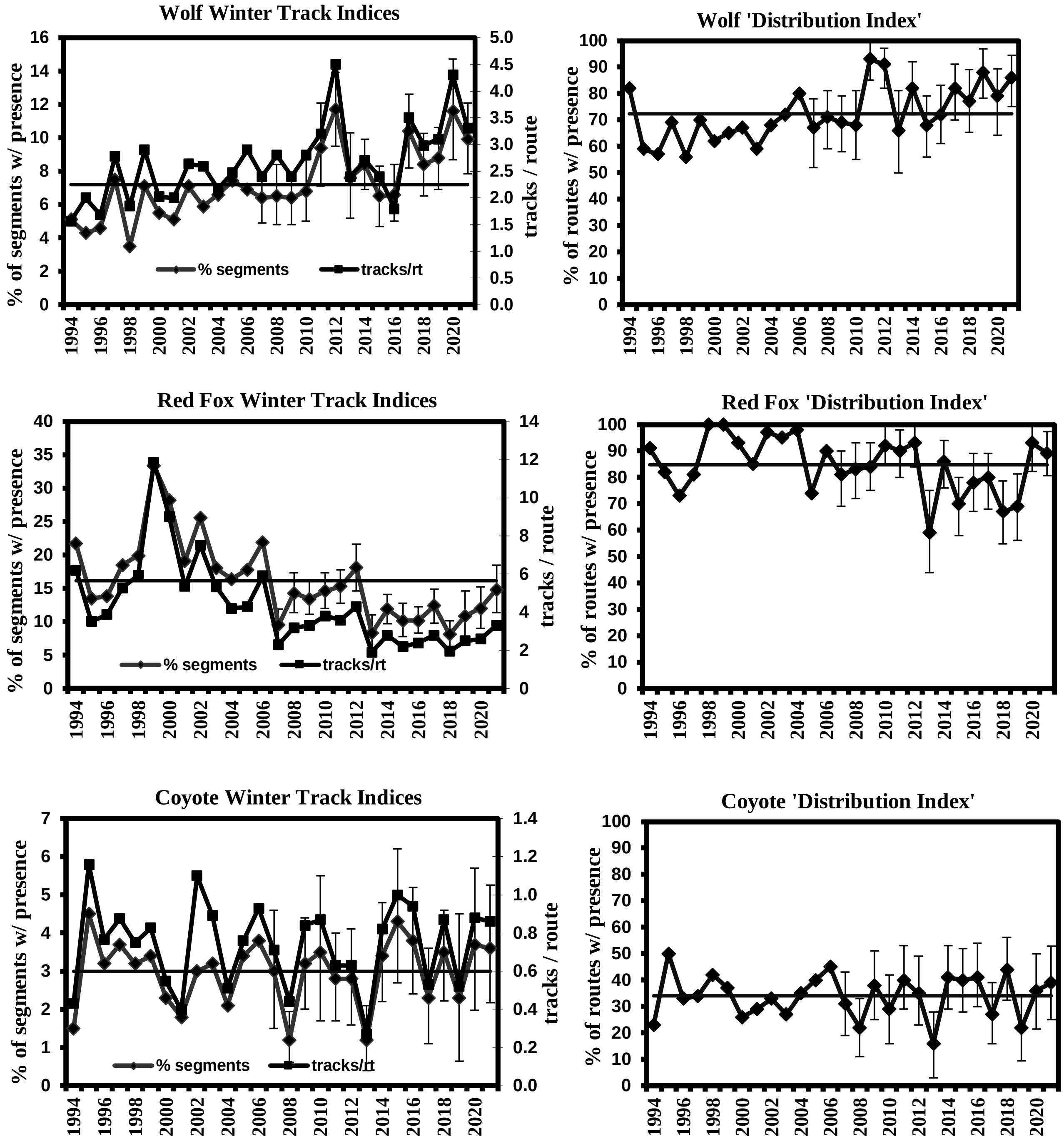


Figure 4 (continued). Winter track indices for selected species in Minnesota, 1994-2021.

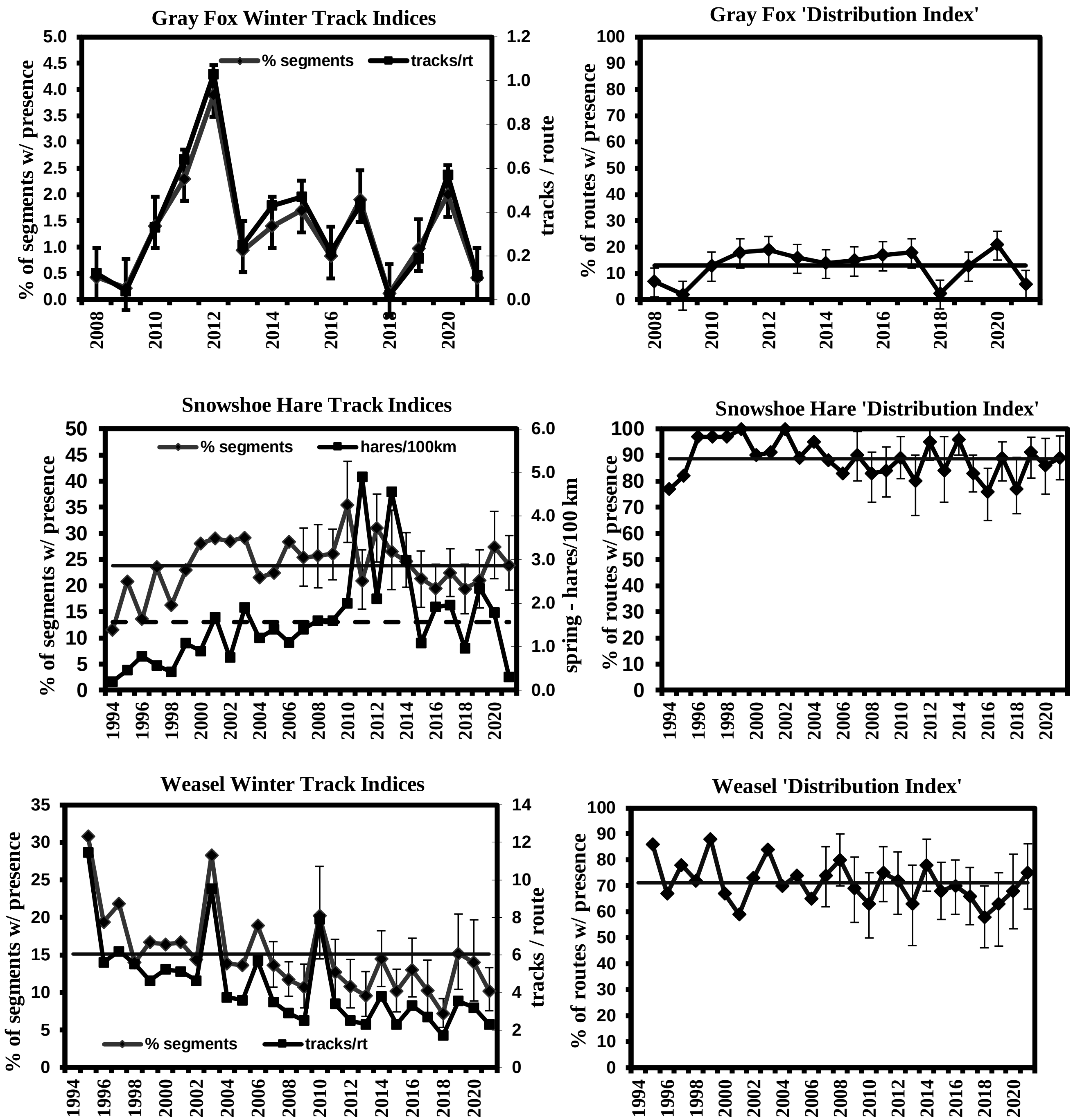


Figure 4 (continued). Winter track indices for selected species in Minnesota, 1994-2021.

STATUS OF MINNESOTA BLACK BEAR POPULATIONS, 2021*

Andrew N. 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 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 (1980): 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: Statewide and quota vs no-quota zones

A new Bayesian model developed by Allen et al. (2018) for bear monitoring in Wisconsin includes not only the sex-age composition of harvested bears (like the Downing), but also reproductive and survival parameters (obtained from data collected from long-term monitoring of radio-collared bears in different study sites across Minnesota). This model does not have a lag time like the Downing (so projections are available to post-hunt 2021, but the estimation method provides a “dampening” effect on the year-to-year variation in population estimates that results in a flatter curve than expected. The trajectory of this model is robust to assumption violations but is certainly an underestimate when considering our tetracycline estimates. The models for this year indicated that the statewide population has stabilized and is slowly recovering. Notably, the quota area as a whole has stabilized since 2012 and only had a minor decline after the past 2 years of increased harvest, but the no quota area has been increasing steadily for the last 20 years (Figure 1). The credible intervals for these 2 estimates are not included for ease of reading.

POPULATION TREND: BMU-LEVEL ESTIMATES

Using the Allen et al. (2018) population model, we were able to estimate population trend for each BMU (Figures 2 and 3). This has been something out of reach until this year due to limitations from small annual harvests over time and the insensitivity of the Downing model with small populations. The population estimates tended to follow what we know about bear reproduction in Minnesota. The poor soils in NE Minnesota BMUs produce less bear food and subsequently, have much worse bear reproduction (BMUs 12, 24, 25, 31) than areas farther south. In the western and southern BMUs (the periphery of bear range in Minnesota), oak forest and agriculture provide bears with abundant food. Bears in these BMUs (11, 46 and 47 [former 44], 45, 51, and 52) reproduce at younger ages and will be the quickest to recover from our population reduction in the 2000s. The remaining BMUs have reproduction levels between the north and south. They are the areas we would expect to stabilize and recover after the periphery of bear range.

Acknowledging that these results are post-hunt 2021, caution in interpreting the estimates is needed. Modeled population trends are far more robust than population estimates for a given year. The scale (estimated population size) is not as accurate as the overall trend (increasing, decreasing, or stable). Furthermore, a way to evaluate our current management goals is to compare the most recent estimates with those in 2012–2013, when permits were cut dramatically. Harvest quotas have been essentially level since that point and comparing with that cut point will allow for a better understanding of recent trends.

The drought in 2021 resulted in one of the worst bear food years on record. The drought, Memorial weekend killing frost, and large fires resulted in particularly hard effects of harvest on the population in the Northeastern BMUs. The harvest in 2021 was high in the northern BMUs for the second year in a row and harvest statewide was the second highest it has been in 15 years. Our BMU-level results suggest that the populations in BMUs 12, 24, 25, and 31 have continued to decline after the 2012 permit drop, albeit at a slower rate than before permits were dropped. The steepest decline seems to be in BMU 31, where current population levels have declined 20% from when permits were steeply cut in 2012. BMU 13 shows a very slight decline since 2013.

The good news is that populations in BMUs 26, 41, 44 (current BMUs 46 and 47), 45, and 51 seem to have stabilized since the permit cuts in 2012. All of the aforementioned BMUs have been stable since the permit cut, but BMU 41 has had a very minor decline over the past few years. BMU 44 had a minor increase prior to the 2020 hunt, but those gains were lost after the high harvest in 2020.

The no-quota BMUs have been increasing rather quickly since 2012. Estimates of growth are 5.5% (BMU 11) and 2.3% (BMU 52) annually from 2012–2021. We do not have an explanation for why these areas with unlimited hunting are growing so quickly, but hypothesize that it is the high-quality habitat and relatively low/uneven hunting pressure across BMU 11 and 52. There are big tracts of public land in the no-quota areas (especially in BMU 11), but generally these WMAs are large wetland complexes and hard to access by hunters. The remainder of the areas are dominated by private land with limited access to hunters. The modeled population trend seems to match the perception among the public and area wildlife staff that bear populations are increasing quickly. Specifically, in BMU 11, bears were non-existent in the early 1990s, but bear range and population size have expanded since then. Commensurately in BMU 52, there are regular bear sightings in the northern suburbs of the Twin Cities in Anoka, Chisago, and Washington counties.

Trends in harvest rates

The sex ratio of harvested bears varies by age (Figure 4). 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 (≥8 years) are nearly always dominated by females, because, although old females continue to be less vulnerable as individuals, 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 5). Based on this method, harvest rates in recent years have been similar to the early 1980s when the population was similarly small (~15%).

One problem in using this very simple method is that it assumes that the relative difference for males versus females in their vulnerability to harvest does not change systematically through time. This may not be true, given the steadily increasing male-skewed harvests since the late 1990s, and especially in recent years (Figure 1).

Nuisance complaints and kills

The total number of recorded bear complaints has remained stable over the past decade, reaching a peak in 2015 and 2016 (Table 1, Figure 6). Number of complaints declined in 2017, despite a higher number of DNR personnel recording complaints, and declined again in 2018, with abundant natural foods all summer (Tables 2 & 3). Below-average foods during the summer of 2021 led to complaints, but complaints overall were 22% lower than in 2020, despite intense drought in bear range. This year, there was a perceived increase in the number of calls received by ENF; the total number of calls was similar to last year, but the number of on-site visits by Conservation Officers for bear calls has been increasing the past few years. 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 implemented a similar system beginning July 2019. This dramatically increased the number of officers reporting bear complaints. Also, a relatively high number of the reports from officers involved a bear being killed by a private party. In 2018 and 2019, a list was distributed of “area 88” hunters, who expressed interest in taking a nuisance bear in the quota area on a no-quota license. This year 41 hunters purchased an “88” license and 6 hunters were successful (15% success rate). Using validation letters (either an area 88 hunter or a hunter who had a license that was validated early on a nuisance bear), 96 licenses were validated and 45 were successful (47% success). It is not known how many licenses were validated because reporting is incomplete. The number of validated hunters is likely an underestimate.

Spatial distribution of bear complaints

All bear complaints, whether handled by phone or at an on-site visit, are now recorded spatially. These maps (Figures 7, 8, 9) represent the complaints taken by Wildlife Managers because these data have the most accurate spatial locations. Complaint calls most often occur on in the core of bear range, but there is a growing number of trash and birdfeeder complaints on the edge of bear range or in areas with low bear density. There also are a number of complaints where people feel threatened by bears. They are most common on the edge of bear range where people aren’t used to bears, in cities, and along the north shore of Lake Superior (a popular tourist destination). The wildfires that occurred in Northeastern Minnesota due to the drought likely shifted a number of bears out of their home ranges, which sometimes results in increase bear-human conflict if attractants are not secured.

Food abundance

The composite range-wide, all-season abundance of natural bear foods (fruits and nuts) in 2021 was the worst ever (Table 2). Abundance of many summer foods was below the long-term (36-year) average all regions (Table 3). In general, summer food conditions were exceptionally poor across the state, and in most regions rivaled the drought of the mid-1980s. Fall foods were also exceptionally poor (Table 4), but not a total bust due to some surprising production of acorns locally (worst fall food year in our records statewide, but only the worst year on record in the northeast and west central parts of the state). The statewide fall food index (productivity of dogwood + oak + hazel), which helps predict annual harvest after accounting for hunter effort (Figure 11), was the worst on record (Figure 10). Hazelnut production was almost non-existent across the state. Dogwood production was generally poor across the range. Oak production was below average across the state with patches of average production near Grand Rapids and in the Red River Valley. Note that due to the COVID-19 pandemic, DNR staff were not out as frequently as normal, and the data reported are a smaller sample of the landscape than normal.

Predictions of harvest from food abundance

The 2021 statewide harvest was 15% lower than expected, based on regression of harvest as a function of hunter numbers and the fall food productivity index (Figure 11). This regression is nearly as strong (and has accurately predicted previous harvests) when only the past 15 years are considered. For the quota zone, the actual harvest in 2020 was also only 6% lower than predicted by this regression. These discrepancies might be due to the changes in BMU 451 and limited time that staff spent in the field due to the COVID-19 pandemic.

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 (Figure 12). Reminder notices were sent to non-compliant hunters each year during 2014–2017, which spurred a higher initial compliance the following years (>80%). Since 2018, with no reminder mailing, compliance has been 82–87%. Since 2013, hunters could register by phone or internet, and pick up a tooth submission envelope later: tooth submission compliance by these hunters has equalized across all registration types. A decreasing proportion of hunters are registering their bear at a registration station over the past years (Figure 13). Compliance with tooth submission was higher in the quota zones than in the no-quota area but was especially low (<80%) in a number of units (BMUs 10, 22, 41, and 52).

**Population data extracted from the Status of Minnesota Black Bears, 2021: Final Report to the Bear Committee. All data contained herein are subject to revision, due to updated information, improved analysis techniques, and/or regrouping of data for analysis.*

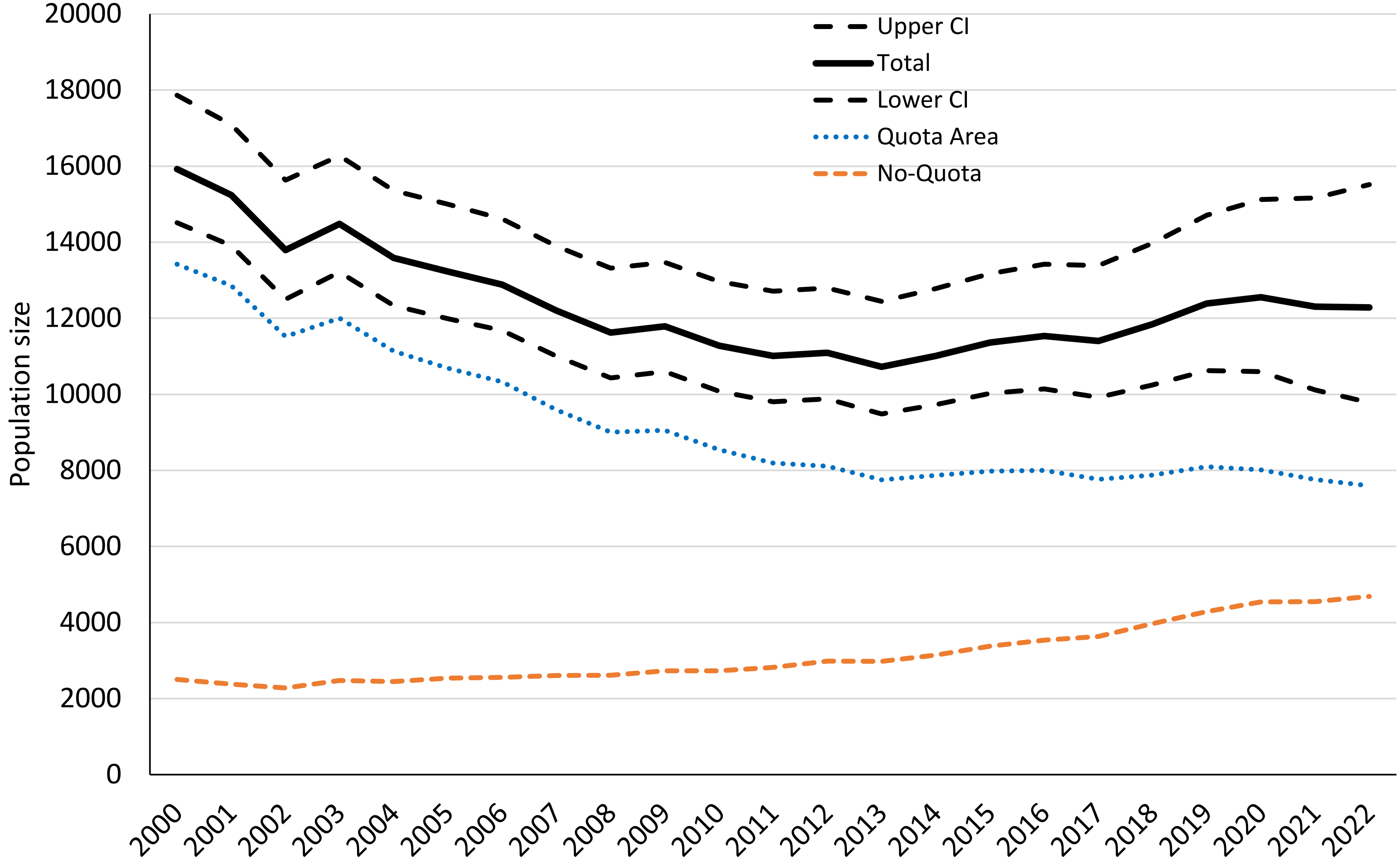


Figure 1. Population trends during 2000s derived from Allen model statewide estimates (± 95% credible intervals) and population estimates for quota and no-quota zones. Note the actual scale of the population estimates is an underestimate to true population size (based on previous tetracycline estimates), but population trend seems consistent with the BMU-level models and the Downing.

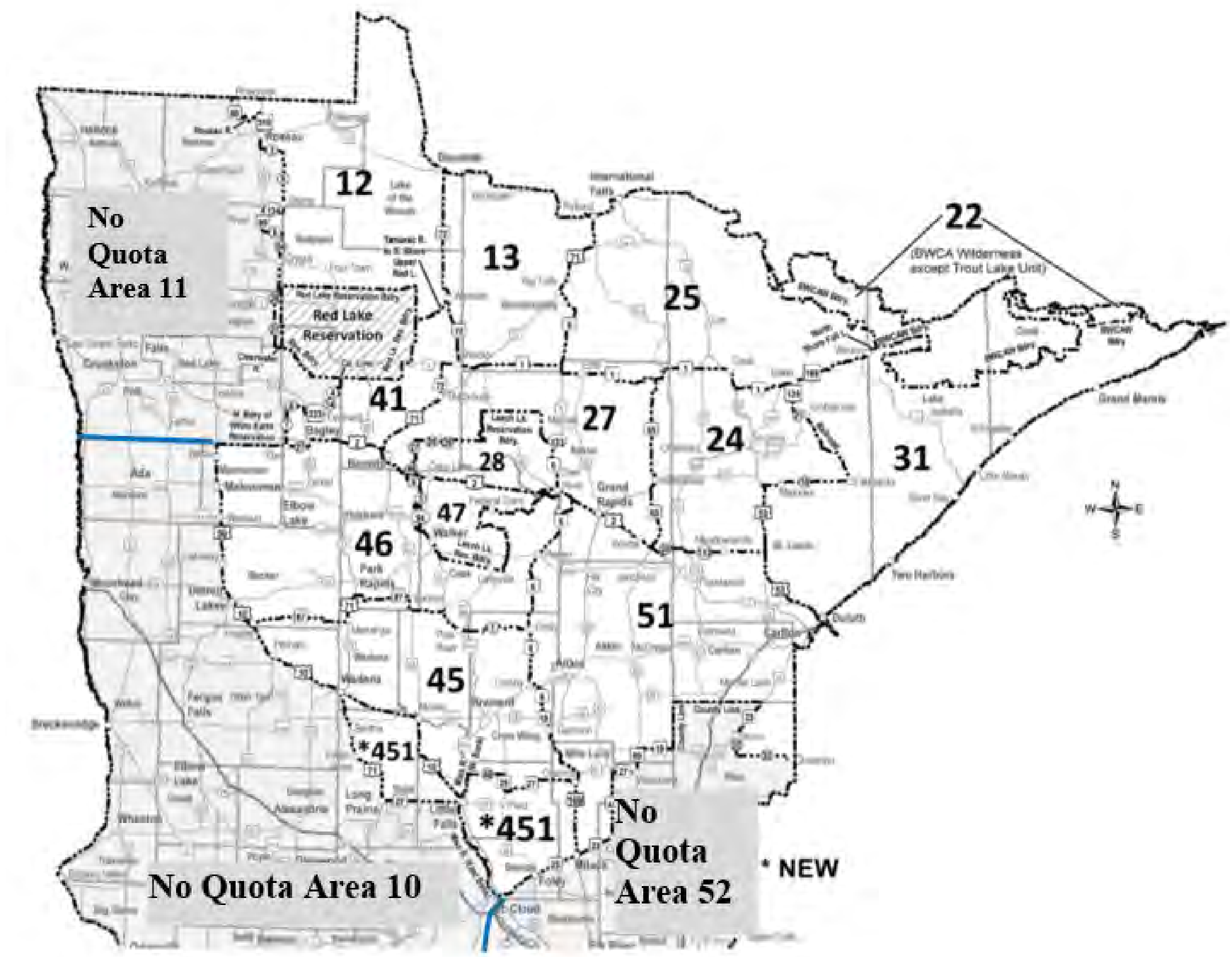


Figure 2. Bear management units (BMUs) within quota (white) and no-quota (gray) zones. Hunters in the quota zone are restricted to a single BMU. In 2016, BMU 26 was divided into 27 and 28, and BMU 44 was split into 46 and 47 (BMUs 28 and 47 comprise the Leech Lake Reservation). No-quota hunters can hunt anywhere within the gray-colored zone, including the southeast corner of Minnesota (not shown; designated area 60). In 2020, zone 451 was split from 3 deer permit areas of 45 to relieve crop damage in the area. This area is in the quota-zone, but with an unlimited number of participants.

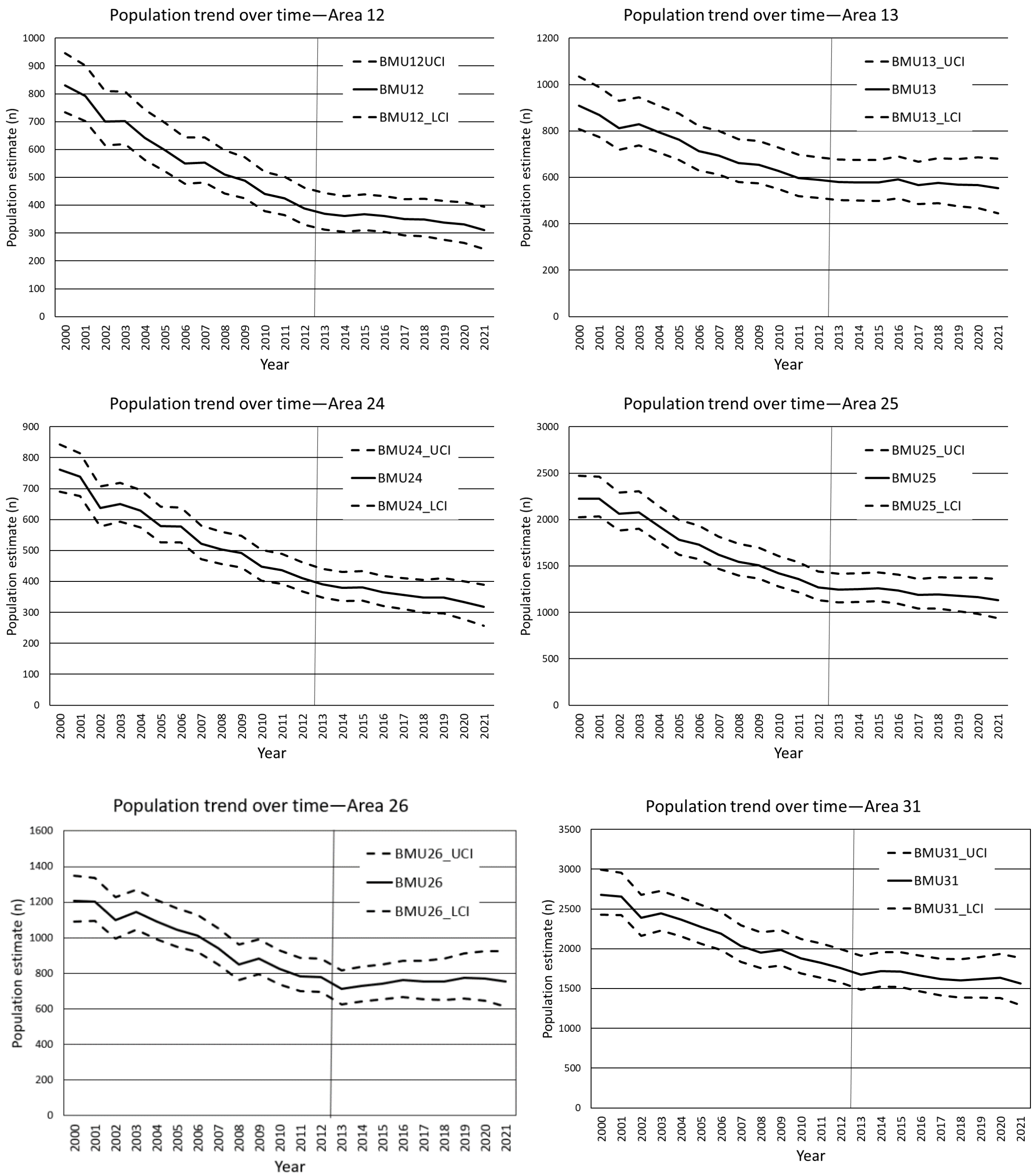


Figure 3. Allen et. al (2017) BMU-level, pre-hunt estimates 2000–2021. The vertical black line in 2012-2013 represents when quota permits were cut by >50% and have remained stable at low levels since then. The dashed lines represent the 95% pointwise credible intervals of the population estimate. With the small population size at BMU level, estimates of population trend are more reliable than actual population size. BMU harvest in area 22 is too small to reliably model. BMU population estimates are compiled into pre-2017 BMUs (e.g., BMU 27 and 28 are aggregated into BMU 26; BMU 46 and 47 are aggregated into BMU 44).

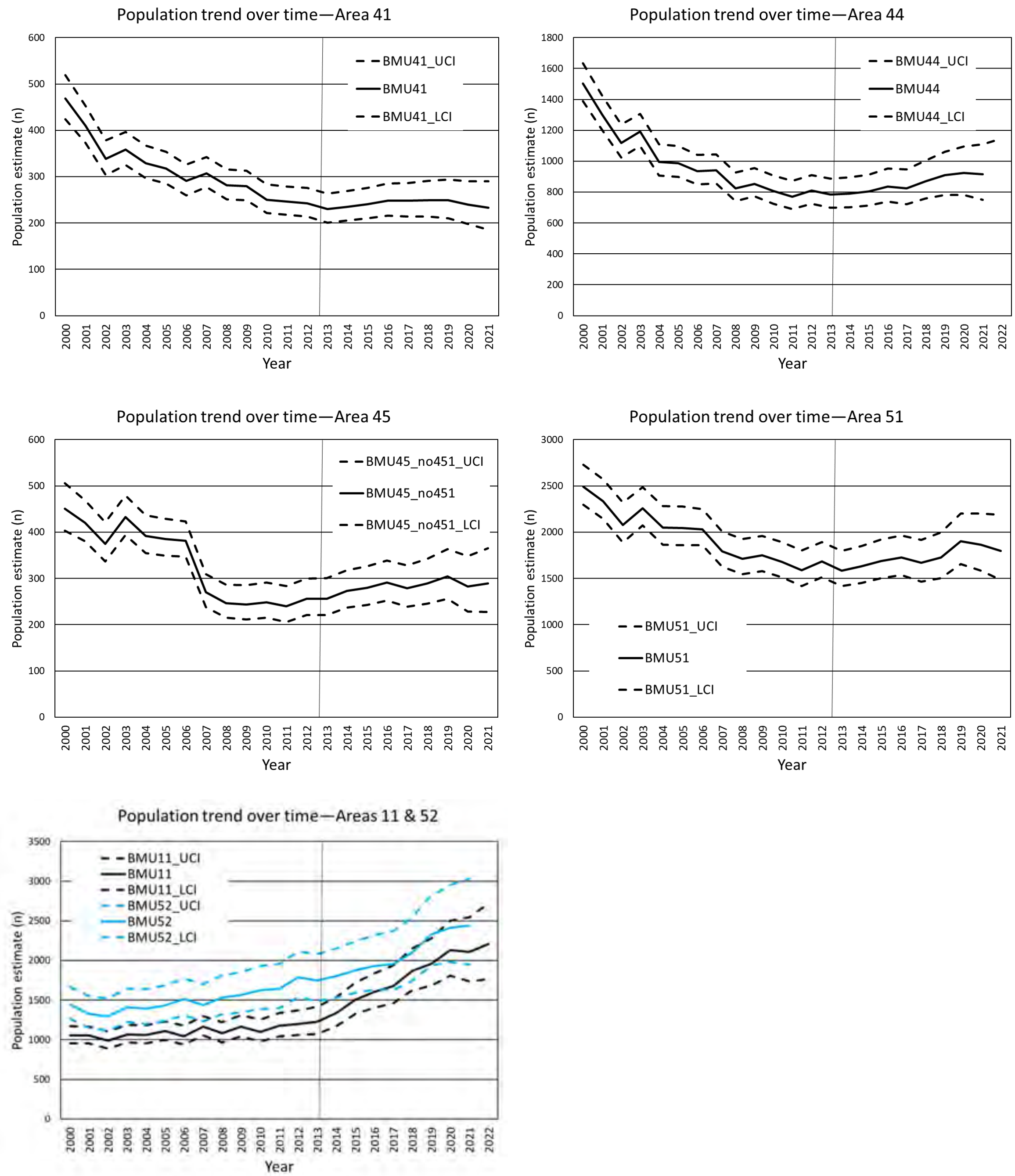


Figure 3 cont.

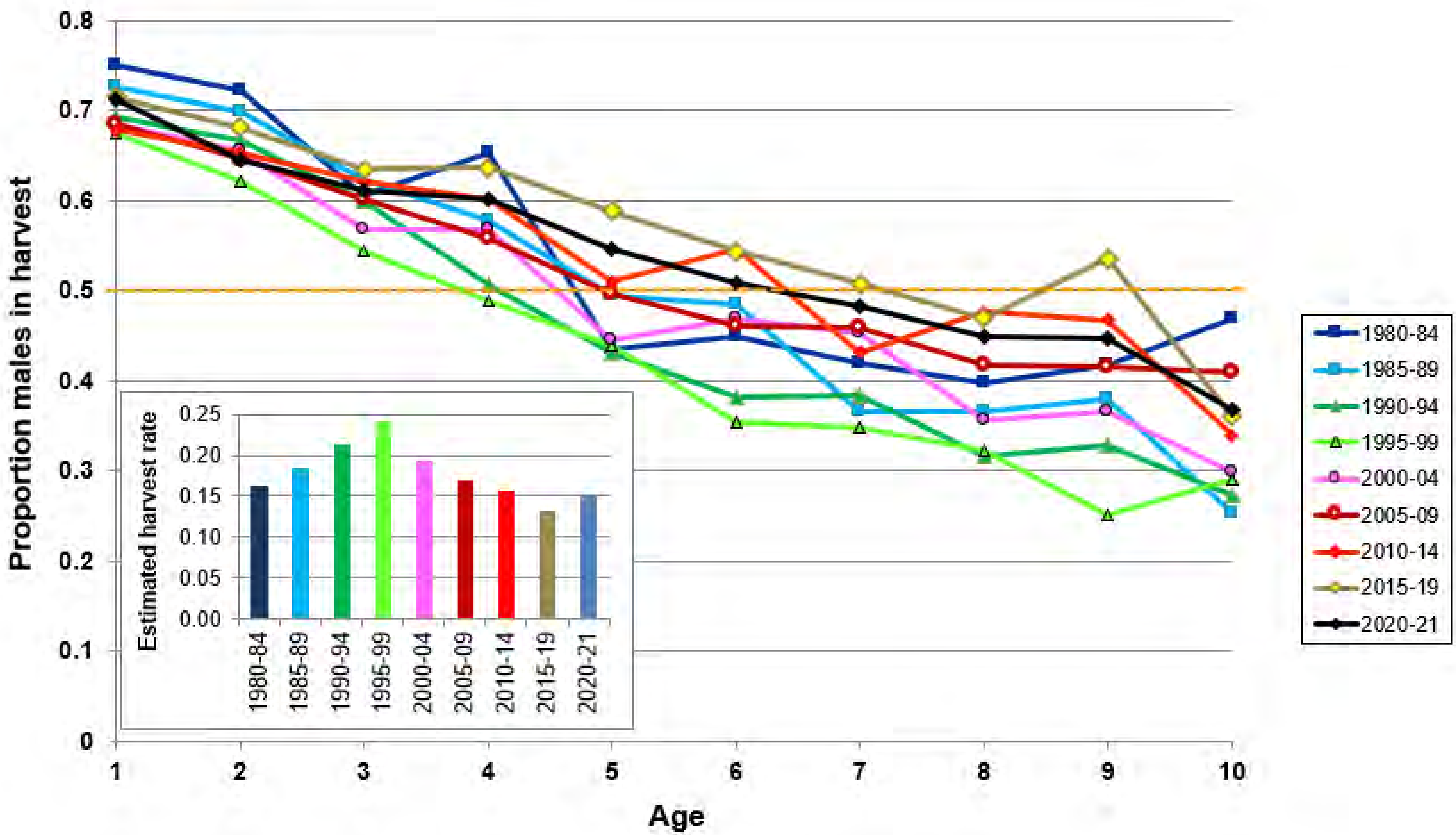


Figure 4. Trends in proportion of male bears in statewide harvest at each age, 1–10 years, grouped in 5-year time blocks, 1980–2020. Higher harvest rates result in steeper curves because males in the living population are reduced faster than females. Fitting a line to the data for each time block and predicting the age at which 50% of the harvest is male (dashed orange horizontal line) yields approximately the inverse of the harvest rate (derived rates are shown in inset). Flatter curves in recent years indicate lower harvest rates (e.g., 2015–20 lower than 1980–84), but a slight increase in recent years.

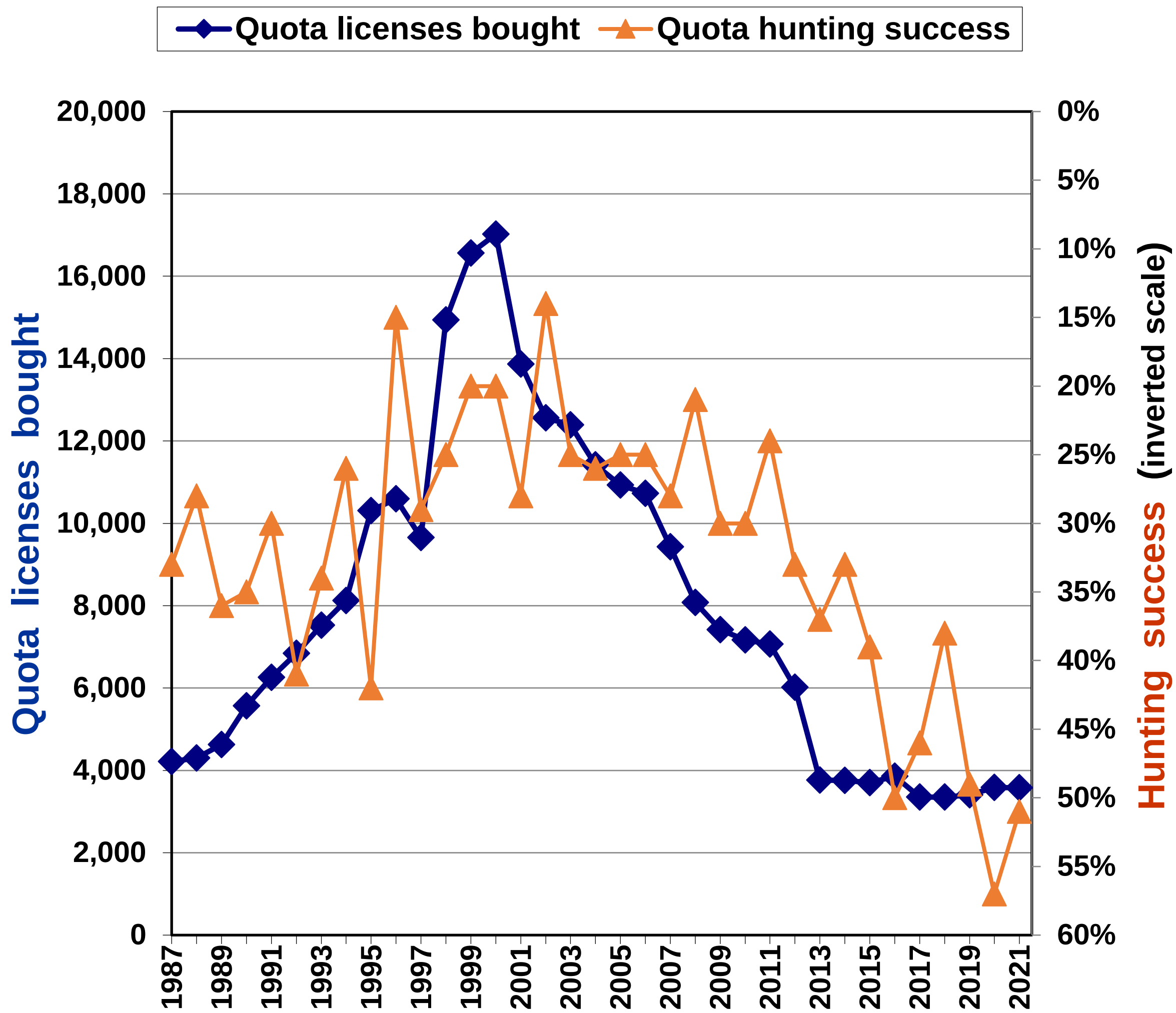


Figure 5. Relationship between licenses sold and hunting success (*note inverted scale*) in quota zone, 1987–2021 (quota and no-quota zones first partitioned in 1987). Number of licenses explains 59% of variation in hunting success during this period. Large variation in hunting success is also attributable to food conditions (e.g., during 2013–2021, when licenses were held relatively constant). Statistics from BMU 451 are not included in this graph to allow for quota zone comparisons with the past.

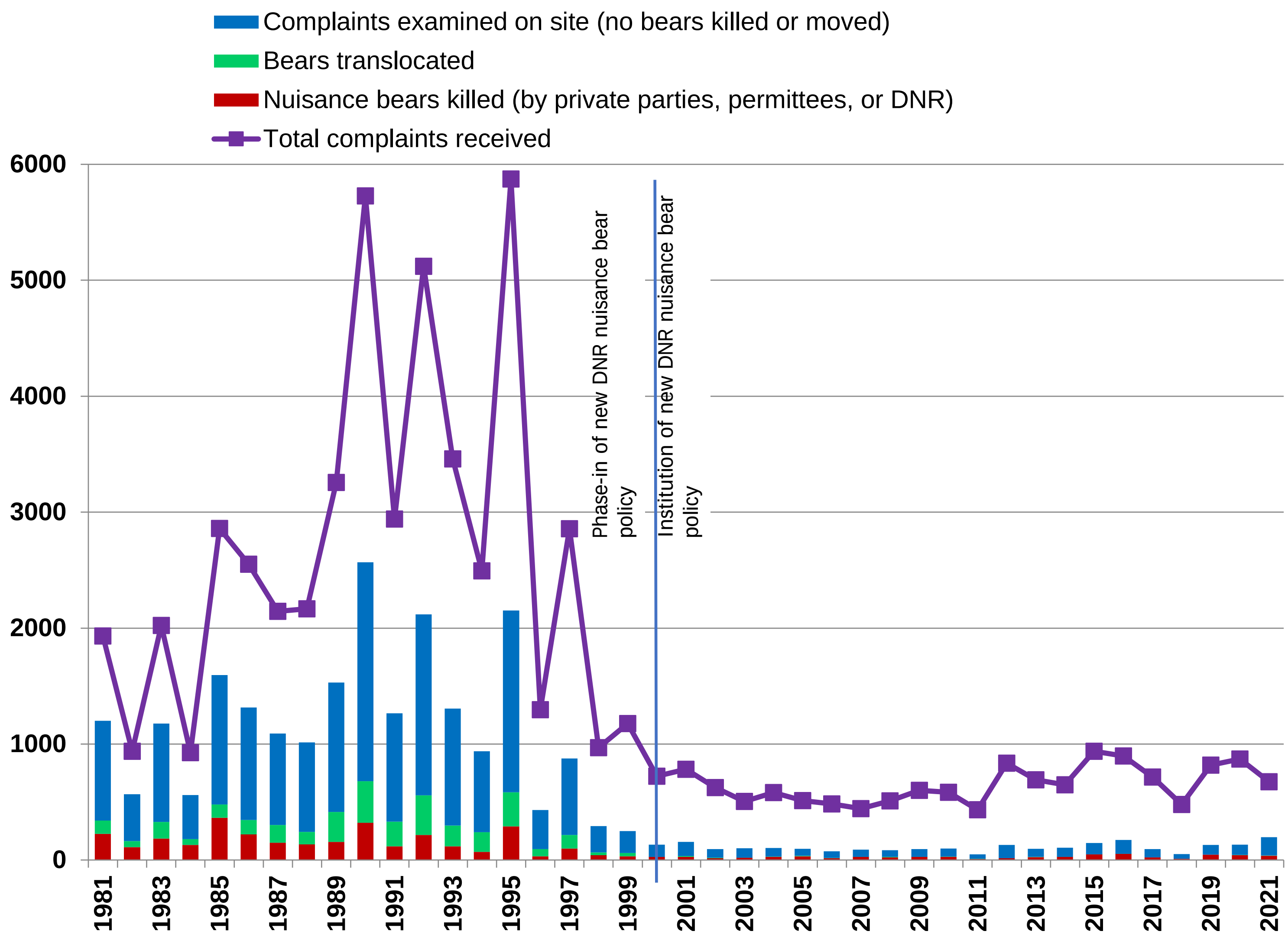


Figure 6. Trends in nuisance bear complaints, and nuisance bears killed and moved, 1981-2021, showing dramatic effect of change in nuisance bear policy, and a stable number of bear complaints over the last decade. Total complaints received for 1981-2000 are interpolated in years that did not include a nuisance survey.

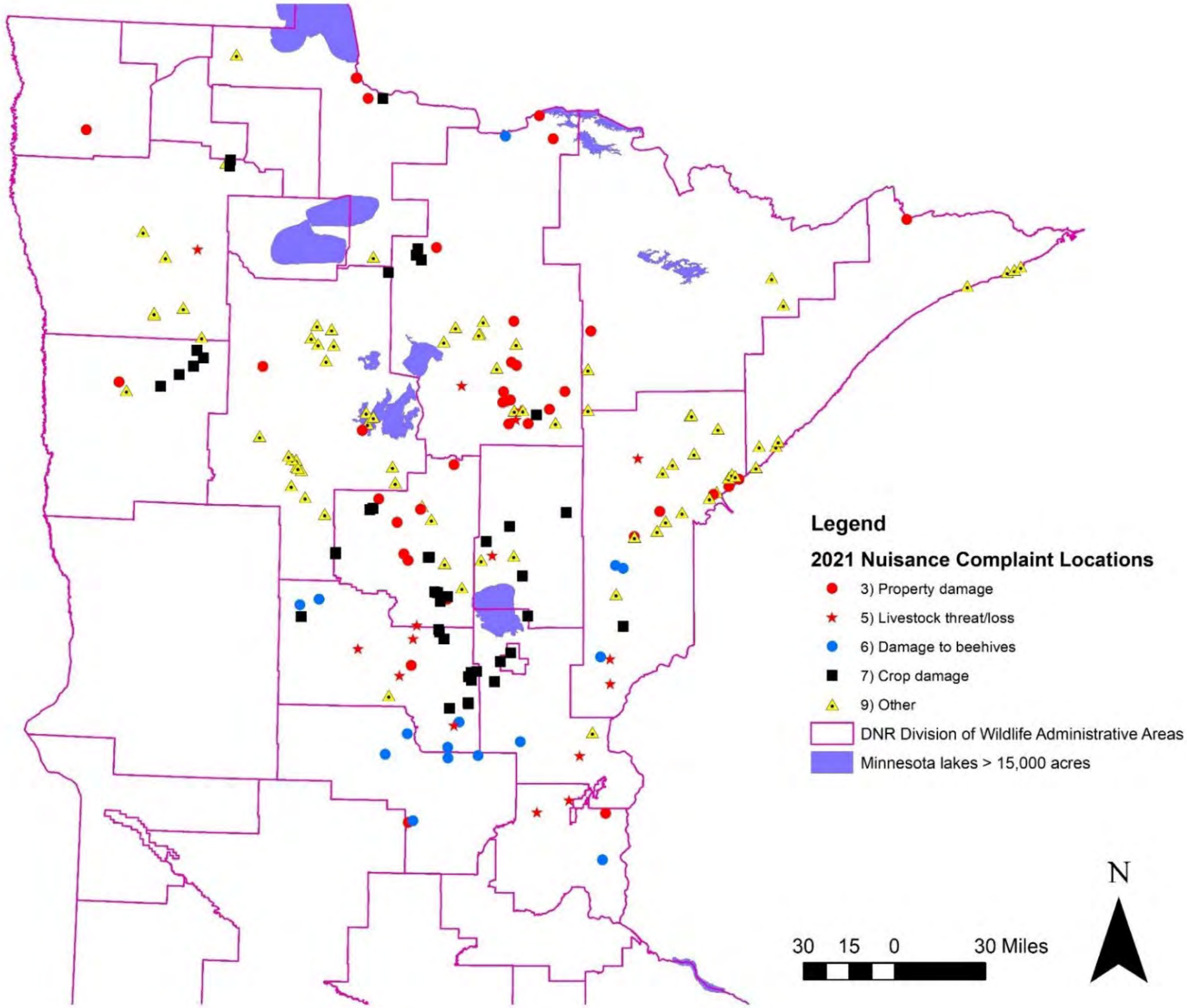


Figure 7. Spatial distribution of nuisance bear complaints to wildlife managers involving agriculture, property damage, or non-anthropogenic food related complaints in 2021.

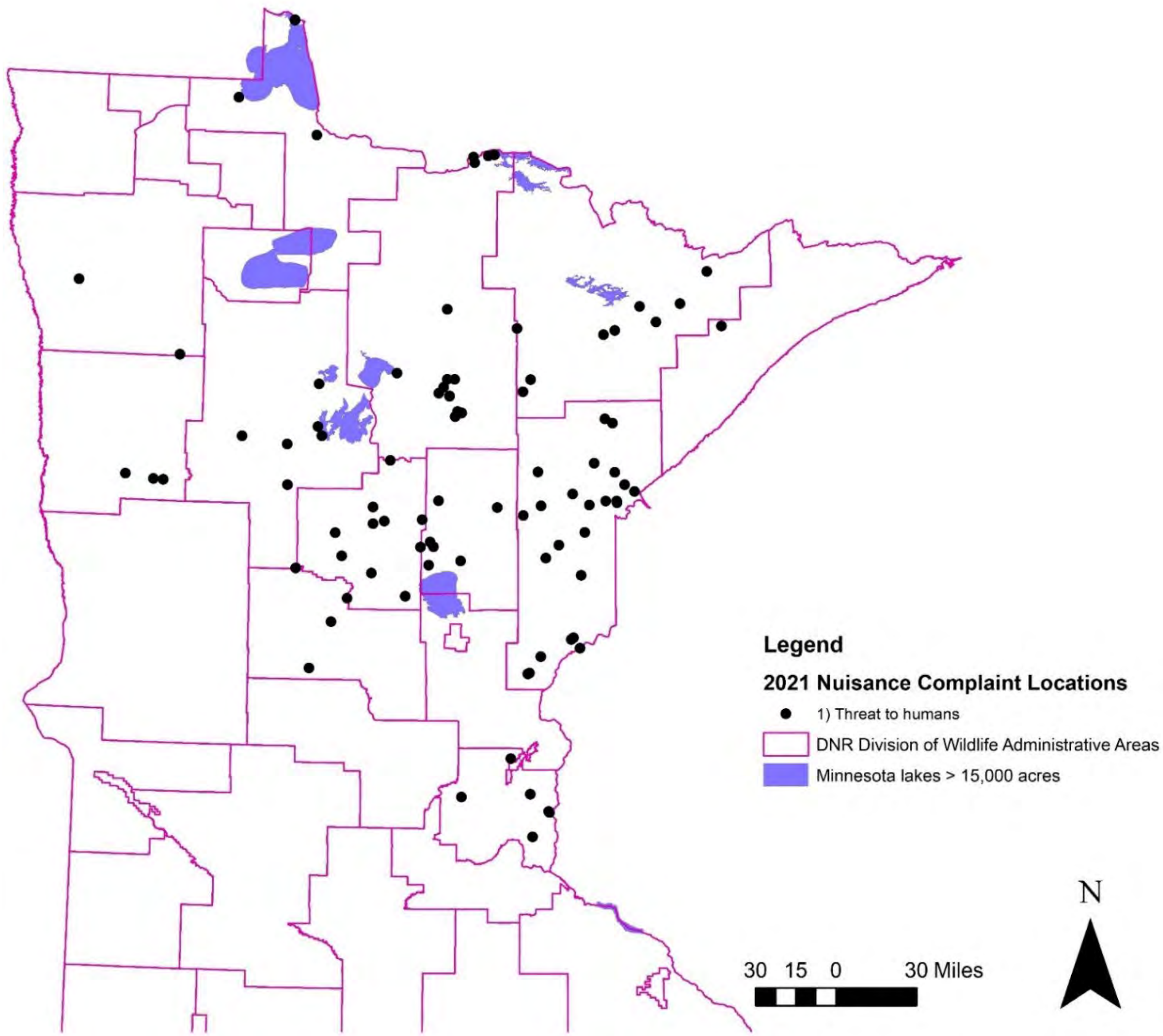


Figure 8. Spatial distribution of nuisance bear complaints where people felt threatened by bear presence in 2021.

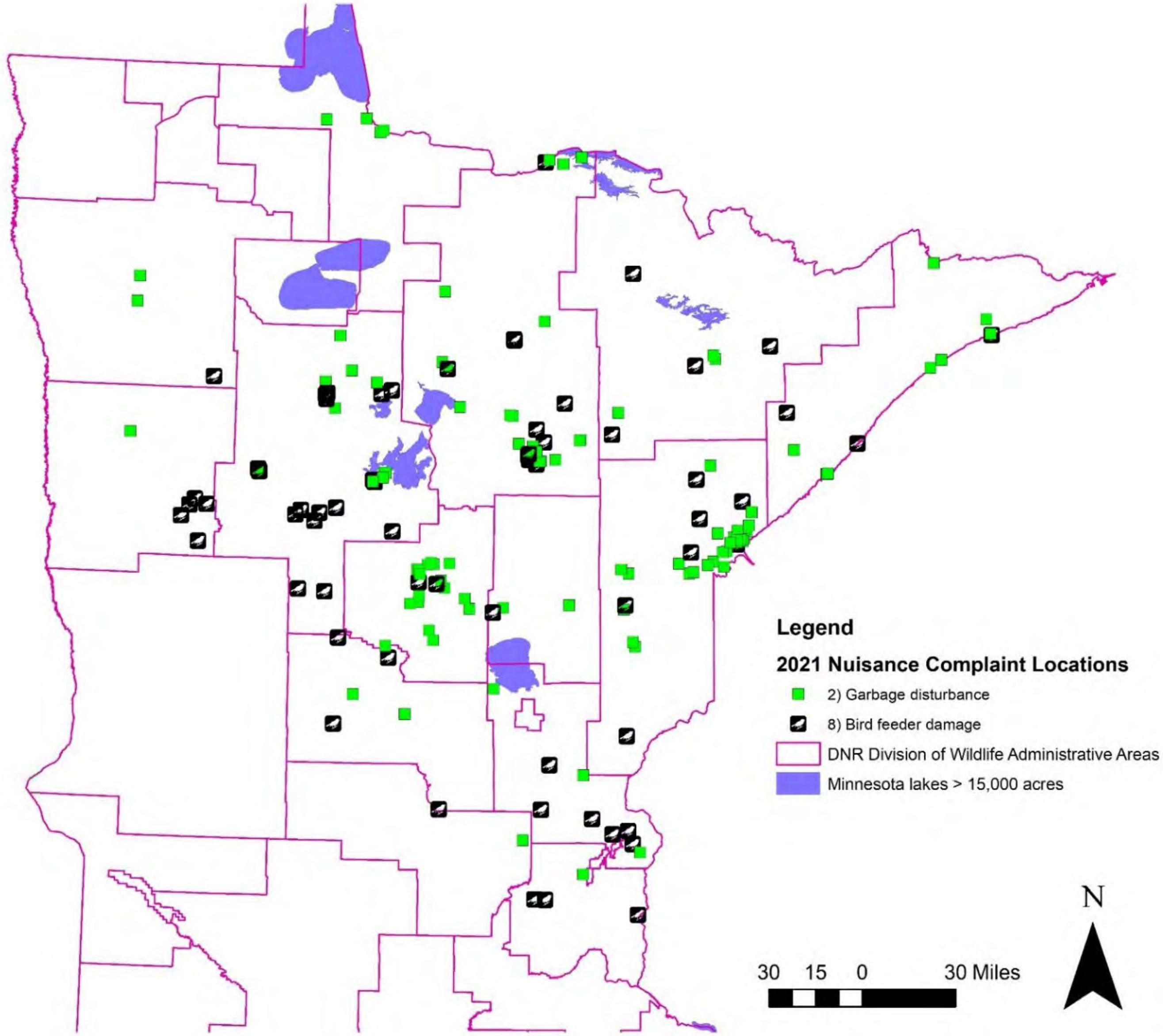


Figure 9. Spatial distribution of nuisance bear complaints involving attraction to garbage or birdfeeders in 2021.

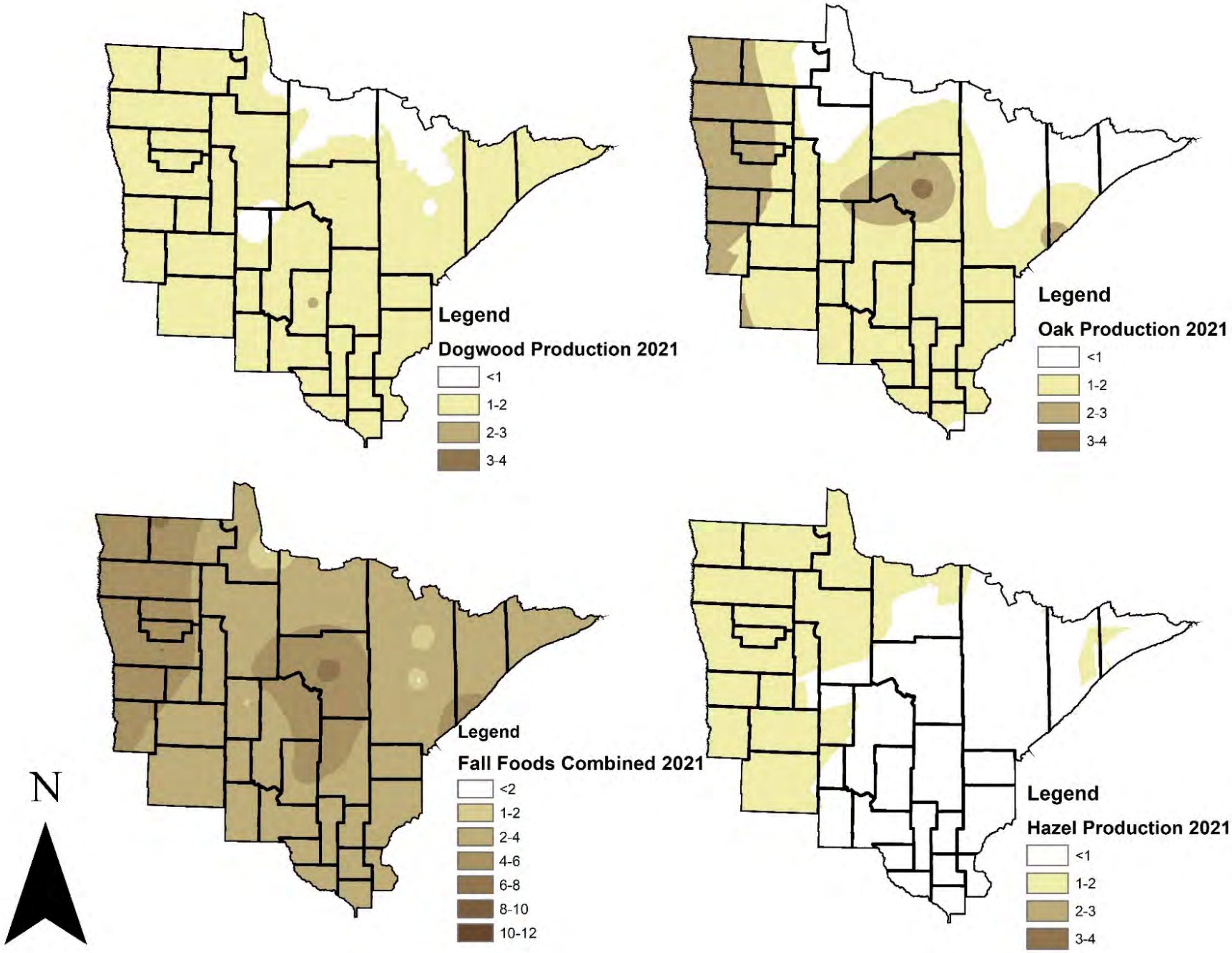


Figure 10. Production of fall bear foods (dogwood, oak, hazel) across Minnesota, 2021.

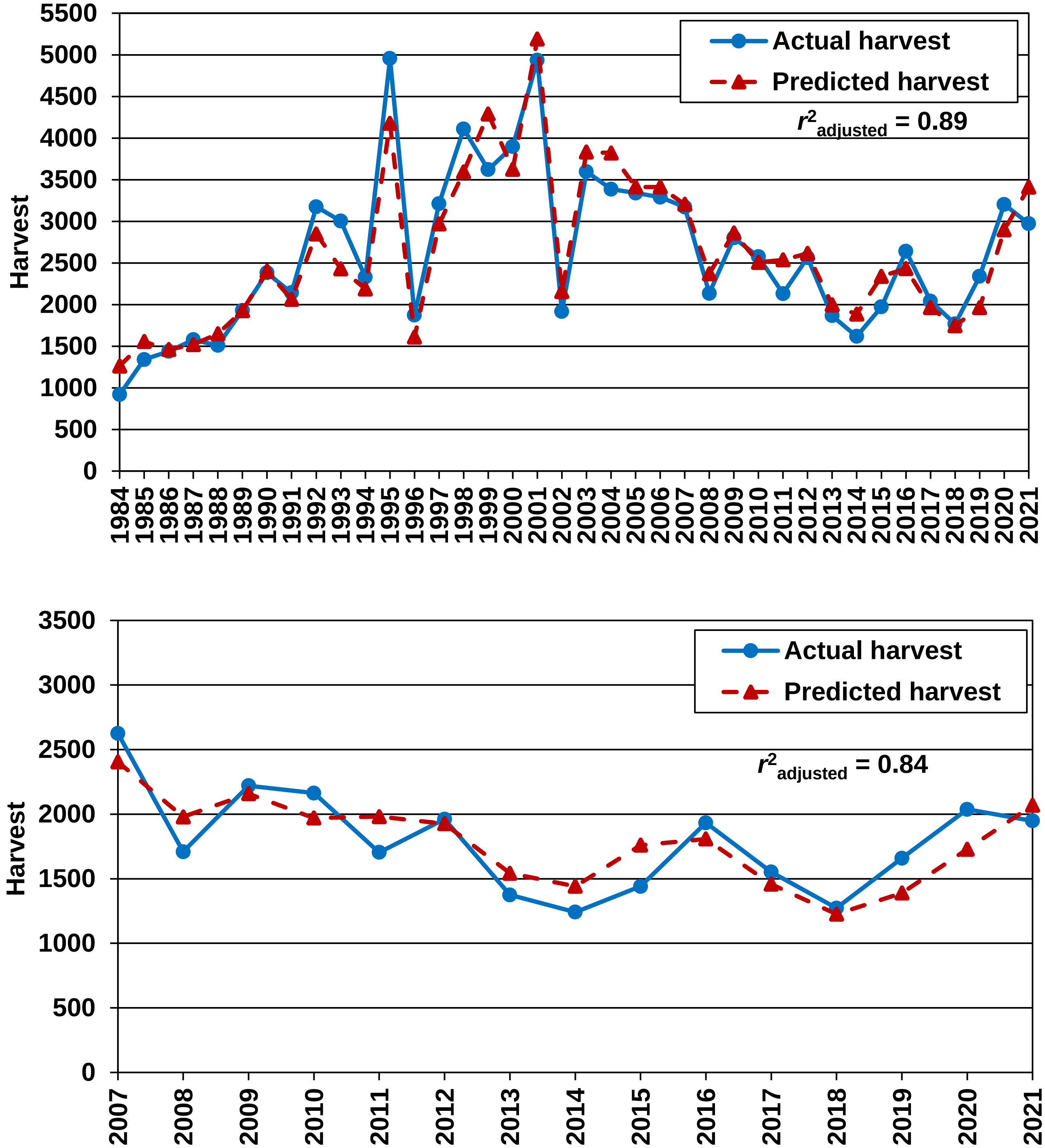


Figure 11. Number of bears harvested vs. number predicted to be harvested based on number of hunters and fall food production — top panel: statewide 1984–2021; bottom panel: quota zone only (including area 451 hunters and harvest), most recent 15 years. Regression for both datasets included an interaction term between food and hunters to better predict the drastic changes in harvest when fall foods were extremely high or low.

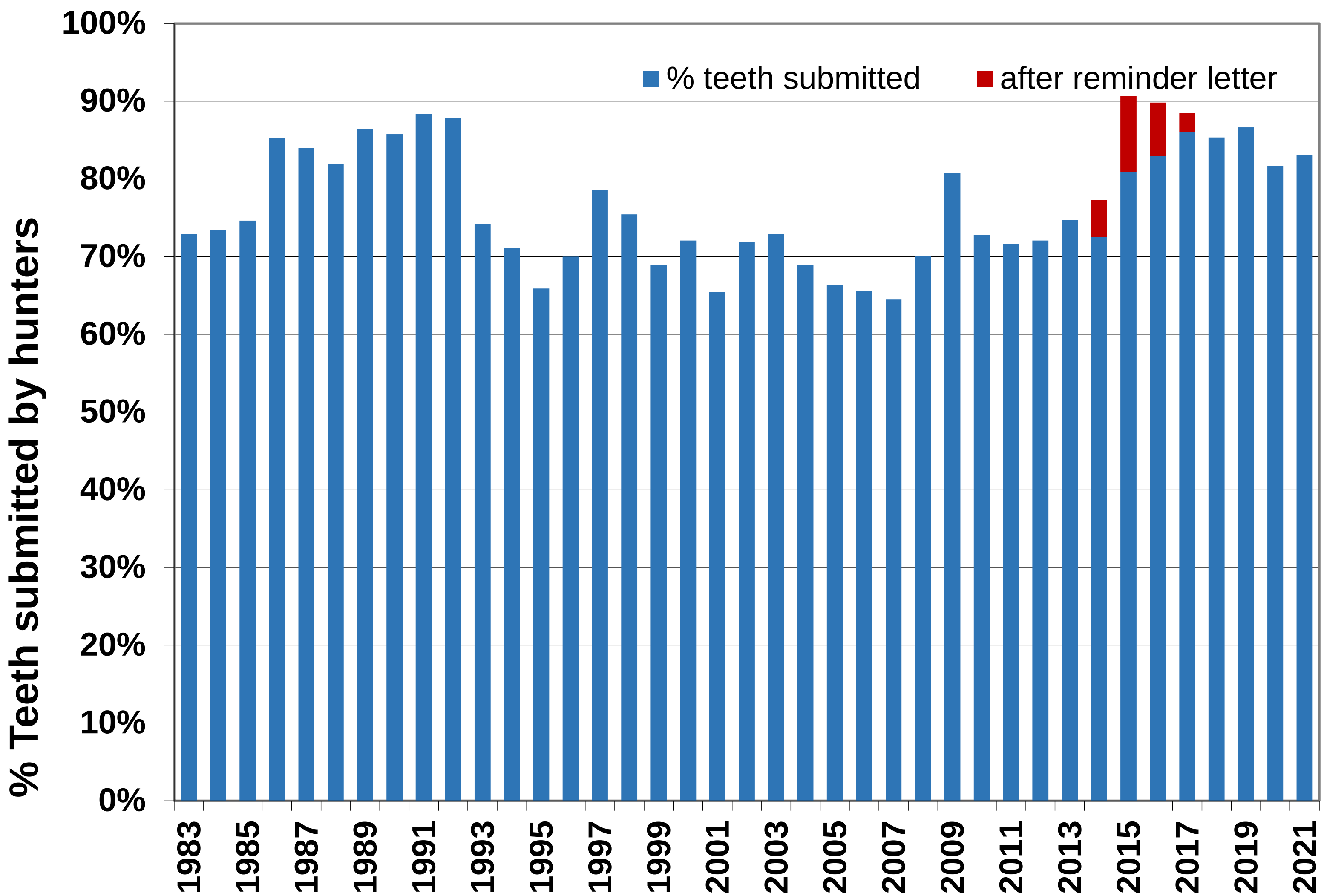


Figure 12. Percent of hunters submitting useable bear teeth for aging (vital for population monitoring. Cooperation levels exceeded 80% when registration stations were paid to extract teeth (this practice ended in 1993), and in recent years after a series of reminder letters (no letter was sent after 2017).

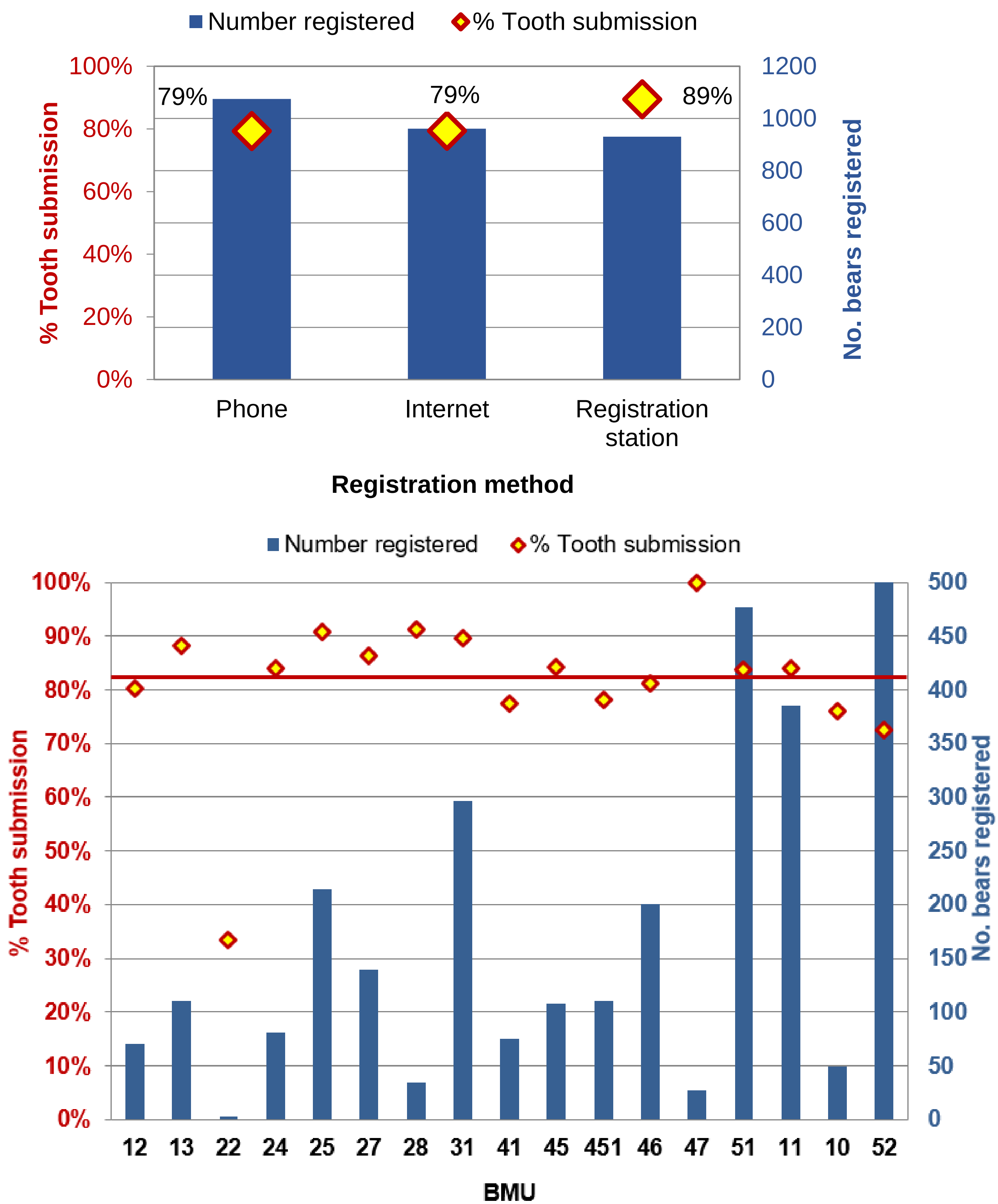


Figure 13. Percent of hunters who submitted a bear tooth in 2021 by method of registration (top panel) and by BMU (bottom panel). Beginning in 2013, hunters could register their bear by phone or internet, as well as in person at a station. The 2021 statewide submission average (83%) was above the long-term average (76%).

Table 1. Number of nuisance bear complaints registered by Wildlife Managers and Conservation Officers during April–October during 2002–2021, including number of nuisance bears killed and translocated, and bears killed in vehicular collisions.

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017 [j]	2018 [j]	2019 [j]	2020 [j]	2021 [j]
Number of personnel participating in survey [a]	50	39	34	42	46	46	37	51	40	34	56	63	64	61	55	86 (51,35)	78 (56,23)	126 (60,66)	112 (70,42)	94 (36,58)
Complaints examined on site	75	81	75	61	57	63	59	65	70	37	113	69	79	97	118	71 (22,49)	40 (21,19)	82 (37,45)	87 (3,84)	81 (6,75)
Complaints handled by phone [b]	550	424	507	451	426	380	452	535	514	396	722	623	570	840	780	644 (450,194)	438 (369,69)	736 (599,137)	784 (591,193)	593 (450,143)
Total complaints received [o]	625	505	582	512	483	443	511	600	584	433	835	692	649	937	898	715	478	818	871	674
• % Handled by phone	88	84	87	88	88	86	88	89	88	91	86	90	88	90	87	90	92	90	90	88
• Calls handled by the information center [n]																			281	364
Bears killed by:																				
• Private party or DNR	12	13	25	28	11	21	22	23	22	9 [k]	16	24	26	45	53	22 (4,18)	9 [k] (4,5)	45 (5,40)	42 (3,39)	36 (3,33)
• Hunter before season [c]																				
– from nuisance survey	0	3	3	6	2	18	3	4	3	3	11	0	0	1	13	1	2	0	20	4
– from registration file	11	8	4	13	6	25	5	15	10	5	12	0	1	4	6	3	11	5	34	24
• Hunter during/after season [d]	0	0	0	1	0	0	0	0	0	0	0	1	0	1	1	1	0	0	3	23
• Hunter by Area 88 license [e]																1		3 [m]	40 [m]	45 [m]
• Permittee [f]	4	6	1	5	4	5	1	3	5	0	0	1	0	3	0	0	1	2	5	2
Bears translocated [g]	3	1	3	3	3	1	3	2	2	2	0	3	2	0	0	0	0	0	3	2
Bears killed by cars [h]	26	25	16	22	18	20	27	18	28	15	33	32	28	47 [h]	27	9 (0,9) [h]	25 (15,10) [h]	16 (11,5) [h]	25 (23, 2) [h]	15 (10,5)

[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 Wildlife Managers only recorded actual complaints (not zero complaints), generally at the time the complaint was received. Since then, 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. Beginning July 2019, COs recorded complaints electronically and individually (as they occurred), similar to Wildlife Managers (but using a different recording system).

[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. In 2021, data included all validation letter information in this total.

[e] In 2017, hunters could choose Area 88 in the quota lottery, and if drawn, could hunt for a nuisance bear, if authorized. In 2021, Area 88 was only a designation for hunters willing to take a nuisance bear in the quota area on a no-quota license, if so authorized; 41 hunters used the Area 88 designation. Only 23 of these hunters were authorized to do so. Other hunters were authorized to take a nuisance bear on a validated license (96 in total).

[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 14 bears have been killed by permittees since 2011. In 2020, 13 permits were issued but only 5 bears killed.

[g] According to DNR nuisance policy, trapped nuisance bears should not be translocated. In these cases, translocations were reports of orphaned cubs or animal welfare cases.

[h] Car kill data were reported on the monthly nuisance form beginning 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, and in 2018 there were just 2. In 2017, the electronic system used by managers did not allow for recording of car kills. In 2018, an effort was made to increase car-kill reporting by managers, which was further increased in 2019 by adding a distinct coding for non-confiscated car kills that were either observed or reported by the public.

[j] 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). Beginning in 2019, COs also used an electronic app to record bear complaints (but a different app than wildlife). Because the 2 survey tools are not exactly the same, data are presented separately for each in parenthesis (Wildlife Managers, COs). For consistency, only April–October data are included (in 2017 managers recorded 10 calls in other months, in 2018 14 calls were in other months, in 2019 16 calls were in other months, in 2020 21 calls were in other months, in 2021, 17 calls were in other months). For the wildlife manager data, anytime a WCIL row was entered, it is considered an independent complaint, so there are some duplicates when there were repeat issues at the same.

[k] Lowest number of nuisance bears were killed in 2011 and 2018, since recording began in 1982.

[m] 96 hunters were authorized to take nuisance bears in the quota area in 2021, of which 45 (47%) were successful. Data are from the registration files only until 2020. After which, it was cross-validated with validation letters. 41 hunters bought area 88 licenses, only 25 had matching validation letters. 39 hunters were authorized in the quota area, the remainder of the 96 were in the no-quota or BMU 451.

[n] Although it is unknown when this started, the information center at Central Office has been fielding bear nuisance calls. We started to record these data in 2020. To date, some calls (~40%) are forwarded on to wildlife managers or conservation officers, but the rest are handled by the information center.

Table 2. Regional bear food indices[a] in Minnesota's bear range, 1984–2021. Shaded blocks indicate particularly low (<50; pink) or high (≥70; green) values.

	Survey Area					
Year	NW	NC	NE	WC	EC	Rangewide
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	62.7	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	67.3	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	61.4	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	47.2	56.3	44.8	57.2	46.5	50.7
2016	79.5	64.3	75.8	64.4	60.6	70.3
2017	67.1	57.5	56.2	70.6	73.9	61.3
2018	72.6	82.4	101.8[b]	71.5	88.3[b]	83.9[b]
2019	68.8	60.9	64.4	59.8	65.1	63.9
2020	65.3	42.1	47.5	51.7	51.9	53.0
2021	28.8	38.0	34.7	32.0	42.1	35.2

[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).

[b] Record high food rating in NE and EC regions, and second-highest statewide.

Table 3. Regional mean index values[a] for bear food species in 2021 compared to the previous 36-year mean (1984-2020) 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	
	36yr mean	2021 (*n* = 11[b])	36yr mean	2021 (*n* = 4)	36yr mean	2021 (*n* = 8)	36yr mean	2021 (*n* = 10)	36yr mean	2021 (*n* = 6)	36yr mean	2021 (*n* = 35)
SUMMER												
Sarsaparilla	4.7	3.0	5.8	5.8	5.3	2.4	4.5	2.0	5.2	3.5	5.0	3.4
Pincherry	3.4	1.2	4.4	2.0	4.3	2.4	3.8	1.6	3.7	2.5	3.9	1.7
Chokecherry	5.9	2.6	5.4	2.0	4.6	2.7	5.4	2.5	4.7	3.0	5.3	2.4
Juneberry	5.2	2.1	4.8	1.0	5.0	1.3	3.7	1.5	4.0	1.0	4.5	1.6
Elderberry	1.6	1.5	2.9	0.5	3.6	3.0	3.0	2.0	3.2	3.0	2.9	2.0
Blueberry	5.2	0.4	5.4	2.3	5.0	2.3	3.7	0.3	3.9	2.0	4.5	1.3
Raspberry	6.5	2.3	7.8	8.0	7.9	4.7	7.1	4.9	7.0	3.7	7.1	4.4
Blackberry	1.3	0.4	2.3	2.0	1.2	0.7	3.6	2.8	4.4	4.0	2.9	2.6
FALL												
Wild Plum	2.4	2.4	1.9	0.3	1.4	0.4	2.7	0.5	2.4	0.8	2.3	1.1
HB Cranberry	5.2	2.1	4.4	2.0	3.9	3.8	3.7	1.8	3.8	3.0	4.1	2.5
Dogwood	6.2	3.1	5.6	4.5	4.9	3.2	5.9	4.1	5.8	5.6	5.7	4.1
Oak	3.5	4.0	3.2	2.3	2.0	1.5	5.9	4.4	5.7	3.2	4.5	3.5
Mountain Ash	1.6	0.2	2.6	2.0	4.7	3.4	1.8	1.0	2.4	3.0	2.7	1.6
Hazel	6.4	3.4	7.4	3.5	6.9	2.8	7.8	2.7	7.5	3.8	7.2	3.1
TOTAL[d]	59.1	28.8	63.9	38.0	60.9	34.7	62.5	32.0	63.8	42.1	62.7	35.2

[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.

[d] Because of rounding error, these totals may be slightly different than the sum of adding down the columns.

Table 4. Regional productivity index[a] for important fall bear foods (oak + hazel + dogwood), 1984–2021. Particularly low (≤ 5.0; yellow) or high (≥8.0; tan) values are shaded.

	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	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	8.2	3.7[b]	5.6
2016	5.7	5.2	6.0	5.4	5.2	5.3
2017	6.8	5.6	5.1	7.4	7.1	6.5
2018	5.8	6.1	7.7	8.3	8.4	7.2
2019	6.2	7.1	6.6	6.5	7.1	6.7
2020	5.8	5.4	5.1	5.4	5.4	5.5
2021	3.8	4.3	3.3[b]	4.2[b]	4.4	4.2[b]

[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.

2022 MINNESOTA RUFFED GROUSE BROOD SURVEY

Charlotte Roy, Forest Wildlife Populations and Research Group

SUMMARY OF FINDINGS

The Minnesota DNR launched a new ruffed grouse (*Bonasa umbellus*) brood survey during summer 2019, with 2022 being its fourth year. Staff and cooperators kept a log of time spent in the forest and any grouse observations while on foot or while driving. In 2022, 52 observers submitted data for time spent afield and grouse observed during June, July, and August, which is a 21% increase in participation from last year. The total number of grouse observed was 948, including 251 adults, 635 chicks, and 62 grouse of unknown age. Participants reported observing 74 broods during 1979 hrs on foot in the forest and 141 broods during 1988 hrs driving in the forest. The annual brood indices were 3.7 broods/100 person-hrs on foot (95% confidence interval [CI]: 0.0–14.9) and 7.1 broods/100 person-hrs driving (95% CI: 0.0–23.1) in 2022, which was similar to last year (4.2 broods/100 person-hrs on foot (95% confidence interval [CI]: 0–25.9) and 9.0 broods/100 person-hrs driving (95% CI: 0–23.5). A peak in brood observations occurred in early July this year, which is later than the usual peak in hatching during late June, likely due to the cold, wet spring in much of the forested part of Minnesota this year. The number of adult grouse with broods increased from 62.6% in June, to 68.8% in July, and remained steady in August at 71.6%, consistent with strong brood survival after a later nesting effort. The number of chicks (mean ± SE) in broods where chick counts were attempted was 5.7 ± 0.6 in June (n = 32), 5.0 ± 0.6 in July (n = 46), and 4.1 ± 0.5 in August (n = 46). Brood sizes in August 2022 were similar to last year (5.0 ± 0.5 in June (n = 38), 3.7 ± 0.3 in July (n = 45), and 3.9 ± 0.4 in August (n = 54)). This pattern of declining brood size throughout the summer is consistent with chick losses due to various sources of mortality. Counties with the most brood observations per unit of survey effort included Cook, Hubbard, Itasca, Lake, and St. Louis. Further interpretation of the observed patterns will be dependent on future data collection to determine production over several years and relationships to harvest statistics. Thus far, mean ruffed grouse harvest per active hunter reported by hunters has ranged 3.5-3.7 during 2019-2021. I will continue to recruit observers in upcoming years because increased participation will allow more robust data collection and interpretation.

INTRODUCTION

The Minnesota DNR coordinates a multi-agency spring drumming survey to monitor ruffed grouse (*Bonasa umbellus*) breeding populations. However, drumming surveys are conducted 4 months before hunting season begins and do not reflect production of young over the summer, which is an important component of the number of birds that hunters see each fall. Juvenile birds (i.e., <6 months old) typically comprise the majority of birds harvested (Dorney and Kabat 1960, Dorney 1963). In a recent West Nile virus study involving hunter-submitted grouse, juveniles comprised 64% and 71% of submitted samples in Minnesota during 2018 and 2019, respectively (Roy et al. 2020). Therefore, hunter experiences may be negatively impacted by lower production and the smaller resulting harvestable surplus. Production of young is influenced not only by weather conditions (Bump et al. 1947, Dorney and Kabat 1960), but also may be influenced by numerous other factors (e.g., disease, parasites, food availability, predators, Hewitt et al. 2001).

Between 1949 and 2005, ruffed grouse harvest in Minnesota was strongly related to the statewide drumming survey index (r = 0.77, Figure 1). Similar patterns between statewide drumming survey indices and hunting success were also documented in Michigan, Ohio, and New York (Ammann and Ryel 1963; r = 0.90 in Ohio, Stoll 1980; New York Department of Environmental Conservation 2018). Thus, hunters came to rely on the drumming survey as an indication of the upcoming season. However, since 2005 this relationship has weakened considerably in Minnesota (r = 0.35, Figure 1), which is likely influenced, in part, by reductions in hunter numbers from a high of 161,600 in 1989, to as low as 57,284 in 2021 (Davros 2022). Hunter numbers used to peak with peaks in the drumming cycle, but that has not been the case for the last two cycles.

Another possible contributor to the weakening relationship between the drumming survey data and harvest is that summer production of young might have declined, despite an otherwise robust breeding population that is cycling around a stable 30-year average. Lower production would not be reflected in the drumming survey data of the same year because the drumming survey is conducted in the spring before nests hatch. Furthermore, lower production may not be reflected in the drumming survey the following year if hunting is compensatory, although hunters might see and harvest fewer birds in the fall during years of low production. Lower production would be expected to become discernable in the drumming survey data if hunting became a source of additive mortality, although this is not currently supported by the available data.

The DNR needs better information on brood production to bridge the gap between the drumming survey, which is conducted in April and May, and the time when most ruffed grouse hunters go afield in September and October. Such information may help improve the ability to forecast the hunting season and may also improve our understanding of the causal mechanisms behind the changing pattern between the drumming survey and fall harvest period. Thus, the DNR launched a new passive brood survey in 2019, which was modeled after similar efforts in Pennsylvania that have been conducted since 1981 and for which survey data exhibit a strong relationship to fall flush rates. In Pennsylvania, a strong relationship between grouse observed per day and hunter flushes per hour existed during 1981–2001 (r = 0.75), and this data informed predictions of “above average,” “average,” or “below average” fall harvests (pers. comm., L. Williams, Pennsylvania Game Commission). Since 2002, the relationship between grouse observed per day and hunter flushes weakened slightly (r = 0.65, pers. comm., L. Williams, Pennsylvania Game Commission), but is still much stronger than the recent relationship between the drumming survey data and total harvest in Minnesota.

METHODS

I asked cooperators on the ruffed grouse drumming survey, private and county foresters, and DNR Forestry, DNR Wildlife, and DNR Ecological and Water Resources staff in forested regions to keep a record of the number of broods encountered each hour afield during June, July, and August. Each observer reported hours afield on foot separately from hours driving each day in the forest (to account for partial days afield), county, the number of grouse broods seen, brood size, and the total number of adult grouse seen, as well as broods of other species observed (e.g., woodcock, turkey, spruce grouse). Observations were conducted while doing other planned field work, so did not incur additional cost or substantial time beyond recording daily observations (or lack thereof), which was reported to take ~1 min per observer per day.

I summarized the total number of broods and total number of grouse observed each day, as well as the broods/hr in a catch-per-unit-effort type of approach, where effort was defined by total observer hours in the field (e.g., broods/100 person-hrs afield). People working alongside each other in the field reported observations for 1 observer. This allowed distinction between changes in numbers of birds due to changes in time spent afield vs changes in numbers of birds due to actual changes in the number of birds. I also expected changes in the number of birds observed each month to be influenced by changes in the behavior of young birds as they mature, but assumed birds would behave similarly among years, whereas sources of mortality may vary considerably among years. If these assumptions are true, then this survey should allow meaningful comparisons of brood numbers among years.

RESULTS & DISCUSSION

Cooperators from 1854 Treaty Authority (7), Leech Lake Band of Ojibwe (1), Red Lake Nation (3), Fond du Lac Reservation (1), Superior National Forest (3), Chippewa National Forest (3), county foresters (2), private foresters (2), a Bemidji State University student (1), DNR Ecological and Water Resources staff (1), DNR Forestry staff (5), DNR Fisheries staff (1), and DNR Wildlife staff and volunteers (21) submitted data in 2022. Observations occurred while doing other work between 1 June and 31 August for a total of 1979 hrs on foot and 1988 hrs driving in the forest. Reported time afield was 672, 654, 653 hrs on foot in June, July, and August, and 631, 683, and 674 hrs driving in the forest during June, July, and August, respectively. Consistent participation assists with interpretation of patterns over time.

Observers recorded 215 ruffed grouse broods and 96 broods of other species while working in the forest, including 60 turkey broods, 6 woodcock broods, and infrequent sightings of broods of numerous other species. The total number of grouse observed was 948, including 251 adults, 635 chicks that could be counted, and 62 grouse of unknown age (i.e., a mix of juveniles and adults). Most of the grouse reported to be of unknown age were reported in August, when it is more difficult to discern adults from chicks. The total number of grouse observed, including adult grouse, chicks, and grouse of unknown age, was less related to survey effort over time this year, perhaps reflecting more consistent survey effort than in previous years (Figure 2).

The brood index (broods/100 person-hrs afield) adjusts for changes in survey effort and is more appropriate for comparison of brood numbers among years than brood counts that do not take survey effort into consideration. The annual index during 2022 was 3.7 broods/100 person-hrs on foot (95% confidence interval [CI]: 0–14.9, Table 1) and was 7.1 broods/100 person-hrs driving (95% CI: 0–23.1), which is similar to 2021. Looking at weekly and monthly patterns in brood metrics provides additional insights. The weekly brood index rose markedly in early July (Figure 3), after the usual peak in hatching at this latitude (mid-June, Maxson 1978, Larson et al. 2003). A drop in the weekly brood index was evident shortly thereafter, when mortality of ruffed grouse chicks is highest (Larson et al. 2001). Broods/100 hrs effort in August was similar this year compared to last year, but a higher proportion of adults had broods this August than last year (Tables 1 and 2). While one might expect a decline in monthly brood indices over time as chicks are lost to various mortality factors, chicks are more detectable as they mature (Godfrey 1975), which offsets the actual loss of chicks and broods throughout the summer to some degree. The number of adults reported with broods increased with hatch from 62.6% in June to 68.8% in July but did not decline in August (71.6%, Table 1).

The number of chicks (mean $\pm$ SE) per brood, when counted, was 5.7 $\pm$ 0.6 in June (n = 32), 5.0 $\pm$ 0.6 in July (n = 46), and 4.1 $\pm$ 0.5 (n = 46) in August. The decline in this metric over time is consistent with chick mortality and partial brood loss during summer. The chick counts were lower than brood sizes reported for July (7.3 and 8.1) and August (6.2 and 6.8) in Alberta over 50 years ago (Rusch and Keith 1971) and also by Dorney and Kabat (1960) for Wisconsin (7.4 and 7.9 in July, 6.8 and 7.9 in August). However, these counts are consistent with a previous study of a radio-marked brood of 9.0 known chicks per encounter in Minnesota that averaged 4.7 chicks observed per encounter (Godfrey 1975). Chick counts are known to underestimate the actual number of chicks and are considered very unreliable for young broods with many chicks that hide quickly because the degree of undercounting varies with many factors (Godfrey

1975, Larson et al. 2001). Moreover, observers in this brood survey were counting chicks while performing other duties, which may have produced lower counts than those of observers focused primarily on obtaining accurate counts, and potentially dedicating more time to search for chicks. Nevertheless, participants in this survey will likely have similar competing demands on their time among years, so comparisons among years of this survey are more likely to be tenable. Future data collection will be helpful to see how brood counts vary among years in Minnesota and whether they can be informative.

The brood index was highest in the northeastern forested counties this year, with the exception of Hubbard county which is located in west-central MN. Hubbard, Cook, Itasca, Lake, and St. Louis counties had the most brood observations of those counties with ≥100 hrs of reported time afield (on foot and driving combined). Other counties with ≥100 hrs of reported time afield included Becker, Beltrami, Carlton, Cass, Crow Wing, and Koochiching counties, but fewer brood observations per unit effort were reported in these counties. All other counties had ≤100 hrs of observations submitted.

Interpretation of the observed patterns as “above average,” “average,” or “below average” will require additional years of data collection to determine an average. I will continue to reach out to potential observers to increase participation in the survey next year to allow for more robust data comparisons among years. Strong participation is imperative to produce useful information, because variability in brood counts among years is likely to be caused by many factors and extracting meaningful patterns will require that sample sizes are sufficient to detect a meaningful signal from among the variability.

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Table 1. Ruffed grouse brood observation metrics in Minnesota during 2019–2022 and harvest metrics for the fall hunting seasons the same year.

	Prop. adults with broods			Brood size (Mean ± SE)			Harvest/ hunter[3]
Timeframe	Jun	Jul	Aug	Jun	Jul	Aug	Sep-Jan
2019[1]	66.7	58.6	0.00[1]	4.1 ± 0.9	4.7 ± 0.7	4.0 ± 2.1	3.7
2020	63.6	51.8	43.5	5.5 ± 0.7	4.0 ± 0.4	3.7 ± 0.4	3.5
2021	60.7	77.4	70.1	5.0 ± 0.5	3.7 ± 0.3	3.9 ± 0.4	3.6
2022	62.6	68.8	71.6	5.7 ± 0.6	5.0 ± 0.6	4.1 ± 0.5	

[1] Effort was low the first year of the survey with only 7 adults without broods observed Aug 2019.

[2]Broods observed while driving were not included in the survey during the first year but were added in 2020.

[3]Harvest metrics are from Davros (2022).

Table 2. Ruffed grouse brood indices in Minnesota by month during 2019-2022.

	Broods/100 hrs on foot				Broods/100 hrs driving[1]			
Timeframe	Jun	Jul	Aug	Summer	Jun	Jul	Aug	Summer
2019[1]	4.57	5.92	4.48	5.1	NA	NA	NA	NA
2020	3.35	3.35	3.34	3.4	3.46	5.99	5.80	5.3
2021	2.48	5.15	5.48	4.2	7.46	8.20	10.90	9.0
2022	3.57	2.60	5.06	3.7	6.02	9.37	5.79	7.1

[1]Records of observations of broods while driving were implemented beginning in 2020, so no data are available for 2019.

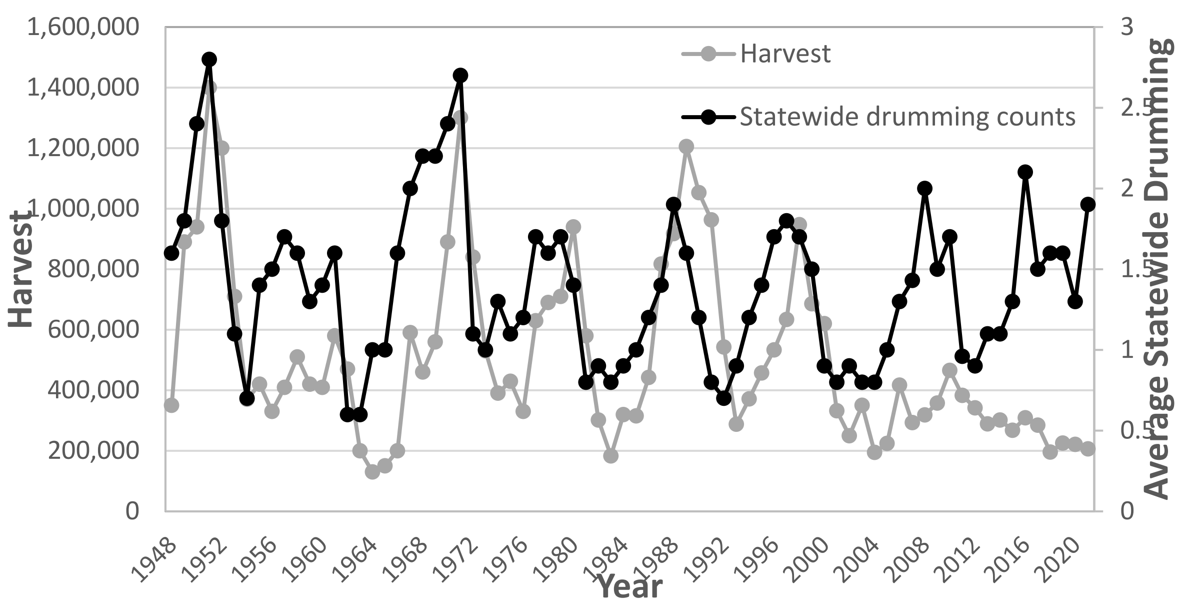

Figure 1. Comparison of average statewide ruffed grouse drumming survey data (Roy 2022) and data on harvest of ruffed grouse from the Small Game Hunter Harvest Survey (Davros 2022) in Minnesota during 1948–2022. The two metrics were correlated more strongly prior to the early 2000's.

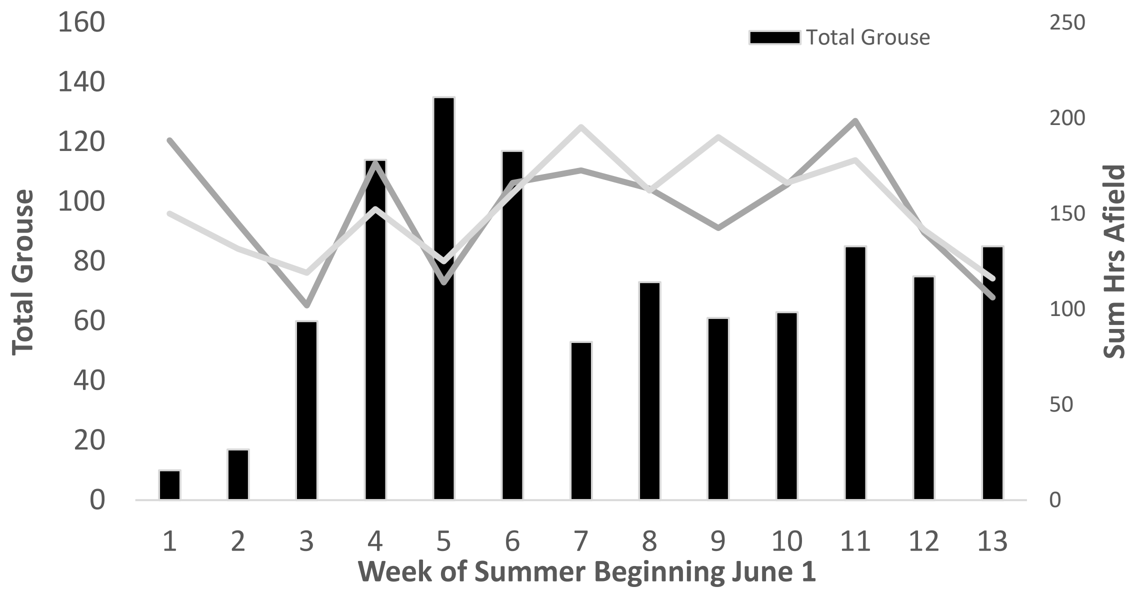

Figure 2. The chronology of ruffed grouse brood survey effort in the forest on foot and while driving and total number of grouse observed (young, adults, and birds of unknown age) by participating staff and cooperators during summer 2022 in Minnesota. Survey effort varied throughout the 13-week season.

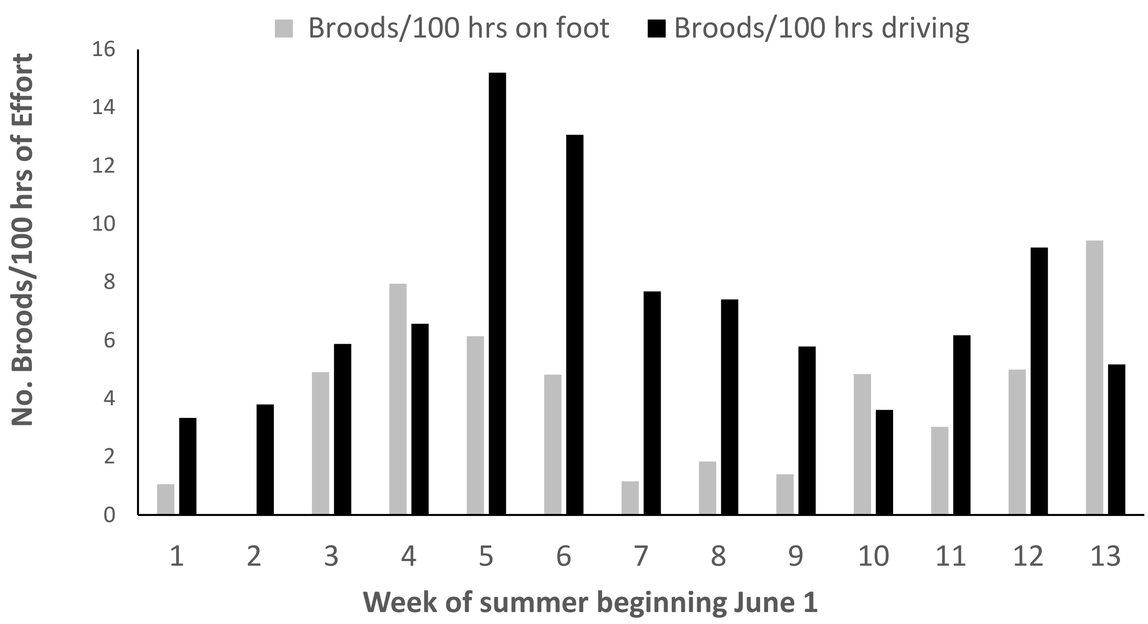

Figure 3. Ruffed grouse broods/100 person-hrs afield each week while either on foot or while driving in Minnesota during June, July, and August 2022. This index is adjusted for effort so that comparisons can be made among years in which time spent afield varies.

2022 MINNESOTA RUFFED GROUSE SURVEY

Charlotte Roy, Forest Wildlife Populations and Research Group

SUMMARY OF FINDINGS

The Minnesota DNR coordinates ruffed grouse (Bonasa umbellus) drumming surveys each spring with the help of wildlife staff and cooperating federal, tribal, and county biologists. Mean ruffed grouse drums per stop (dps) were 1.9 statewide (95% confidence interval = 1.7 – 2.2), which is unexpectedly up from 1.3 dps last year. Lower dps were expected because we are in the declining phase of the 10-year population cycle. However, spring and summer of 2021 were very hot and dry (i.e., extreme drought throughout much of northern Minnesota), which may have resulted in exceptional production of young because cold, wet weather adversely affects nests and chicks. This drought was followed by favorable snow roosting conditions throughout much of the core of ruffed grouse range during winter 2021–2022. Snow roosting provides thermoregulatory benefits, cover from predators, and may increase overwinter survival. These favorable environmental factors might explain the unexpectedly high spring drumming counts this spring. However, widespread flooding and numerous heavy rainfall events during May and June 2022 in the core of grouse range may reduce production of young birds this year, and potentially confound expectations for the fall hunting season.

INTRODUCTION

The ruffed grouse (*Bonasa umbellus*) is the most popular game bird in Minnesota, with an annual harvest of 200,000 – 500,000 birds. Ruffed grouse hunter numbers have been as high as 92,000 during the last decade, although hunter numbers did not peak with recent peaks in grouse numbers, as they have traditionally.

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 provide evidence that the ruffed grouse population cycles at approximately 10-year intervals. The spring survey data also correlated strongly with the fall harvest before the early 2000s, but in recent decades, this relationship has weakened.

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 then, staff and cooperators have conducted spring drumming counts 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.

METHODS

Observers conducted ruffed grouse surveys 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.

I engaged survey observers from among state, federal, tribal, private, and student biologists that had a professional background in wildlife science. Most observers had previously participated in the survey. I provided each observer a set of instructions and route location information, but did not provide formal survey training. I asked participants to conduct surveys at sunrise during peak drumming activity (in April or May) on days that had little wind and no precipitation. I provided guidance about the timing of the usual peak in drumming but allowed flexibility in timing to match the peak if it occurred outside the usual survey windows. 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.

I used the number of drums heard per stop (dps) as the survey index value. I determined the mean dps for each route, for each survey region (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 each Ecological Classification Section (ECS). 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 ECS sections in the Northeast region and the 7 ECS sections in the state. I used the geographic area of the section 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). I reduced the area used to weight drum index means for the MIM and PP sections to reflect the portion of these areas within ruffed grouse range (~50%) using subsection boundaries. I calculated a 95% confidence interval (CI) 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. I defined confidence interval boundaries as the 2.5th and 97.5th percentiles of bootstrap frequency distributions.

RESULTS & DISCUSSION

Observers from 14 cooperating organizations surveyed routes between 7 April and 24 May 2022. Many observers reported a later spring than usual and completed surveys when they believed the peak of drumming was occurring in their local area. Most routes (89%) were surveyed between 19 April and 18 May, with a median survey date of 5 May, which is similar to most years when the median survey date is close to May 3. Observers reported Excellent (64%), Good (31%), and Fair (5%) survey conditions for 114 routes reporting conditions.

Statewide counts of ruffed grouse drums averaged 1.9 dps (95% confidence interval = 1.7 – 2.2 dps) during 2022 (Figure 2). Drum counts were 2.0 (1.7 – 2.2) dps in the Northeast (n = 94 routes), 2.9 (2.0 – 3.8) dps in the Northwest (n = 8), 1.4 (0.6 – 2.3) dps in the Central Hardwoods (n = 11), and 1.0 (0.4 – 1.7) dps in the Southeast region (n = 8) (Figure 3a-d).

Statewide drum counts were up from last year, which was unexpected during the declining phase of the 10-year cycle, after the most recent peak in 2017. Peaks in the cycle occur on average every 10 years, but vary from 8 to 11 years apart (Figure 2). Many survey cooperators reported higher than expected counts this spring. Warm temperatures and drought conditions last spring and summer may have resulted in strong production of young birds last year (Bump et al. 1947, Dorney and Kabat 1960). Drought followed by winter conditions favorable for snow roosting in much of the core of ruffed grouse range may have increased overwinter survival (Thompson and Fritzell 1988), perhaps explaining the high counts this spring. However, May and June 2022 have been much wetter, with widespread flooding and numerous heavy rainfall events throughout much of northern Minnesota, which may adversely affect nest and chick survival in the core of the ruffed grouse range. If this is true, the high spring counts of 2022 may not translate into high fall grouse numbers. In recent years, the drumming survey has not been a reliable predictor of fall hunting experiences.

ACKNOWLEDGMENTS

The ruffed grouse survey was accomplished this year through the combined efforts of staff and volunteers at 1854 Treaty Authority; Agassiz National Wildlife Refuge (NWR); Blandin Paper; Beltrami and Cass County Land Departments; Chippewa National Forest (NF); Fond du Lac, Leech Lake, and Red Lake Reservations; Superior NF; Tamarac NWR; Vermilion Community College; White Earth Reservation; and DNR staff at Aitkin, Baudette, Bemidji, Brainerd, Cloquet, Crookston, Detroit Lakes, Fergus Falls, Grand Rapids, 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. G. Drotts, J. Erb, and R. Horton organized entry of 1982–2004 survey data, with D. Mailhot and another volunteer prior to 2013. J. Bates and N. Dotson entered 1979–1981 data in 2020; L. Spann entered 1972–1978 data in 2021; J. Hanrahan entered 1968–1971 data in 2022. M. Larson reviewed this report. This work was funded in part by the Federal Aid in Wildlife Restoration Act.

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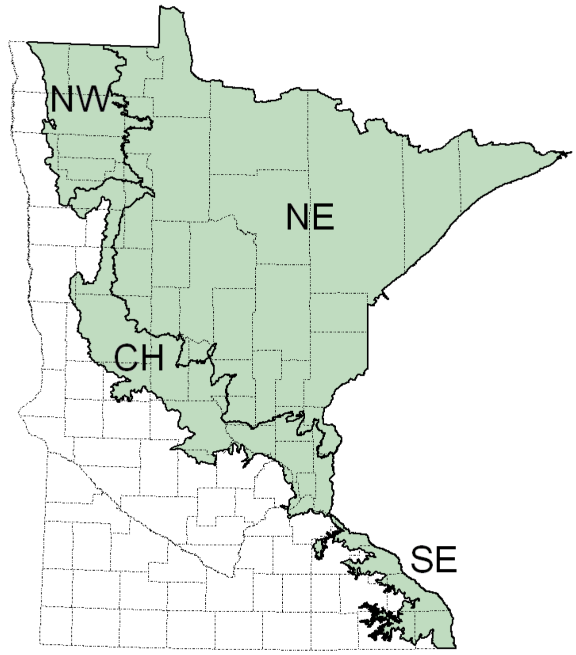


Figure 1. Survey regions for **ruffed grouse** in Minnesota. Northwest (NW), Northeast (NE), Central Hardwoods (CH), and Southeast (SE) survey regions are depicted relative to county boundaries (dashed lines) and influenced by the Ecological Classification System.

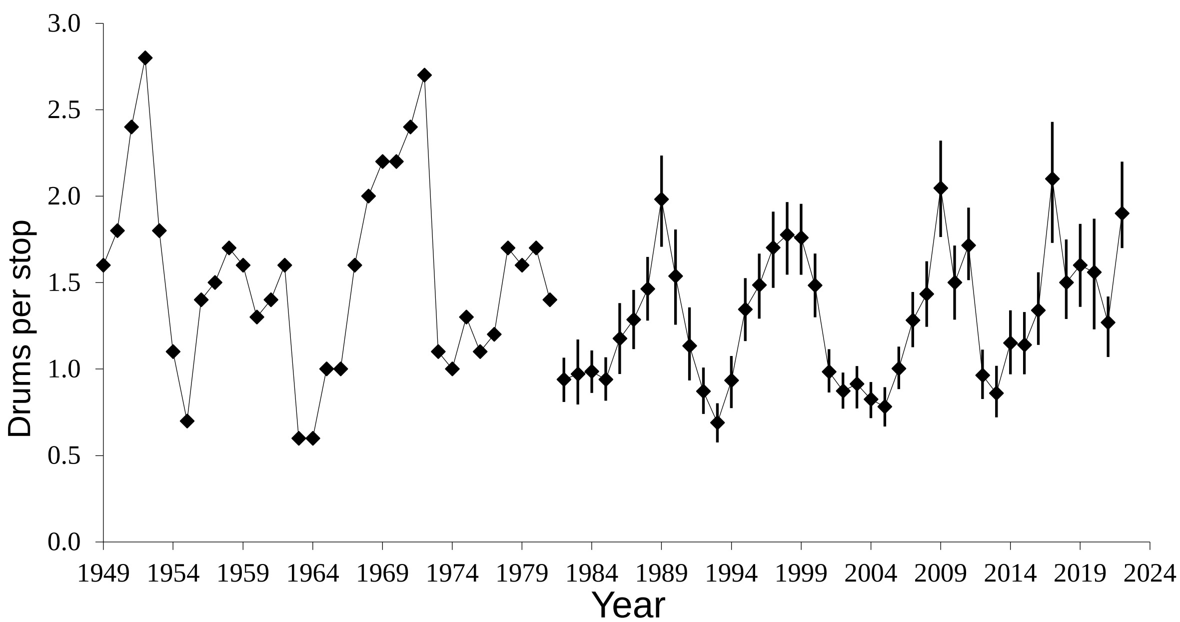
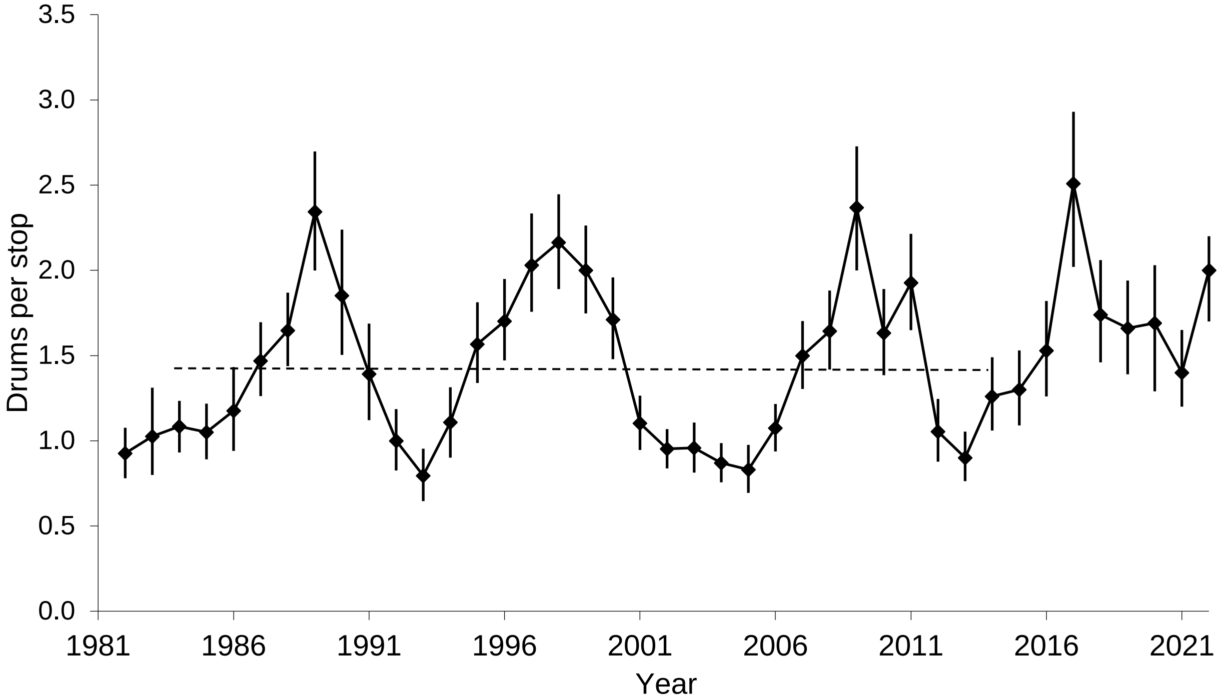


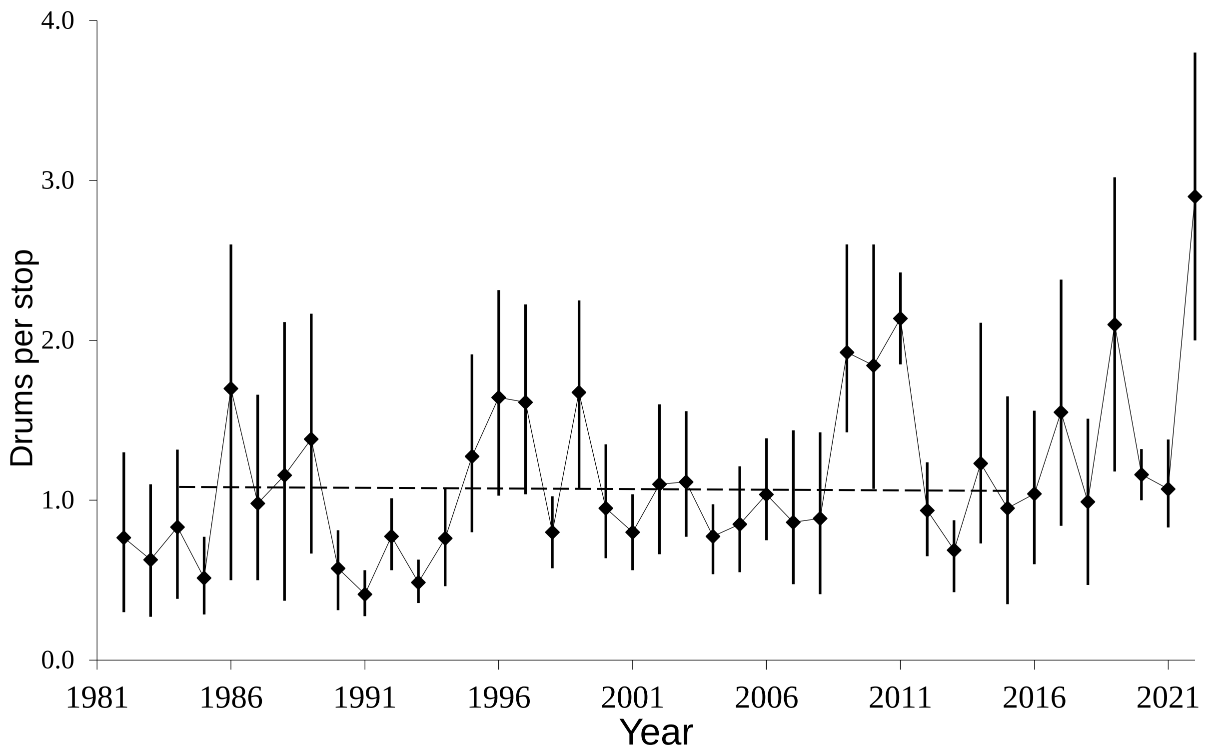
Figure 2. Statewide ruffed grouse population index values in Minnesota. Bootstrap (95%) confidence intervals (CI) are provided after 1981, but different analytical methods were used prior to this and thus CI are not available for earlier years. The difference between 1981 and 1982 is biological and not an artifact of the change in analysis methods.

a.



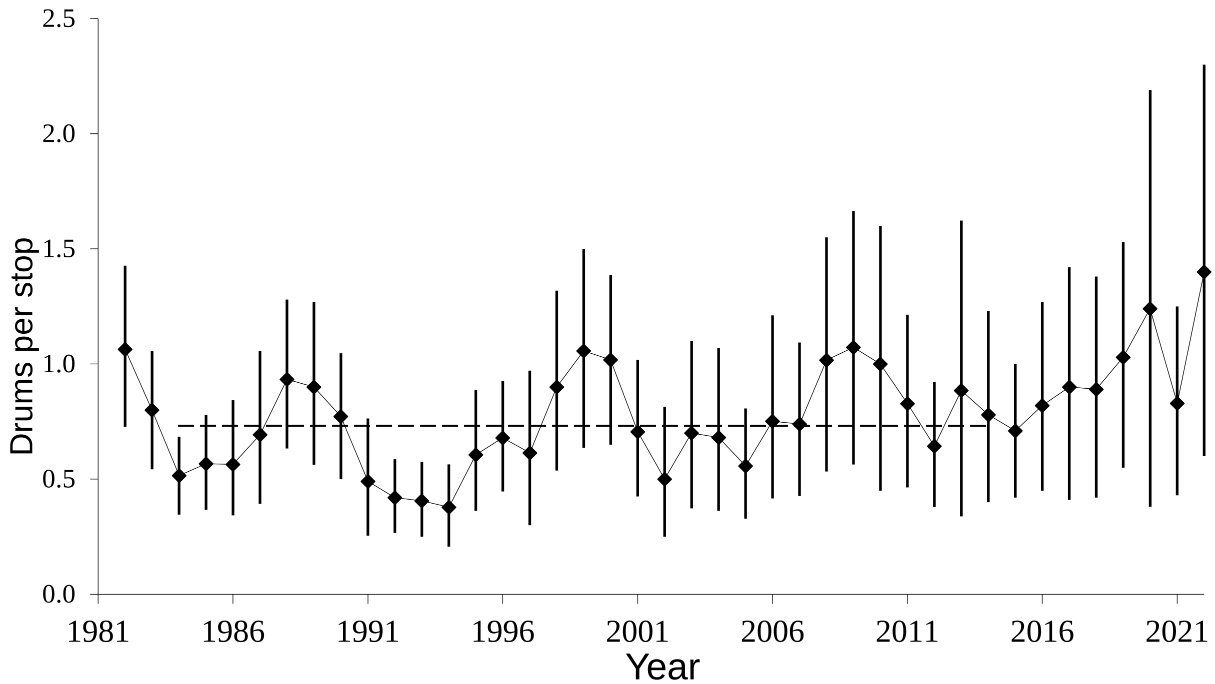
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Drums per stop
1981
1986
1991
1996
2001
2006
2011
2016
2021
Year

b.



4.0
3.0
2.0
1.0
0.0
Drums per stop
1981
1986
1991
1996
2001
2006
2011
2016
2021
Year

c.



d.

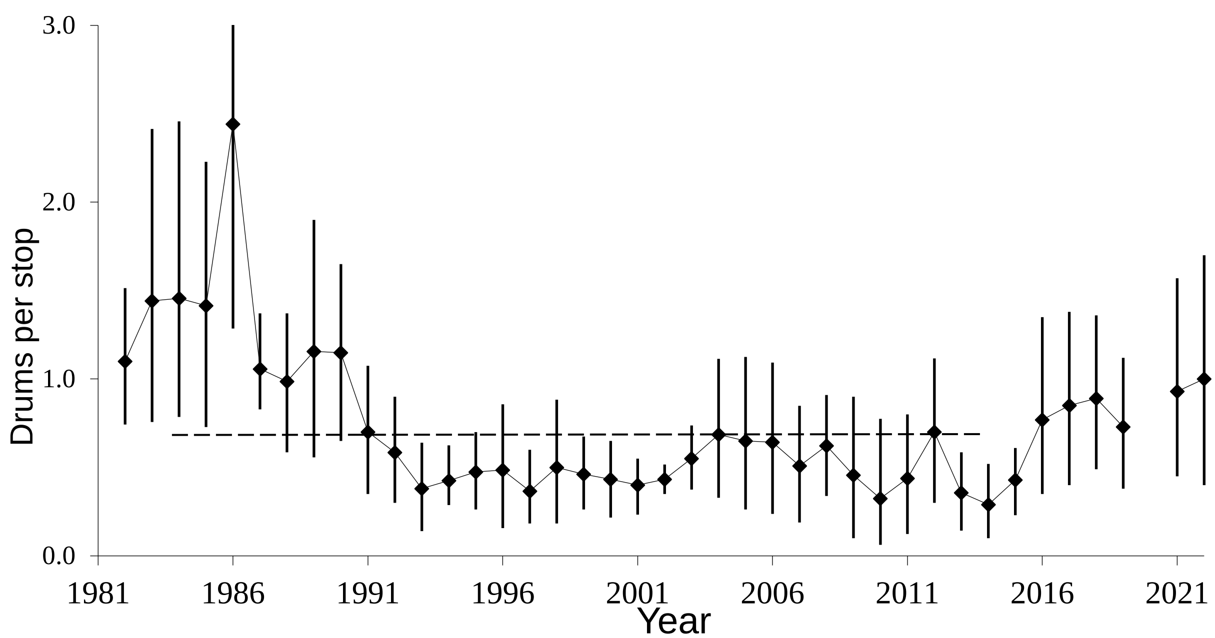


Figure 3a,b,c,d. Ruffed grouse population index values in the **Northeast** (a), **Northwest** (b), **Central Hardwoods** (c), and **Southeast** (d) survey regions of Minnesota. The mean for 1984-2014 is indicated by the dashed line. Bootstrap (95%) confidence intervals are provided for each mean. In the bottom panel, the CI for 1986 extends beyond area depicted in the figure. Data were not collected during the survey window in the Southeast during the COVID-19 pandemic in 2020.

2022 MINNESOTA SHARP-TAILED GROUSE SURVEY

Charlotte Roy, Minnesota Department of Natural Resources, Forest Wildlife Research Group

SUMMARY OF FINDINGS

The Minnesota DNR coordinates sharp-tailed grouse (*Tympanuchus phasianellus*) surveys each spring with the help of wildlife staff and cooperating biologists in the Northwest (NW) and East-Central (EC) survey regions. Sharp-tailed grouse surveys were conducted between 1 April and 11 May 2022, with 1,984 birds (males and birds of unknown sex) observed at 163 leks. Additionally, 6 birds were observed at 1 lek just south of the traditional NW survey region, and 22 birds were observed at 3 leks in southwestern Minnesota. The mean numbers of sharp-tailed grouse/lek were 9.8 (7.0 – 13.0) in the EC survey region, 12.5 (11.2 – 13.9) in the NW region, and 12.2 (11.0 – 13.4) statewide (EC and NW combined). Comparisons between leks observed in both 2021 and 2022 indicated similar numbers of birds/lek were observed in the NW region ($t = 1.50$, $P = 0.13$), more birds/lek in the EC region ($t = 2.3$, $P = 0.03$), and more birds/lek statewide ($t = 2.3$, $P = 0.03$). The increase in birds/lek in the EC region should be regarded cautiously, because only 21 leks were observed in 2022, which remains low compared to 30 leks in 2019 and 70 leks as recently as 2010. Such small populations are vulnerable to stochastic events like catastrophic storms, extreme flooding, and disease outbreaks.

INTRODUCTION

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.

The first surveys of sharp-tailed grouse in Minnesota occurred 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. Staff and cooperators conduct surveys in openland portions of the state where sharp-tailed grouse persist, although sharp-tailed grouse were formerly much more widely distributed in Minnesota at the early part of the 20th century. In recent years, sharp-tailed grouse have reportedly been expanding southward into the range of the Greater Prairie-chicken (*Tympanuchus cupido*) in western Minnesota but have been declining in the east-central part of the state.

Sharp-tailed grouse (*Tympanuchus phasianellus*) are popular among hunters. Annual harvest is 5,000 – 22,000 birds since the early-1990s, with 4,000 – 10,000 hunters in Minnesota. However, the hunting season was closed in the East-Central (EC) region beginning in 2021 due to concerns about the population decline in this region and challenges to implementing a hunting season with remaining leks concentrated primarily in the Aitkin Wildlife area.

METHODS

Wildlife staff and volunteers survey known sharp-tailed grouse lek locations in the Northwest (NW) and EC portions of the state (Figure 1) during the peak in lek attendance, which usually occurs in the latter half of April and the first week of May. The NW region consists of Lake Agassiz & Aspen Parklands, Northern Minnesota & Ontario Peatlands, and Red River Valley Ecological Classification Sections (ECS). The EC region consists 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 believe that they include most of the leks in their work area, with the exception of Aitkin and Tower work areas where workloads have not permitted 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 $\geq$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.

In 2022, the Minnesota Sharp-tailed Grouse Society (MSGS) led an independent citizen volunteer effort to search for sharp-tailed grouse in southwestern Minnesota. I included their findings in this report to document the presence of lek activity outside the traditional survey reg

RESULTS AND DISCUSSION

A total of 2,012 male sharp-tailed grouse and grouse of unknown sex were counted statewide at 167 leks, including 22 birds at 3 leks found in Lac Qui Parle and Yellow Medicine Counties by MSGS volunteers and 6 birds at 1 additional lek just outside the traditional survey region in Clearwater County (Table 1). Surveys were conducted during 1 April to 11 May 2022. Leks with $\geq$2 grouse were observed an average of 1.6 times. The statewide index value of 12.2 (11.0 – 13.4) grouse/lek was centrally located among values observed since 1980 (Figure 2) and leks observed in 2021 and 2022 were larger statewide (t = 2.3, P = 0.03). This increase was primarily driven by increases in grouse/lek in the EC region.

In the EC survey region, 205 sharp-tailed grouse were counted on 21 leks in 2022, which was 55% more than the 132 birds counted on 18 leks in 2021. Birds and leks declined sharply in this region in the 2021 survey compared to 2019 (surveys were not conducted in 2020 during the Governor's Stay at Home Order), when 216 grouse were counted on 30 leks (Figure 3), prompting the hunting season closure in this region. The grouse/lek index was higher (9.8, CI: 7.0 – 13.0) in 2022 indicating that increases in bird numbers resulted in larger leks, and consistent with this interpretation, counts at leks surveyed in both 2021 and 2022 increased (t = 2.3, P = 0.03; Table 2). However, the distribution and number of leks in the EC region remains localized and small. Most (71%) leks reported in the EC region were in the Aitkin work area. No leks were reported in the Cambridge work area, and this has been the case since 2018, despite fairly consistent survey effort. The Tower work area reported 3 leks in 2022 in contrast to 2021 when none were observed. Five birds were reported at St. Croix State Park, which is the first recent report of birds in this area during spring, with 2 additional leks observed in the Cloquet work area. The increase in bird numbers this year is likely due to strong production of young in 2021, when both spring and summer were very dry in Minnesota, and possibly by favorable fall and winter survival. However, 2022 has been extremely wet thus far, which can adversely affect production of young. Therefore, gains in bird numbers this year should be regarded cautiously, especially when the population is so spatially restricted and subject to stochastic events like catastrophic storms, extreme flooding, and disease outbreaks. These survey data, in combination with studies indicating a genetic population bottleneck in the EC region (Roy and Gregory, 2019) and reporting inconsistent lek attendance (Roy and Coy, 2021), support the conclusion that birds in the EC region are exhibiting traits of a population in decline.

In the NW survey region, 1,779 grouse were counted on 142 leks with 12.5 (11.2 – 13.9) grouse/lek. More leks were surveyed in 2022 due to greater survey effort (i.e., more leks) in a few areas as staffing vacancies were filled (Figure 3). Counts at leks that were observed during both 2021 and 2022 were similar in the NW survey region (t = 1.50, P = 0.13). Thus, sharp-tailed grouse appear to be stable in the NW region, although they may be increasing in some parts of the region and declining in others. For example, biologists in the greater prairie-chicken survey regions (the southern part of the NW survey region) are reporting more sharp-tailed grouse in areas that used to hold greater prairie-chickens. However, reports of sharp-tailed grouse observed during prairie-chicken surveys were not included in this report because data were incomplete at the time of report writing. Nevertheless, this report provides an index of sharp-tailed grouse in the traditionally surveyed regions. Range shifts to new areas are not easily detected with these methods, but if survey effort expands and is consistent each year, new areas could be incorporated into this report.

ACKNOWLEDGMENTS

Annual sharp-tailed grouse surveys were accomplished through the efforts of staff and volunteers at Aitkin, Baudette, Bemidji, Cambridge, Cloquet, Grand Rapids, Karlstad, Red Lake WMA, Roseau River WMA, Thief Lake WMA, Thief River Falls, and Tower work areas. Cooperators from Agassiz and Glacial Ridge National Wildlife Refuges also participated. In 2022, the Minnesota Sharp-tailed Grouse Society initiated an effort to survey southwestern Minnesota for sharp-tailed grouse leks and submitted data for state records. Dave Pauly also completed surveys in the Cambridge work area and at St. Croix State Park. Lindsey Shartell assisted with surveys in the Grand Rapids work area. Mike Larson reviewed this report. This work was funded in part through the Federal Aid in Wildlife Restoration Act.

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Table 1. Sharp-tailed grouse / lek (≥2 males) at leks observed during spring surveys each year in the Northwest and East Central regions 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
2019	10.2	9.1 – 11.4	152	11.0	9.7 – 12.3	122	7.2	5.4 – 9.5	30
2020	NA[e]	NA	NA	NA	NA	NA	NA	NA	NA
2021	10.8	9.7 – 11.9	150[d]	11.3	10.1 – 12.5	131	7.3	5.1 – 9.8	18
2022	12.2	11.0 – 13.4	163	12.5	11.2 – 13.9	142	9.8	7.0 – 13.0	21

[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.

[e]No data were collected in 2020 due to the Governor's Stay at Home Order during the COVID-19 pandemic.

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
2018 – 2019	-0.3	-1.5 – 1.0	132	0.0	-1.5 – 1.6	101	-1.4	-3.0 – 0.1	31
2019 – 2020[f]	NA	NA	NA	NA	NA	NA	NA	NA	NA
2019 – 2021[g]	-0.7	-2.2 – 0.7	124	-0.5	-2.3 – 1.3	96	-1.6	-2.9 – -0.3	28
2021 – 2022	1.6	0.2 – 3.0	122	1.3	-0.3 – 3.0	96	2.7	0.5 – 5.0	26

[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.

[f]No data were collected in 2020 due to the Governor's Stay at Home Order during the COVID-19 pandemic.

[g]Comparisons were made between 2019 and 2021 because the survey was not conducted in 2020.

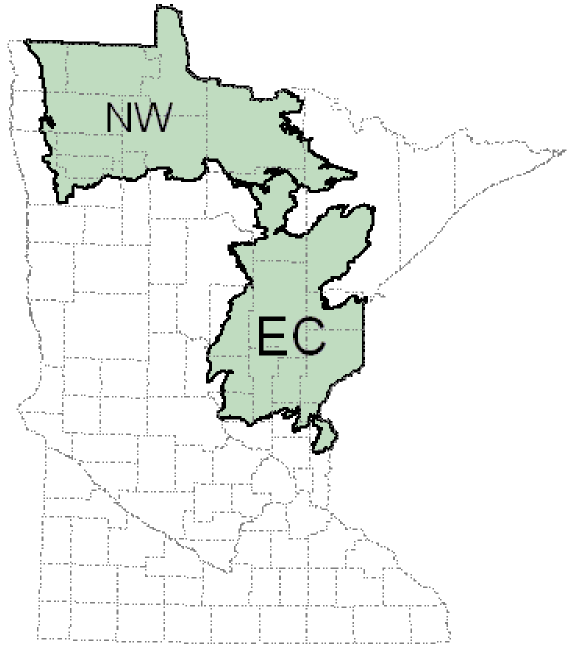

Figure 1. Survey regions for **sharp-tailed grouse** in Minnesota. Northwest (NW) and East Central (EC) survey regions are depicted relative to county boundaries (dashed lines) and influenced by Ecological Classification System Subsections boundaries.

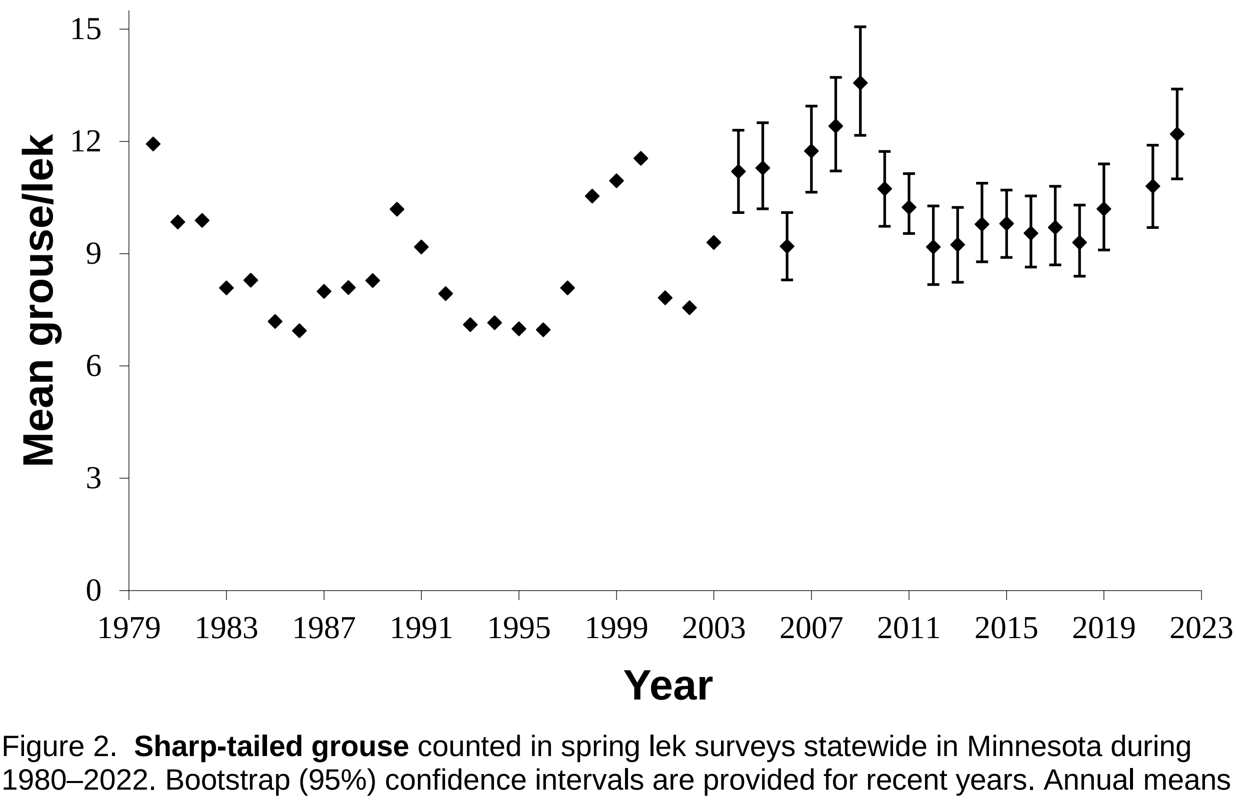

Figure 2. **Sharp-tailed grouse** counted in spring lek surveys statewide in Minnesota during 1980–2022. Bootstrap (95%) confidence intervals are provided for recent years. Annual means are not connected by lines because the same leks were not surveyed every year. No data were collected in 2020 due to the Governor’s Stay at Home Order during the COVID-19 pandemic.

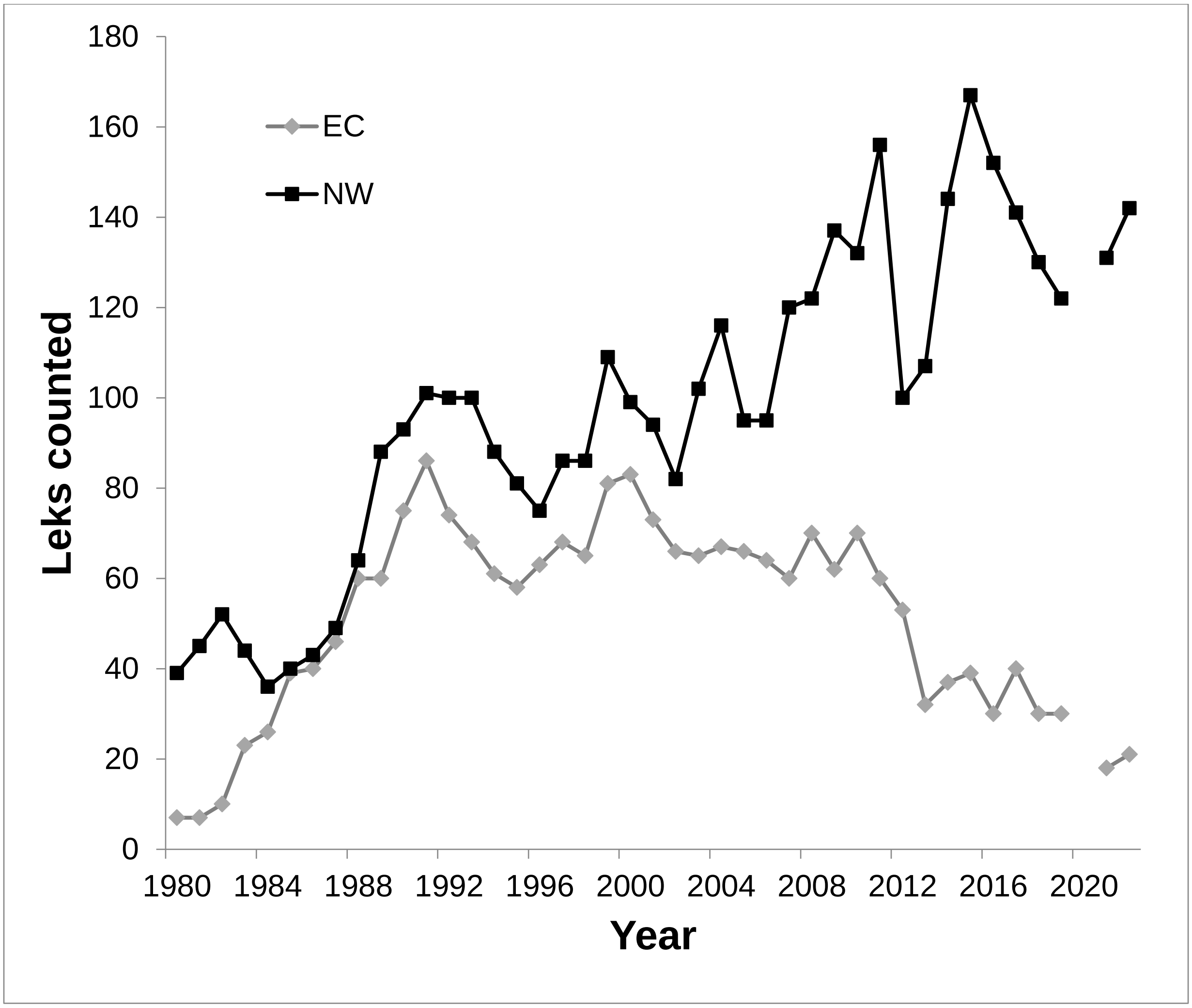

Figure 3. The number of **sharp-tailed grouse** leks with 2 or more birds counted in spring lek surveys in the Northwest (NW) and East Central (EC) survey regions of Minnesota during 1980 – 2022. Survey data were not collected in 2020 due to the Governor's Stay at Home Order during the COVID-19 pandemic.

2022 MINNESOTA SPRUCE GROUSE SURVEY

Charlotte Roy and John Giudice, Minnesota Department of Natural Resources,

Forest Wildlife Populations and Research Group

SUMMARY OF FINDINGS

The Minnesota Department of Natural Resources (MNDNR) initiated a spring (March-May) spruce grouse (*Falcipennis canadensis)* survey in 2018 with the help of dozens of cooperators and citizen volunteers. The survey is comprised of 319 road-based sites organized into 67 survey routes with 4-5 sites/route. Observers walk a circular transect and record grouse pellets within 1 m of the transect. During 2018-2021, we used replicate surveys to quantify variation in the pellet detection process. Beginning in 2022, we conducted single-effort surveys (i.e., each site was surveyed once). Participants surveyed for spruce grouse pellets at an average of 289 sites/year (90% of sites; range: 240 sites in 2020 and 314 sites in 2019). Sixty-two percent of sites were surveyed every year during 2018-2022, which reflects access challenges in the spring and staffing shortages during the pandemic. Spruce grouse pellets were detected at an average of 30% of sites (range: 26% in 2020 to 36% in 2022) during initial visits, with the highest naïve occupancy rates occurring the last 2 years. However, data from replicate surveys indicated that 57–66% of survey sites classified as "unused" in initial surveys may have had spruce grouse pellets present but they were missed (overlooked) or not available for detection (e.g., buried in the snow). Fortunately, the detection process appears to be relatively consistent over time. Therefore, although naïve occupancy is a biased estimate of true occupancy, it should serve as reasonable monitoring metric in this case; especially given our monitoring goal is to be able to detect a relatively large decrease over a 10-yr interval. Observers counted an average of 17.1 spruce-grouse pellet groups (single pellets or roost piles) at "used" sites during 2018-2022, but it varied greatly among sites and years (range: 1 to 212 pellet groups). The lowest mean conditional count occurred in 2022 (12.6 pellet/used site) but more sites (36%) had $\geq$1 pellet detected in 2022. The average unconditional pellet count in 2022 was 4.5 pellet groups/site, which is within the range of mean counts observed since 2018 (range: 3.9 in 2018 to 6.9 in 2021). A trend analysis did not find evidence of statistically significant changes (slope coefficient) in naïve occupancy rates over time, except possibly in the Minnesota & Ontario Peatlands where naïve occupancy increased from 39% in 2018 to 60% in 2022 and in the Minnesota Drift and Lake Plains where naïve occupancy decreased from 9% in 2018 to 2% in 2022. Thus, based on the 5-year dataset, the overall spruce grouse population appears to be stable in terms of our monitoring metrics and spatial extent. This was the final year of our feasibility study and the next steps are to finalize the survey design (e.g., conduct a thorough review of existing routes and survey sites) and analytical methods for the operational survey.

INTRODUCTION

Spruce grouse, *Falcipennis canadensis*, are a conifer-dependent gamebird in Minnesota and are expected to experience a range contraction due to climate change-induced habitat loss (Scheller and Mladenoff 2005, Prasad et al. 2007, Iverson et al. 2008). Thus, spruce grouse will likely have a more limited distribution in the southern portions of their range, which includes the Great Lakes region, in the future. Minnesota is unique among the Great Lakes states in that it still permits spruce grouse hunting, although they are a Species of Greatest Conservation Need because they are vulnerable to decline (Minnesota Department of Natural Resources, MNDNR 2015). The spruce grouse is considered a Species of Special Concern in Michigan (Michigan DNR 2005) and was listed as threatened in Wisconsin in 1997 (Wisconsin DNR 2004). Yet, the only data the MNDNR collected on spruce grouse before 2018 was estimated total harvest as part of the annual Small Game Harvest Mail Survey (Dexter 2016). Estimated total harvest of spruce grouse has been 10,000–27,000 birds/year since 2006 (Dexter 2016). However, variation in spruce grouse harvest among years may be more reflective of the number of ruffed grouse (*Bonasa umbellus*) hunters; thus these harvest data cannot be used as a population index for spruce grouse (Gregg et al. 2004).

During 2014–2017, we developed survey methodology to provide an index of the spruce grouse population (Roy et al. 2014, 2015, 2016, 2017, 2020). We evaluated an auditory survey using playback of female cantus calls (Roy et al. 2020), which is the most common approach to survey spruce grouse (Fritz 1979, Boag and McKinnon 1982, Schroeder and Boag 1989, Whitcomb et al. 1996, Lycke et al. 2011), and also evaluated a fecal pellet survey (Roy et al. 2020) as a means to monitor the population. Fecal pellets are easily detected in late winter/early spring as the snow pack dissipates and pellets that have been deposited and frozen during winter become visible on the snow surface, indicating spruce grouse use of forest stands. The pellet survey was more efficient and had higher detection rates than the auditory survey. We also found road effects to be negligible in high-use cover types (e.g., jack pine (*Pinus backsiana*) and black spruce (*Picea mariana*)). Thus, we designed a monitoring program based on a survey of sites centered on road-based points (hereafter, survey “sites”) in spruce grouse cover types dispersed across their range in Minnesota.

In 2018, MNDNR launched the annual spruce grouse pellet survey with the cooperation of biologists from the Chippewa National Forest, Grand Portage Band of Lake Superior Chippewa, Leech Lake Band of Ojibwe, Minnesota Department of Natural Resources, Red Lake Band of Chippewa Indians, Superior National Forest, 1854 Treaty Authority, Vermilion Community College, and dozens of citizen volunteers. This survey is expected to be able to detect meaningful changes in the population over a 10-year period (i.e., $\geq$15% decline) and is intended to provide population information (i.e., status and distribution) that can be used to guide management decisions.

METHODS

The pellet survey is comprised of 67 survey routes with 4-5 road-based sites per route spaced $\geq$400 m apart. Each route has $\geq$1 point with $\geq$30% black spruce or jack pine habitat. Observers use a Global Positioning System (GPS) to walk a circular transect with a 100-m radius (i.e., 628-m length) centered on roadside sampling points. Observers record single grouse pellets and roost piles $\leq$1 m on either side of transects. Multiple pellets within a 30-cm diameter circle are considered a “roost” for the purpose of this survey. This standardization of the method is necessary because spruce grouse often roost in trees during winter and pellets fall to the ground in poorly defined roost piles. Ruffed grouse pellets are distinguished from spruce grouse pellets on the basis of length, thickness, uric acid wash, and color. Ruffed grouse pellets tend to be shorter, thicker, and usually have a uric acid wash, whereas spruce grouse pellets are longer, thinner, and infrequently have a uric acid wash. Spruce grouse pellets are also darker green in color when spruce grouse are consuming conifer needles (during winter), but color changes depend on diet; spruce grouse pellets can have a similar color to ruffed grouse pellets later in the spring. At each site observers also record covariate data for detection of grouse pellets, including the proportion of the 628-m transect that is located in spruce grouse cover types; days since last snow fall; whether snow cover is complete, partial, or gone; and survey conditions on a scale of 0-10, with 10 being the best conditions to detect pellets. Surveys were repeated up to 5 times at a subset of sites (where seasonal technicians and/or volunteers were available) during 2018-2020 to allow modeling of the detection process and to help determine whether repeat visits will be necessary to account for annual variation in the detection process.

We used a Bayesian dynamic occupancy model (Kéry and Schaub 2012, Su and Yajima 2015) to estimate and compare detection probabilities over time, as well as explore turnover and colonization rates. Our model contained the following covariates for the initial occupancy state (year 1): an indicator variable for the presence of jack pine and/or black spruce, the proportion of the transect that went through spruce grouse habitat (year 1), and a random effect for the geographic clustering of sites into routes. For the observation process, we included covariates for survey conditions (1-10, with 10 being very good), visit, year, and a random effect for route. We did not attempt to use covariates to model transition probabilities, although we did allow them to vary annually.

Beginning in 2022, we only visited each site once (i.e., a single-effort survey), which is how we envision operational surveys being conducted in the future. Thus, going forward, we will focus on presence-absence data from initial surveys as our primary monitoring metric, and use a bootstrap procedure (over routes and sites|routes) to generate 85% confidence intervals. We will also explore developing some monitoring metrics based on the count data, but these metrics are likely to be more variable and difficult to interpret (e.g., several factors can cause variation in pellet counts, but not all of them are correlated with bird abundance).

RESULTS AND DISCUSSION

In 2022, 66 of 67 routes (median 5 points per route, range: 4–5) were surveyed by 24 cooperating biologists and 25 citizen volunteers, between 20 March and 5 June (Table 1). Spring 2022 was generally late, cold, and with more snow than in 2018 and 2019, which is dissimilar to 2021 in which spring was early. Observers detected spruce grouse pellets at 111 (36%) of 312 survey sites during the initial visit in 2022. On average 12.6 (range: 1–122) spruce grouse single pellets and roosts were detected in initial visits at used sites. Similarly, ruffed grouse pellets and roosts were detected at 180 (58%) sites in initial visits with a mean count of 6.6 (range: 1–58) pellets per used site. Observers detected pellets of both species at only 66 sites (21%) in 2022, whereas pellets of neither species were detected at 87 sites (28%). This is similar to concordance rates observed in previous years.

Our naïve estimate of spruce grouse use (the proportion of sites where $\geq$1 pellet was detected in the initial survey) was slightly higher in 2022 (36%) compared to previous years (range: 27 to 32%; Figure 1), but the trend was not statistically significant (slope coefficient = 0.075, SE = 0.062, z = 1.217, $P = 0.224$). Conversely, the mean pellet count at used sites decreased in 2022 (Figure 2), but trends in pellet-count metrics are more difficult to estimate and interpret because of inherent variability in pellet counts (Figure 2) and the potential for a noisy relationship between pellet counts and bird abundance. Naïve occupancy estimates and trends for the Northern Superior Uplands were similar to the overall estimates, but this is not surprising because this Ecological Classification System (ECS) section accounts for 60% of total survey routes. However, some evidence exists for a positive trend (slope = 0.215, SE = 0.084, z = 2.55, $P = 0.011$) in naïve occupancy in the Minnesota & Ontario Peatlands (Figure 1), but this was driven by a relatively large increase in 2022 (60%) compared to previous years (range: 36% to 44%). Likewise, we found weak evidence (slope = -0.071, SE = 0.366, z = -1.931, $P = 0.054$) that naïve occupancy declined in the Minnesota Drift and Lake Plains (Figure 1), but with only 10 routes and few detections (mean = 3.4% of sites; range: 0 to 9.1%) it will be difficult to reliably estimate trends for this ECS section. Likewise, trend estimates based on count metrics is challenging for all ECS sections separately (e.g., Figure 2). The spatial distribution of detections also has been reasonably consistent over time (Figure 3), although we will explore additional methods for summarizing this aspect of the survey in the future.

ACKNOWLEDGMENTS

C. Scharenbroich assisted with selection of survey points in GIS during the design phase of the survey. Special thanks to G. Mehmel and S. Laudenslager for their suggestion and support of survey development. Biologists at Grand Portage Band of Chippewa Indians, Red Lake Nation, 1854 Treaty Authority, Leech Lake Band of Ojibwe, U.S. Forest Service, and MNDNR Wildlife provided valuable feedback on survey design and assisted with surveys. Special thanks to all the cooperators and volunteers that assisted with this survey, with special thanks to cooperators in the Superior National Forest and 1854 Treaty Authority who conducted additional surveys during the COVID-19 pandemic in 2020. Seasonal technicians that assisted with repeat surveys included L. Hause, A. Elliott, J. Bates, N. Dotson, and C. Bradley. Citizen-scientist volunteers usually include D. Johnson, A. Swarts, R. Anderson, J. Bigelow, G. Larson, J. Keenan, J. Asfoor, J. Elton Turbes, W. Fleischman, B. Rothauge, K. Boettcher, E. Gdula, C. Jensen, G. Jensen, D. Kuder, M. Rothstein, D. Klett, J. Ridlbauer, A. Vinar, E. Berg, R. Berg, D. Elliott, A. Krulc, A. Sporre, R. Langerud, N. Scheffler, M. Gabrys, S. Anderson, K. Jankofsky, E. Shea, and Vermilion Community College students. L. Gilbert assisted with paperwork for volunteers, logistics, and data entry. M. Larson reviewed this report. This work was funded through the Federal Aid in Wildlife Restoration Act.

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Table 1. Spruce grouse (SPGR) routes and sites surveyed in northern Minnesota in 2022 by staff, cooperators, and volunteers, and detections of SPGR, ruffed grouse (RUGR), and snowshoe hare (SNHA) pellets (singles and roosts per used site) during initial visits.

Cooperator Area	No. citizen volunteers	Routes	Sites surveyed	Proportion sites used by SPGR	Proportion sites used by RUGR	Proportion sites used by SNHA
Aurora SNF[1]	2	3	14	0.21	0.86	1.00
Baudette DNR[2]	0	4	19	0.74	0.21	1.00
Bemidji DNR	0	2	10	0.10	0.50	1.00
Chippewa NF[3]	1	4	19	0.00	0.53	0.74
Cook SNF	0	4	20	0.30	0.65	0.95
Duluth DNR	2	2	9	0.33	0.78	1.00
Ely SNF	10	4	19	0.21	0.11	0.58
Grand Marais DNR[4]	2	3	12	0.42	0.67	1.00
Grand Marais SNF	0	3	14	0.36	0.71	1.00
Grand Portage Res.	1	3	15	0.00	0.60	1.00
Grand Rapids DNR	2	1	4	0.25	0.25	1.00
I Falls DNR	1	3	13	0.23	0.54	1.00
Leech Lake Res.	0	2	9	0.00	0.67	1.00
Orr DNR	2	4	18	0.56	0.72	1.00
Red Lake Res.	0	3	14	0.29	0.71	1.00
Red Lake WMA	0	5	25	0.72	0.56	0.96
1854 Treaty Authority	0	4	20	0.65	0.60	1.00
Tofte SNF	2	6	30	0.50	0.73	0.80
Two Harbors DNR	1	3	14	0.07	0.86	1.00
Tower DNR	5	3	14	0.36	0.21	0.71
Total		66	312	0.36	0.58	0.85
Not Surveyed		1	7	---	---	---

[1]SNF = Superior National Forest

[2]DNR = Minnesota Department of Natural Resources –Section of Wildlife

[3]Some volunteers worked in groups on the same route, and some volunteers did routes in >1 work area.

[4]Grand Marias DNR Office has been moved to the Two Harbors DNR Office, but routes remain separated based on their geographic location.

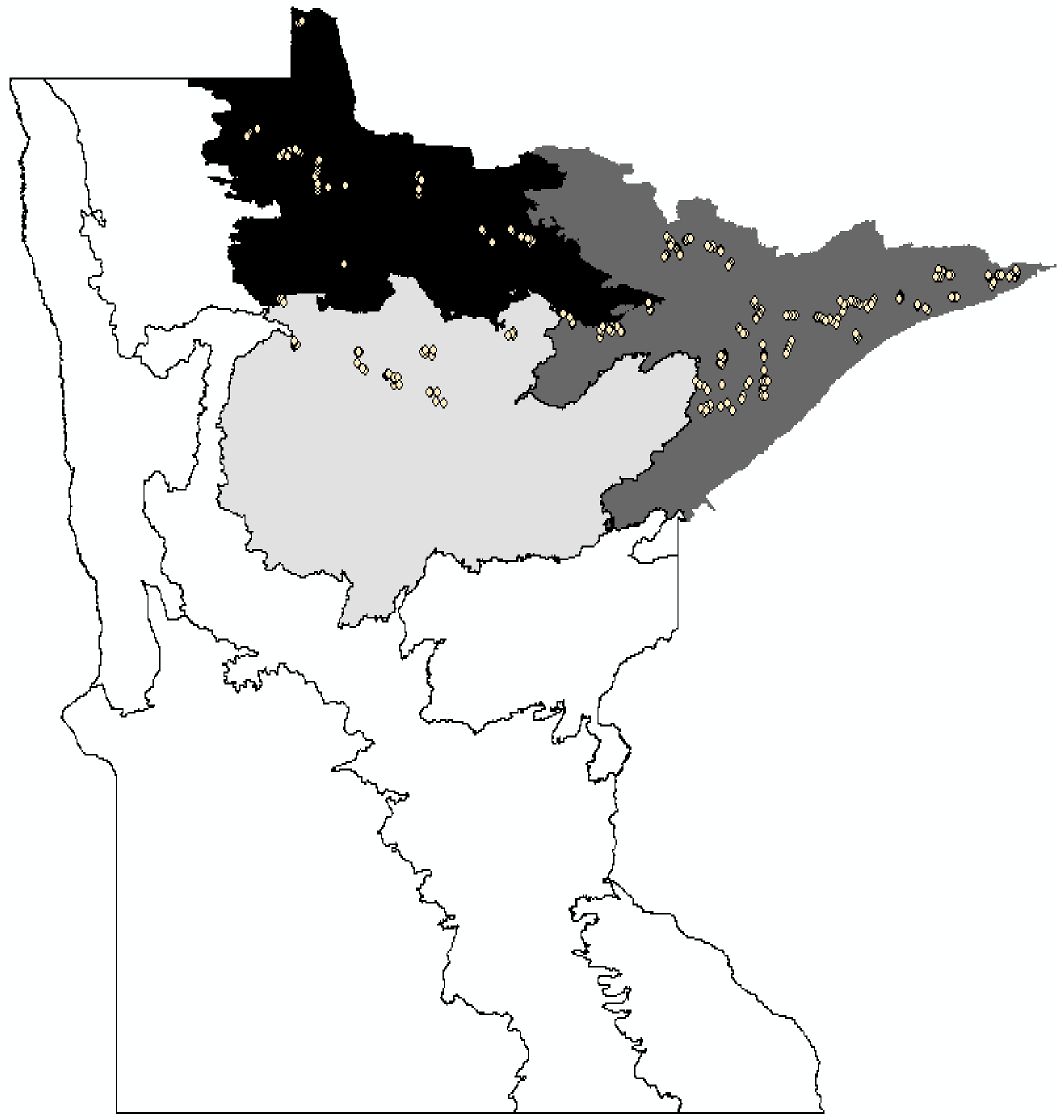

Figure 1. Distribution of sampling sites in northern Minnesota. Ecological Classification System sections included the Northern Minnesota and Ontario Peatlands (n = 17 routes and 85 sites) in the northwest, the Northern Superior Uplands (n = 40 routes and 190 sites) in the east, and the Northern Minnesota Drift and Lake Plains (n = 10 routes and 44 sites) in the southcentral survey region.

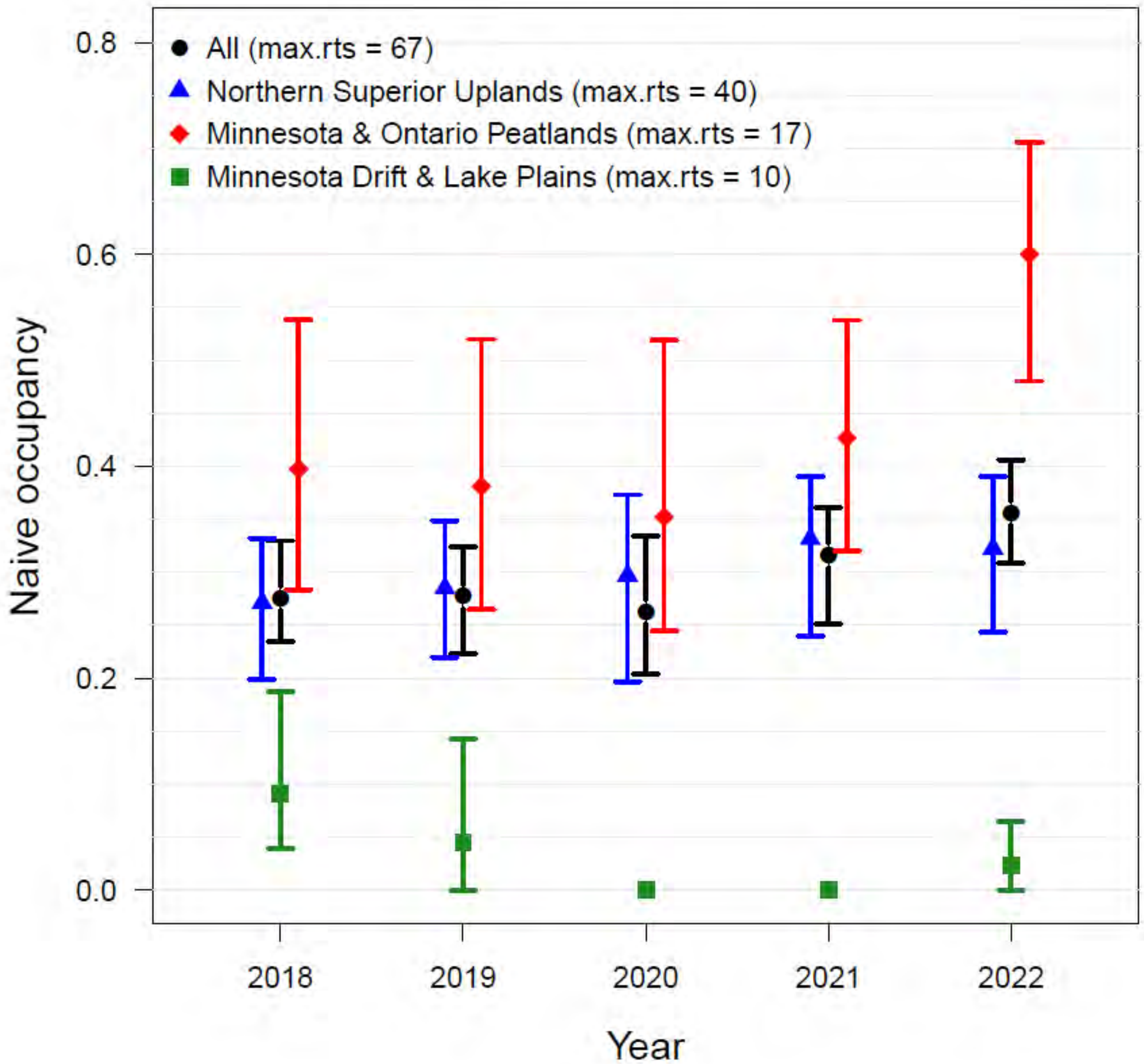

Figure 2. Spruce grouse naïve occupancy rates by Ecological Classification System section and across all sections in northern Minnesota during 2018–2022. Error bars denote 85% bootstrapped confidence intervals.

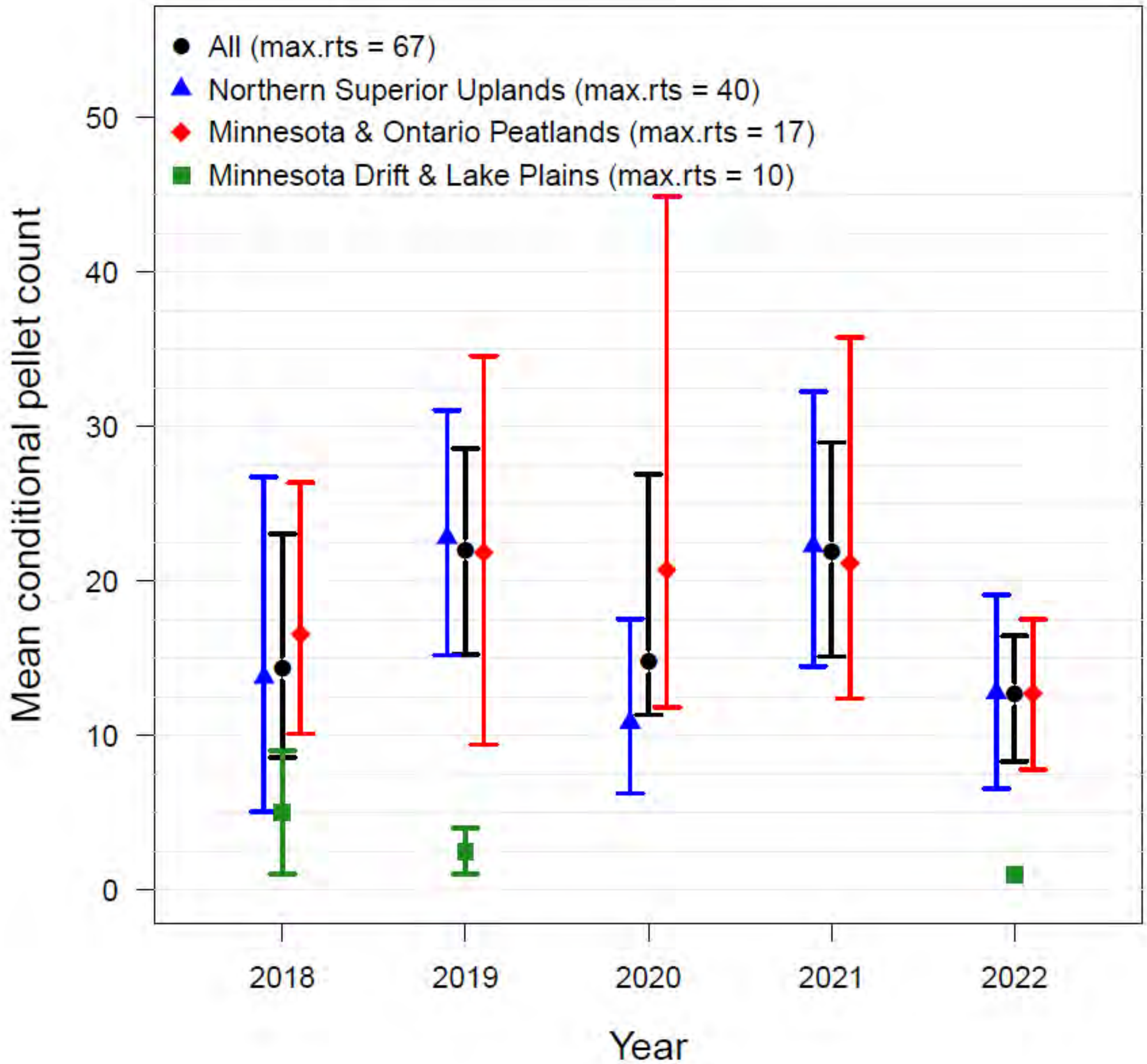

Figure 3. Mean spruce grouse pellet-group counts at used sites (≥1 pellet detected) by Ecological Classification System section and across all sections in northern Minnesota during 2018–2022. Error bars denote 85% bootstrapped confidence intervals.

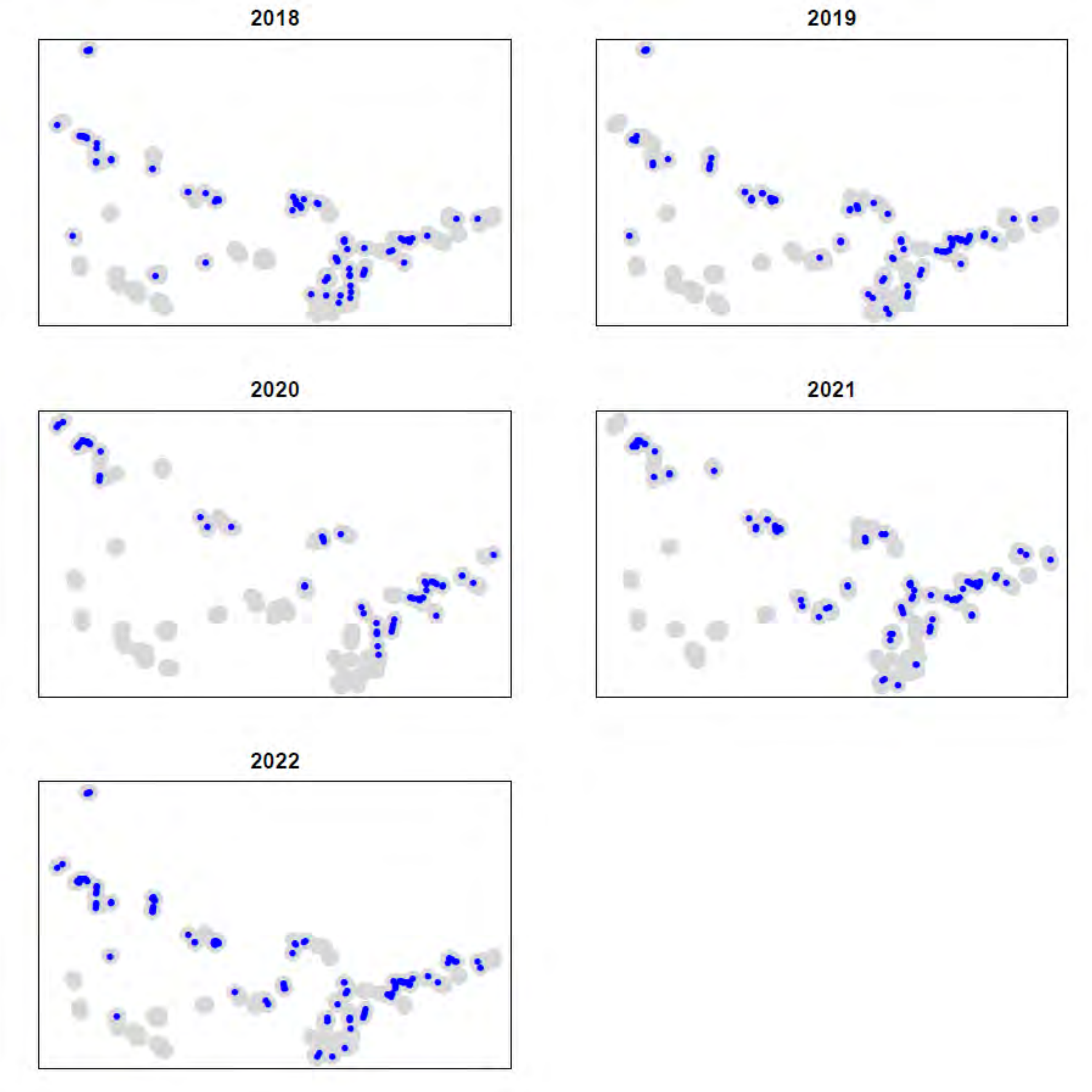

Figure 4. Spatial distribution of spruce grouse survey sites (gray dots) and used sites ($\geq$1 pellet detected; blue dots) in Northern Minnesota during 2018-2022.

2022 MINNESOTA PRAIRIE-CHICKEN POPULATION SURVEY

Charlotte Roy, Minnesota Department of Natural Resources, Forest Wildlife Research Group

SUMMARY OF FINDINGS

Greater prairie-chickens (*Tympanuchus cupido pinnatus*) were surveyed in all 17 survey blocks during the spring of 2022. Observers located 50 booming grounds and counted 606 males and birds of unknown sex in the survey blocks. Including areas outside the survey blocks, observers located 120 booming grounds, 1,336 male prairie-chickens, and 37 birds of unknown sex throughout the prairie-chicken range. Estimated densities of 0.07 (0.05–0.10) booming grounds/km^2 and 12.1 (9.6–14.6) 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).

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 European colonists expanded and modified the landscape with farming and forest removal, providing abundant food sources and access to new areas. 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 (MNDNR) conducted a series of unsuccessful 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 ~100 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 on 17 designated survey blocks in western Minnesota (Figure 2) during April and 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.

In 2021, MPCS requested that sharp-tailed grouse (*Tympanuchus phasianellus*) observed during prairie-chicken surveys be included in this report because of concerns that sharp-tailed grouse are expanding into range previously occupied primarily by the prairie-chicken. Prior to the survey season, I asked observers to include observations of sharp-tailed grouse with their data.

RESULTS AND DISCUSSION

Observers from MNDNR Section of Wildlife, the U.S. Fish & Wildlife Service, and The Nature Conservancy, as well as many unaffiliated volunteers counted prairie-chickens between 1 April and 6 May 2022. Observers located 120 booming grounds and observed 1,336 male prairie-chickens and 37 birds of unknown sex within and outside the survey blocks (Table 1). These counts represent a minimum number of prairie-chickens in Minnesota during 2022, 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, 606 males and birds of unknown sex were counted on 50 booming grounds during 2022 (Table 2). This contrasts with the high count of 1,618 males and 114 booming grounds in 2007. Each lek was observed an average of 2.4 times (median = 2), with 38% 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 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.

Densities of prairie-chickens in the 10 core survey blocks were 0.09 (0.05–0.12) booming grounds/km^2 and 13.3 (10.3–16.3) males/booming ground (Figure 3). In the peripheral survey blocks, densities were 0.05 (0.03–0.07) booming grounds/km^2 and 9.1 (4.7–13.5) males/booming ground. For all survey blocks, the density of 0.07 (0.05–0.10) booming grounds/km^2 during 2022 was similar to densities during recent years (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 12.1 (9.6–14.6) males/booming ground in all surveyed blocks during 2022 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 (Figure 3).

The observed densities are lower than the years preceding 2008 when CRP enrollments in the counties containing the survey blocks were highest. These changes in the population indices coincide with gains and losses in enrollments in the Conservation Reserve Program. Changes in the quantity of grassland on the landscape impacts prairie-chicken populations. More explicit examination of these patterns can be found in the recent publication, *Adkins, K., C. L. Roy, D. E. Anderson, R. Wright. 2019. Landscape-scale Greater Prairie-chicken Habitat Relations and the Conservation Reserve Program. The Journal of Wildlife Management DOI: 10.002/jwmg.21724.*

Prairie-chicken survey cooperators submitted reports of sharp-tailed grouse observed during prairie-chicken surveys in 2022. In Polk County, 228 sharp-tailed grouse were counted at 18 sharp-tailed grouse dancing grounds. Additionally, 1 sharptail-chicken hybrid was observed at a prairie-chicken booming ground in Polk County. In Norman County, a sharp-tailed grouse lek with 12 males and 1 female was observed. In Clay County, 1 sharp-tailed grouse was observed at each of 3 prairie-chicken booming grounds. In Mahnomen County, 3 sharp-tailed grouse and a sharptail-chicken hybrid were at a booming ground. In Wilkin county, 1 sharp-tailed grouse was observed at a prairie-chicken booming ground. Sharp-tailed grouse will utilize areas with more brush than prairie-chickens will.

ACKNOWLEDGMENTS

I would like to thank cooperators who conducted and helped coordinate the prairie-chicken survey. Cooperators with The Nature Conservancy included Travis Issendorf, and volunteers Pat Beauzay, Matt Mecklenburg, Derek Savage, and Sara Nagel; cooperators within MNDNR included Emily Hutchins, Rob Baden, Greg Henderson, Mark Palm, Michael Oehler, and Matt Morin; cooperators with the US Fish and Wildlife Service including Shawn Papon, Chad Raitz, Ben Walker, and Stacy Salvevold; and numerous additional volunteers, including Brian Winter, Dan Svedarsky, Doug Wells, Jon Voz, Ross Hier, Phil Doll, Dan Hertel, and Doug Hedtke. This survey was funded in part by the Wildlife Restoration (Pittman-Robertson) Program W-69-S-13 Project #16. Mike Larson reviewed this report.

Table 1. Minimum abundance of prairie-chickens within and outside hunting permit areas in Minnesota during spring 2022. Lek and bird counts are not comparable among permit areas or years.

Permit Area	Area (km^2)	Leks	Males	Unknown[a]
803A	1,411	11	73	0
804A	435	0	0	0
805A	267	18	197	7
806A	747	9	60	0
807A	440	21	259	10
808A	417	19	317	0
809A	744	13	183	0
810A	505	6	56	0
811A	706	5	39	0
812A	914	5	40	0
813A	925	4	50	0
PA subtotal	7,511	111	1274	17
Outside PAs[b]	NA[c]	9	62	20
Grand total	NA[c]	120	1336	37

[a] Unknown = 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.

Table 2. Prairie-chicken counts within survey blocks in Minnesota during spring 2022, and change in counts compared to 2021.

			2022		Change from 2021[a]	
Range[b]	Survey Block	Area (km^2)	Booming grounds	Males[c]	Booming grounds	Males[c]
Core	Polk 1	41.2	1	11	-1	-4
	Polk 2	42.0	4	32	0	-18
	Norman 1	42.0	2	11	0	7
	Norman 2	42.2	2	12	0	-4
	Norman 3	41.0	5	65	0	16
	Clay 1	46.0	9	168	-3	-31
	Clay 2	41.0	4	67	0	-25
	Clay 3	42.0	6	79	1	-2
	Clay 4	39.0	0	NA	-1	NA
	Wilkin 1	40.0	3	34	0	-15
	Core subtotal	415.0	36	479	-4	-82
Periphery	Mahnomen	41.7	3	52	1	11
	Becker 1	41.4	4	35	0	-1
	Becker 2	41.7	2	4	1	-2
	Wilkin 2	41.7	2	13	1	9
	Wilkin 3	42.0	2	17	0	-5
	Otter Tail 1	41.0	1	6	0	0
	Otter Tail 2	40.7	0	NA	-2	NA
	Periphery subtotal	290.6	14	127	1	-15
Grand total		705.5	50	606	-3	-97

[a] The 2021 count was subtracted from the 2022 count, so positive values indicate increases.

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

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

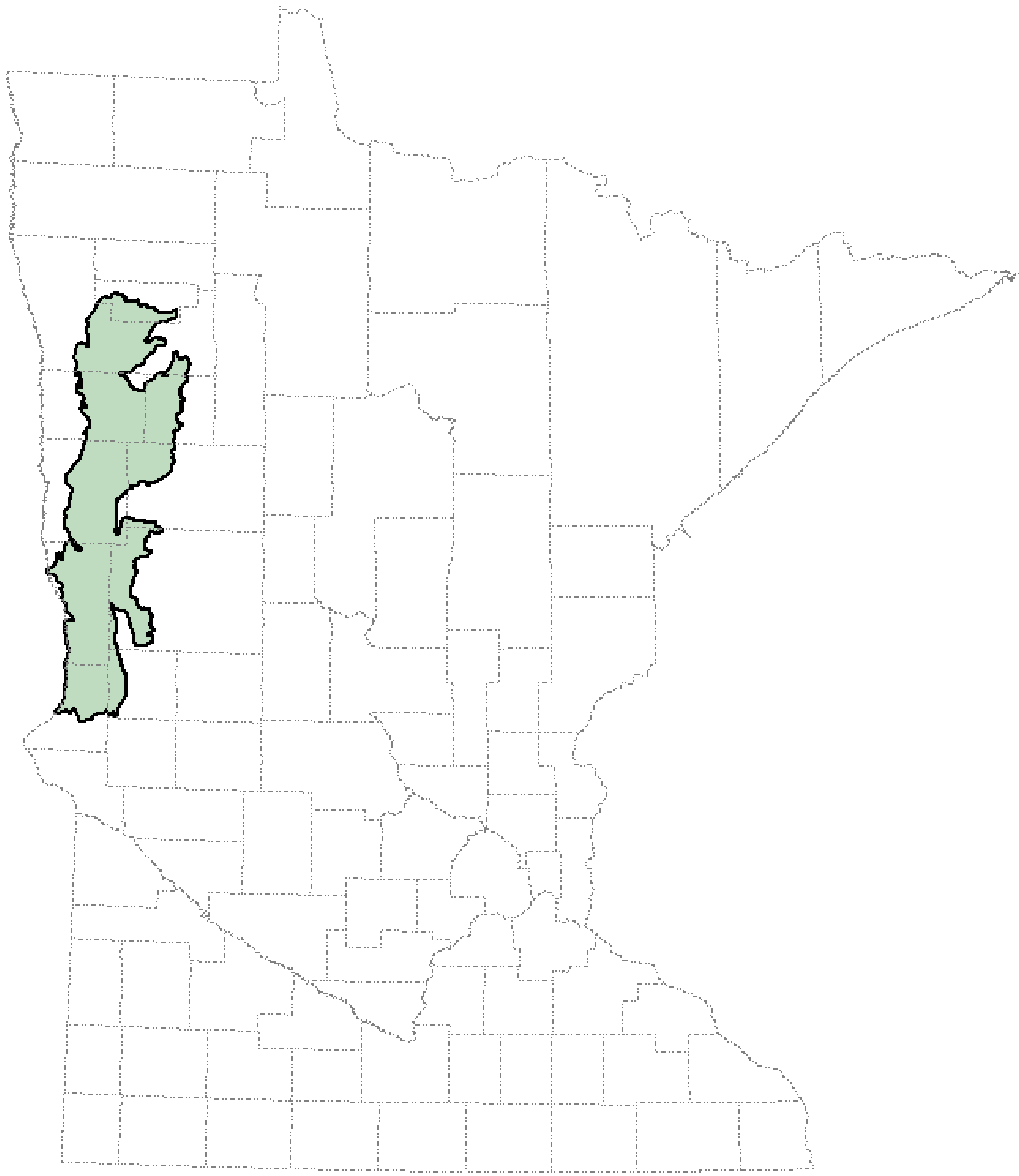

Figure 1. Primary greater prairie-chicken range in Minnesota (shaded area) relative to county boundaries. The range boundary was based on Ecological Classification System Land Type Associations and excludes some areas known to be occupied by prairie-chickens.

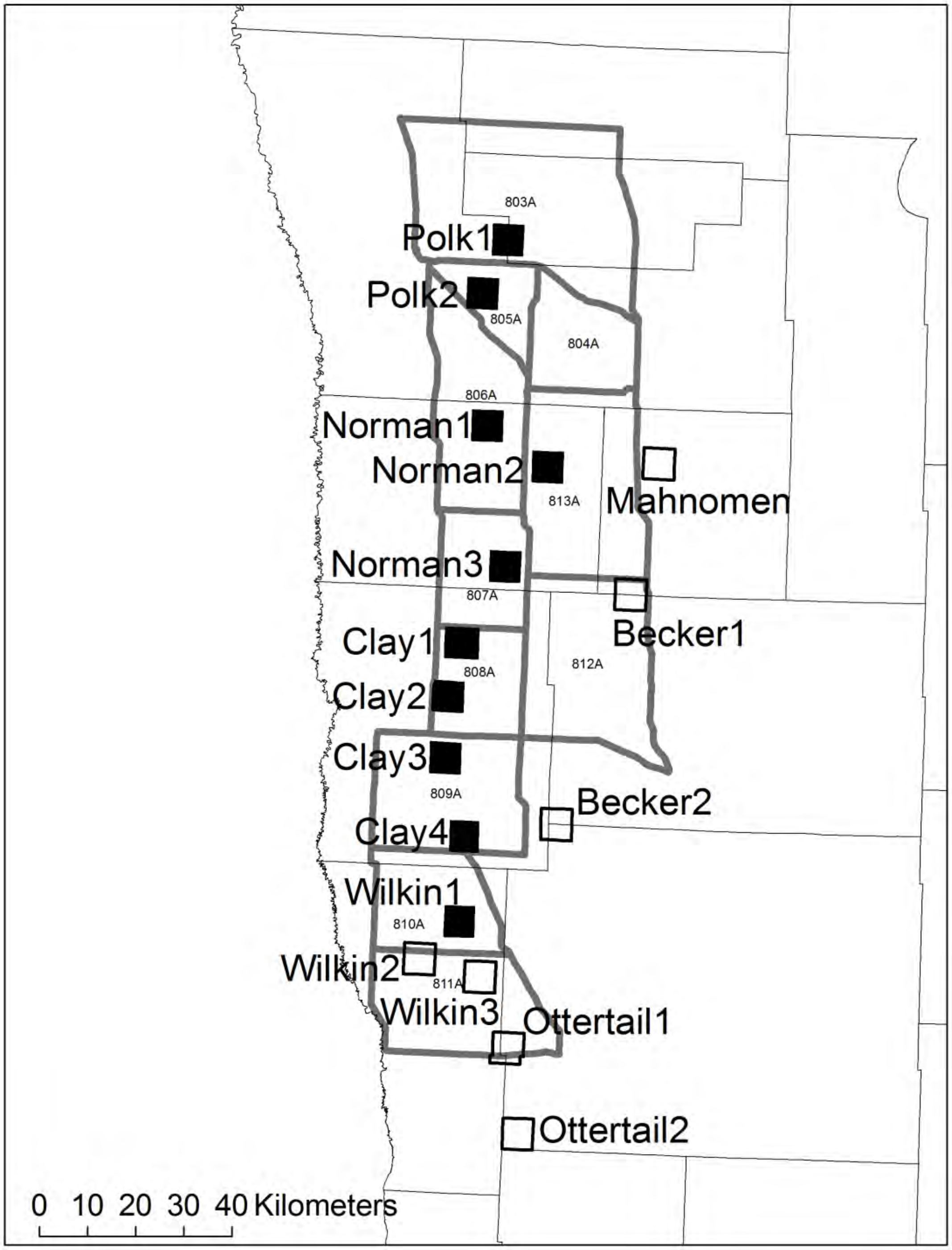

Figure 2. Prairie-chicken lek survey blocks (41 km^2, labeled squares) and hunting permit areas (thick grey lines) in western Minnesota. Survey blocks were either in the core (black) or periphery (white) of the range with a threshold of 1.0 male/km^2 in 2010, and were named after their respective counties (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.

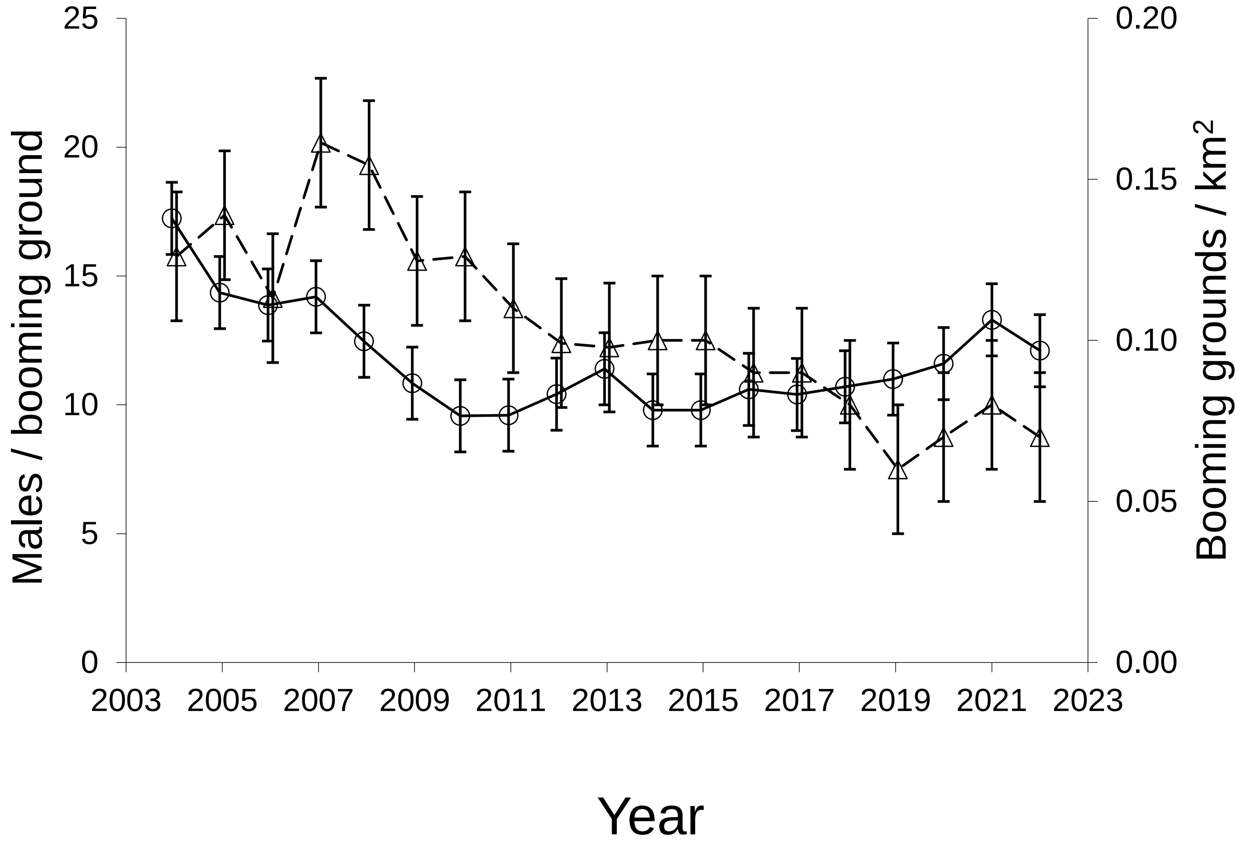

Figure 3. Mean prairie-chicken males/booming ground (circles connected by solid line) and booming grounds/km^2 (triangles connected by dashed line) in survey blocks in Minnesota with 95% confidence intervals.

2022 MINNESOTA AERIAL ELK SURVEY

Doug Franke, Minnesota Department of Natural Resources, Area Wildlife Supervisor, Thief River Falls Area Wildlife

INTRODUCTION

This report summarizes the 2022 Minnesota Aerial Elk Survey (AES). Since the mid 1990's, Minnesota Department of Natural Resources (MN DNR) Section of Wildlife and MN DNR Enforcement (ENF) personnel have conducted the annual AES from mid-January to early March in Northwest Minnesota. The primary objective of this annual survey is to record a minimum count of antlerless and antlered elk. This data enables the Department to monitor the elk population's long-term trend, document changes in spatial distribution and sex ratios, and to help set harvest quotas for potential hunting seasons in accordance with the 2016-2019 interim elk management plan and Minnesota Statute 97B.516.

METHODS

The AES survey area is divided into three separate blocks: Kittson Central, Caribou-Vita, and Grygla (Figure 1). The Kittson Central survey block encompasses 166 mi^2 in Kittson County and includes two subgroups of elk (Kittson Central North and Kittson Central South). The Caribou-Vita survey block incorporates approximately 35 mi^2 in Kittson and Roseau Counties and includes one elk herd that frequently alternates on either side of the U.S.-Canadian border. A Caribou-Vita survey is only conducted in years when DNR staff can coordinate with Manitoba Conservation staff to complete concurrent surveys on both sides of the border. The Grygla survey block covers 122 mi^2 in Marshall and Beltrami counties and includes one subgroup of elk. This survey is currently completed every other year since the recent elk population has been below the population goal range (30 – 38) to warrant a hunting season and does not justify the cost and safety risk to fly every year. Annual flights could resume if ground observations or damage complaints indicate an increasing population trend.

Each survey block is flown using a single DNR-owned fixed-wing aircraft (e.g., Cessna 185 Skywagon) piloted by an ENF or natural resource (NR) pilot and two Section of Wildlife observers. The aircraft is flown at an altitude of 300 to 400 feet and at speeds of 80-90 mph. Each survey block is subdivided into consecutive linear transects spaced 0.2 miles apart. When elk are observed, the aircraft exits the transect line and circles the observed animal(s) to record location and classify antlerless (cow, calf) and antlered animals. Differentiation between cow and calf elk is difficult at current survey altitude and airspeed protocol and is not attempted. Antlered elk are recorded as either branch antlered or spike. Elk observations are recorded using a GPS-linked laptop with DNRSurvey software (an ESRI ArcMap AddIn (toolbar) developed by MNDNR Wildlife and Minnesota Information Technology (MNIT) Services, as well as a hard copy datasheet. Anticipated ground coverage is 100% within each survey block. To maximize sightability, surveys are completed between 1 January and 15 March when snow cover measures at least 8 inches.

RESULTS AND DISCUSSION

The 2022 AES included the Grygla and Kittson Central survey blocks (the Caribou-Vita survey block was not completed since Manitoba Conservation (MB Conservation) staff did not fly the Canadian side). Observation conditions (snow depth and coverage) were considered very good this year for both elk survey blocks. Snow depths averaged 15 inches across the Grygla block and ranged from 15 to 20 inches in the Kittson Central block. Snow (precipitation and blowing), high winds, and cold temperatures caused a nine-day delay between the completion of the Grygla survey and the start to the Kittson Central survey. There were also two weather delays (one and two-days) during the Kittson Central survey. Temperatures ranged from a low of -30°F to a high of 0°F with sunny to cloudy skies.

Grygla Survey Block

This survey started on 2 February and was completed on 3 February with no weather delays. Total aircraft engine time to complete this survey (takeoff to landing) was 10.7 hours. Elk were recorded at five separate locations within the survey block--all elk were observed on the second day. Total elk observed was 29 (Table 1) and included 16 antlerless and 13 antlered (11 branch antlered and 2 spike). Of special note is that all but one of the elk were located on State Wildlife Management Area land at the time of the survey.

Kittson Central Survey Block

This survey started on 12 February and was completed on 17 February. The area surveyed was the same 166 mi^2 area that has been flown the past several years. Total aircraft time to complete the survey was 16.4 hours (takeoff to landing). Elk were recorded at eight separate locations within the survey block. Total elk recorded within the survey block was 84 (Table 2) and included 51 antlerless and 33 antlered (28 branch antlered and 5 spike).

- The Kittson Central North subgroup had 28 antlerless elk and was located approximately 1.3 miles north of the wintering locations observed from 2017 to 2020. In addition, there were 9 branch antlered elk located within 0.75 to 6 miles of the antlerless group.
- The Kittson Central South subgroup had 23 antlerless elk that were located just north and south of the Percy WMA. As observed in 2020, the antlerless elk were again split into two smaller groups (16 and 7) spread 3 miles apart. Historically, antlerless elk for each subgroup have stayed in close proximity and have been observed together during winter months. In addition, there were 19 branch antlered and 5 spike elk observed within 2 to 4 miles north of the antlerless groups.

Caribou-Vita Survey Block

Although this survey block was not completed in 2022, there were 6 branch antlered elk (Table 3) recorded outside of the Kittson Central survey block when the aircraft was turning. These elk were located within the hunt zone established for the Caribou-Vita elk subgroup. Therefore, these elk were recorded as occurring in the Caribou-Vita survey block. Historical survey results for the years with concurrent surveys (MB Conservation and MN DNR) of the Caribou-Vita subgroup are listed in Table 4.

ACKNOWLEDGMENTS

Special thanks to all those that helped with the survey this year, especially the fixed-wing pilot Bob Geving who provided safe flying for all onboard. Observers this year included Kyle Arola (Thief Lake Area Wildlife Supervisor), Jason Wollin (Karlstad Area Wildlife Supervisor), and Doug Franke (Thief River Falls Area Wildlife Supervisor). Special thanks to Brian Haroldson who helped put together all the survey materials. This work was funded in part through the Federal Aid in Wildlife Restoration Act.

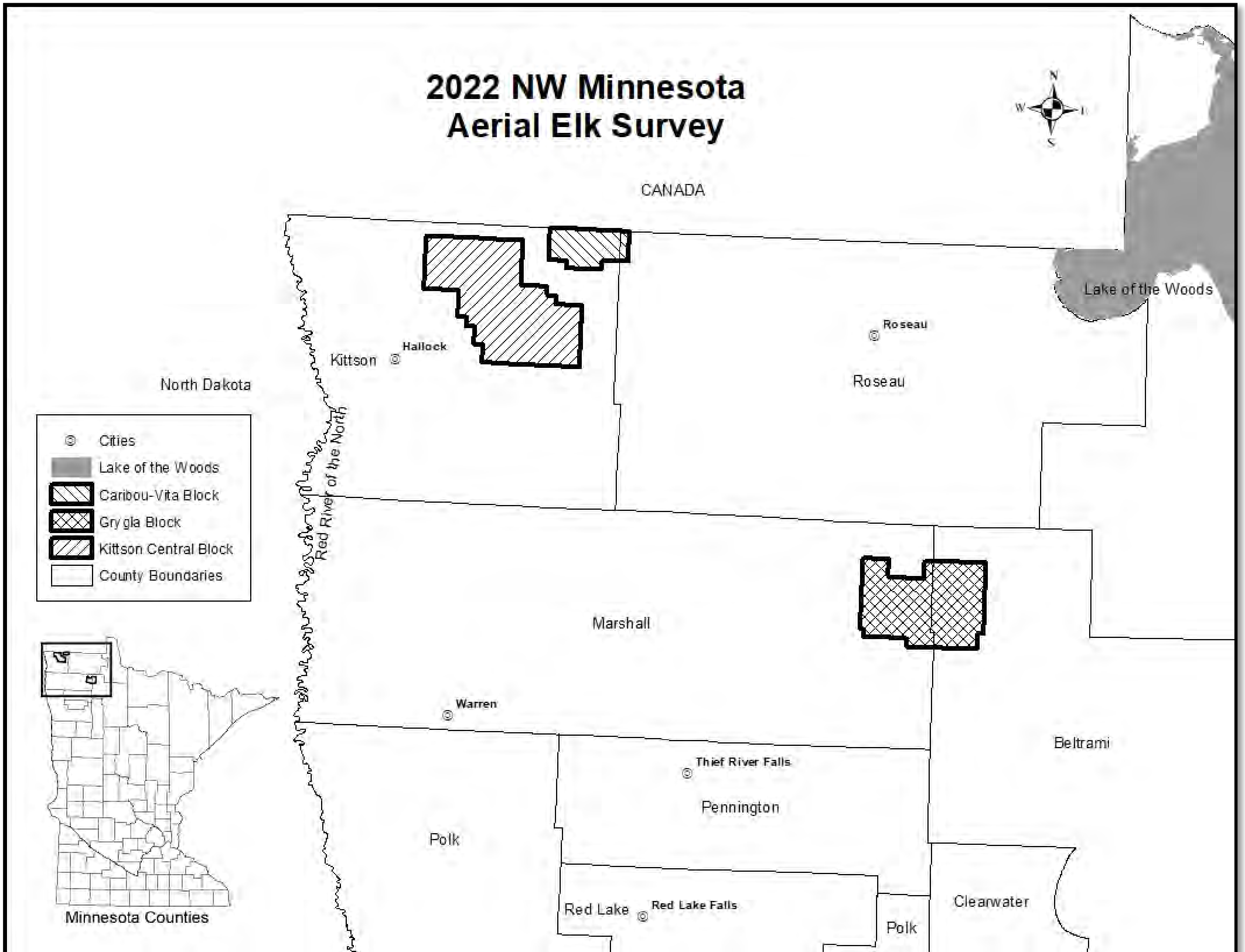

Figure 1. 2022 Northwest Minnesota Aerial Elk Survey Blocks

Table 1. Grygla Block aerial elk survey observations 2013 to 2022.

Survey	Spike Bull	Branch Antlered Bull	Antlerless	Total Elk	Antlered:Anterless Ratio
2013	2	10	16	**28**	0.75
2014	2	4	14	**20**	0.43
2015	3	6	9	**18**	1.00
2016	2	9	10	**21**	1.10
2017	4	6	7	**17**	1.43
2018	2	6	7	**15**	1.14
2019	1	10	8	**19**	1.38
2020	1	9	14	**24**	0.71
2021[a]	-	-	-	-	-
2022	2	12	15	**29**	0.93

Table 2. Kittson Central Block aerial elk survey observations 2013 to 2022.

Survey	Spike Bull	Branch Antlered Bull	Antlerless	Total Elk	Antlered:Anterless Ratio
2013	3	14	15	**32**	1.13
2014	3	14	20	**37**	0.85
2015	2	16	16	**34**	1.13
2016	6	12	34	**52**	0.53
2017	2	14	45	**61**	0.36
2018	5	13	57	**75**	0.32
2019	11	22	61	**94**	0.54
2020	6	27	69	**102**	0.48
2021[a]	-	-	-	-	-
2022	5	28	51	**84**	0.65

a Survey not completed due to Department COVID-19 restrictions

Table 3. Caribou-Vita Block aerial elk survey observations 2013 to 2022.

Survey	Spike Bull	Branch Antlered Bull	Antlerless	Total Elk	Antlered:Anterless Ratio
2013	0	15	2	**17**	7.50
2014	10	7	34	**51**	0.50
2015	5	9	57	**79**	0.25
2016	0	6	4	**10**	1.50
2017	0	1	0	**1**	-
2018	1	6	0	**7**	-
2019[2]	-	-	-	-	-
2020[a]	-	-	-	-	-
2021[3]	-	-	-	-	-
2022[a]	-	-	-	-	-

Table 4. Manitoba Conservation elk observations for the Caribou-Vita subgroup 2013 to 2022. MN DNR elk observations for the Caribou-Vita survey block are included parenthetically in the corresponding columns.

Survey	Spike Bull	Branch Antlered Bull	Antlerless	Total Elk	Antlered:Anterless Ratio
2017	6 (0)	24 (0)	133 (1)	**163 (164)**	0.23
2018	5 (1)	17 (6)	104 (0)	**126 (133)**	0.28
2019[a]	-	-	-	-	-
2020[a]	-	-	-	-	-
2021[b]	-	-	-	-	-
2022[a]	-	-	-	-	-

2 Survey not completed—MB Conservation was not able to fly Canadian side of border.

3 Survey not completed due to Department COVID-19 restrictions

2022 AERIAL MOOSE SURVEY

Glenn D. DelGiudice, Forest Wildlife Populations and Research Group

John H. Giudice, Biometrics Unit

INTRODUCTION

Each year we conduct an aerial survey in northeastern Minnesota to estimate the moose (*Alces alces*) 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 spatial 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. This annual survey was not flown in 2021 due to safety considerations associated with the Covid-19 pandemic.

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 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, and high density classes are based on whether up to 2, 3–7, or 8 or more moose, respectively, would be expected to be observed in a specific plot. The most recent complete re-stratification review was conducted in October 2018. Additionally, individual plots may be 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 to the survey approach, 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, this year we surveyed 53 (43 randomly sampled and 10 habitat plots) of the 436 plots; we included a 10th habitat plot (number 208) to facilitate monitoring moose response to the 2021 Greenwood Lake Fire.

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 similarly oriented and evenly spaced 0.3 mi apart. A Minnesota Department of Natural Resources (MNDNR) Enforcement pilot and a Forestry pilot 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).

Recently, Fieberg et al. (2013) and ArchMiller et al. (2018) developed alternative model- based abundance estimators that allow for time-series modeling (TSM) of multiyear survey counts and, potentially, modeling of animal populations over space and time. An important advantage of model-based estimators is that information can be shared across time or space to help increase the precision of annual population estimates and smooth estimated trends over time. This year, solely for the purpose of exploring a potentially improved method of estimating moose abundance, we applied the Bayesian TSM methods of ArchMiller et al. (2018) to our 2005-2022 moose-survey data (see Addendum A) and qualitatively compared the derived estimates to our conventional abundance and trend estimates. Similar applications and comparisons of estimating bull:cow and calf:cow ratios may be explored in the future.

RESULTS AND DISCUSSION

The survey was conducted from 6 to 14 January 2022. It consisted of 8 actual survey days to fly the 53 plots. This year, based on optimal allocation analyses, we surveyed 15 low-, 18 medium-, and 10 high-density plots, and the 10 habitat plots (Giudice 2022). Generally, 8" of snow cover is our minimum threshold depth for conducting the survey. Snow depths were 8"−16" and greater than 16" on 38% and 62% of the sample plots, respectively. Overall, survey conditions were rated as good for 94%, fair for 6%, and poor for 0% of the plots when surveyed. Average survey intensity was 45 minutes/plot (13.9 mi^2) and ranged from 35 to 55 minutes/plot (Giudice 2022).

This year 373 moose were observed on 40 (75%) of the 53 plots surveyed (a total 737 mi^2), which is more than the 308 moose observed on 39 of 52 plots during the 2020 survey. An average of 9.3 moose (range = 1–33) were observed per "occupied" plot. Plot occupancy during the past 16 years when the survey was flown averaged 81% (range = 65–95%) with a mean 11.4 moose observed per occupied plot. This year the average group size was 1.8 moose, similar to the previous 16 years (2 moose), and ranged from 1 to 6 moose per group.

This year's 373 observed moose included 151 bulls, 154 cows, 62 calves, and 6 unclassified adults. Overall, estimated VO averaged 44% (range = 5−85%) and average estimated detection probability was 0.55 (range = 0.23−0.83). Both VO and detection probability have remained relatively constant since 2005.

After adjusting for sampling and sightability, we estimated the population in northeastern Minnesota at 4,700 (3,440–6,780, 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 2020). However, recent data suggest the population has at least stabilized and may even be increasing slightly, corroborated by a piecewise polynomial curve (Figure 3). This year's population estimate is only 47% less than the peak estimate in 2006 (early in the trend), compared to being 64% less in 2020, when the survey was last conducted. Although the long- term declining linear trend (2005−2022) remains statistically significant (r^2 = 0.593, P< 0.001, Figure 2), the overall strength of the decline has been weakened by recent population estimates. These conclusions are further supported by our Bayesian time-series model (Addendum A). As predicted, the TSM approach reduced uncertainty associated with annual population estimates and smoothed the changes between consecutive years and over the long- term (2005−2022) (Addendum A). But regardless of the method, we caution that current population trends do not necessarily predict future population trends, because underlying demographic factors affecting population abundance can change over time.

The January 2022 calf:cow ratio of 0.45 is notably greater than the 16-year average since 2005 (0.35, Table 1, Figure 4). Calves were 17% of the total 373 moose actually observed and represented 19% of the estimated population (Table 1, Figure 4). Twin calves were observed with 5 of the 154 (3%) 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 January 2022 remains relatively low, albeit somewhat improved 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, Severud et al. 2019). Calf survival by spring 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-collared moose changed little (85–88%) during 2014−2017 (Carstensen et al. 2017), but was slightly higher than the previous long-term (2002−2008) average of 81% (Lenarz et al. 2009).

The January 2022 estimated bull:cow ratio (0.94, Table 1; Figure 5) is similar to the long- term average of 1.00 during 2005–2020, but greater than the mean ratio of 0.87 observed during 2009−2012, when the population decline was steepest. However, this ratio has been as low as 0.64 (2011) during the steep decline. During the recent 11-year (2012−2022) trend of stability, the average bull:cow ratio has been 1.10. However, due to the notable annual variability associated with the bull:cow ratios, the apparent upward trend line is not statistically meaningful (Figure 5).

ACKNOWLEDGMENTS

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Table 1. Estimated moose abundance, 90% confidence intervals, calf:cow ratios, percent calves in the population, percent cows with twins, and bull:cow ratios from aerial surveys in northeastern Minnesota, 2005–2022. *The survey was not conducted in 2021 due to the Covid-19 pandemic.

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 – 9,150	0.29	13	3	0.89
2008	7,890	6,080 – 10,600	0.36	16	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	12	3	1.23
2014	4,350	3,220 – 6,210	0.44	17	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
2019	4,180	3,250 – 5,580	0.32	13	3	1.24
2020	3,150	2,400 – 4,320	0.36	18	2	0.90
2022	4,700	3,440 – 6,780	0.45	19	3	0.94

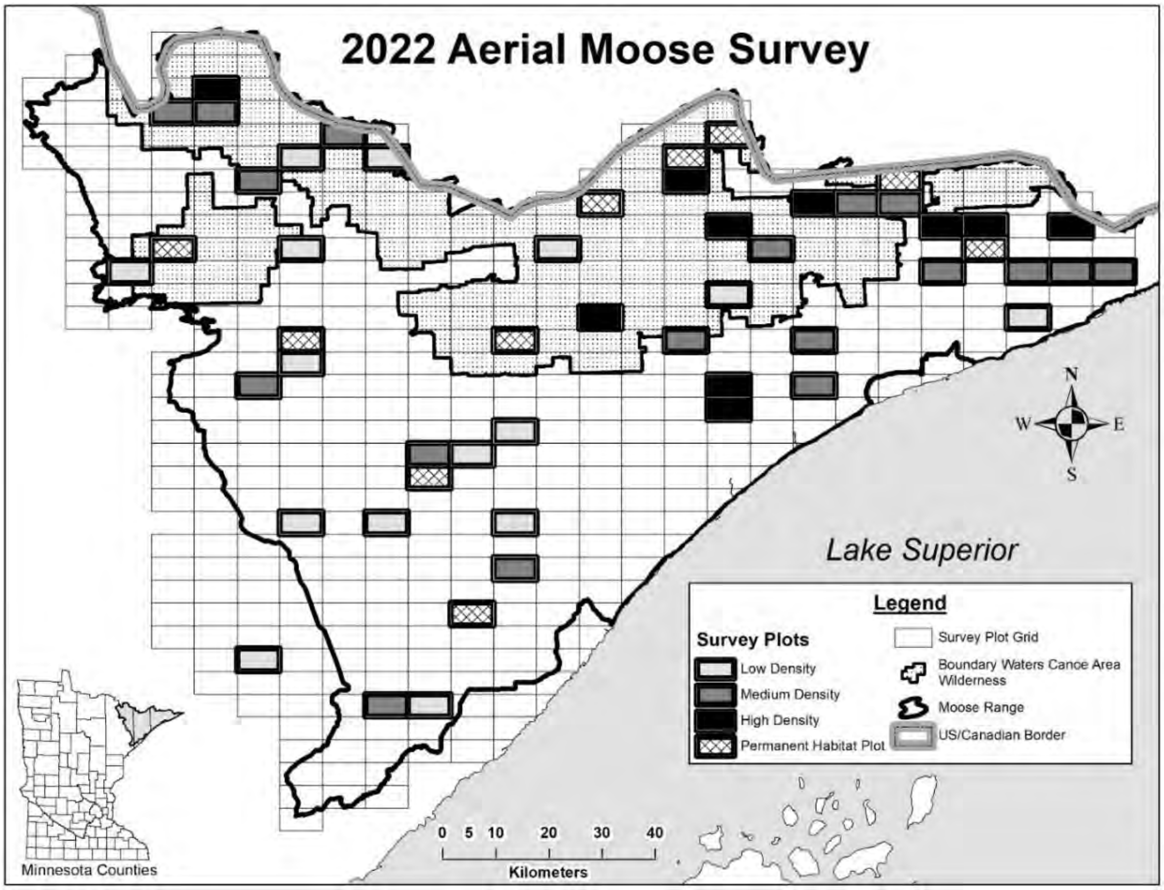

Figure 1. Moose survey area and 53 sample plots flown in the 2022 aerial moose survey.

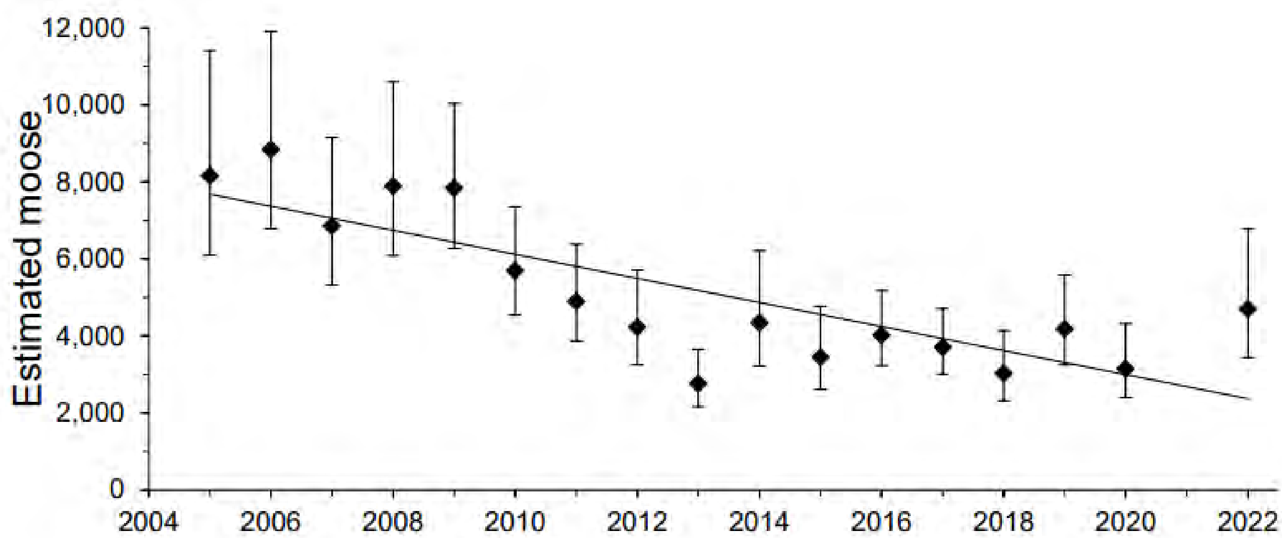

Figure 2. Point estimates, 90% confidence intervals, and a linear trend line of moose abundance in northeastern Minnesota, 2005–2022 ($y = -301x + 610455$, $r^2 = 0.593$, $P < 0.001$). Note: The 2005 survey was the first to be flown with helicopters, and to include a sightability model and a uniform grid of east-west oriented, rectangular 13.9-mi^2 plots. *The survey was not conducted in 2021 due to the Covid-19 pandemic.

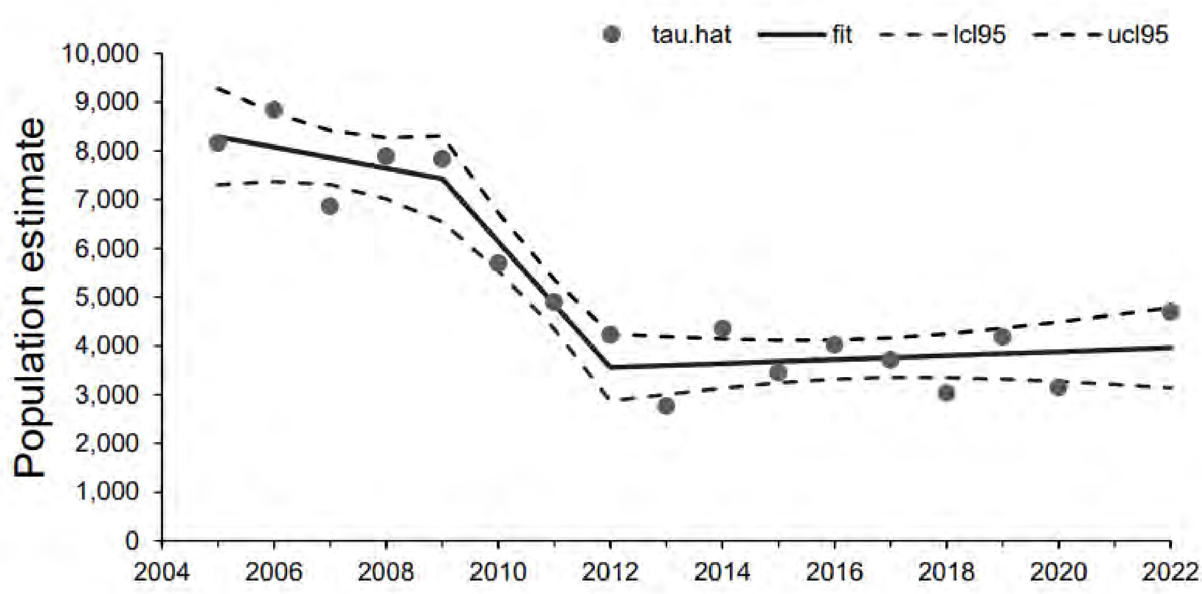

Figure 3. Point estimates, 95% confidence intervals (dashed lines), and a piecewise polynomial curve of moose abundance in northeastern Minnesota, 2005−2022 (Giudice 2022). This curve shows a change in the short-term slope of the trend from 2012 to 2022 compared to 2009 to 2012.

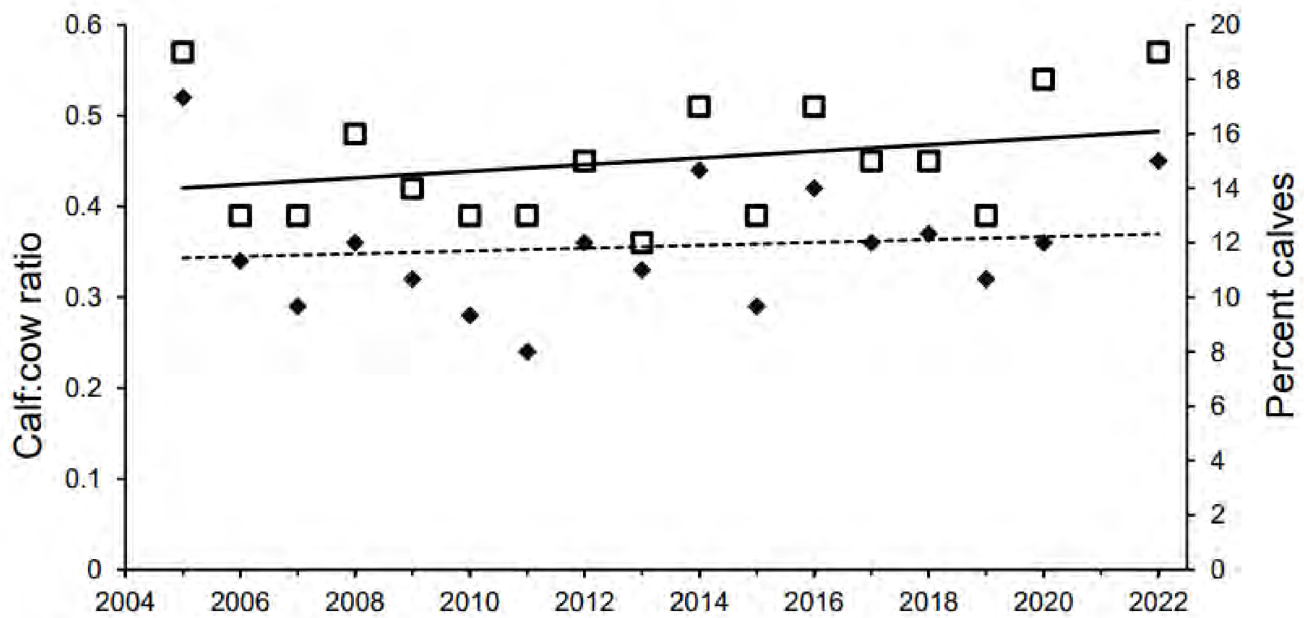

Figure 4. Estimated calf:cow ratios (solid diamonds, dashed trend line) and percent calves (open squares, solid trend line) of the population from aerial moose surveys in northeastern Minnesota, 2005–2022. *The survey was not conducted in 2021 due to the Covid-19 pandemic.

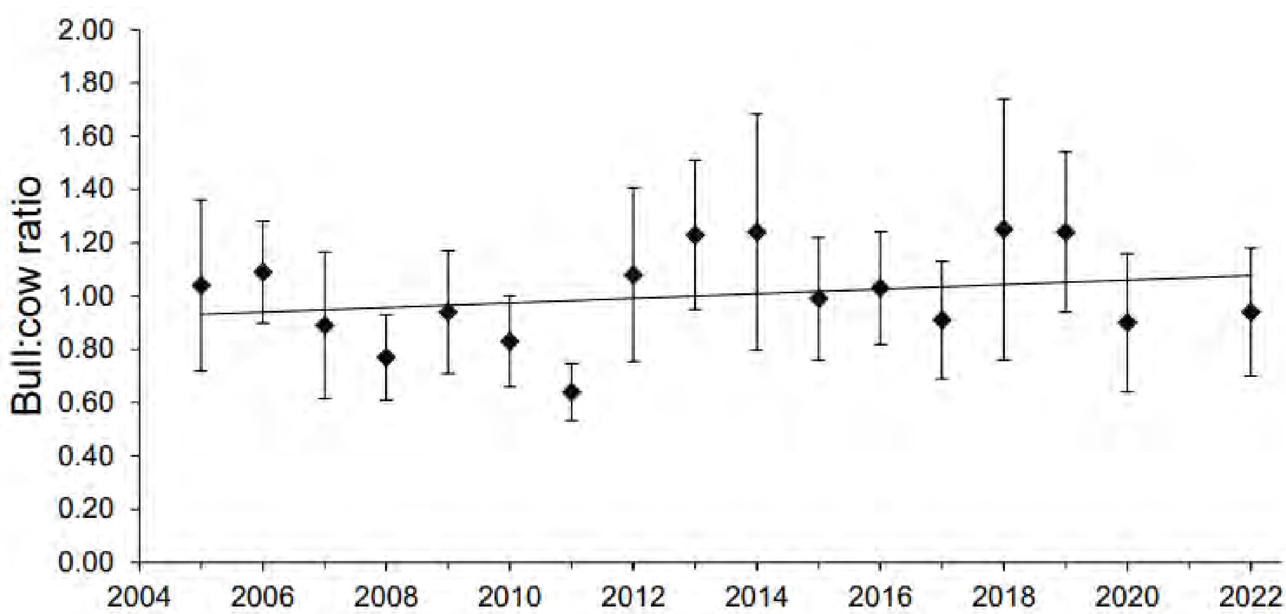

Figure 5. Estimated bull:cow ratios, 90% confidence intervals, and trend line from aerial moose surveys in northeastern Minnesota, 2005–2022. *The survey was not conducted in 2021 due to the Covid-19 pandemic.

ADDENDUM A: EXPLORING AN ALTERNATIVE MODE OF INFERENCE

John H. Giudice, Wildlife Biometrics Unit

Glenn D. DelGiudice, Forest Wildlife Populations and Research Group

INTRODUCTION

We currently use a design-based estimator (referred to as a modified Horvitz-Thompson estimator; mHT) with data from aerial surveys and a sightability model to compute estimates of moose abundance in northeastern Minnesota (see DelGiudice and Giudice 2022). Design-based estimators are analytical formulas derived from the principles of survey sampling (Cochran 1977, Thompson 2002). Design-based estimators are generally robust and have proven to be a useful and popular approach in wildlife population estimation. However, in the case of the moose survey, there are some important limitations, including imprecise annual estimates (due to high sampling uncertainty), large inter-annual variation (due to treating survey years as independent), and in some cases, estimates of population change that are biologically suspect. Furthermore, sampling issues in the low-density stratum and the inability to make inferences to sub-regions of the NE moose range (the Small Area Estimation conundrum) are problematic. Significantly increasing the sampling effort to ameliorate these issues is not a viable alternative in this case.

One potential solution is to explore an alternative model-based mode of inference (*sensu* Gregoire 1998, Chambers and Clark 2012). Under this paradigm, the focus switches from expanding the sample using analytical formulas and survey weights (design-based inference) to prediction/imputation (for unsampled plots) given the sample data, survey design, and distributional assumptions about how plot counts (moose groups) and group sizes are distributed over space (e.g., survey strata) and time (e.g., survey years). In 2011, Dr. John Fieberg of the MNDNR Wildlife Biometrics Unit (now a faculty member at the University of Minnesota) began research on a model-based estimator for the MN moose survey. He eventually published a peer-reviewed paper (Fieberg et al. 2013) that described a Bayesian model-based estimator that closely mimicked the design-based estimator (mHT) that we currently use. This is important, because it validates model and distributional assumptions that are integral to model-based estimators. The authors also noted the power and flexibility of their model-based approach for addressing complicated sampling issues (e.g., see the previous paragraph). ArchMiller et al. (2018) expanded on this research by developing a temporally smoothed Bayesian time-series model (TSM) estimator that allowed information on stratum-specific plot counts to be shared among survey years, which resulted in more precise population estimates and greatly reduced inter-annual variability. The TSM approach also has the potential to generate spatially explicit population estimates, which is a continuing area of research by Dr. Althea ArchMiller and Dr. John Fieberg.

The primary limitations of the TSM approach are that it is computationally expensive (e.g., it takes 4 days to run on a high-end computer) and it currently only generates estimates of the total population (vs. age/sex and stratum-specific population estimates). We resolved the first issue by purchasing a high-end desktop computer that is dedicated to biometrics simulation work. The second issue will be part of future work on the TSM estimator; in the interim, we can apply composition ratios (generated using conventional estimators) to the TSM population estimate to derive estimates of bulls, cows, and calves. Thus, as part of our continued effort to improve inferences from the moose survey, we fit the TSM estimator to moose survey data from 2005-2022 and compared it to conventional estimates derived using the design-based mHT approach. In this addendum, we describe the results of this exploratory analysis and discuss the potential benefits and challenges of using the TSM approach going forward.

RESULTS AND DISCUSSION

Similar to the findings of ArchMiller et al. (2018), the TSM estimator generated more precise population estimates than the mHT estimator (Figure 1A) and it greatly reduced inter-annual variability in both estimates of abundance and log rates of population change (Figure 1A,B). The estimated log rates of change from the TSM approach are also more biologically plausible, especially for a species with relatively low reproductive potential (e.g., see years 2013-2015 and 2019-2022 in Figure 1B). Likewise, it is easier to visualize estimated population trend(s) with the TSM approach compared to the mHT approach where it can be difficult to separate true population changes from sampling noise, especially when comparing annual estimates (Figure 1A). Nevertheless, the big-picture conclusion from both methods is the same: the population declined significantly from a high of about 8,000 animals in 2005-2006 to a low of about 3,000 animals, and it has only recently (the last 4-5 years) exhibited signs of slow but positive population growth. It is just easier to visualize with the TSM approach. However, we caution that survey estimates (from either method) should not be the only metric used to inform management decisions. The greatest utility comes from combining survey estimates with ancillary information from the aerial survey (e.g., proportion of moose with hair loss), directed field studies (e.g., annual estimates of survival and fecundity, moose health research, snow-urine analysis, habitat research), and professional on-the-ground expertise.

Composition-specific population estimates exhibit slightly less inter-annual variation when derived using TSM population estimates, whereas overall trends are similar for both approaches. Nevertheless, annual variation in subpopulation estimates is high for both approaches and probably reflects sampling uncertainty more than process variation (i.e., true annual variation in composition rates). The ultimate issue with subpopulation estimates is large sampling uncertainty associated with conventionally derived composition-ratio estimates, especially calf:cow and bull:cow ratios (see DelGiudice and Giudice 2022). Resolving this issue is more complicated than the challenge of estimating overall abundance. Thus, we urge caution when making inferences about composition-specific population estimates, regardless of whether they are based on mHT or TSM population estimates.

CONCLUSIONS

1. If we treat years as independent, then the model-based approach mimics our conventional design-based estimator. The code looks different, but the assumptions and estimates are fundamentally the same.
2. Treating years as independent is fine, but sometimes it can lead to estimated population changes that are not biologically reasonable (especially for a species with low reproductive potential). In addition, the precision of annual estimates is relatively poor.
3. Allowing the sharing of information among years (TSM) helps smooth out annual fluctuations and reduces uncertainty in annual population estimates. However, we acknowledge that smoothed estimates (TSM method) could occasionally mask a true large population change (e.g., high winter mortality due to an epizootic event), at least until additional years of data are available for the time series. Nevertheless, one could make similar incorrect conclusions under the mHT method because of high sampling uncertainty (e.g., the sample data may not be representative in some years). Thus, regardless of whether we use the mHT or TSM method, it is important to consider ancillary information from surveys (e.g., proportion of moose with hair loss), directed field studies (e.g., annual estimates of survival and pregnancy rates), and professional on-the-ground expertise when making management decisions.

4. Regardless of the approach (mHT vs. TSM), the implications are consistent: there was a significant population decline from a high of about 8,000 moose to a low of about 3,000 moose, but the population appears to have at least stabilized and there is some evidence of slow, positive growth the last 4-5 years. The trend is just easier to visualize with the TSM approach.
5. Compared to the mHT approach, the Bayesian TSM approach offers more flexibility to deal with sampling and estimation issues, including missing data, sampling and estimation issues in the low-density strata, non-linear trends, spatially explicit population estimates, etc.
6. The TSM approach has many potential benefits, but we acknowledge there are some limitations too. It is computationally expensive (computer time) and requires a high-level of technical expertise to modify and run the analysis each year. The TSM estimator is complicated and thus challenging to explain to a lay audience (the black-box conundrum). Historic population estimates can change (albeit trivially in most cases) with the addition of new data (years), with each model run (due to the simulation-component of the Bayesian TSM), or if model and/or distributional assumptions are modified in the future.
7. We could theoretically estimate composition ratios via the TSM approach too, but it would take a lot of coding work and some new assumptions. We currently use the Combined Ratio Estimator (Cochran 1977:165) to compute composition ratios, which means they do not depend on sightability or the mHT estimator. Furthermore, ratio statistics are not population totals and do not need to be expanded for sampling; thus, if the sample is representative, then the estimated ratios should be too. Unfortunately, the precision of our ratio estimates is relatively poor and inter-annual variability is high, which limits the utility of our composition ratios as monitoring metrics (especially cow:calf and bull:calf ratios). Nevertheless, for simplicity and consistency, we could continue to use our conventional estimator to compute composition ratios and simply apply those ratios to the TSM estimate to derive subpopulation estimates, although we would still recommend caution when making management decisions based on subpopulation estimates.

NEXT STEPS

1. At least for the next few years, we will continue to use our conventional mHT-derived population estimates to make management and harvest decisions. Even if or when we switch to the TSM approach for inference, we will likely continue to compute mHT-derived population estimates because it is an efficient method and would provide a check on model- based estimates. The challenge will be how to present the two estimates in way that will not cause confusion with our constituents.
2. We will continue to conduct research on the TSM estimator, including some additional investigative work on the temporal smoother (e.g., number and location of nodes) and the potential for deriving smoothed estimates of composition ratios and subpopulation components (cows, bulls, calves).
3. Dr. Althea ArcMiller and Dr. John Fieberg are working on a Bayesian TSM approach that could account for spatial covariates and potentially generate spatially explicit population estimates.

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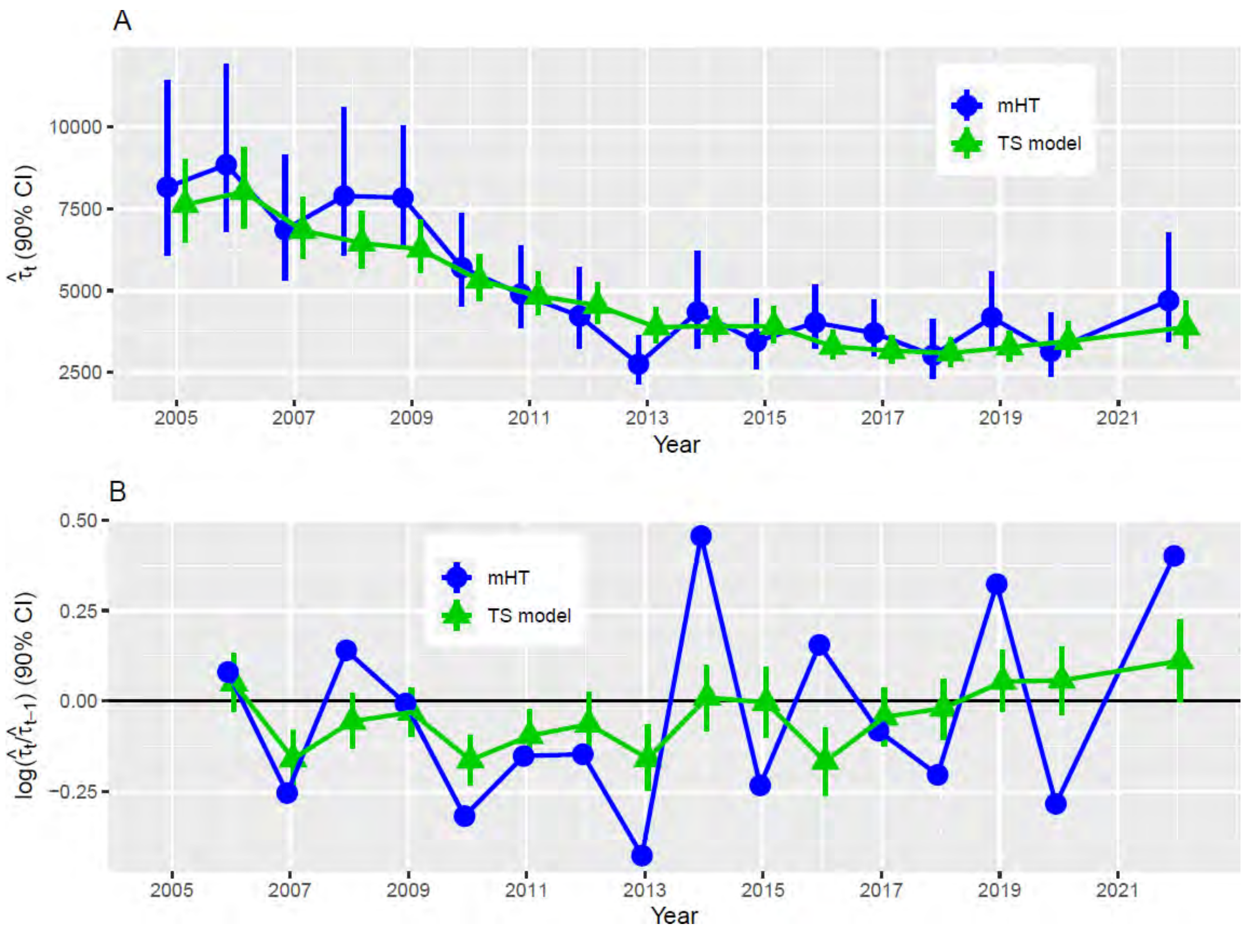

Figure 1. **A**) Moose population estimates (with 90% confidence intervals) from the TSM estimator (green) compared to the conventional mHT estimator (blue). **B**) Estimated log rates of population change (0 = no change, + = increase, – = decrease) using the TSM estimator (green) compared to the conventional mHT estimator (blue).

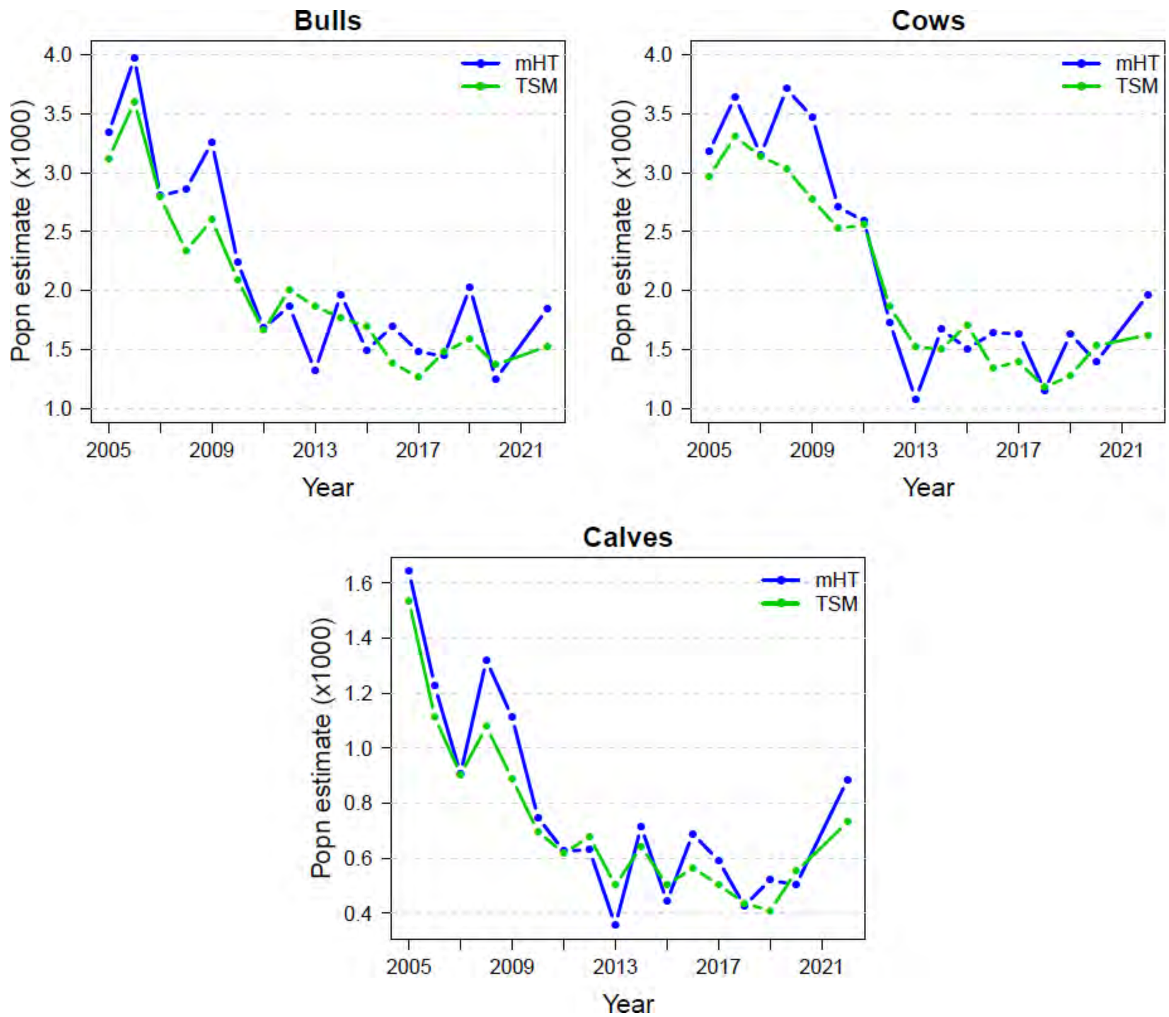

Figure 2. Population estimates for bulls, cows and calves based on the TSM estimator (green) compared to the conventional mHT estimator (blue). Note: these are approximations based on applying conventionally derived composition ratios (bull:cow and calf:cow) to mHT and TSM population estimates.

MINNESOTA WOLF POPULATION UPDATE 2022

John Erb and Carolin Humpal, Forest Wildlife Populations and Research Group

INTRODUCTION

Since the late 1970's, 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 of the state occupied by wolf packs. The methods employed have changed only slightly during this time. Initially, surveys were conducted at approximately 10-year intervals (1978, 1988, 1997), thereafter at approximately 5-year intervals (2003, 2007, 2012). 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). These results were generally consistent with separate wolf population trend indicators (annual scent station survey, winter track survey, and number of verified depredations) in Minnesota.

In 2012, wolves in the Western Great Lakes Distinct Population Segment were removed as a listed species under the federal Endangered Species Act. The de-listing coincided with the normally scheduled (every 5th year) wolf survey as well as survey timeline specifications in the Minnesota Wolf Management Plan (i.e., first and fifth year after delisting; Minnesota Department of Natural Resources 2001). The 2012-13 survey (Erb and Sampson 2013) concluded that overall wolf range had expanded along its south and west edge, but with only minor change in the total amount of land occupied by wolf packs; similar patterns were found 5 years later as part of the winter 2017-18 survey (Erb et al. 2018).

After federal de-listing in 2012, wolf harvest seasons were established and population surveys have been conducted annually to better inform annual management decisions. In the first three winters after de-listing, wolf population point estimates varied from approximately 2,200 to 2,400 (Erb et al. 2014). In December 2014, following the third consecutive wolf harvest season, a court ruling returned wolves in Minnesota to the list of federally threatened species. Since that time, wolf surveys have continued on an annual basis. Herein we provide an update of population status from the 2021-22 winter survey.

METHODS

The methodology used to estimate wolf population size in Minnesota utilizes three primary pieces of information: 1) an estimate of the total area of land occupied by wolf packs; 2) an estimate of average wolf pack territory size; and 3) an estimate of average mid-winter pack size. It is likely that occupied range changes on a comparatively slow timescale compared to fluctuations in average territory and pack size. As such, occupied range is estimated at approximately 5 year intervals, with the last being during winter 2017-18; we assume that occupied range has remained unchanged (i.e., 73,972 km^2; Erb et al. 2018) and use that in our population calculations for winter 2021-22.

To track pack movements, 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. Some wolves are also captured with the use of live-restraining neck snares (Gese et al. 2019), and a few by helicopter dart-gun. Wolves were typically immobilized using a mixture of either Ketamine:Xylazine or Telazol:Xylazine. After various project-specific wolf samples and measurements were obtained, an antagonist (Yohimbine or Atipamezole) and an antibiotic were typically administered to all animals prior to release. Various models of tracking collars were deployed depending on study area and collar availability. Most GPS collars were programmed to take 3-6 locations per day, and wolves fitted with VHF-only 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 collared packs using minimum convex polygons (MCP) for consistency with previous surveys. Prior to delineating wolf pack territories, we removed 'outlier' locations using the following guidelines, though subjective deviations were made in some cases as deemed biologically appropriate: 1) for wolves with approximately weekly VHF locations only, locations > 5 km from other locations were excluded as extraterritorial forays (Fuller 1989); 2) for GPS collars that provided 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 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), locations that result in notable overlap with adjacent territories are removed.

In past surveys where all or the majority of territories were delineated using comparatively few VHF locations, raw territory sizes were increased 37% to account for the average amount of interstitial space between delineated wolf pack territories, as estimated from several Minnesota studies (Fuller et al. 1992:50) where the number of VHF locations per pack typically averaged 30-60. Interstitial spaces are a combination of small voids created by landscape geometry and wolf behavior, but can also be an artifact of territory underestimation when there are fewer locations. Hence, for packs with < 100 locations (n = 7; mean number of locations = 41), we multiplied each estimated territory size by 1.37 as in the past. For packs with > 100 locations (n = 33; mean number of locations = 2,748), territories were assumed to be fully delineated and not re-scaled.

To estimate average mid-winter pack size, collared wolves were repeatedly located via aircraft during winter to obtain visual counts of pack size. In cases where visual observations were limited, we also rely on any estimates of pack size based on tracks observed in the snow and trail camera images from within the pack's territory. If any reported count produced uncertain estimates (e.g., 4 to 5 wolves), we used the lower estimate. Overall, counts are assumed to represent minimum known mid-winter pack size.

The estimated number of packs within occupied wolf range is computed by dividing the area of pack-occupied range 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 method (Manly 1997), the population size confidence interval (90%) 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. For purposes of discussion, we base our informal assessments of significant differences in results across years on visual comparison of the degree of confidence interval overlap (Cumming and Finch 2005).

RESULTS AND DISCUSSION

Pack and Territory Size

We obtained data on 40 packs that were monitored during all or part of the survey period (April 2021 to April 2022). Both territory and winter pack size data were available from 37 marked wolf packs (Figure 1). Three additional wolf packs had adequate location data to delineate territories, but we were unable to obtain a reliable mid-winter pack count.

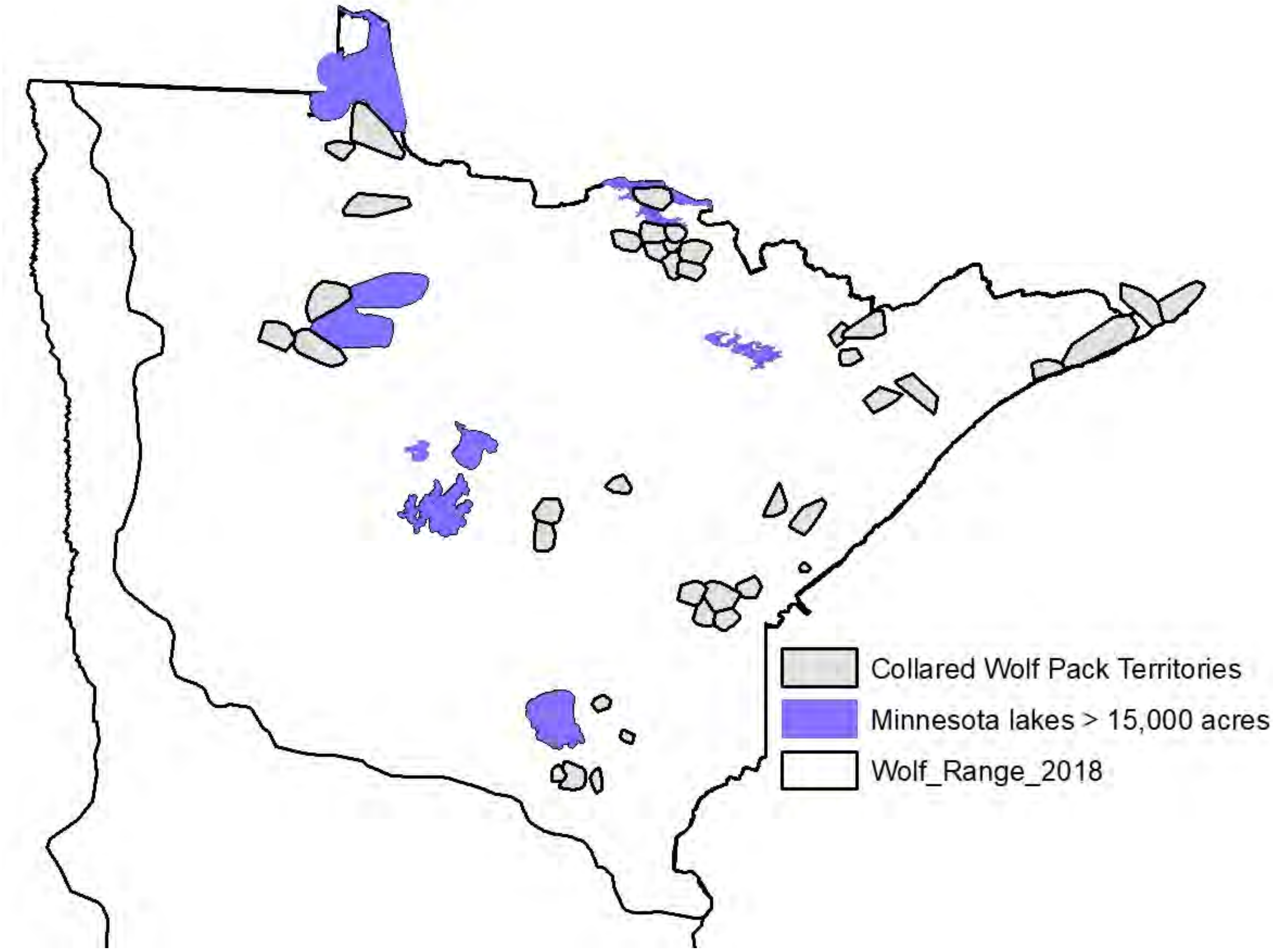

Figure 1. Location of territories for marked wolf packs during the 2021-22 survey.

A land cover comparison using the 2019 National Land Cover Database suggests that land cover in territories of collared packs closely reflected habitat in overall occupied wolf range, with some under-representation of agricultural cover types in collared pack territories (Table 1). Using spring 2021 deer density data (MNDNR, unpublished data) for deer hunting permit areas, weighted by number of radio-collared wolf packs in a permit area, we estimate an average of approximately 14.4 deer/mi^2 (pre-fawn) in territories of radio-marked packs during spring 2021. In comparison, 2021 spring deer density for the entirety of occupied wolf range, weighted by permit area and excluding permit areas within which a majority of the area is not considered pack-occupied, was approximately 17.7 deer/mi^2.

Table 1. Comparison of land cover[a] in territories of radio-collared wolf packs 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	38.2	38.1
Deciduous Forest	17.5	17.7
Emergent Herbaceous Wetlands	10.9	8.3
Mixed Forest	11.3	14.4
Evergreen Forest	5.3	7.6
Open Water	4.8	5.6
Shrub/Scrub	1.8	2.0
Pasture/Hay/Grassland/Crops	7.8	4.3
Developed, All	2.3	1.9

[a] Land cover data derived from the 2019 National Land Cover Database

Following some decline the previous 2 years, the point estimate for average territory size in winter 2021-22 increased back to a level like other years post-2002 (Figure 2). After applying the territory scaling factors, average estimated territory size for radio-marked packs during the 2021-22 survey was 148.4 km^2 (range = 25 – 463 km^2).

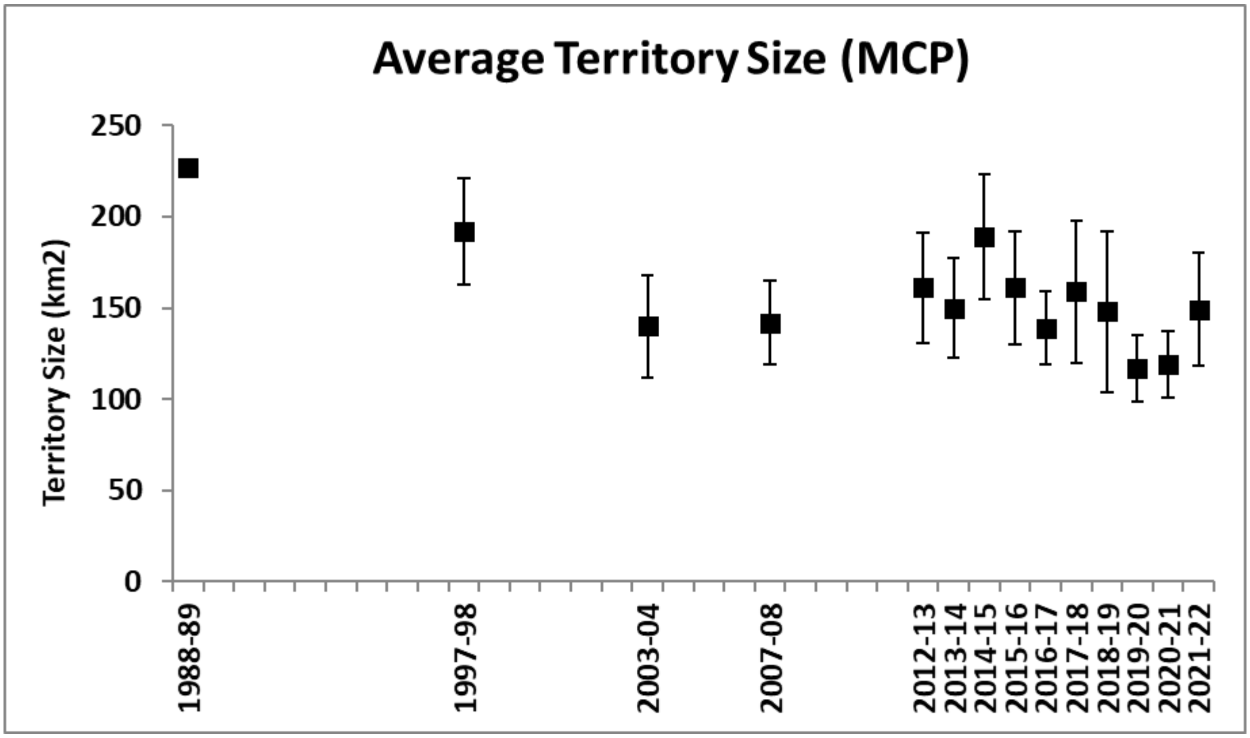

Figure 2. Average scaled territory size for marked wolf packs in Minnesota from winter 1988-89 to 2021-22.

Similar to changes in average territory size but with an opposite effect on the abundance estimate, the point estimate for average winter pack size, after declining the past 2 years, increased 21% back to a level near other post-2011 estimates (Figure 3). Average winter pack size in 2021-22 was estimated to be 4.59 (range = 2 – 9).

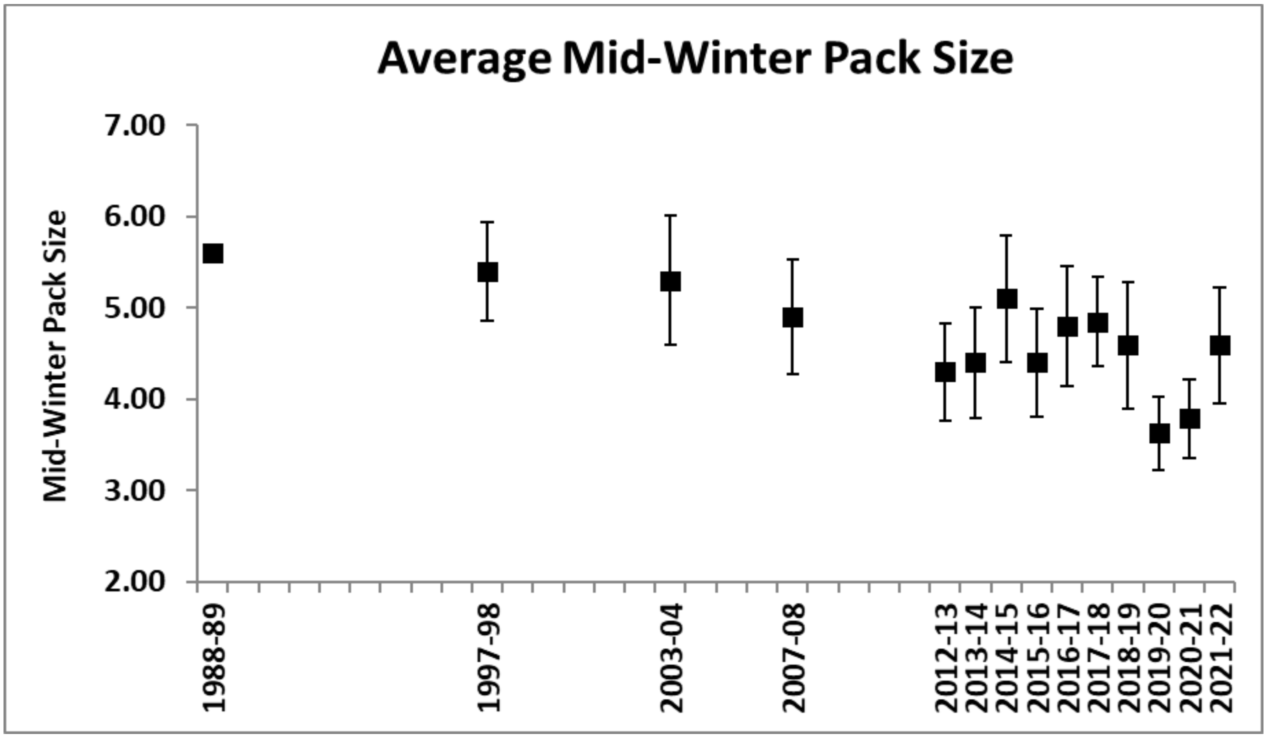

Figure 3. Average mid-winter pack size for marked wolf packs in Minnesota from winter 1988-89 to 2021-22.

Wolf Numbers

With an average territory size of 148 km^2 and assuming that occupied range has not changed since the 2017-18 survey (73,972 km^2; Erb et al. 2018), we estimate a total of 498 wolf packs in Minnesota during winter 2021-22 (Figure 4). Although also influenced by the estimated amount of occupied range, trends in the estimated number of packs are inversely correlated with trends in estimated territory size (i.e., for a given amount of occupied range, increases in average territory size yield lower estimates of the number of packs within the state).

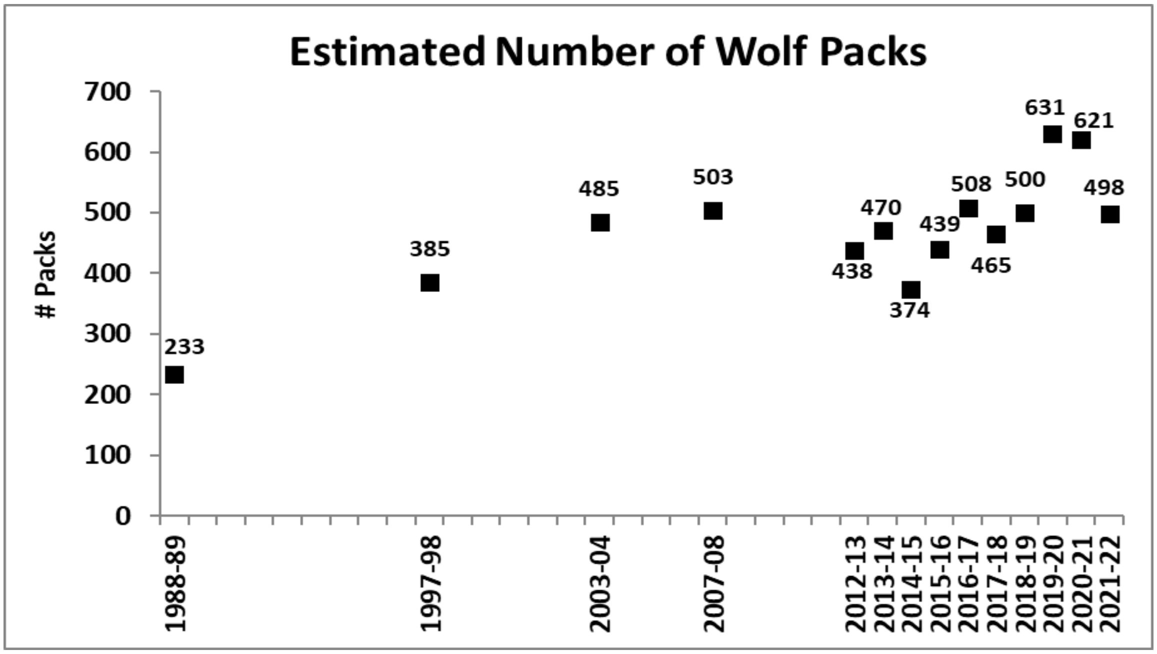

Figure 4. Estimated number of wolf packs in Minnesota at periodic intervals from winter 1988-89 to 2021-22.After accounting for the assumed 15% lone wolves in the population, we estimate the 2021-22 mid-winter wolf population to be 2,691 wolves, or 3.6 wolves per 100 km^2 of occupied range. The 90% confidence interval was approximately +/- 500 wolves, specifically 2,173 to 3,240. Given the nearly complete overlap with the 2020-21 confidence interval, we conclude that the 2021-22 statewide wolf population size was unchanged from the previous winter, but with fewer and larger packs occupying larger territories compared to the past 2 winters.

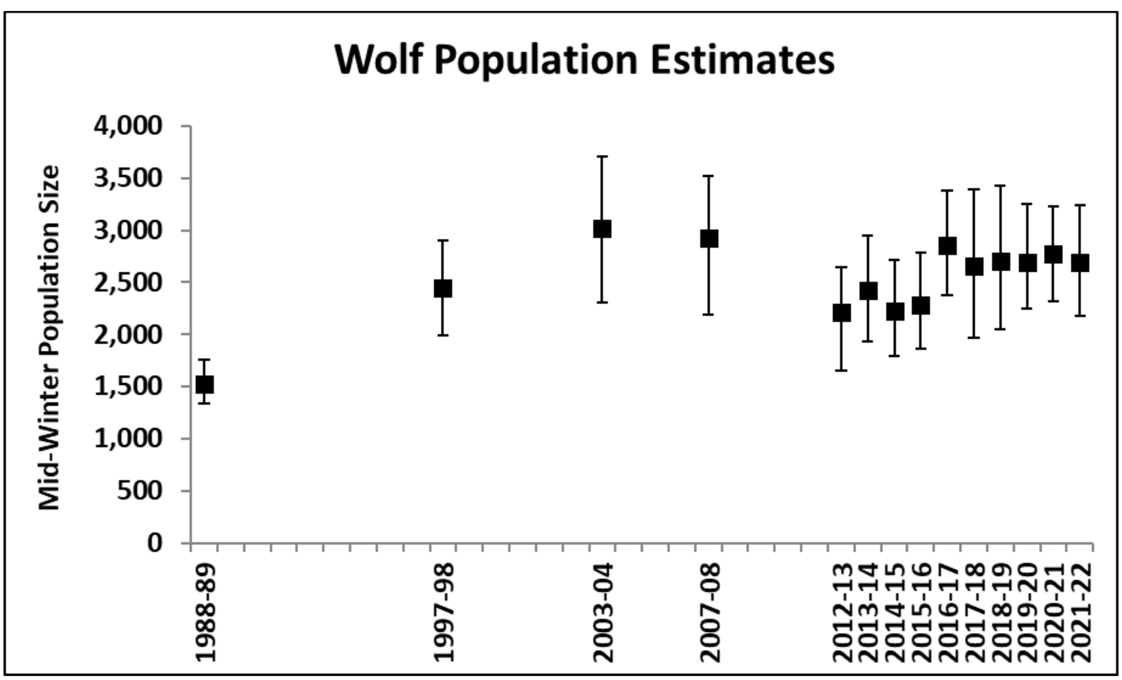

Figure 5. Wolf population estimates from periodic standardized surveys in Minnesota from winter 1988-89 to 2021-22.

From spring 2020 to spring 2021, average weighted deer density within pack-occupied wolf range increased 16%, though with much spatial variability (17% decline to 50% increase) across permit areas. Due to periodic recalibration or changes to deer modeling methods, the relationship between estimated wolf and deer trends may have time-varying degrees of uncertainty and should be treated with caution, but over the past 11 years the trend in winter wolf population size has been positively correlated with average deer density within wolf range the preceding spring (Figure 6).

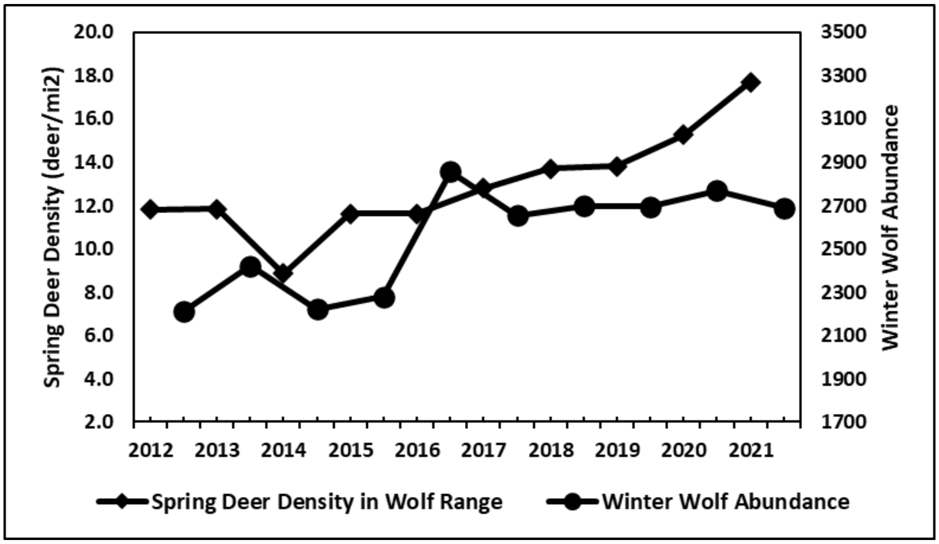

Figure 6. Comparison of estimated spring (pre-fawn) deer density in pack-occupied wolf range with winter wolf abundance in Minnesota, 2012-2021.

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WETLAND WILDLIFE POPULATIONS

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2022 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. Surveys were not conducted in 2020 or 2021 due to COVID-19 restrictions. The 2022 aerial survey portion was flown from May 4-22. Overall, it was a very late spring across the state, especially in the northern portions. Spring ice-out dates were near median dates in southern MN but 2-3 weeks later than median dates in northern MN. Temperatures in April averaged 5.5°F below normal statewide and was the 10th coldest April on record (1895-2022). Temperatures in May averaged 1.4°F above normal statewide and were near the long-term median temperatures. Precipitation was 1.61 inches above normal in April and the 6th wettest April on record (1895-2022). Precipitation in May was 1.76 inches above normal and the 15th wettest May on record (1895-2022). Overall, wetland numbers (Types II-V) were 19% higher than 2019 and 21% above the 10-year and 3% above the long-term average. This was the 4th wettest spring since 1968.

The 2022 estimated mallard breeding population was 231,000, which was 19% lower than the 2019 estimate of 286,000 mallards but statistically unchanged (P=0.28). Mallard numbers were 9% below the 10-year average and unchanged from the long-term average of 230,000 breeding mallards. The estimated blue-winged teal population was 161,000, which was 28% below the 2019 estimate of 223,000 blue-winged teal, but statistically unchanged (P=0.45). Blue-winged teal numbers were 10% below the 10-year average and 24% below the long-term average of 211,000 blue-winged teal. The combined population index of other ducks, excluding scaup, was 175,000 ducks, which was 6% below the 2019 estimate of 185,000 ducks, 7% below the 10-year average and 3% below the long-term average of 180,000 other ducks.

The estimate of total duck abundance (567,000), which excludes scaup, was 18% below the 2019 estimate and 9% below the 10-year average and 9% below the long-term average of 622,000 ducks. The estimated number of Canada geese was 115,000 and 4% above the 2019 estimate, 20% below the 10-year average and 27% below the long-term average. The estimated number of swans was 25,000. The swan population continues to increase and expand their breeding range across the state.

Due to the late spring, nesting effort and production (number of young produced) is expected to be below average for both ducks and Canada geese.

METHODS: The aerial survey is based on a sampling design that includes three survey strata (Table 1, Fig. 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).

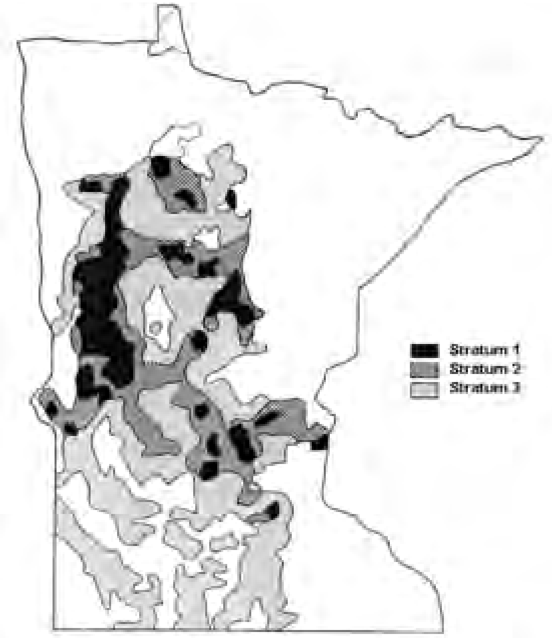

Figure 1. Location of waterfowl breeding population survey strata in Minnesota.

All aerial transects in Strata I-III (Table 1) were flown using an American Champion Scout and Cessna 185. 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 2019 and 2022 were compared using two-tailed Z-tests.

SURVEY CHRONOLOGY: The 2022 aerial survey began on 4 May in southern Minnesota and concluded in northern Minnesota on 22 May. Transects were flown on 10 days (May 4-5, May 11, May 14-18, May 21-22) 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 16, which was similar to 2019. Much of northern MN was still ice-covered on May 4 but most lakes opened by May 11.

WEATHER AND HABITAT CONDITIONS: For the southern 1/3 of the state, ice out was near historical median dates. For the northern 2/3 of the state, ice out was 2-3 weeks later than median dates. Temperatures in April averaged 5.5°F below normal and precipitation was 1.61 inches above normal statewide. Temperatures in May averaged 1.4°F above normal statewide and precipitation was 1.76 inches above normal statewide (http://climate.umn.edu). Precipitation from early April until the survey was completed showed well above average precipitation in northern and central Minnesota and below average precipitation in southern Minnesota (Appendix A).

Overall wetland conditions in spring 2022 were improved from last year. In early May 2022, the U.S. drought monitor indicated 94% of the state was under no dryness designation. By late May, 98% of the state was under no drought designation. On May 15, statewide topsoil moisture indices were rated as 0% very short, 1% short, 64% adequate and 35% surplus moisture compared to 14% very short, 37% short, 48% adequate, and 1% surplus last year (http://droughtmonitor.unl.edu).

Wetland numbers (Types II-V) in 2022 were an estimated 341,000 ponds, which was 9% above the 2019 estimate of 313,000 ponds. Wetland numbers were 21% above the 10-year average and 33% above the long-term average (Table 2; Fig. 2) and the 4th highest on record (1968-2022). The number of temporary (Type 1) sheet water wetlands was 52% higher than 2019 and 67% above the long-term average.

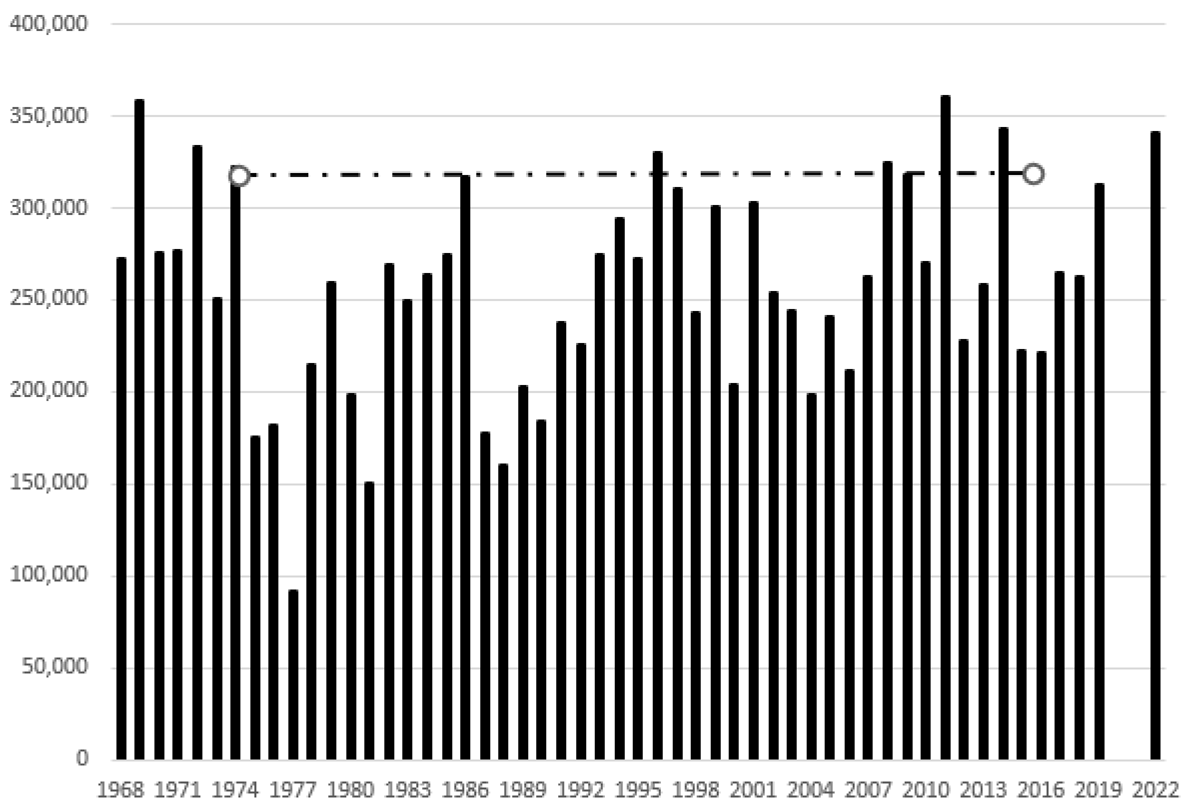

Figure. 2. Number of May ponds (Type II-V) and long-term average (dashed line) in Minnesota, 1968-2022.

Planting dates for row crops were very late in 2022. On May 15, only 35% of the corn acres had been planted compared to 94% in 2021. Similarly, only 11% of soybean acres had been planted by May 15 compared to 85% in 2021. By June 5th, about 23% of alfalfa hay had been cut compared to 53% last year (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 2022 breeding population estimate of mallards was 231,000 (SE = 36,411), which was 19% lower than the 2019 estimate of 286,000 mallards, but statistically unchanged ($Z = 1.09$, $P = 0.28$) (Table 7, Fig. 3). Mallard numbers were 9% below the 10-year average and unchanged from the long-term average of 230,000 mallards. In 2022, the mallard population was comprised of 77% lone or flocked males, 13% pairs, and 11% flocked mallards. The 5-year average is 79% lone or flocked males, 13% pairs, and 8% flocked mallards.

The 2022 breeding population estimate of blue-winged teal was 161,000 (SE = 69,123), which was 28% lower than the 2019 estimate of 223,000 blue-winged teal, but statistically unchanged ($Z = 0.76$, $P = 0.45$). Blue-winged teal numbers were 10% below the 10-year average and 24% below the long-term average (Table 7, Fig. 4). The blue-winged teal population was comprised of 11% lone males, 47% pairs, and 42% flocks. The 5-year average is 10% lone males, 43% pairs, and 47% flocks. With the late spring, it is likely that some blue-winged teal were still south of Minnesota when the survey began.

The combined population estimate of other ducks (excluding scaup) was 175,000 which was 6% below the 2019 estimate of 185,000 other ducks, 7% below the 10-year average and 3% below the long-term average (Table 7, Fig. 5). Wood ducks, ring-necked ducks, and buffleheads were the most abundant species of other ducks (Table 6). Scaup numbers (40,000) were 2% below the 2019 estimate and 33% below the long-term average.

The total duck population index, excluding scaup, was 567,000 ducks and was 18% below the 2019 estimate of 695,000 ducks and 9% below the 10-year average and 9% below the long-term average (Table 8, Fig. 6).

The population index for total ducks was 607,000 ducks, which was 17% below the 2019 estimate, 8% below the 10-year average and 11% below the long-term average.

Annual Visibility Correction Factors (VCFs) are calculated and used for mallards, blue-winged teal, other ducks combined, and Canada geese (Table 7, Table 8). In 2022, the VCFs were very low for all species. The mallard VCF (1.84) was 22% below the 10-year average. The blue-winged teal VCF (3.60) was 5% below the 10-year average. The VCF for other ducks (2.23) was 15% below the 10-year average. The VCF for Canada geese (1.36) was 26% below the 10-year average and the lowest on record (1988-2022). Due to the extremely late spring, leaf out and emergence of wetland vegetation was not an issue during the survey.

The population estimate of Canada geese (adjusted for visibility) was 115,000, which was 4% above the 2019 estimate and 20% below the 10-year average (Table 8, Fig. 7). A total of 19 Canada goose broods were observed. The 5-year average is 27 Canada goose broods observed (range: 2-56). All goose broods observed were in the southern ½ of the state.

The estimated coot population, uncorrected for visibility, was 57,317 compared to 4,700 in 2018. There were some large rafts of coots observed on the first 2 days of the survey, likely a result of lakes in northern Minnesota still being ice-covered.

The estimated number of swans (likely all trumpeters) was 25,100 compared to the 2019 estimate of 23,200 (Table 6; Fig. 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 increase in numbers and expand their range further south and west from core breeding areas in north central and central Minnesota.

ACKNOWLEDGMENTS: Thanks to the ground crews and the pilot for all of their efforts. This project was funded in part by the Wildlife Restoration (Pittman-Robertson) Program.

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

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

Ground Crew Leaders:

Wayne Brininger, USFWS, Tamarac National Wildlife Refuge; Natalie Yates, USFWS, Fergus Falls; John Riens, USFWS, Twin Cities; Bruce Davis, Minnesota DNR; Greg Dehmer, USFWS, Sherburne National Wildlife Refuge; Beth Rigby, USFWS

Ground Crew Assistants:

Jason Strege, Minnesota DNR; Gina Kemper, Ken Mattson, USFWS, Tamarac National Wildlife Refuge; Jackie Gehrt, Kris Spaeth, USFWS; Kyle Jenson, Trey Langston, Grayson Smith, USFWS

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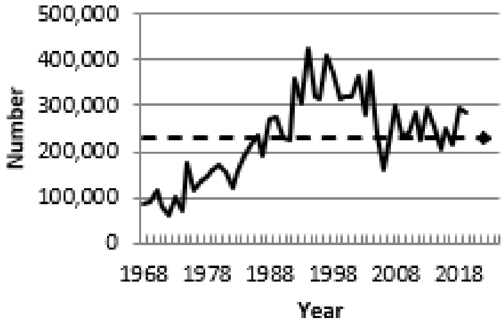


Figure 3. Mallard population estimates (adjusted for visibility bias) and long-term average (dashed line) in Minnesota, 1968-2022.

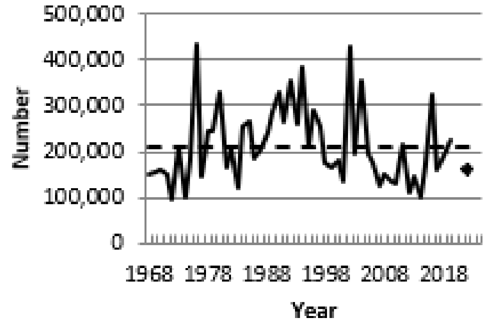


Figure 4. Blue-winged teal population estimates (adjusted for visibility bias) and long-term average (dashed line) in Minnesota, 1968-2022.

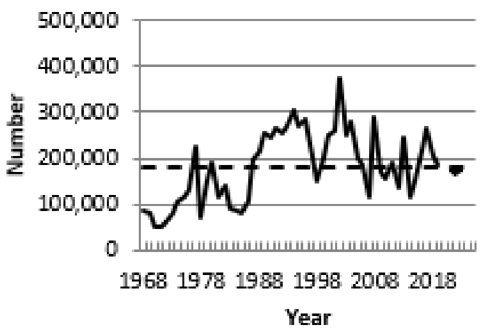


Figure 5. Other duck (excluding scaup) population estimates (adjusted for visibility bias) and long-term average (dashed line) in Minnesota, 1968-2022

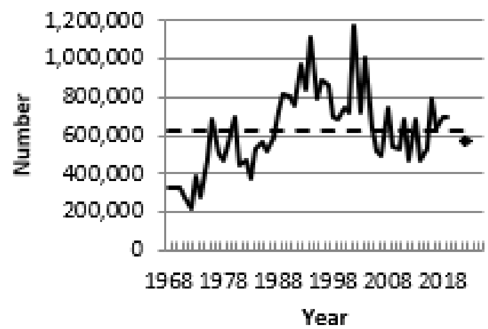


Figure 6. Total duck (excluding scaup) population estimates (adjusted for visibility bias) and long-term average (dashed line) in Minnesota, 1968-2022

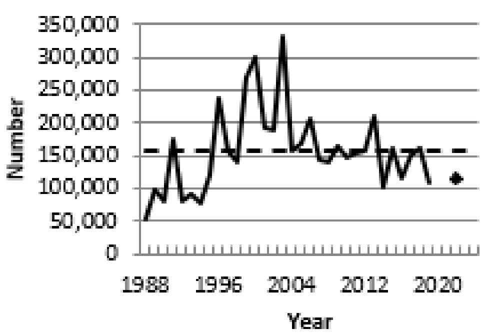


Figure 7. Canada goose population (adjusted for visibility bias) and long-term average (dashed line) in Minnesota, 1988-2022.

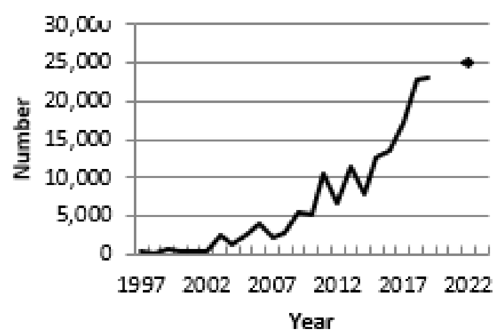


Figure 8. Trumpeter swan population in Minnesota, 1997-2022.

Table 1. Survey design for Minnesota, May 2022.[1]

	Stratum 1	Stratum 2	Stratum 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), 1968-2022.

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
			2019	66,000	313,000
			2020		
			2021		
			2022	100,000	341,000
		Averages:	10-year	48,000	281,000
			Long-term	60,000	256,000
		% change from:	2019	52%	9%
			10-year	108%	21%
			Long-term	67%	33%

[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, 2002-2022.

	Year																		
Species	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2022
Dabblers:																			
Mallard	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	23,632	22,466
Black Duck	0	0	0	56	0	0	0	0	0	0	0	333	167	222	0	56	0	0	0
Gadwall	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	167	278
American Wigeon	0	56	555	167	0	56	111	56	56	111	222	222	167	111	111	167	167	111	250
Green-winged Teal	278	222	444	56	56	167	278	167	56	56	56	0	0	56	111	278	0	0	56
Blue-winged Teal	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	3,860	5,360
Northern Shoveler	1,277	278	1,166	333	167	56	1,000	666	1,027	111	56	333	722	111	666	916	333	500	167
Northern Pintail	56	111	56	0	56	0	56	56	0	111	0	111	167	222	0	111	111	56	0
Wood Duck	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	5,276	3,971
Dabbler Subtotal	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	33,602	32,548
Divers:																			
Redhead	750	333	805	666	666	916	1,389	472	944	805	750	861	1,333	583	2,166	1,000	333	639	417
Canvasback	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	1,250	1,194
Scaup	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	2,694	1,250
Ring-necked Duck	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	6,220	2,055
Goldeneye	111	0	222	222	56	222	278	278	222	56	56	333	444	278	278	1,000	500	111	222
Bufflehead	222	111	389	167	222	56	1,611	833	389	278	56	611	56	278	500	2,444	611	222	1,027
Ruddy Duck	1,305	417	305	1,222	305	0	1,027	861	28	56	0	305	111	694	1,500	222	1,722	305	83
Hooded Merganser	555	333	278	333	555	111	666	944	555	500	555	333	666	1,000	1,222	1,222	1,222	2,333	1,111
Large Merganser	0	972	0	111	0	278	333	333	333	111	56	222	139	167	56	167	56	56	56
Diver Subtotal	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	13,830	7,415
Total Ducks	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	47,432	39,963
Other:																			
Coot	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	83	2,360
Canada Goose	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	18,717	18,967
Swan	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	4,665	6,748

Table 4. Minnesota waterfowl breeding populations by species for Stratum II (medium wetland density), expanded for area but not visibility, 2002-2022.

	Year																		
Species	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2022
Dabblers:																			
Mallard	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	33,312	32,903
Black Duck	0	0	0	0	0	0	0	0	0	0	0	0	0	117	0	0	117	0	0
Gadwall	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	4,091	1,052
American Wigeon	0	0	2,513	117	0	0	351	0	351	0	117	234	0	234	234	1,052	234	468	234
Green-winged Teal	468	234	234	0	117	0	0	234	117	0	0	117	351	584	0	0	0	117	117
Blue-winged Teal	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	9,760	8,240
Northern Shoveler	2,221	1,403	1,753	234	584	351	468	701	2,513	1,052	0	351	935	877	935	3,857	584	2,279	935
Northern Pintail	0	117	0	0	0	234	0	0	0	234	0	0	117	0	0	0	0	117	234
Wood Duck	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	4,792	4,442
Dabbler subtotal	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	54,936	48,157
Divers:																			
Redhead	234	584	1,110	292	175	935	935	584	760	1,578	468	468	526	468	1,110	818	117	175	117
Canvasback	468	1,052	234	0	0	1,169	468	234	117	584	117	935	1,286	1,169	1,403	2,338	234	701	351
Scaup	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	1,052	1,636
Ring-necked Duck	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	3,214	4,675
Goldeneye	234	234	351	117	117	0	351	584	468	468	584	935	1,519	935	1,169	818	234	234	1,403
Bufflehead	1,169	117	468	351	117	117	1,403	818	643	1,403	468	0	818	0	234	2,279	584	234	3,682
Ruddy Duck	1,870	2,688	0	351	58	0	0	175	409	58	234	117	0	351	643	468	0	1,461	0
Hooded Merganser	701	701	234	234	351	234	584	701	117	2,221	1,636	701	234	1,169	2,455	3,448	1,403	2,045	1,403
Large Merganser	0	0	234	351	0	0	351	0	0	234	0	234	117	234	117	0	117	117	234
Diver subtotal	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	9,233	13,501
Total Ducks	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	64,169	61,658
Other:																			
Coot	4,909	1,519	8,007	584	292	409	23,961	0	117	292	292	2,571	877	0	0	6,370	584	1,169	23,377
Canada Goose	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	19,286	28,169
Swan	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	10,344	8,708

Table 5. Minnesota waterfowl breeding populations by species for Stratum III (low wetland density), expanded for area but not visibility, 2002-2022.

	Year																		
Species	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2022
Dabblers:																			
Mallard	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	51,937	70,207
Black Duck	0	0	174	0	0	174	174	0	0	0	174	174	0	0	0	0	0	0	174
Gadwall	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	6,873	3,045
American Wigeon	1,218	174	1,566	1,044	174	348	348	174	348	1,044	174	348	174	1,566	870	174	0	348	870
Green-winged Teal	522	174	0	174	522	0	0	0	0	174	348	696	0	348	0	348	174	870	2,610
Blue-winged Teal	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	35,321	31,232
Northern Shoveler	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	696	1,740
Northern Pintail	0	174	348	174	174	348	174	0	174	0	174	174	0	174	522	174	522	0	522
Wood Duck	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	10,875	15,050
Dabbler subtotal	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	106,920	125,450
Divers:																			
Redhead	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	1,131	3,219
Canvasback	696	1,131	2,784	0	0	348	1,566	1,218	348	1,044	1,044	696	522	696	348	1,914	522	696	1,218
Scaup	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	11,919	14,963
Ring-necked Duck	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	5,742	11,136
Goldeneye	3,132	1,305	696	1,044	1,044	870	348	522	174	870	0	348	174	1,218	870	1,566	1,392	1,044	2,610
Bufflehead	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	3,132	2,610
Ruddy Duck	18,878	87	2,262	870	696	261	87	348	0	3,828	522	522	174	0	87	1,305	783	1,218	1,131
Hooded Merganser	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	1,914	1,740
Large Merganser	522	0	0	261	957	348	348	348	348	174	174	0	0	0	870	957	0	0	870
Diver subtotal	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	26,796	39,497
Total Ducks	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	133,716	164,947
Other:																			
Coot	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	3,393	31,580
Canada Goose	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	38,192	37,409
Swan	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	8,178	9,657

Table 6. Minnesota waterfowl breeding populations by species for Stratum I-III combined, expanded for area coverage but not for visibility, 2002-2022.

	Year																		
Species	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2022
Dabblers:																			
Mallard	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	108,881	125,575
Black Duck	0	0	174	56	0	174	174	0	0	0	174	507	167	339	0	56	117	0	174
Gadwall	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	11,130	4,375
American Wigeon	1,218	230	4,634	1,327	174	404	810	230	754	1,155	513	804	341	1,911	1,215	1,393	400	927	1,354
Green-winged Teal	1,267	630	678	230	694	167	278	400	172	230	404	813	351	988	111	626	174	987	2,782
Blue-winged Teal	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	48,941	44,832
Northern Shoveler	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	3,475	2,842
Northern Pintail	56	402	404	174	230	582	230	56	174	345	174	285	284	396	522	285	633	172	756
Wood Duck	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	20,943	23,463
Dabbler subtotal	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	195,456	206,153
Divers:																			
Redhead	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	1,945	3,752
Canvasback	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	2,647	2,763
Scaup	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	15,664	17,850
Ring-necked Duck	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	15,177	17,866
Goldeneye	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	1,389	4,235
Bufflehead	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	3,588	7,319
Ruddy Duck	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	2,984	1,214
Hooded Merganser	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	6,292	4,253
Large Merganser	522	972	234	723	957	626	1,032	681	681	519	230	456	256	400	1,042	1,124	172	172	1,159
Diver subtotal	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	49,858	60,411
Total Ducks	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	245,314	266,564
Other:																			
Coot	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	4,645	57,317
Canada Goose	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	76,195	84,545
Swan	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	23,187	25,113

Table 7. Mallard, blue-winged teal, and other duck (excluding scaup) populations in Minnesota, 1968-2022.

	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

	Mallard				Blue-winged teal				Other ducks (exc. scaup)		
Year	Unad. PI	VCF	PI	SE	Unad. PI	VCF	PI	SE	Unad. PI	VCF	PI
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
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
2019	108,881	2.63	286,357	35,570	48,941	4.56	223,171	42,200	71,258	2.58	185,316
2022	125,575	1.84	231,058	38,411	44,832	3.60	161,395	69,123	78,307	2.23	174,625
Averages:											
10-year	108,050	2.36	254,139	44,234	48,766	3.78	179,503	58,754	72,510	2.63	187,869
Long-term	103,507	2.23	230,349	37,877	56,995	3.88	211,472	45,487	62,775	3.06	179,915
% change from											
2019	15%	-30%	-19%	8%	-8%	-21%	-28%	64%	10%	-14%	-6%
10-year average	16%	-22%	-9%	-13%	-8%	-5%	-10%	18%	8%	-15%	-7%
Long-term average	21%	-18%	0%	-1%	-21%	-7%	-24%	52%	25%	-27%	-3%

Table 8. Scaup, total ducks (excluding scaup), total ducks, and Canada goose populations in Minnesota, 1968-2022.

	Scaup			Total Ducks (exc. scaup)		Total ducks		Canada 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

	Scaup			Total Ducks (exc. scaup)		Total ducks		Canada geese		
Year	Unad. PI	VCF	PI	Unad. PI	PI	Unad. PI	PI	Unad. PI	VCF	PI
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
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
2019	15,664	2.58	40,413	229,650	694,844	245,314	735,257	76,195	1.45	110,410
2022	17,850	2.23	39,806	248,714	567,078	266,564	606,884	84,545	1.36	114,981
Averages:										
10-year	14,082	2.63	36,431	229,417	621,512	243,464	657,943	78,709	1.84	143,948
Long-term	20,527	3.06	59,628	223,265	621,868	243,786	681,496	51,459	2.20	156,478
% change from 2019	14%	-14%	-2%	8%	-18%	9%	-17%	11%	-6%	4%
10-year average	27%	-15%	9%	8%	-9%	9%	-8%	7%	-26%	-20%
Long-term average	-13%	-27%	-33%	11%	-9%	9%	-11%	64%	-38%	-27%

Appendix A. Precipitation in selected regions of Minnesota, 1 April - 21 May 22 (Source: Minnesota DNR; http://www.dnr.state.mn.us/climate/historical/summary.html).

Region	Precipitation	Departure from normal
Northwest	9.46	6.53
North Central	7.27	2.49
Northeast	7.78	3.66
West Central	6.79	2.34
Central	7.90	2.68
East Central	6.95	1.48
Southwest	5.61	-0.11
South Central	6.29	-0.49
Southeast	6.51	-0.10
Statewide	6.99	1.56

WATERFOWL POPULATION STATUS, 2022.

Waterfowl information is taken from the U.S. Fish and Wildlife Service report Waterfowl Population Status, 2021 by Joshua Dooley, Walt Rhodes, and Nathan Zimpfer. The entire report is available on the Division of Migratory Bird Management website [Waterfowl Population Status, 2022 (fws.gov)]

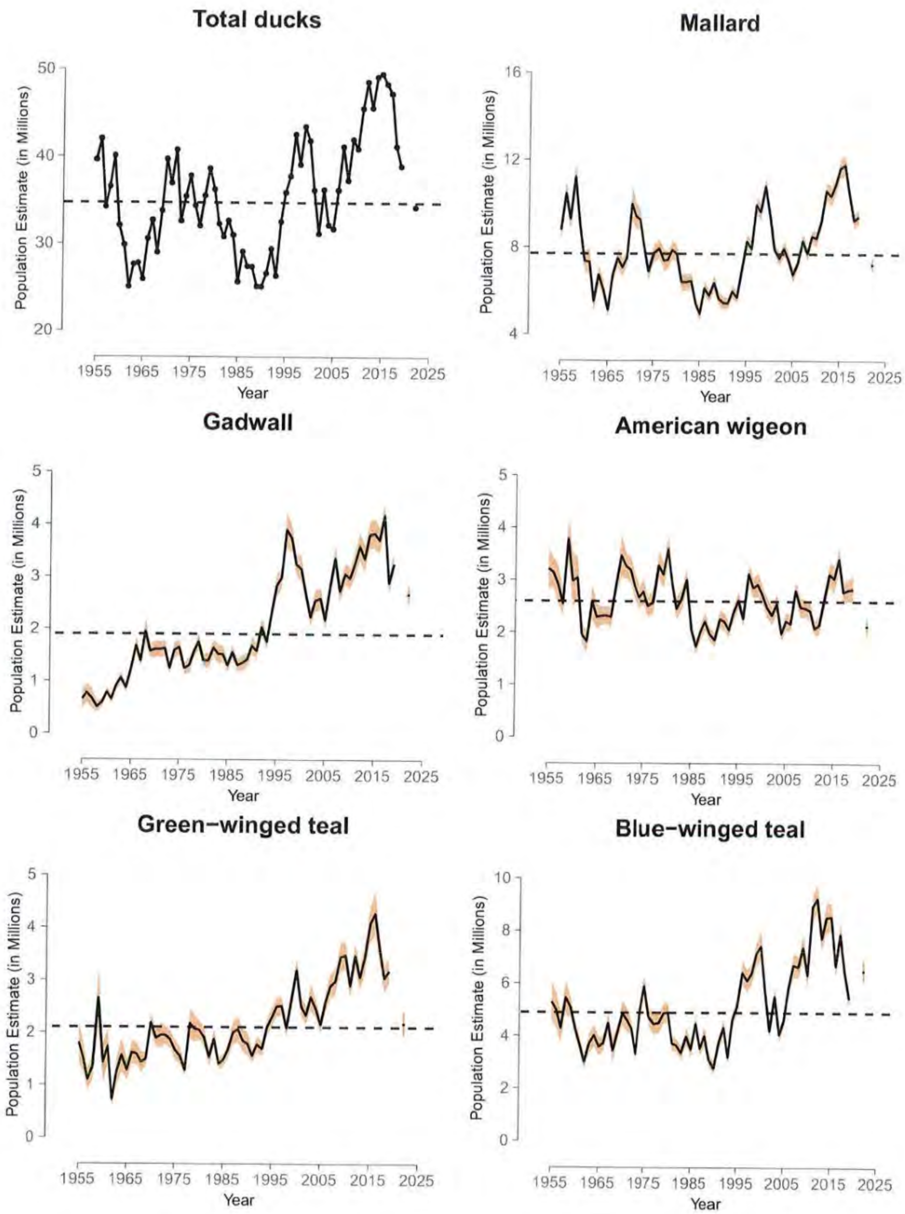


Figure 1. Estimates of North American breeding populations, 90% confidence intervals, and North American Waterfowl Management Plan population goal (dashed line) for selected species and number of water areas in May in Prairie Canada and Northcentral U.S (from: U.S. Fish and Wildlife Service 2022).

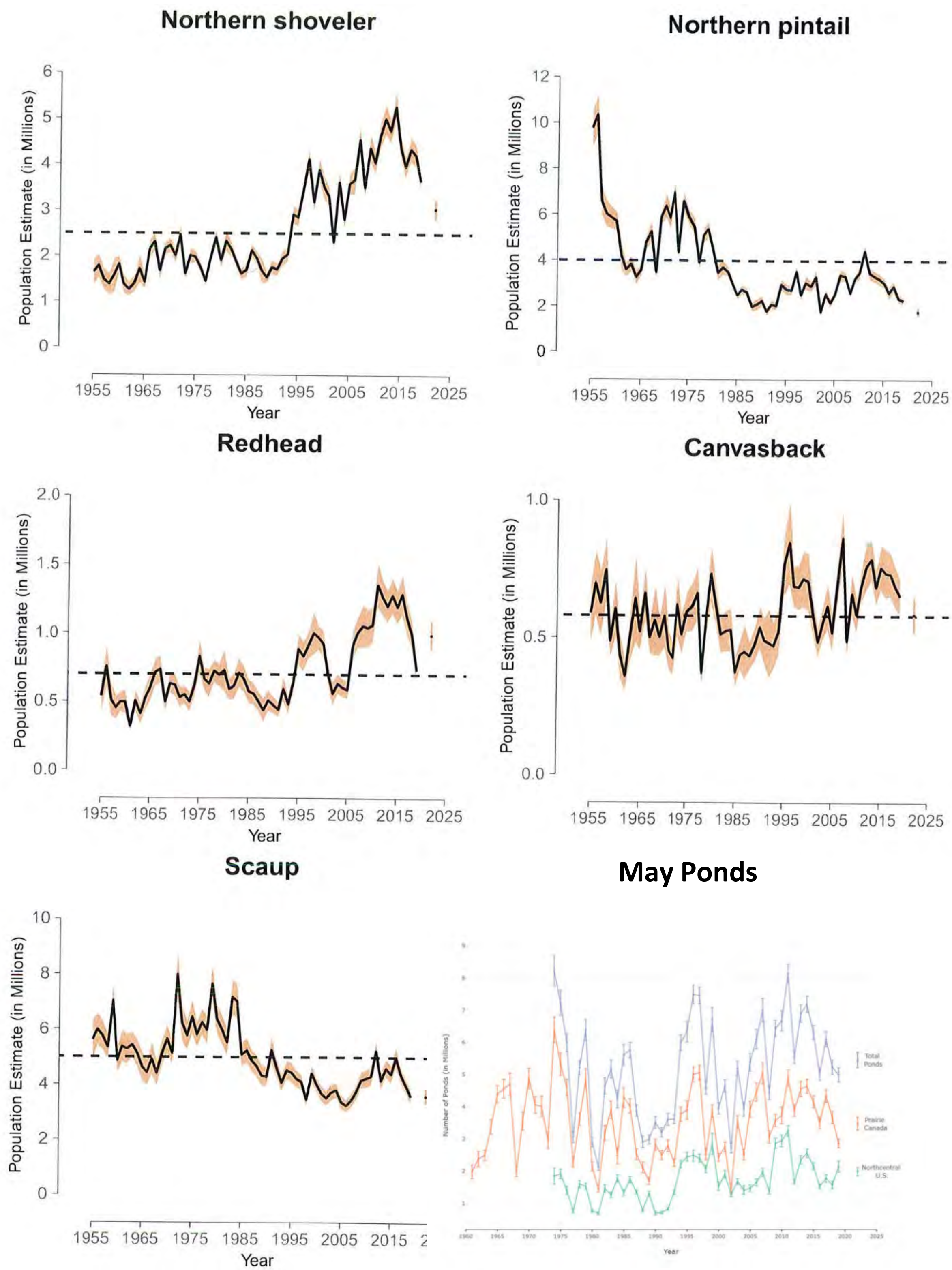


Figure 1. (cont.)

MOURNING DOVE POPULATION STATUS, 2022

Mourning dove information is taken from the U.S. Fish and Wildlife Service report by Seamans, M.E. 2022. Mourning dove population status, 2022. U.S. Department of the Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Washington, D.C. 20 pp. The entire report is available on the Division of Migratory Bird Management web site (Mourning Dove Population Status, 2022 | FWS.gov).

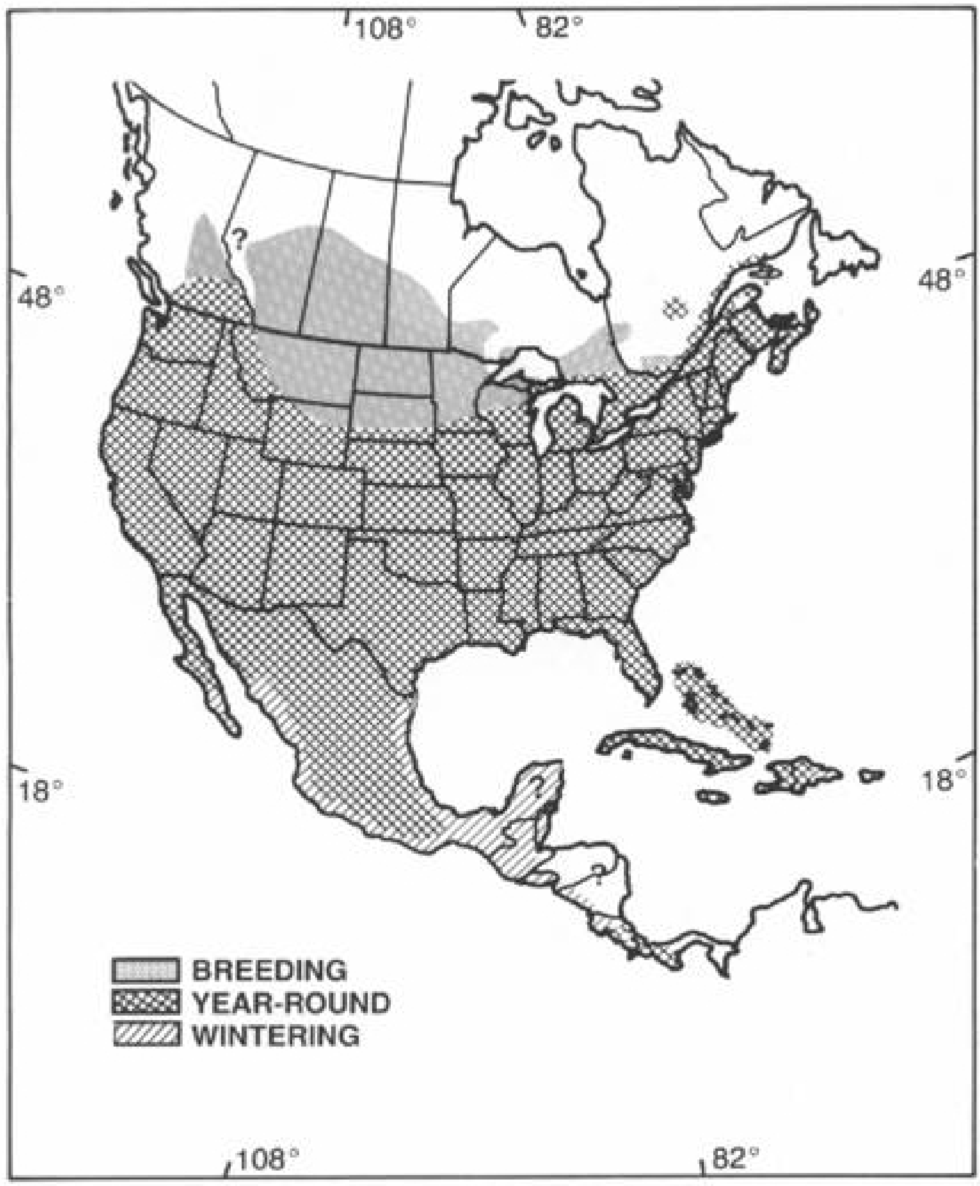


Figure 1. Breeding and wintering ranges of the mourning dove (adapted from Mirarchi and Baskett 1994). (From: Seamans, M.E. 2022. Mourning dove population status, 2022. U.S. Department of the Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Washington, D.C. 20 pp.)

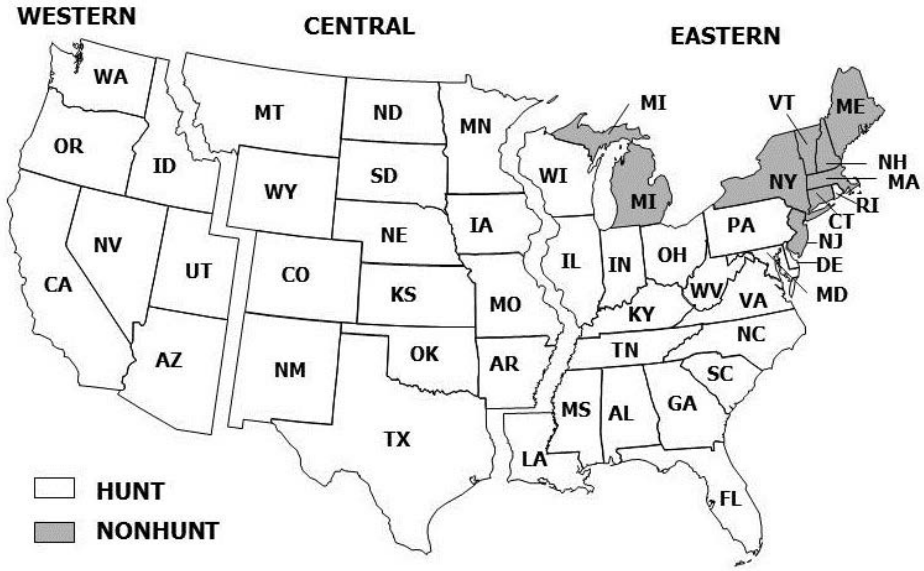


Figure 2. Mourning dove management units with 2021 -22 hunting and non-hunting states. (From: Seamans, M.E. 2022. Mourning dove population status, 2022. U.S. Department of the Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Washington, D.C. 20 pp.)

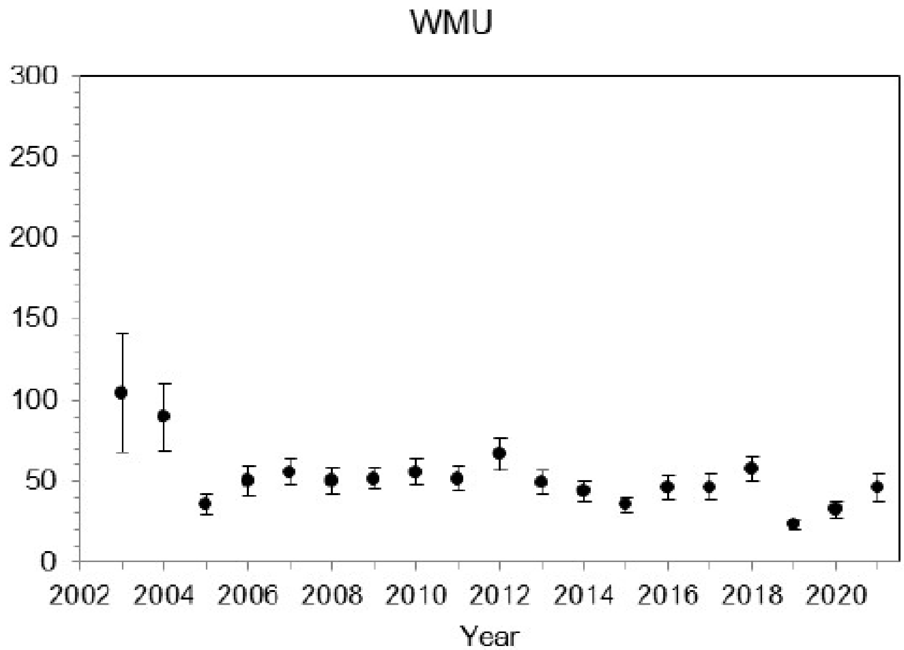


Figure 3. Estimates and 95% confidence intervals of mourning dove absolute abundance by in the Central Management Unit (CMU), 2003-21. Estimates based on band recovery and harvest data. (From: Seamans, M.E. 2022. Mourning dove population status, 2022. U.S. Department of the Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Washington, D.C. 20 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 2019, 2020 and 2021 seasons [a]. (From: Seamans, M.E. 2022. Mourning dove population status, 2022. U.S. Department of the Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Washington, D.C. 20 pp.)

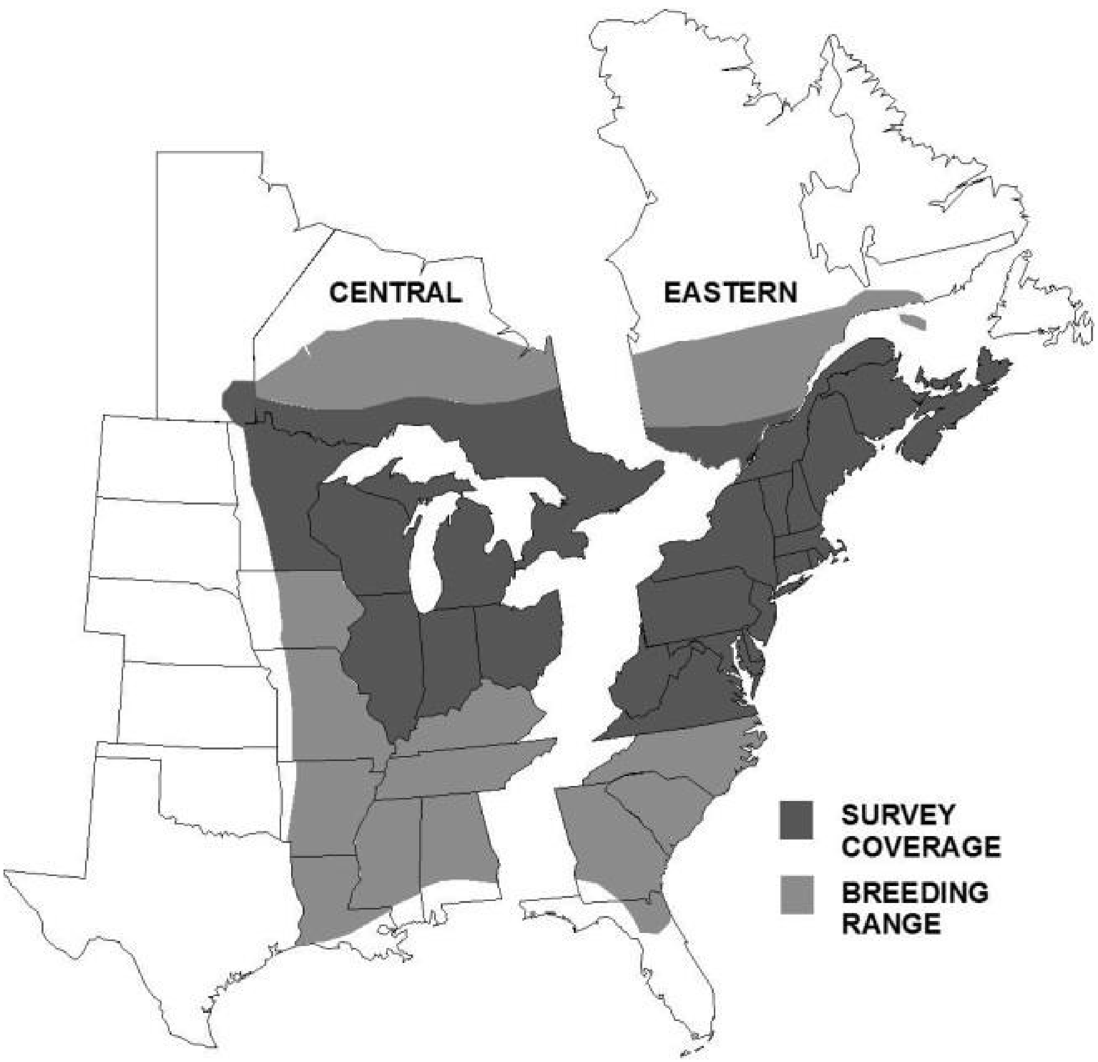
Management unit / State	Active Hunters			Hunter Days Afield			Total Harvest		
	2019	2020	2021	2019	2020	2021	2019	2020	2021
CENTRAL	337,700 [b]	368,200 [b]	303,500 [b]	986,800 ±50,800	1,171,000 ±79,800	874,700 ±50,300	5,266,400 ±335,500	5,885,700 318,100	4,236,600 234,500
AR	14,200 ±2,200	20,000 ±2,300	15,500 ±2,100	37,500 ±7,100	47,600 ±7,300	31,200 ±4,700	328,100 ±74,800	320,300 ±44,600	181,300 ±29,400
CO	10,700 ±800	12,700 ±1,000	9,800 ±800	22,800 ±2,000	27,200 ±2,500	25,700 ±3,000	106,300 ±9,500	124,600 ±11,800	122,900 ±13,900
IA	3,600 ±400	9,700 ±700	7,500 ±1,000	11,000 ±1,800	25,000 ±2,400	20,900 ±4,000	29,900 ±4,700	104,600 ±9,000	61,400 ±10,000
KS	22,300 ±1,900	22,800 ±2,500	25,500 ±2,500	64,800 ±8,500	62,800 ±7,700	64,600 ±6,900	389,800 ±64,200	366,000 ±60,100	400,200 ±44,000
MN	3,900 ±1,400	7,000 ±2,200	4,200 ±2,000	9,400 ±2,300	23,800 ±7,700	9,700 ±2,800	40,200 ±11,800	63,100 ±28,400	22,600 ±6,500
MO	21,100 ±1,500	24,300 ±1,700	19,800 ±2,000	47,100 ±3,800	63,600 ±6,900	51,300 ±6,300	268,000 ±28,400	318,400 ±39,900	259,700 ±39,700
MT	1,600 ±400	2,200 ±500	2,100 ±400	3,600 ±800	6,600 ±1,900	4,700 ±1,200	16,600 ±4,600	32,900 ±13,100	18,400 ±4,400
NE	10,700 ±1,000	12,400 ±1,200	10,400 ±1,100	24,500 ±2,500	33,600 ±4,300	27,000 ±3,000	137,700 ±14,100	159,900 ±15,900	148,000 ±15,800
NM	8,300 ±700	10,600 ±700	11,500 ±1,400	28,800 ±4,100	37,000 ±3,400	33,700 ±5,000	125,400 ±22,000	147,400 ±16,600	151,800 ±26,600
ND	4,100 ±500	4,500 ±600	5,500 ±900	11,900 ±2,000	13,900 ±2,800	20,100 ±3,400	75,000 ±19,500	75,400 ±11,400	91,500 ±15,800
OK	14,800 ±1,200	19,000 ±1,800	14,800 ±2,100	38,000 ±4,200	58,200 ±8,800	38,100 ±4,800	247,900 ±26,700	339,600 ±39,300	212,900 ±35,500
SD	4,700 ±600	6,000 ±700	5,400 ±900	15,500 ±2,700	14,500 ±1,600	12,300 ±1,800	103,300 ±19,100	92,800 ±14,800	88,200 ±16,900
TX	216,300 ±13,100	216,100 ±14,000	170,300 ±13,100	669,000 ±48,800	754,800 ±77,400	532,500 ±48,100	3,385,000 ±315,600	3,729,300 ±300,600	2,467,700 ±218,000
WY	1,300 ±200	1,000 ±200	1,200 ±300	2,800 ±500	2,300 ±500	2,900 ±800	13,200 ±2,200	11,300 ±2,300	10,000 ±2,600

[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 POPULATION STATUS, 2022

American Woodcock information is taken from the U.S. Fish and Wildlife Service report American Woodcock Population Status, 2022. Seamans, M.E. and R.D. Rau. 2022. U.S. Fish and Wildlife Service, Laurel, MD. 18 pp.



The entire report is available on the Division of Migratory Bird Management website American Woodcock Population Status, 2022 | FWS.gov

Figure 1. Woodcock management regions, breeding range, singing-ground survey coverage. (from: Seamans, M.E. and R.D. Rau. 2022. American woodcock population status, 2022. U.S. Fish and Wildlife Service, Laurel, MD. 18 pp.).

Table 1. Short term (2021–22), 10 –year (2012-2022), and long-term (1968-2022) 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. 2021) (from: Seamans, M.E. and R.D. Rau. 2022. American woodcock population status, 2022. U.S. Fish and Wildlife Service, Laurel, MD. 18 pp.).

Management Unit/State	Number of Routes[b]	n[c]	2021-22			2012-22			1968-22		
			% Change	95% CI[d]		% Change	95% CI[d]		% Change	95% CI[d]	
				lower	upper		lower	upper		lower	upper
CENTRAL	450	782	3.36	-2.48	9.70	-1.85	-2.61	-1.09	-0.62	-0.83	-0.42
IL	29	51	25.27	-20.10	117.01	10.32	1.44	20.43	0.28	-1.48	2.40
IN	14	63	-0.84	-28.00	35.78	-3.42	-10.56	3.42	-3.85	-5.23	-2.51
MB[e]	4	31	-4.69	-25.36	17.81	-0.95	-5.20	2.74	-0.48	-2.92	1.71
MI	113	161	9.65	-1.51	22.49	-1.84	-3.11	-0.58	-0.76	-1.09	-0.43
MN	76	126	0.08	-11.72	13.70	-0.79	-2.44	0.84	0.85	0.33	1.39
OH	37	74	-3.84	-20.94	16.62	-5.59	-8.91	-2.50	-2.08	-2.82	-1.38
ON	83	175	-0.77	-12.21	12.34	-3.21	-4.88	-1.64	-1.16	-1.58	-0.74
WI	94	132	1.83	-10.02	15.32	-1.17	-2.82	0.52	-0.08	-0.50	0.34

[a] Median of route trends estimated used hierarchical modeling. To estimate the total percent change over several years, use: $100(\%\ change/100+1)^{y}$-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 2022 for which data were received by 18 July, 2022.

[c] Number of routes with at least one year of non-zero data between 1968 and 2022.

[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.

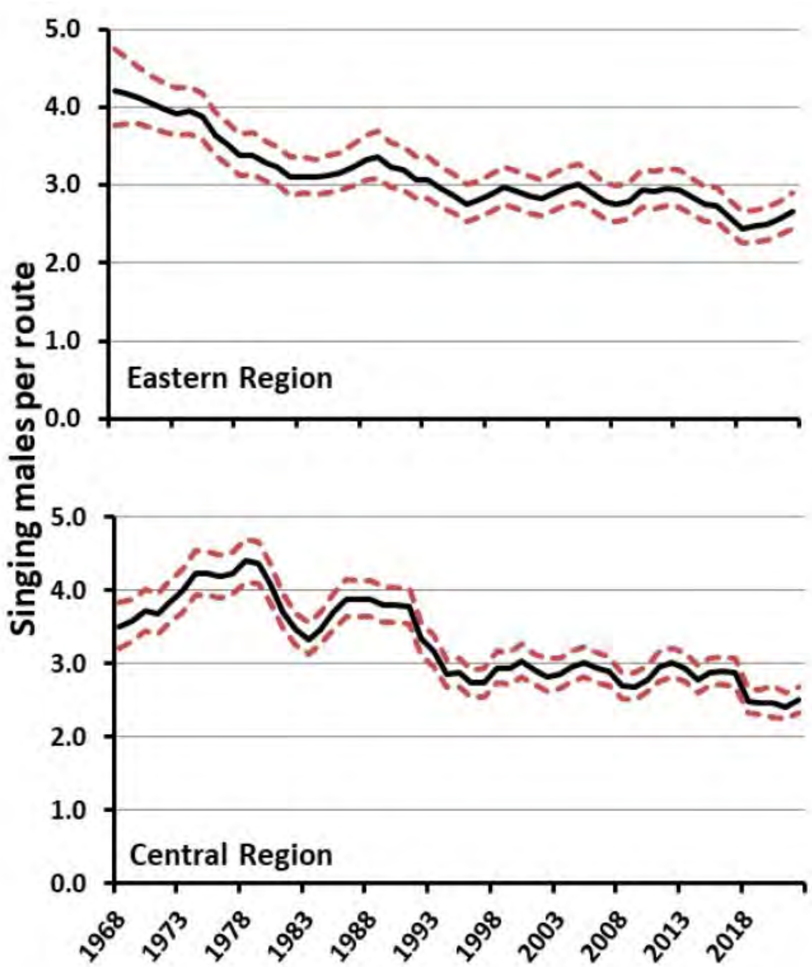


Figure 2. Annual indices of the number of woodcock heard on the Singing-ground Survey, 1968-2022. The dashed lines represent the 95 % credible interval. (from: Seamans, M.E. and R.D. Rau. 2022. American woodcock population status, 2022. U.S. Fish and Wildlife Service, Laurel, MD. 18 pp.).

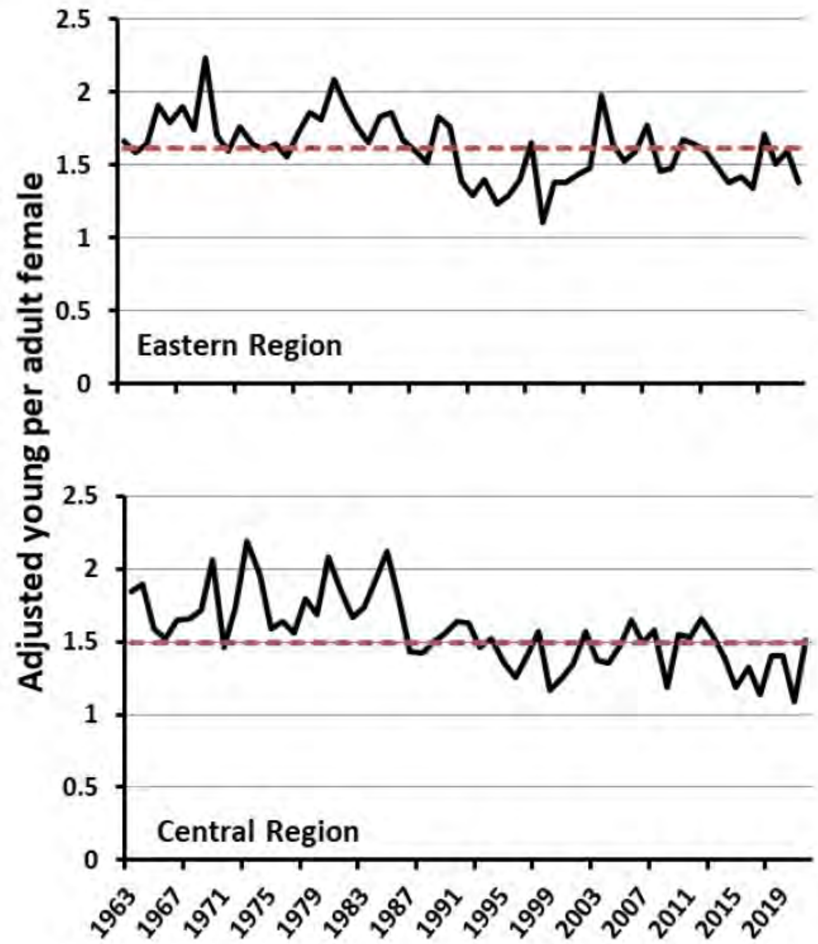


Figure 3. Annual indices of American woodcock recruitment, 1963-2021. Dashed line is the 1963-2020 average. (from: Seamans, M.E. and R.D. Rau. 2022. American woodcock population status, 2022. U.S. Fish and Wildlife Service, Laurel, MD. 18 pp.).

Table 2. Preliminary estimates of woodcock hunter numbers, days afield, and harvest for selected states, from the 2018-19, 2019-20, 2020-21 and 2021-22 Harvest Information Program surveys. (from: Seamans, M.E. and R.D. Rau. 2022. American woodcock population status, 2022. U.S. Fish and Wildlife Service, Laurel, MD. 18 pp.).

Management Unit / State	Active woodcock hunters ([a])				Days afield ([a, c])				Harvest ([a, c])			
	2018-19	2019-20	2020-21	2021-22	2018-19	2019-20	2020-21	2021-22	2018-19	2019-20	2020-21	2021-22
Central Region	n.a. [b]	n.a. [b]	67,100[d] n.a.[d]	60,700[d] n.a.[d]	246,000 ±35,800	216,600 ±24,500	260,600 ±23,800	273,100 ±26,900	130,600 ±16,400	136,000 ±18,900	123,700 ±13,300	141,300 ±16,400
IL	<100 <100	2,300 ±1,600	1,800 ±1,800	1,500 ±1,400	100 ±100	11,300 ±9,300	5,400 ±5,300	1,500 ±1,400	0 0	3,400 ±3,400	100 ±100	200 ±200
IN	100 <100	500 ±300	1,100 ±500	800 ±500	200 ±100	1,100 ±500	3,200 ±1,600	2,100 ±800	200 ±100	400 ±100	1,000 ±500	1,700 ±700
MI	29,300 ±3,700	19,100 ±2,400	18,500 ±2,100	20,100 ±2,500	135,800 ±31,900	86,100 ±12,600	82,900 ±10,000	93,700 ±11,100	59,600 ±10,400	64,500 ±15,200	37,400 ±5,600	47,500 ±6,000
MN	10,400 ±2,100	8,700 ±1,900	12,000 ±2,100	11,000 ±2,300	41,500 ±9,700	29,300 ±5,700	49,700 ±9,700	47,800 ±10,800	22,500 ±3,900	20,800 ±4,500	25,000 ±4,700	26,300 ±6,600
OH	500 ±100	1,100 ±900	2,000 ±800	1,500 ±1,100	800 ±300	2,400 ±1,000	5,200 ±2,200	9,300 ±6,500	600 ±400	700 ±300	2,900 ±1,300	1,400 ±600
WI	10,800 ±2,100	9,500 ±1,700	17,200 ±2,500	12,900 ±2,200	45,900 ±9,300	47,000 ±9,400	82,300 ±14,800	72,700 ±15,600	25,500 ±4,300	26,800 ±5,300	49,300 ±10,700	42,400 ±12,200

[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.

[d] Hunter number estimates at the regional and national levels may be biased high because the HIP sample frames are state specific; therefore, hunters were counted more than once if they hunted in >1 state. Variance was inestimable.

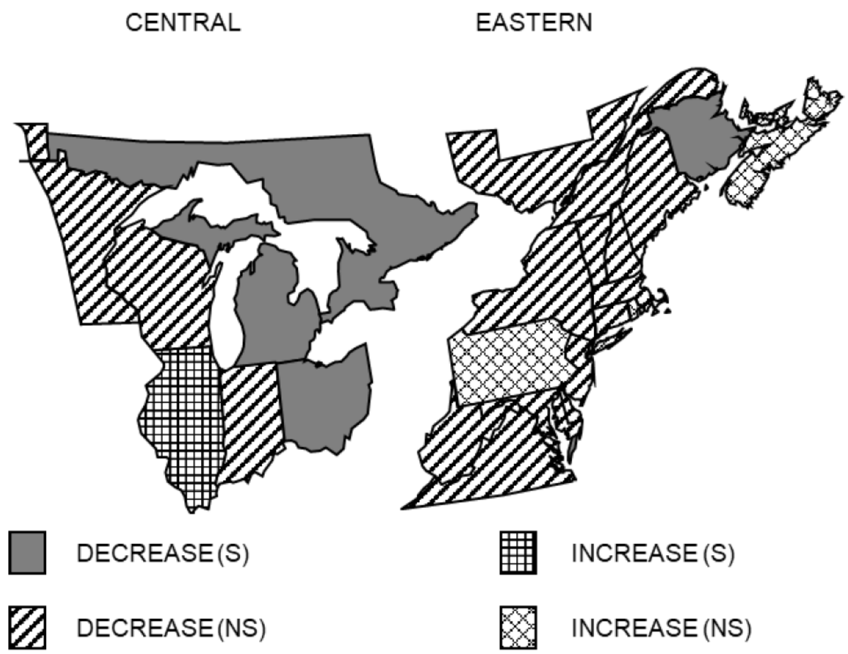


Figure 4. Ten-year trends in number of American woodcock heard on the Singing-ground Survey; 2012-22, as determined by the hierarchical modeling method. A significant trend (S) does not include zero in the 95% credible interval, while a non-significant (NS) trend does include zero. (from: Seamans, M.E. and R.D. Rau. 2022. American woodcock population status, 2022. U.S. Fish and Wildlife Service, Laurel, MD. 18 pp.).

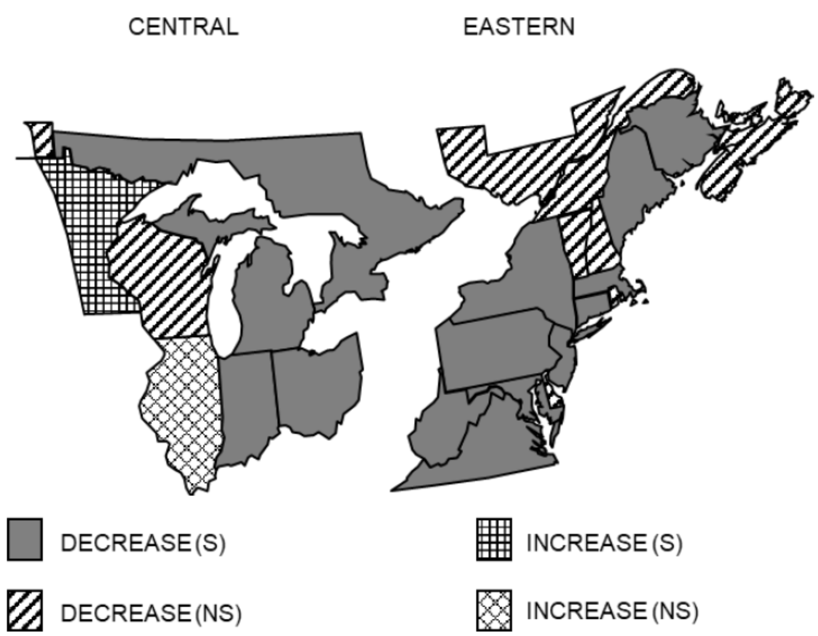


Figure 5. Long-term trends in number of American woodcock heard on the Singing-ground Survey; 1968-2022, as determined by the hierarchical modeling method. A significant trend (S) does not include zero in the 95% credible interval, while a non-significant (NS) trend does include zero. (from: Seamans, M.E. and R.D. Rau. 2022. American woodcock population status, 2022. U.S. Fish and Wildlife Service, Laurel, MD. 18 pp.).

HUNTING HARVEST STATISTICS

Division of Fish and Wildlife
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2021 SMALL GAME HUNTER MAIL SURVEY

Prepared by staff in the Wildlife Research Unit

INTRODUCTION

The Minnesota Department of Natural Resources (MNDNR), 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 (Figure 1) was mailed in early March 2022 following the close of the 2021-22 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 2021-22 small game hunting season (N=233,901). A stratified random sample (n=7,000, 3%), allocated proportionally by license type, was drawn from the MNDNR 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, Non-resident Youth, and Non-resident Adult. For analysis, license types were pooled into “Resident” (N=225,171) and “Non-resident” (N=8,730) (Figure 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-years 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 2021-22 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 were tabulated using Viking Data Entry VDE+ software and analyzed using R programming language (R version 4.1.3 [2022-03-10]; R Core Team 2022).

RESULTS

Survey Response and Overall License Sales Trends

Statewide (resident and non-resident) small game license sales and survey response rate are shown in Figure 2. Of the 7,000 mailed surveys, 172 surveys were returned as undeliverable; 2,356 surveys were completed and returned for an adjusted response rate of 34%. The percent of respondents who said they hunted or did not hunt is reported in Table 1. Overall, statewide license sales (233,901 small game licenses) decreased by 4% from the previous year and was 7% below the 10-year average (251,074 licenses; Figure 2, Table 2). Non-resident small game license sales (8,730 licenses) increased 4% in 2021 and was 30% above the 10-year average (6,715 licenses; Table 2).

Estimates by Species

Harvest trends for the four most sought-after small game species (ducks – all species, Canada geese, ruffed grouse, and ring-necked pheasants) in Minnesota since 2002 are shown in Figure 3 and discussed separately below. For all other species, the estimated number of statewide hunters and harvest for 2021-22, the previous year, and the 10-year averages are shown in Tables 4 and 5, respectively. Non-resident estimates over the past decade are shown in Table 3. Table 6 shows the estimated mean harvest per active hunter and Table 7 shows the estimated mean harvest for successful hunters and hunter success rates (%) for all species for 2021-22, the previous year, and the 10-year averages. Tables 4-6 also provide trend information (i.e., the percent change) for annual and 10-year comparisons.

Ducks – all species

The number of state duck stamps sold in 2021 (84,327 stamps) was 4% below 2020 (88,163 stamps) and 6% below the 10-year average (89,627 stamps; Table 2). An estimated 56,589 hunters pursued ducks in 2021 which was 21% below the 10-year average (71,872 hunters; Table 4). The 2021 harvest estimate (589,916 ducks) was 16% below the 10-year average (702,753 ducks; Table 5). Duck hunters harvested an average of 10.4 ducks/hunter, slightly greater than the 10-year average (Table 6). The 2021 duck hunter success rate (83%) and mean harvest per successful hunter (12.5 ducks) were similar to the 10-year averages (85% and 11.5 ducks, respectively; Table 7).

Canada geese

An estimated 36,138 hunters harvested approximately 218,218 Canada geese in 2021, averaging 6.0 geese/active hunter (Tables 4, 5, and 6, respectively). The number of hunters in 2021 was 26% below the 10-year average (48,878 hunters; Table 4) whereas the 2021 harvest was 13% below the 10-year average (251,791 geese; Table 5). The hunter success rate (79%) and mean harvest per successful hunter (7.7 geese) were only slightly above their respective 10-year averages (76%, 6.7 geese; Table 7).

Ruffed grouse

In 2021, an estimated 57,284 hunters pursued and harvested an estimated 206,699 ruffed grouse (Tables 4 and 5). These estimates are 26% below and 27% below the 10-year averages, respectively (77,889 hunters and 281,866 grouse; Tables 4 and 5). The mean harvest per active hunter was 3.6 grouse, which was similar to the 10-year average (Table 6). Hunter success (71%) and mean harvest per successful hunter (5.1 grouse) were also similar to their 10-year averages (70% and 5.1 grouse, respectively; Table 7).

Ring-necked pheasants

Pheasant stamp sales in 2021 (78,538 stamps) were also 4% below the previous year's sales (81,850 stamps) but similar to the 10-year average (78,873 stamps; Table 2). Approximately 48,945 hunters harvested an estimated 210,275 roosters in 2021 for an average of 4.3 roosters/active hunter (Tables 4, 5, and 6, respectively). The estimated number of hunters was 18% below the 10-year average whereas the estimated harvest was slightly above the 10-year average (59,929 hunters and 200,396 roosters; Tables 4 and 5, respectively). Hunter success (72%) was greater than the 10-year average (67%) but mean harvest per successful hunter (5.9 roosters) was only slightly above the 10-year average (5.0 roosters; Table 7).

ACKNOWLEDGMENTS

This project was funded in part by the Federal Aid in Wildlife Restoration Program. John Giudice analyzed the data, Nicole Davros and Margaret Dexter compiled the report, and John Giudice provided comments on a previous draft of this report.

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 2021-2022 small game hunting season (**March 2021 - February 2022**). We need information to estimate the season's harvest and to help set future small game seasons. Answer only for your Minnesota 2021 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. No envelope or stamp is necessary; just tear along the perforation and drop into a mailbox.

THANK YOU FOR YOUR COOPERATION

Wildlife Research Program Manager
Division of Fish and Wildlife
Department of Natural Resources

2021 Small Game Hunter Report

1. Did you hunt small game, listed below, in Minnesota this year (March 2021 - Feb 2022)? ☐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			
Pheasant	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 1. Sample of Small Game Hunter survey card.

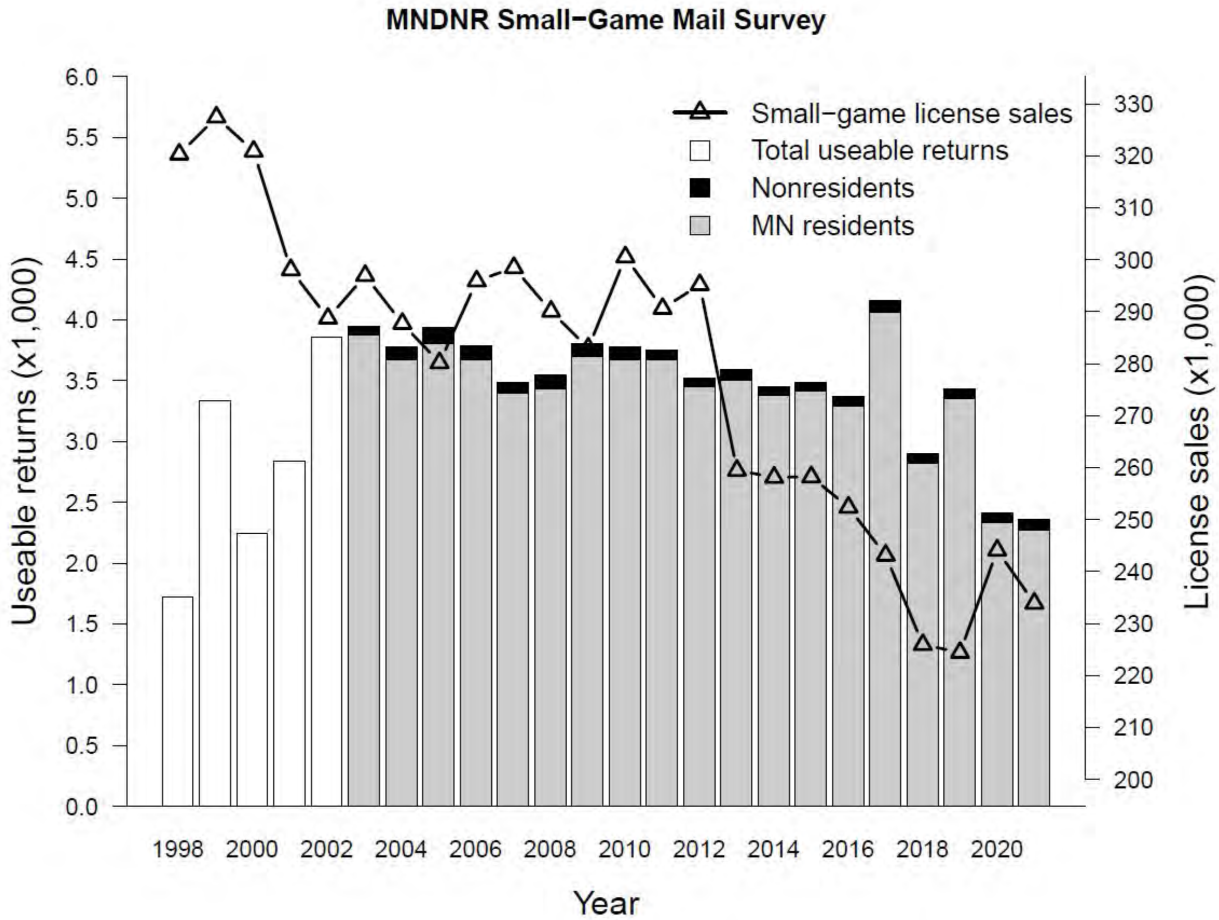

Figure 2. Number of Minnesota small game licenses sold and usable returned surveys, 1998-2021. Includes resident and non-resident licenses and excludes duplicate and free licenses.

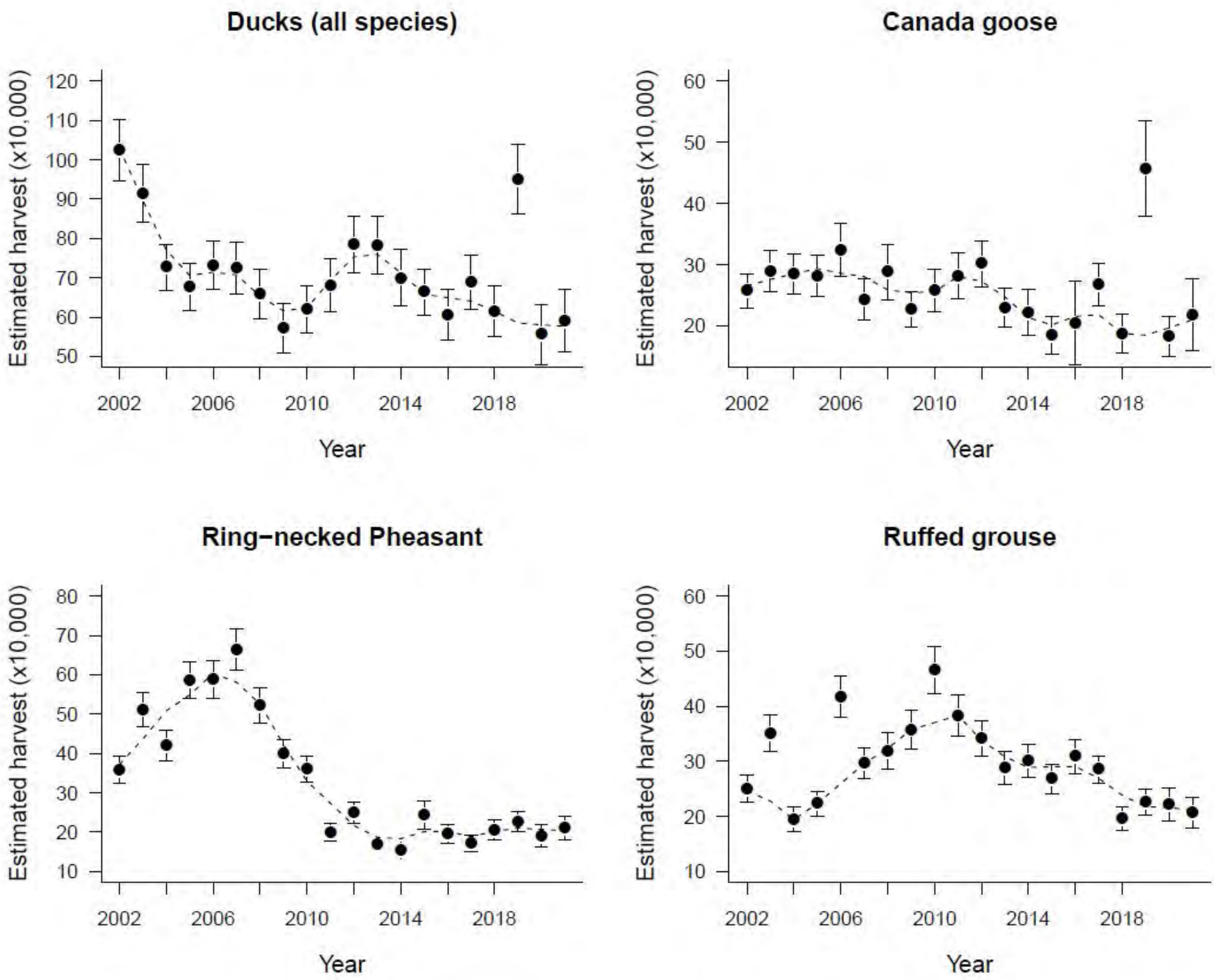

Figure 3. Harvest trends for top four small game species harvested in Minnesota, 2002-2021.

Table 1. Percent of respondents who hunted small game, 2011-12 through 2021-2022[a].

Year	Status	Returns from mail survey	Projections from license sales
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
2018-19	Hunted Did not hunt	2,000 (69%) 904 (31%) 2,904 (100%)	155,601 70,331 225,932
2019-20	Hunted Did not hunt	2,524 (73%) 911 (27%) 3,435 (100%)	164,896 59,517 224,413
2020-21	Hunted Did not hunt	1,487 (62%) 926 (38%) 2,413 (100%)	150,425 93,675 244,100
2021-22	Hunted Did not hunt	1,399 (59%) 957 (41%) 2,356	138,891 95,010 233,901

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

Table 2. Statewide (resident and non-resident) small game hunting license sales and stamp sales, 2011-12 through 2021-22.

	2011-12[a]	2012-13[a]	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22
Total small game license sales[b]	271,768	264,063	258,581	258,109	258,208	252,358	243,130	225,932	224,413	244,100	233,901
Non-resident license sales[c]	6,312	6,456	6,031	6,056	6,755	6,701	6,854	6,718	6,887	8,375	8,730
State duck stamp sales	89,681	90,052	93,412	94,265	92,176	88,905	86,258	82,955	86,568	88,163	84,327
Pheasant stamp sales	86,868	90,541	77,597	74,295	77,750	76,920	71,925	72,192	74,921	81,850	78,538

[a] Estimates from these years were recomputed without license type 99- free youth license to be consistent with other years of data.
[b] Includes all types of small game licenses. Duplicate and free licenses not included.
[c] Excludes duplicate licenses and non-resident shooting preserve licenses.

Table 3. Mail survey results of non-resident small game hunters, 2011-12 through 2021-22.

	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22
Estimated non-residents and (percent) of all licensed non-residents hunting:											
Ducks	2,430 (39)	2,360 (37)	2,010 (33)	2,340 (39)	1,850 (27)	2,320 (35)	2,350 (34)	1,680 (25)	3,040 (44)	1,230 (15)	3,740 (43)
Canada goose	1,620 (26)	1,360 (21)	1,270 (21)	1,300 (21)	650 (10)	770 (12)	1,730 (25)	1,260 (19)	3,120 (45)	1,560 (19)	1,770 (20)
Ring-necked pheasant	1,780 (28)	1,910 (30)	1,420 (24)	1,380 (23)	1,480 (22)	1,550 (23)	1,520 (22)	2,350 (35)	1,120 (16)	890 (11)	1,460 (17)
Ruffed grouse	1,460 (23)	2,820 (44)	2,010 (33)	2,600 (43)	2,870 (43)	3,520 (53)	2,280 (33)	2,270 (34)	1,760 (26)	3,800 (45)	2,700 (31)
Estimated non-resident harvest[a]:											
Ducks	13,840	20,380	20,410	13,060	16,863	17,701	15,717	15,792	21,228	5,810	39,395
Canada goose	4,050	2,270	3,650	2,680	1,484	1,462	6,994	2,940	15,060	4,134	30,039
Ring-necked pheasant	4,860	6,820	3,430	3,720	6,581	4,040	7,274	6,048	2,645	5,141	5,924
Ruffed grouse	8,980	10,090	4,990	9,090	13,805	11,772	6,994	2,856	4,325	24,793	11,020

[a] Estimates for non-resident hunters in 2021-22 are based on small samples sizes (range: 14-36 hunters); harvest estimates therefore have moderate to high sampling uncertainty.

Table 4. Estimated number of statewide hunters (residents and non-residents) by species for current year (2021-22), previous year (2020-21), and the preceding 10-year (2011-2020) average. Annual and 10-year trends (% change) are also shown.

	2021-22			2020-21			10-yr mean (2011-20)		Change from 2020		Change from 10-yr mean	
	n	Hunters	SE	n	Hunters	SE	Hunters	SE	%	95% CI	%	95% CI
Ducks	570	56,589	2,054	557	56,347	2,084	71,872	617	0	5	-21	3
Canada geese	364	36,138	1,734	370	37,430	1,782	48,878	539	-3	7	-26	4
Other geese	22	2,185	462	21	2,125	460	2,599	139	3	31	-16	18
American coot	23	2,284	472	32	3,238	566	3,561	162	-29	19	-36	14
Common snipe	7	695	262	13	1,316	363	1,079	90	-47	25	-36	25
Rails & Gallinules	4	398	198	3	304	175	269	43	31	100	48	77
American crow	54	5,362	718	39	3,946	624	7,804	236	36	28	-31	9
American woodcock	103	10,226	981	105	10,622	1,009	11,373	285	-4	13	-10	9
Mourning dove	63	6,255	774	60	6,070	771	8,740	250	3	18	-28	9
Ring-necked pheasant	493	48,945	1,951	519	52,503	2,033	59,929	585	-7	5	-18	3
Ruffed grouse	577	57,284	2,063	627	63,428	2,169	77,889	633	-10	4	-26	3
Spruce grouse	63	6,255	774	80	8,093	886	8,699	251	-23	13	-28	9
Sharp-tailed grouse	30	2,979	538	43	4,350	655	5,444	200	-32	16	-45	10
Gray partridge	9	894	296	19	1,923	438	2,276	130	-54	19	-61	13
Gray squirrel	156	15,488	1,193	164	16,591	1,245	21,066	380	-7	10	-26	6
Fox squirrel	74	7,347	837	72	7,284	842	11,721	288	1	16	-37	7
Eastern cottontail	85	8,439	895	106	10,724	1,014	13,304	307	-21	11	-37	7
White-tailed jackrabbit	10	993	312	13	1,316	363	1,206	96	-25	32	-18	27
Snowshoe hare	17	1,688	406	21	2,125	460	3,445	159	-21	26	-51	12
Raccoon	44	4,369	650	66	6,677	807	6,884	224	-35	13	-37	10
Red fox	27	2,681	511	27	2,732	521	4,563	182	-2	26	-41	11
Gray fox	5	497	221	6	607	247	1,234	94	-18	49	-60	18
Coyote	123	12,212	1,067	123	12,443	1,088	17,389	346	-2	12	-30	6
Badger	3	298	172	2	203	143	310	48	47	134	-4	57

Table 5. Estimated hunter harvest (residents and non-residents) by species for current year (2021-22), previous year (2020-21), and the preceding 10-year (2011-2020) average. Annual and 10-year trends (% change) are also shown.

	2021-22			2020-21			10-yr mean (2011-20)		Change from 2020		Change from 10-yr mean	
	n	Harvest	SE	n	Harvest	SE	Harvest	SE	%	95% CI	%	95% CI
Ducks	570	589,916	40,553	557	555,985	39,044	702,753	11,409	6	10	-16	6
Canada geese	364	218,218	29,524	370	182,194	16,934	251,791	7,264	20	20	-13	12
Other geese	22	2,086	832	21	2,024	1,112	6,210	864	3	70	-66	14
American coot	23	8,342	3,431	32	7,792	2,036	15,096	1,343	7	52	-45	23
Common snipe	7	398	198	13	1,620	740	1,452	205	-75	17	-73	14
Rails & Gallinules	4	498	495	3	507	364	552	145	-2	120	-10	93
American crow	54	72,884	21,567	39	21,248	6,809	59,498	4,535	243	150	22	37
American woodcock	103	35,742	7,115	105	33,182	5,859	32,655	1,685	8	29	9	23
Mourning dove	63	61,558	12,221	60	41,883	11,939	78,014	4,269	47	51	-21	16
Ring-necked pheasant	493	210,275	15,872	519	190,185	14,414	200,396	4,090	11	12	5	8
Ruffed grouse	577	206,699	13,918	627	221,746	15,161	281,866	4,670	-7	9	-27	5
Spruce grouse	63	7,248	1,697	80	14,467	2,937	12,442	690	-50	16	-42	14
Sharp-tailed grouse	30	3,774	1,652	43	15,883	6,234	9,338	879	-76	14	-60	18
Gray partridge	9	398	242	19	1,822	805	3,568	419	-78	16	-89	7
Gray squirrel	156	92,928	13,170	164	87,002	14,590	97,466	3,228	7	23	-5	14
Fox squirrel	74	29,091	5,592	72	18,413	3,457	38,309	1,604	58	42	-24	15
Eastern cottontail	85	25,417	5,070	106	27,923	4,167	40,998	1,704	-9	23	-38	13
White-tailed jackrabbit	10	795	464	13	4,657	2,482	1,813	353	-83	13	-56	27
Snowshoe hare	17	2,880	1,139	21	5,060	1,865	7,462	748	-43	31	-61	16
Raccoon	44	37,733	15,986	66	38,140	9,126	42,267	2,919	-1	48	-11	38
Red fox	27	5,462	2,214	27	3,947	1,114	4,995	437	38	68	9	45
Gray fox	5	497	408	6	304	175	910	170	63	164	-45	46
Coyote	123	53,614	14,533	123	29,540	9,590	33,529	2,187	81	77	60	45
Badger	3	100	99	2	203	143	256	51	-51	60	-61	39

Table 6. Mean harvest per active hunter (residents and non-residents) for current year (2021-22), previous year (2020-21), and the preceding 10-year (2011-2020) average. Annual and 10-year trends (% change) are also shown.

	2021-22			2020-21			10-yr mean (2011-20)		Change from 2020		Change from 10-yr mean	
	n	Mean	SE	n	Mean	SE	Mean	SE	%	95% CI	%	95% CI
Ducks	570	10.4	0.61	557	9.9	0.59	9.8	0.14	5	9	6	6
Canada geese	364	6.0	0.76	370	4.9	0.39	5.1	0.14	22	18	18	15
Other geese	22	1.0	0.33	21	1.0	0.49	2.3	0.30	0	59	-57	15
American coot	23	3.7	1.33	32	2.4	0.47	4.2	0.33	54	63	-12	32
Common snipe	7	0.6	0.20	13	1.2	0.47	1.3	0.15	-50	26	-54	16
Rails & Gallinules	4	1.2	1.24	3	1.7	0.88	2.0	0.47	-29	82	-40	64
American crow	54	13.6	3.62	39	5.4	1.52	7.3	0.56	152	98	86	52
American woodcock	103	3.5	0.61	105	3.1	0.47	2.9	0.13	13	26	21	22
Mourning dove	63	9.8	1.54	60	6.9	1.78	8.8	0.43	42	43	11	18
Ring-necked pheasant	493	4.3	0.28	519	3.6	0.24	3.4	0.06	19	11	26	8
Ruffed grouse	577	3.6	0.21	627	3.5	0.21	3.6	0.05	3	8	0	6
Spruce grouse	63	1.2	0.23	80	1.8	0.31	1.4	0.07	-33	17	-14	17
Sharp-tailed grouse	30	1.3	0.51	43	3.7	1.34	1.8	0.17	-65	19	-28	29
Gray partridge	9	0.4	0.24	19	0.9	0.37	1.6	0.17	-56	32	-75	15
Gray squirrel	156	6.0	0.72	164	5.2	0.79	4.6	0.13	15	22	30	16
Fox squirrel	74	4.0	0.62	72	2.5	0.38	3.2	0.11	60	34	25	20
Eastern cottontail	85	3.0	0.51	106	2.6	0.30	3.1	0.10	15	24	-3	17
White-tailed jackrabbit	10	0.8	0.41	13	3.5	1.68	1.3	0.23	-77	16	-38	34
Snowshoe hare	17	1.7	0.55	21	2.4	0.73	2.1	0.18	-29	31	-19	27
Raccoon	44	8.6	3.47	66	5.7	1.19	6.1	0.39	51	68	41	58
Red fox	27	2.0	0.74	27	1.4	0.31	1.1	0.08	43	62	82	69
Gray fox	5	1.0	0.77	6	0.5	0.22	0.6	0.10	100	178	67	131
Coyote	123	4.4	1.13	123	2.4	0.75	1.9	0.12	83	74	132	61
Badger	3	0.3	0.33	2	1.0	0.00	0.8	0.08	-70	33	-62	42

Table 7. Hunter success rates and mean harvest per successful hunter (residents and non-residents) for current year (2021-22), previous year (2020-21), and the preceding 10-year (2011-2020) average.

	2021-22				2020-21				10-yr mean (2011-20)		
	n	% Success	Mean	SE	n	% Success	Mean	SE	% Success	Mean	SE
Ducks	474	83	12.5	0.69	456	82	12.1	0.68	85	11.5	0.14
Canada geese	286	79	7.7	0.95	275	74	6.5	0.48	76	6.7	0.14
Other geese	9	41	2.3	0.55	7	33	2.9	1.24	44	5.2	0.30
American coot	17	74	4.9	1.70	22	69	3.5	0.55	72	5.8	0.33
Common snipe	4	57	1.0	0.00	7	54	2.3	0.64	60	2.1	0.15
Rails & Gallinules	1	25	5.0	---	2	67	2.5	0.50	44	4.1	0.47
American crow	48	89	15.3	4.01	32	82	6.6	1.79	86	8.5	0.56
American woodcock	64	62	5.6	0.89	74	70	4.4	0.60	68	4.2	0.13
Mourning dove	55	87	11.3	1.68	49	82	8.4	2.12	81	10.9	0.43
Ring-necked pheasant	357	72	5.9	0.34	356	69	5.3	0.31	67	5.0	0.06
Ruffed grouse	412	71	5.1	0.26	422	67	5.2	0.27	70	5.1	0.05
Spruce grouse	31	49	2.4	0.36	45	56	3.2	0.45	55	2.6	0.07
Sharp-tailed grouse	13	43	2.9	1.04	20	47	7.8	2.61	48	3.7	0.17
Gray partridge	3	33	1.3	0.33	6	32	3.0	0.57	46	3.5	0.17
Gray squirrel	133	85	7.0	0.81	136	83	6.3	0.92	82	5.7	0.13
Fox squirrel	60	81	4.9	0.71	55	76	3.3	0.44	77	4.2	0.11
Eastern cottontail	63	74	4.1	0.64	81	76	3.4	0.35	75	4.1	0.10
White-tailed jackrabbit	4	40	2.0	0.70	7	54	6.6	2.68	49	2.8	0.23
Snowshoe hare	10	59	2.9	0.73	15	71	3.3	0.91	62	3.4	0.18
Raccoon	40	91	9.5	3.79	63	95	6.0	1.23	91	6.7	0.39
Red fox	17	63	3.2	1.09	18	67	2.2	0.35	52	2.0	0.08
Gray fox	2	40	2.5	1.49	3	50	1.0	0.00	33	1.7	0.10
Coyote	85	69	6.4	1.59	67	54	4.4	1.32	52	3.7	0.12
Badger	1	33	1.0	---	2	100	1.0	0.00	74	1.1	0.08

The following information has been excerpted from: U.S. Fish and Wildlife Service. Migratory bird hunting activity and harvest during the 2020 - 2021 and 2021-22 hunting seasons. U.S. Fish and Wildlife Service, Laurel, Maryland, U.S.A. The entire report is available on-line at 2021-22 Migratory Bird Hunting Activity and Harvest Report (fws.gov)

Table 1. Species composition of the Minnesota waterfowl harvest, 2020 and 2021. (from: Raftovich, R.V., K.K. Fleming, S.C. Chandler, and C.M. Cain. 2022. Migratory bird hunting activity and harvest during the 2020-21 and 2021-22 hunting seasons. U.S. Fish and Wildlife Service, Laurel, Maryland. USA August, 2022. 67 pp).

	Minnesota Harvest					Mississippi Flyway Harvest		
Species	2020	% of Harvest	2021	% of Harvest	Percent change in Harvest 20-21	2020	2021	Percent change Harvest 20-21
Mallard	107,860	20.37	84,070	19.61	-22	1,211,677	1,184,216	-2
Domestic mallard	0	0.00	0	0.00		2,162	10,955	80
American black duck	0	0.00	0	0.00		16,746	14,065	-19
Black x mallard	0	0.00	0	0.00		471	837	44
Gadwall	21,787	4.11	14,253	3.32	-35	549,477	414,525	-33
American wigeon	12,911	2.44	13,287	3.10	3	72,343	82,283	12
Green-winged teal	42,498	8.02	71,750	16.73	69	475,539	563,327	16
Blue-winged /cinnamon teal	92,528	17.47	81,171	18.93	-12	547,820	424,854	-29
Northern shoveler	8,876	1.68	2,657	0.62	-70	169,584	135,760	-25
Northern pintail	11,297	2.13	18,843	4.39	67	100,111	132,767	25
Wood duck	101,136	19.10	83,587	19.49	-17	610,197	615,625	1
Redhead	14,525	2.74	2,416	0.56	-83	70,649	21,623	-227
Canvasback	4,842	0.91	2,899	0.68	-40	32,132	19,435	-65
Greater scaup	1,076	0.20	1,691	0.39	57	19,366	11,739	-65
Lesser scaup	8,607	1.63	4,590	1.07	-47	102,147	54,779	-86
Ring-necked duck	62,941	11.88	28,507	6.65	-55	161,580	146,316	-10
Goldeneye	7,800	1.47	3,141	0.73	-60	27,892	21,212	-31
Bufflehead	16,373	2.34	7,731	1.80	-38	119,634	53,307	-124
Ruddy duck	1,345	0.25	0	0.00	-100	9,392	2,180	-331
Scoters	269	0.05	0	0.00	0	6,746	2,473	-173
Hooded merganser	15,601	2.95	7,489	1.75	-52	50,080	38,907	-29
Other mergansers	1,345	0.25	725	0.17	-46	9,599	5,509	-74
Total Duck Harvest [a] (retrieved kill)	529,600 ±14%		428,800 ±19%		-19	4,408,800 ±5%	3,978,300 ±5%	-11

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

Table 2. Top 10 states in number of **adult duck hunters**, 2021, and number of hunter-days and retrieved duck kill (from: Raftovich, R.V., K.K. Fleming, S.C. Chandler, and C.M. Cain. 2022. Migratory bird hunting activity and harvest during the 2020-21 and 2021-22 hunting seasons. U.S. Fish and Wildlife Service, Laurel, Maryland. USA August, 2022. 67 pp).

State	**Number of active duck hunters**	**Duck hunter days afield**	**Total duck harvest**	**Seasonal duck harvest per hunter**
Texas	64,600 ± 23%	295,500 ± 17%	295,500± 17%	10.7 ± 27%
Arkansas	56,500 ± 6%	400,200 ± 9%	915,900 ± 9%	16.2 ± 11%
Minnesota	55,800 ± 16%	297,900 ± 16%	428,800 ± 19%	7.8 ± 25%
Wisconsin	47,500 ± 20%	296,900 ± 15%	318,700 ± 14%	6.7 ± 24%
California	44,000 ± 12%	330,200 ± 11%	929,800 ± 14%	21.1 ± 18%
Louisiana	37,300 ± 7%	262,500 ± 10%	614,000 ± 12%	16.5 ± 14%
Michigan	30,700 ± 14%	174,600 ± 14%	238,800 ± 16%	7.8 ± 21%
North Carolina	30,600 ± 17%	152,900 ± 15%	255,000 ± 18%	8.3 ± 25%
North Dakota	29,900 ± 12%	142,300 ± 14%	289,000 ± 12%	9.7 ± 17%
Washington	27,300 ± 5%	166,100 ± 9%	416,000 ± 11%	15.2 ±12%
Mississippi Flyway		2,393,000 ± 6%	3,978,300 ± 5%	
United States		5,094,100 ± 4%	9,459,400 ± 4%	

Table 3. Top 10 states in number of **adult goose hunters**, 2021, and number of hunter-days and retrieved goose kill. (from: Raftovich, R.V., K.K. Fleming, S.C. Chandler, and C.M. Cain. 2022. Migratory bird hunting activity and harvest during the 2020-21 and 2021-22 hunting seasons. U.S. Fish and Wildlife Service, Laurel, Maryland. USA August, 2022. 67 pp).

State	**Number Of Active Goose Hunters**	**Goose Hunter Days Afield**	**Total Goose Harvest**	**Seasonal Goose Harvest Per Hunter**
Wisconsin	42,300 ± 14%	281,300 ± 19%	136,600 ± 28%	3.2 ± 31%
Minnesota	41,700 ± 17%	250,200 ± 22%	144,500 ± 27%	3.5 ± 27%
Texas	35,500 ± 24%	107,100 ± 47%	103,100 ± 33%	2.9 ± 41%
California [B]	31,600 ± 10%	199,800 ± 12%	229,700 ± 22%	7.2 ± 25%
Michigan	27,900 ± 15%	171,800 ± 19%	152,100 ± 18%	5.5 ± 23%
North Dakota	26,900 ± 11%	112,000 ± 14%	162,700 ± 21%	6.1 ± 24%
Arkansas	23,900 ± 11%	125,000 ± 16%	152,200 ± 19%	6.4 ± 22%
Kansas	17,400 ± 17%	90,300 ± 42%	131,200 ± 36%	7.5 ± 37%
Maryland [B]	15,900 ± 9%	78,800 ± 12%	52,700 ± 14%	3.3 ± 16%
Illinois	15,300 ± 17%	107,900 ± 22%	71,900 ± 26%	4.7 ± 31%
Mississippi Flyway		1,395,900 ± 7%	1,015,800 ± 9%	
United States [B]		2,900,200 ± 5%	2,647,600 ± 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.

2022 LIGHT GOOSE CONSERVATION ORDER HARVEST IN MINNESOTA

Steve Cordts, Wildlife Populations and Regulations Unit

Margaret Dexter, Wildlife Populations and Research Unit

J. Giudice, MNDNR Biometrics Unit

INTRODUCTION

This report documents results of the 2022 Light Goose Conservation Order hunter mail questionnaire survey.

METHODS

Minnesota held a light goose Conservation Order harvest from 15 February - 30 April 2022. Participants were required to obtain a $2.50 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 (except for youth <18 years old) were sent a questionnaire after the season. Survey questions are listed in Figure 1.

RESULTS AND DISCUSSION

A total of 954 permits were issued and 302 responses (32.4%) to the questionnaire were obtained (Table 1, Figure 2). In calculating harvest estimates, we assume that the 533 non-respondents participated in the conservation action and took light geese in the same manner as respondents. An estimated 326 hunters attempted to take light geese during the conservation order period. Active participants pursued light geese for 1,122 days and 967 light geese were shot and retrieved. This was an average retrieved take of 3 geese per active participant. An estimated 86 light geese were wounded and not retrieved.

ACKNOWLEDGMENTS

This project was funded in part by the Wildlife Restoration (Pittman-Robertson) Program.

MINNESOTA 2022 LIGHT GOOSE HARVEST SURVEY
For the Period of February 15- April 30, 2022 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, 2022. 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 2022 hunting experience.** THANK YOU! The Wildlife Research Program, Division of Fish and Wildlife, MN DNR.

1. Did you hunt light geese in Minnesota during February 15 - April 30, 2022? 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, 2022? __________
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? __________

Figure 1. Light Goose Conservation Order hunter mail questionnaire, 2022.

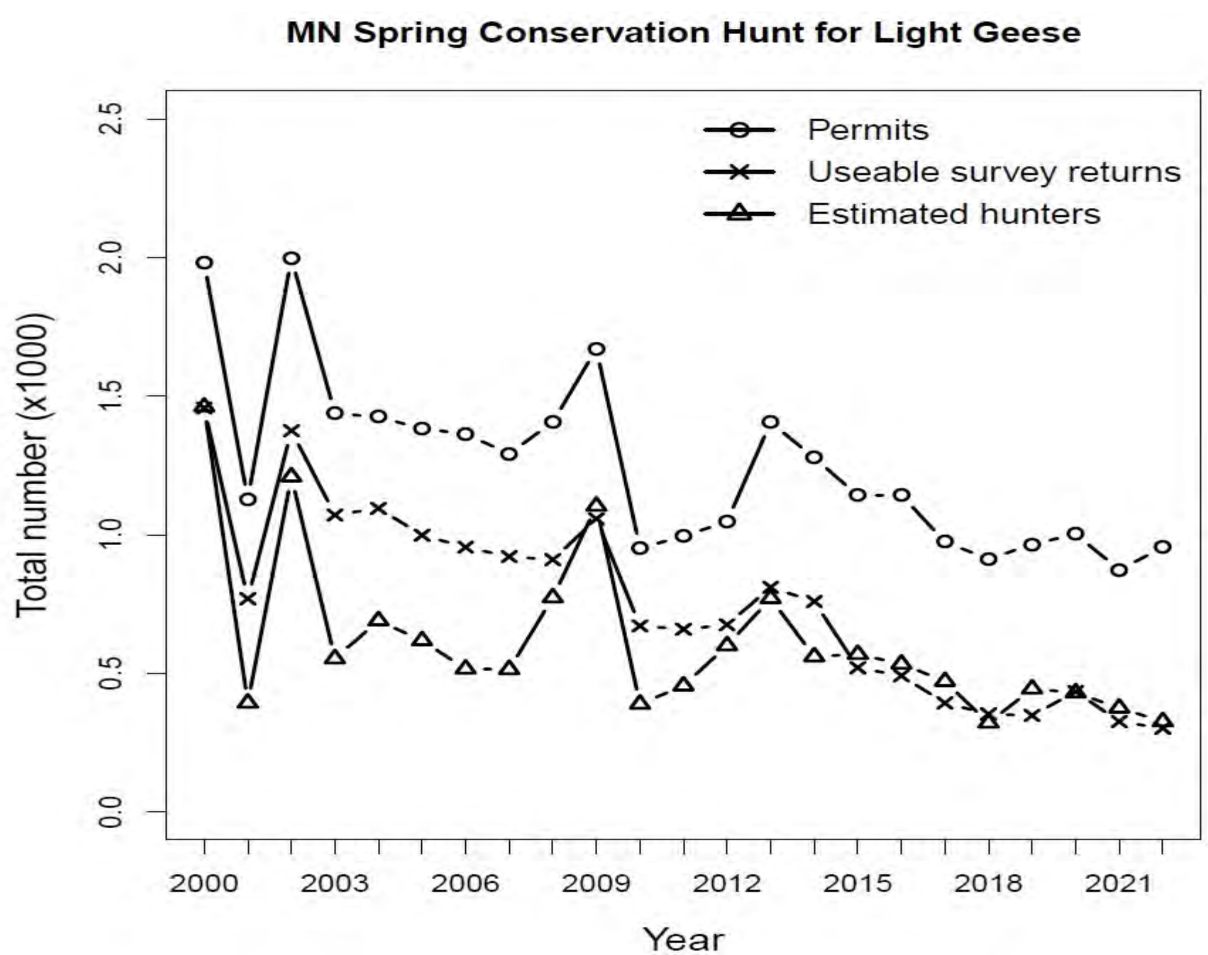

Figure 2. Light goose permits issued, survey response, and estimated hunters in Minnesota, 2000-2022.

Table 1. Summary of Light Goose Conservation Order harvest in Minnesota, 2010 – 2022.

	Year												
Statistic	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Total permits sold	952	994	1,048	1,405	1,278	1,141	1,143	974	912	965	1,002	873	954
Useable returns	671	659	675	810	759	520	491	393	353	348	434	326	302
Response rate (%)	72.3	67.1	65.3	58.3	60.0	46	43	41	43	41	44	38	32
Active hunters (%)	40.8	45.7	56.9	54.9	44.0	50	47	48	35	46	43	43	34
Estimated total hunters	389	455	600	770	560	569	534	471	321	444	430	375	326
Estimated hunter days	1,475	1,830	2,270	3,070	2,580	2,434	2,605	1,966	1,204	1,537	1,529	1,481	1,122
Mean days/hunter	3.8	4.0	3.8	4.0	4.6	4	5	4	3.8	3.5	3.6	4	3.4
Estimated harvest (shot & retrieved)	559	1,554	2,620	2,430	2,880	3,266	2,121	1,713	1,021	1612	785	1,455	967
Mean harvest/hunter	1.4	3.4	4.4	3.2	5.1	6	4	4	3.2	4	2	4	3
Estimated crippling losses	70	145	210	370	210	349	215	298	78	206	54	150	86
Percent using unplugged guns	44.9	44.2	43.0	49.4	48.8	NA	NA	NA	NA	NA	NA		
Est. number hunters using unplugged guns	175	201	260	380	270	NA	NA	NA	NA	NA	NA		
Est. number geese **shot** with unplugged guns	348	742	1,510	1,670	2,060	NA	NA	NA	NA	NA	NA		
Est. harvest with shell 4-5-6	131	311	460	620	770	NA	NA	NA	NA	NA	NA		
Percent using electronic calls	25.9	21.3	22.2	24.5	27.8	NA	NA	NA	NA	NA	NA		
Est. number hunters using e-calls	101	97	130	190	160	NA	NA	NA	NA	NA	NA		
Est. harvest while using e-calls	192	531	460	620	1,710	NA	NA	NA	NA	NA	NA		
Percent hunting 1/2-hr after sunset	39.7	39.7	42.4	33.4	36.2	NA	NA	NA	NA	NA	NA		
Est. number hunting after 1/2-hr sunset	154	180	250	260	200	NA	NA	NA	NA	NA	NA		
Est. harvest 1/2-hr after sunset	87	238	240	260	550	NA	NA	NA	NA	NA	NA		

MINNESOTA'S WILD TURKEY HARVEST- FALL 2021 AND SPRING 2022

Tim Lyons, Farmland Wildlife Populations and Research Group

SUMMARY OF FINDINGS

Fall 2021 hunter participation and harvest both increased compared to the previous season, Hunter participation exceeded the 10-yr average and harvest was the second highest on record. Spring 2022 hunter participation declined compared to 2021 but had the third highest license sales since a spring turkey season was permitted in 1978. The three years with the greatest participation have occurred 2020-2022. Harvest declined from 2020, but, like hunter participation, was the third highest turkey harvest ever recorded. Unlike previous seasons, a cold and wet spring led to lower harvest during the first two weeks of the spring season and an increase among harvest periods later in the season.

INTRODUCTION

The fall 2021 turkey season opened October 2 and closed October 31. An unlimited number of permits were available, but hunters could only harvest a single bird of any sex in any turkey permit area (TPA). All hunters, regardless of license type (archery/firearm), could hunt the entire season.

The spring 2022 hunting season was open April 13 through May 31. Hunters were limited to harvesting a single bird: either a tom, jake, or bearded hen. Firearm hunters were restricted to hunting one of 5 week-long time periods (A-E) in addition to the final two weeks of the season (F) if they did not harvest a bird earlier. Archery and youth hunters could hunt the entire season. An unlimited number of permits were available during all time periods, except for 3 TPAs (502, 511, 512) that maintained a lottery during the A-C periods. All hunters declared a TPA at the time of license purchase but could harvest a bird within any TPA.

OBJECTIVES

Report annual harvest statistics for wild turkeys in Minnesota and monitor trends in hunter participation, success, and total harvest.

METHODS

We obtained fall and spring hunter permit sales and harvest registration from the Electronic Licensing System. We consolidated multiple purchases by an individual (due to license type change, lottery permit, etc.) and aggregated permits sold by license type and declared permit area, though hunters were not restricted to harvesting a bird in their declared permit area. We did not correct for hunter harvest outside of their declared area, nor non-participation in any of our calculations.

RESULTS

Fall 2020 Season

Permits issued

The number of fall turkey hunters in 2021 (9,026) was similar to the number of hunters in fall 2020 (+7%; Table 1) and was 15% above the 10-year average (8,087). The proportion of youth hunters was consistent with the previous season (22%). The number of fall turkey hunters participating in the 2021 season was second only to 2012, the first season after the fall license permit system was ended.

Harvest

The fall 2021 harvest (1,238) was 9% greater than the fall 2020 harvest (Table 1) and 2021 was the second greatest harvest since the inception of a fall hunting season in 1990. Hunter success was 13.7% which was similar to the long-term average (14.4%). Hens comprised 54.7% of the total harvest with jakes and toms comprising 19.5% and 25.8% of the total fall harvest, respectively. Two TPAs -507and 508 accounted for 56% of the total fall harvest. These two permit areas were also the most hunted, accounting for 51% of total fall permit sales

Spring 2021 Season

Permits issued

The number of permits issued across all license types decreased in 2022 from 58,084 hunters in 2021 to 54,491 in 2022 (Tables 3 and 4). The greatest change was among general permit sales which fell from 32,520 in 2021 to 29,603; all other permit category sales remained relatively constant (Table 4). Although permit sales have fallen since the record number issued in 2020 (Table 3, Fig. 3), the number of permits issued 2021 and 2022 are still at least 8,000-10,000 greater than the number issued in any season prior to 2020 (Table 4; Figure 3). All hunters had to declare a TPA in 2022 but they were not restricted to harvesting a bird in the declared area. Permit areas 502, 511, and 512 still instituted a lottery during the A-C time periods. Permit sales were greatest in TPA 507 and along with TPAs 501, 503, and 508, comprised 70% of all permit sales (Table 5).

Harvest

During the 2022 spring turkey season 12,309 turkeys were harvested (Tables 3 and 4). The harvest total increased compared to 2021 and is the second highest season harvest total for the modern turkey season (since 1978; Table 4, Figure 3). Permit areas 507 and 501 saw the greatest harvest but 503, 508, and 510 all reported more than 1,000 birds harvested (Table 5). Harvest success increased among all license holders to an average success rate of 22.6% (Table 3).

Cold weather and snow during the early part of the spring season led to a decline in the harvest during the A period and accounted for only 26.1% of the total spring 2022 harvest (Table 6). Typically, 30%-40% of the total spring harvest occurs during the A season. Collectively, the A-C periods accounted for approximately 65% of the total spring turkey harvest (Table 6), whereas it accounts for more than 75% of the harvest in most years. The decline in harvest during the A season was compensated by greater proportional harvest during the D and E seasons).

ACKNOWLEDGMENTS

Kelly Bettin assisted with retrieving license sale and harvest registration data. Nicole Davros and Margaret Dexter reviewed earlier drafts of this report.

Table 1. Permits available, number of applicants, permits issued, registered harvest, and hunter success rates for the ten most recent fall wild turkey seasons in Minnesota, 2011-2020.

Year	Permits available	Applicants	Permits issued	Registered harvest	Hunter success (%)[a]
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
2018	Unlimited	N/A	6,719	834	12.4
2019	Unlimited	N/A	6,481	855	13.2
2020	Unlimited	N/A	8,408	1,136	13.5

[a] Total hunter success (all permits issued divided by registered harvest). Success rates not adjusted for non-participation or un-registered harvest.

Table 2. Permits issued, registered harvest by sex, and total registered harvest during the 2020 fall wild turkey season in Minnesota.

Permit area	General permits issued[a]	Youth permits issued	Toms[a]	Jakes[a]	Hens[a]	Total registered harvest[a]
501	866	248	23	14	62	99
502	94	26	4	1	5	10
503	636	160	26	15	59	100
504	154	48	12	4	4	20
505	317	89	8	8	35	51
506	280	67	16	11	24	51
507	1,583	522	93	57	203	353
508	1,521	415	67	41	157	265
509	287	144	15	11	47	73
510	633	157	30	16	60	106
511	88	15	2	1	2	5
512	48	10	2	0	1	3
TOTAL	**6,507**	**1,901**	**298**	**179**	**659**	**1,136**

[a] Total harvest for all license types.

Table 3. Total permits issued, harvest, and success rate by permit type during the spring 2021 wild turkey season in Minnesota.

	Total permits issued	Harvest	Success (%)[a]
General	32,520	8,400	25.8
Youth	12,598	2,085	16.6
Archery	12,966	1,585	12.2
Total	58,084	12,070	20.8

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

Table 4. Permits issued, registered harvest, and hunter success rates for the ten most recent spring wild turkey hunting seasons in Minnesota, 2012-2021.

Year	General permits issued	Youth permits issued	Archery permits issued	Registered harvest[a]	Success (%)[b]
2012[c]	30,238	8,839	3,441	11,276	27.2
2013[c]	35,202	5,965	4,014	10,321	23.3
2014[c]	35,451	7,374	4,893	11,425	24.4
2015[c]	34,554	7,042	5,046	11,694	25.6
2016[c]	32,535	7,101	10,336	12,277	25.0
2017[c]	31,605	6,984	11,237	11,803	24.1
2018[c]	28,667	6,022	11,399	10,706	23.6
2019	28,295	6,169	11,794	10,699	23.0
2020	34,173	14,292	14,729	13,996	22.1
2021	32,520	12,598	12,966	12,070	20.8

[a] Includes all license types.

[b] Total hunter success (registered harvest divided by all permits issued). Success rates not adjusted for non-participation or un-registered harvest.

[c] 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 by license type and registered harvest within each TPA during the 2021 spring wild turkey season in Minnesota[a].

Permit area	Archery permits declared	General permits declared	Youth permits declared	Total registered harvest
501	17,07	6,495	1,850	2,007
502	184	620	148	179
503	1,204	3,419	1,263	1,239
504	461	919	388	325
505	623	1,958	608	707
506	585	1,299	562	470
507	3,653	8,268	3,936	3,534
508	2,363	6034	2,289	2,053
509	448	942	531	475
510	1,496	2,245	860	993
511	147	198	94	54
512	95	123	69	34
Total	12,966	32,520	12,598	12,070

[a] Beginning in 2020, all hunters declared but were not restricted to harvesting a turkey in their declared TPA.

Table 6. Permits issued and harvest by license type and time period for the spring 2021 wild turkey season in Minnesota.

Time period	Archery permits issued[a]	Youth permits issued[a]	General permits issued	Registered harvest[b]	Percent of total harvest[b]
Any	12,966	12,598			
A			11,576	4,983	41.3%
B			8,813	2,561	21.2%
C			6,163	1,718	14.2%
D			2,994	887	7.3%
E			1,935	573	4.7%
F			1,039	1,348	11.2%

[a] Archery and youth permits were valid during any time period.

[b] Includes harvest from all license types.

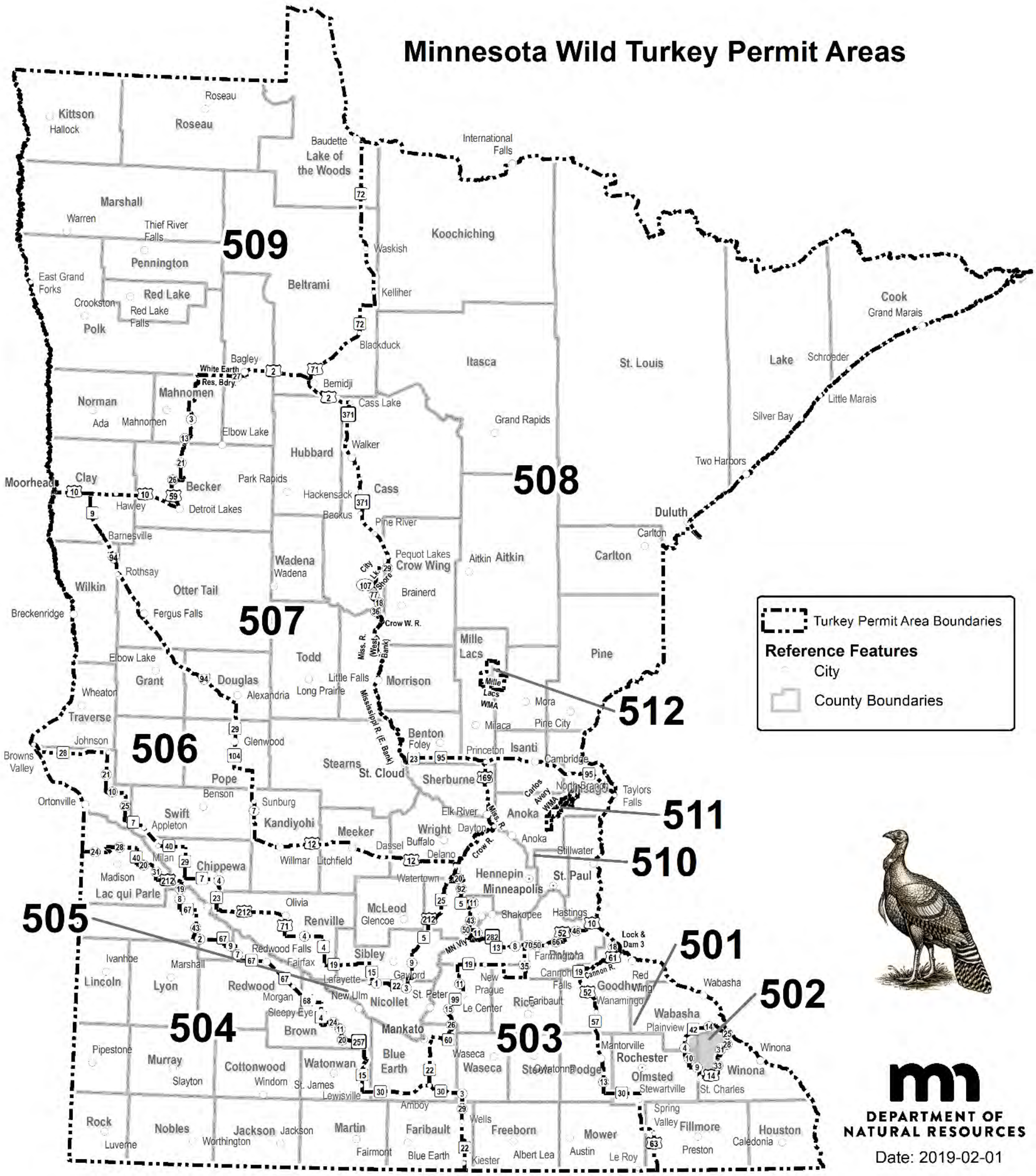

Figure 1. Permit areas open for hunting during fall 2021 and spring 2022 wild turkey seasons in Minnesota.

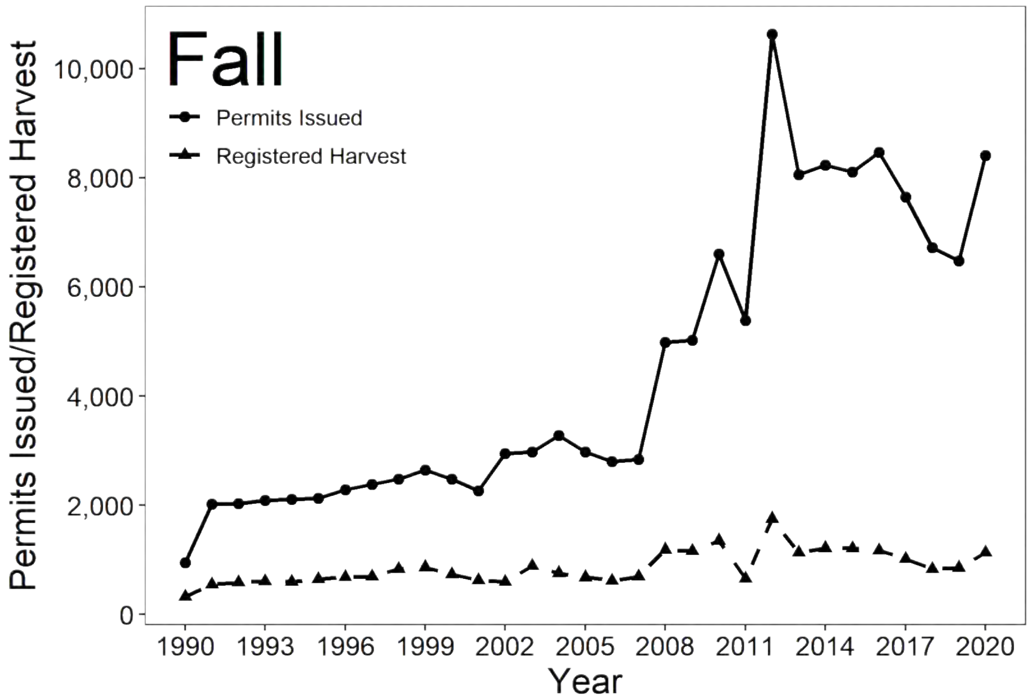

Figure 2. Permits issued and registered harvest for fall wild turkey seasons in Minnesota, 1990-2020.

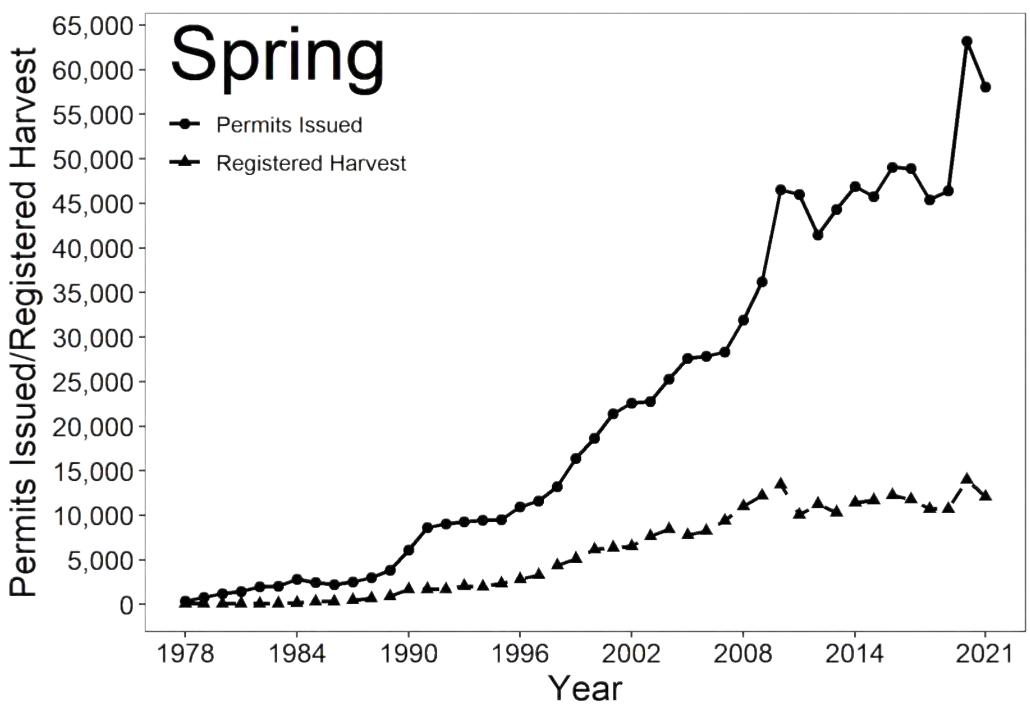

Figure 3. Permits issued and registered harvest for spring wild turkey seasons in Minnesota, 1978-2021.

2021 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 2021, 111 hunters were estimated to have gone afield and harvested 110 prairie-chickens and 44 sharp-tailed grouse (*Tympanuchus phasianellus*) during prairie-chicken hunts. Hunter success (0.49) was lower than last year but similar to recent years. Satisfaction (4.0 on a scale of 1-5) was also 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. Notably, in 2021, the number of applicants for the prairie-chicken lottery was the highest since 2009, indicating more interest in prairie-chicken hunting.

INTRODUCTION

Greater 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 2021, the prairie-chicken season opened 25 September and closed 3 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 up to 20% of the available permits in a permit area. Remaining 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 2003-2007, so I determined harvest through a postcard survey. I sent a postcard to each lottery winner the week before hunting season. Six 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 or reported hunting were considered in the analysis. I compared responses from the first mailing to responses from the second mailing to examine possible nonresponse bias and adjusted as necessary. I calculated the number of birds harvested, birds per harvester, and hunter success (i.e., proportion of estimated hunters harvesting ≥1 prairie-chicken) for each permit area. Each of these metrics was calculated by permit area and for all areas.

RESULTS AND DISCUSSION

The combined quota for the 11 permit areas during 2021 was 125 permits, and 435 individuals applied in the lottery (Table 1). Of the 130 lottery winners, 117—including 6 landowners—later purchased a permit. All permit areas had more applicants than permits available, so surplus permits were not available.

One-hundred-eight purchasers (86%, n = 125) responded to the survey; 88 (70%) responded to the first mailing and 20 (16%) to the second mailing. This response rate is similar to survey response rates since 2010 (mean: 87%; range: 83-95%). I detected a response bias in the number of respondents that hunted, with respondents to the first mailing more likely to have hunted than those responding to the second mailing (92% vs. 75% of respondents). Respondents to the first mailing also harvested prairie-chickens at higher rates than respondents to the second mailing (45% vs. 30%), and harvested more chickens (1.0 vs. 0.6 birds per hunter), but spent a similar number of days afield (2.3 vs. 1.9, respectively), and harvested similar numbers of sharp-tailed grouse (0.5 vs. 0.2 birds per hunter, respectively). Respondents to the first mailing reported similar satisfaction (mean 4.1 vs. 3.6, median 4.0 vs. 4.0), with 93% and 82% of respondents reporting satisfaction scores ≥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 as 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.

Ninety-six respondents reported that they hunted prairie-chickens (Table 2). I estimated the total number of hunters to be 111 (i.e., purchasers who went afield) after accounting for hunting by non-respondents. Hunters reported harvesting 100 prairie-chickens and total harvest after accounting for non-respondents was estimated as 110 prairie-chickens. An estimated 60 hunters bagged ≥1 chicken. Prairie-chicken hunter success during 2021 was lower than last year but similar to recent years of the survey. Survey respondents also reported harvesting 44 sharp-tailed grouse while hunting prairie-chickens from permit areas 803A, 804A, 805A, 806A, 807A, 808A, and 813A (Figure 1). Successful hunters reported higher average satisfaction (4.5) than respondents that were not successful (3.4), but satisfaction of prairie-chicken hunters was high overall.

Prairie-chicken hunter satisfaction was similar to 2013-2020, which is consistent with improved 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 Seth Goreham for commenting on the report.

Table 1. Prairie-chicken hunt lottery applicants, winners, and hunting permit purchasers in Minnesota during 2021.

Permit area	Permits available	No. of applicants	Lottery winners		Permit purchasers[a]		Surplus purchasers[c]
			No.[b]	Proportion	No.	Proportion	
803A	8	23	8	0.35	8	1.00	0
804A	10	17	10	0.59	9	0.90	0
805A	10	63	10	0.16	9	0.90	0
806A	12	45	13	0.29	13	1.00	0
807A	20	76	22	0.29	21	0.95	0
808A	20	78	20	0.26	18	0.90	0
809A	15	48	15	0.31	13	0.87	0
810A	15	55	15	0.27	12	0.80	0
811A	5	6	5	0.83	5	1.00	0
812A	5	14	5	0.36	5	1.00	0
813A	5	10	7	0.70	4	0.57	0
All	125	435	130	0.30	117	0.90	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 available in 2021, because more people applied for permits in each area than there were permits available.

Table 2. Prairie-chicken harvest in Minnesota during 2021.

Permit area	No. of hunters[a]		Birds harvested		Birds per harvester[b]	Success rate[c]
	Self-reported	Estimated	Self-reported	Estimated		
803A	6	7	1	2	1.2	0.14
804A	7	9	3	4	1.6	0.33
805A	8	9	7	8	1.8	0.44
806A	12	12	9	9	1.8	0.42
807A	15	17	23	24	2.0	0.76
808A	14	17	22	24	1.9	0.76
809A	12	13	15	16	1.9	0.62
810A	11	13	9	10	1.8	0.46
811A	3	5	0	1	1.8	0.20
812A	5	5	5	5	1.7	0.60
813A	3	4	6	7	2.0	0.75
All	96	111[d]	100	110[d]	1.8[d]	0.49[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 2003–2021.

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]
2018	125	303	104	82[f]	0.51[f]	3.9[f]
2019	125	354	100	64[f]	0.37[f]	3.8[f]
2020	125	366	105	112[f]	0.62[f]	4.0[f]
2021	125	435	111	110[f]	0.49[f]	4.0

[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, 2017, 2018, 2019, 2020, and 2021.

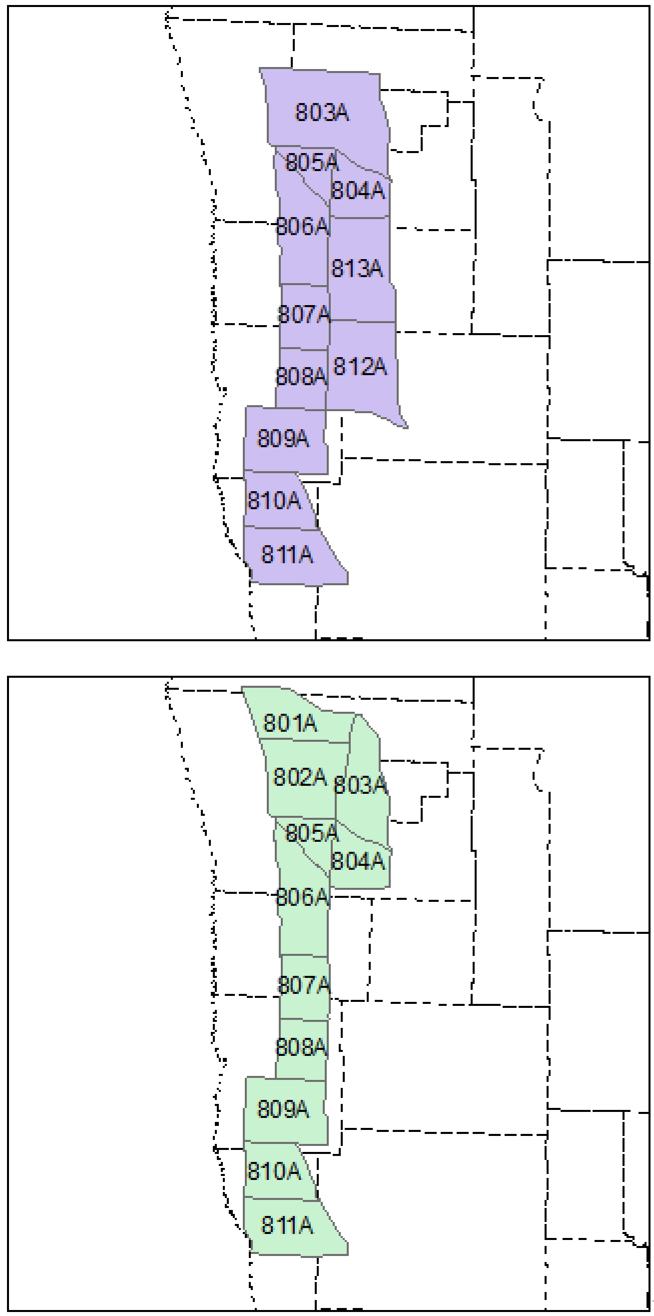

Figure 1. Prairie-chicken hunting permit area boundaries in northwestern Minnesota since 2013 (top) compared to during 2006–2012 (bottom). County boundaries are indicated by dashed lines. Permit areas 812A and 813A were added, 801A was eliminated, and 802A and portions of 803A were combined into a revised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

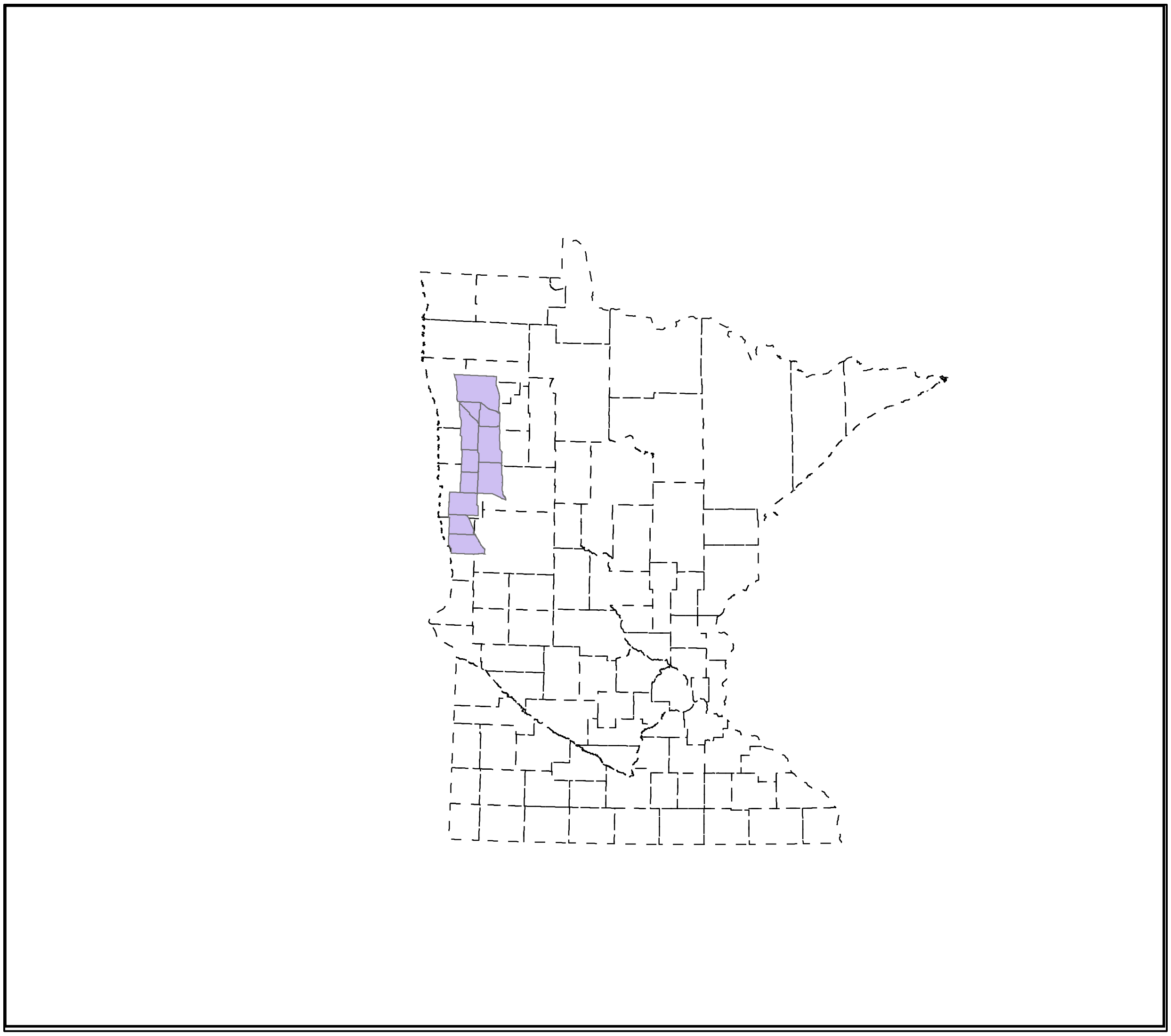

Figure 2. Northwestern location of prairie-chicken hunting permit areas within the state relative to county boundaries (dashed lines).

STATUS OF MINNESOTA BLACK BEAR HARVEST, 2021*

Andrew N. Tri, Forest Wildlife Research Group

INTRODUCTION

The Minnesota bear range has historically been divided into 13 bear management units (BMU). Each has a separate quota on hunting licenses, and 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 is 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 fifth straight year. Applications have not been this high since 2001(Table 1). Of these, >4,100 (17%), a record high number, applied for area 99, meaning that they only sought to raise their preference level for the permit system, but not hunt this year. Permit availability was the same as 2020. Hunting success in the quota zone was the third highest ever and overall statewide harvest was the second highest since 2007 (Figure 1). Hunting success is inversely related to the number of hunters but also strongly affected by fall foods. A record number of people bought no-quota licenses (4,643 hunters or 52% of the overall license sales). The total number of hunters were nearly a 30% increase over the 5-year average and is similar to the increase we saw in 2020.

Quota zone permits and licenses

The number of quota zone permits available in 2021 was the same as 2020 (Table 2). This is the 9th year (since 2013) that permits have been kept low (<3,900). This was the 10th year (since 2011) of a system whereby licenses for the quota zone that were not purchased by permittees selected in the lottery (>400) could be purchased later as surplus. BMU 451 (new in 2020) had an unlimited number of permits but was still part of the quota zone (768 sold, all listed as surplus license sales) (Table 3). This experimental zone was created to test the hypothesis that hunters can effectively reduce nuisance complaints and crop damage. This area will exist for at least 3 years to understand if there are any reductions in crop damage.

Bear Management Units

There are currently 13 Bear Management Units (BMUs) where license sales are limited by a quota, 1 where the number of permits is unlimited, and 4 BMUs with no quota at all (Figure 2). The BMU divisions in the no-quota zone are for internal data analysis purposes only: hunters do not have to choose a BMU in which to hunt within this zone. In the quota zone, hunters must apply for a certain BMU and are drawn through a preference lottery based on their number of previously unsuccessful applications (Table 4). The first digit in each BMU (1–5) refers to 5 larger BMUs in which each was previously a part (when numbering began in 1985). Since then, several BMUs have been split, to adjust hunting pressure and meet different management goals. 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). This split, along former BMU lines, allows current data to be regrouped into these former BMUs and thereby compared to older data (which is done in this report). BMU 451 was split from BMU 45 this year as an experimental unit to understand if we could reduce crop damage through hunting. The results for this BMU are reported under the quota zone but were not remerged with BMU 45. This is because of the unlimited number of tags in BMU 451, so BMU-level results would not be comparable with previous years.

Quota zone applicants

Statewide, quota zone applications have been relatively stable over the past 10 years (Figure 3), but this year, applications increased in almost all BMUs. As in year’s past, BMU 45 showed a significant, two-fold increase over the past 10 years. This year BMU 44 (current BMUs 46 and 47) received ~1500 more applicants than 2020 and ~800 more applicants than 2019.

Quota zone lottery

We do not have (nor have we ever had) a bear population that can sustain levels of harvest where everyone who applies for a tag is successful. The low quota zone permit availability over the past 8 years has made it increasingly difficult to succeed in the lottery and wait times increased again in 2021 (Table 4). The trade-off is that the quality of the hunt and the success rates are exceedingly high in the quota zone (Table 1, Figure 1). This year, although quotas were about the same as last year, a higher level of preference was needed to secure a permit because a large number of hunters who had accumulated preference points by previously applying to area 99 entered the lottery for a BMU. First-time and second-time applicants were successful only in BMU 22 (wilderness area hunt). Six BMUs required a preference level of 4 for guaranteed success, and BMUs 28, 46, 47, and 45 required a preference level of 5 or above for any chance of drawing a tag. This high threshold for these BMUs is due to the increasing number of applicants this year (Figure 3), not a reduced number of available permits (Table 2).

Harvest by BMU

The statewide harvest in 2021 was 7% lower than 2020, but 27% higher than 2019 (Table 5). This was likely due to the range wide drought that caused low natural berry production and low abundance of natural bear foods for the second year in a row. The sex ratio of the harvest was ≥60% males in BMUs 13, 27, 45, 451, 46, and 47. All others had sex ratios closer to 50% male (mostly in NE MN), which similar to 2020. The statewide harvest sex ratio has exceeded 60% in all years except 2021 and 2020 since 2013 (Table 1), when permits were reduced. However, these same highly male-biased sex ratios have also occurred in the no-quota area, suggesting that it is not just due to low hunter density. When natural foods are poor, reproductive females are far likelier to be shot than in average or good food years.

Harvest by quota vs no-quota zones

Permit availability continuously declined during the decade 2003–2013 (Tables 1, 2), and commensurately, 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 continues to increase (34%, a record high), split evenly between BMUs 11 and 52 (Table 5). Over half of the bear hunters were hunting with a no-quota license this year (a record).

Hunting success by BMU

In 2021, success (Table 6) was very high in the quota zone, reaching record or near-record levels in many BMUs in the quota zone (>50% in BMUs 12, 25, 28, 31,46, and 45; >60% in BMUs 27 and 47). Success rate in quota zone nearly 2.5 times higher than in the no-quota zone (51% vs. 21%, respectively). A growing proportion indicated that they planned to hunt in BMU 10 (although the hunting success rate in this area is one of the lowest in the state).

Spatial distribution of hunters' baits

The bait registration system data has records for 7,893 baits placed on the landscape during the 2021 hunt (Figure 5). Bait placement is more dispersed across the state this year and there are fewer townships with >50 baits. Of note, a few hunters set baits outside of primary bear range. One note of caution when interpreting this map is that this is an underestimate of bait density; based on hunter surveys >90% of hunters set 2.5 baits on average, which means that a complete dataset would include the registration locations of nearly 20,000 baits rather than the nearly 8,000 we have.

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). This year lagged behind this pattern somewhat, likely due to the unexpected crops of acorns in the western BMUs).

Predictions of harvest from food abundance

The 2021 statewide harvest was 15% lower than expected, based on regression of harvest as a function of hunter numbers and the fall food productivity index (Figure 6). This regression is nearly as strong (and has accurately predicted previous harvests) when only the past 15 years are considered. For the quota zone, the actual harvest in 2020 was also only 6% lower than predicted by this regression. These discrepancies might be due to the changes in BMU 451 and limited time that staff spent in the field due to the COVID-19 pandemic.

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 (Figures 7, 8). Reminder notices were sent to non-compliant hunters each year during 2014–2017, which spurred a higher initial compliance the following years (>80%). Since 2018, with no reminder mailing, compliance has been 82–87%. Since 2013, hunters could register by phone or internet, and pick up a tooth submission envelope later: tooth submission compliance by these hunters has equalized across all registration types. A decreasing proportion of hunters are registering their bear at a registration station over the past years. Compliance with tooth submission was higher in the quota zones than in the no-quota area but was especially low (<80%) in a number of units (BMUs 10, 22, 41, and 52).

Population trend: Statewide and quota vs no-quota zones

A new Bayesian model developed by Allen et al. (2018) for bear monitoring in Wisconsin includes not only the sex-age composition of harvested bears (like the Downing), but also reproductive and survival parameters (obtained from data collected from long-term monitoring of radio-collared bears in different study sites across Minnesota). This model does not have a lag time like the Downing (so projections are available to post-hunt 2021, but the estimation method provides a "dampening" effect on the year-to-year variation in population estimates that results in a flatter curve than expected. The trajectory of this model is robust to assumption violations but is certainly an underestimate when considering our tetracycline estimates. The models for this year indicated that the statewide population has stabilized and is slowly recovering (Figure 9). Notably, the quota area as a whole has stabilized since 2012 and only had a minor decline after the past 2 years of increased harvest, but the no quota area has been increasing steadily for the last 20 years. The credible intervals for these 2 estimates are not included for ease of reading.

Trends in harvest rates

The sex ratio of harvested bears varies by age. 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 (≥8 years) are nearly always dominated by females, because, although old females continue to be less vulnerable as individuals, 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 10). Based on this method, harvest rates since 2015 have been significantly less than what they were in the early 1980s, when the bear population was increasing.

One problem in using this very simple method is that it assumes that the relative difference for males versus females in their vulnerability to harvest does not change systematically through time. This may not be true, given the steadily increasing male-skewed harvests since the late 1990s, and especially in recent years.

**Harvest data extracted from the Status of Minnesota Black Bears, 2021: Final Report to the Bear Committee. 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, 2001–2021.

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Permit applications[a]	26824	21886	16431	16466	16153	15725	16345	17362	17571	18647	19184	18103	18107	18885	18422	19958	21034	21184	20632	22279	24598
Permits available[b]	20710	20610	20110	16450	15950	14850	13200	11850	10000	9500	7050	6000	3750	3750	3700	3850	3350	3350	3400	3575	3575
Licenses purchased (total)	16510	14639	14409	13669	13199	13164	11936	10404	9892	9689	9555	8986	6589	6620	6962	7177	6655	6550	6801	8882	8990
Quota zone [c]	13632	12350	9833	10063	9340	9169	8905	7842	7342	7086	5684	4951	3188	3177	3257	3420	2954	2922	2988	3178	3187
Quota surplus/military [c]	235	209	2554	1356	1591	1561	526	233	77	83	1385	1070	578	583	446	441	401	428	417	398	392
Quota-no limit area-451																				1038	768
No-quota zone [c]	2643	2080	2022	2238	2268	2434	2505	2329	2473	2520	2486	2965	2823	2860	3259	3316	3300	3200	3396	4262[h]	4643
% Licenses bought																					
Of permits available [d]	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	100	100	100	100
Of permits issued [d]	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	87.2	87.8	80.8	89.1
Residents in Quota [d]															86.3	88.1	76.6	88.9	87.6	86.6	87.5
Estimated no. hunters [e]	15500	13800	13600	12900	12500	12500	11300	9900	9400	9200	9200	8600	6300	6300	6700	6900	6400	6300	6700	8400	8500
Harvest	4936	1915	3598	3391	3340	3290	3172	2135	2801	2699	2131	2604	1866	1627	1971	2641	2040	1766	2340	3203	2971
Harvest sex ratio (%M) [f]	56	61	58	57	59	58	57	62	59	59	61	59	62	62	66 [i]	61	63	66 [i]	61	56	59
Success rate (%)																					
Total harvest/hunters [g]	29	14	26	26	26	26	28	21	30	29	23	30	30	26	30	38	32	28	35	38	35
Quota harvest/licenses [k]	28	14	25	26	25	25	28	21	30	30	24	33	37	33	39[j]	50 [j]	46	38	49 [j]	57[j,k]	51[k]

[a] From 2008 to 2019, 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; 2018=3254, 2019=3450, 2020=3691, 2021=4189(record high); additionally, area 88 nuisance-only bear license applications counted in this total in 2017=3, 2018=6, 2019=5, 2020=11, 2021=4 (people who selected area 88 as 1st preference).

[b] Beginning in 2011 a procedure was implemented 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 2011–20, all unpurchased licenses were put up for sale and were bought. The percent of resident hunters in the quota area each year includes all license types (regular quota, youth, and surplus licenses). This statistic was added to the report in 2021 and was able to easily back-calculate to 2015.

[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%), 2009 (95.3%), and 2018 (92.7%). Beginning in 2011 all unpurchased quota licenses were sold as "surplus" in August, and this process is quick and competitive; thus, for 2011–19 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. In 2018, 3 hunters shot 2 bears. In 2019, 2 hunters shot 2 bears. In 2020, 5 hunters shot 2 bears.

[h] Record high number of no-quota zone licenses purchased in 2020; record high % of licenses in no-quota zone in 2017 (nearly 50%; see Fig. 4).

[i] Record high % males in statewide harvest.

[j] 2020: highest success rate in quota zone ever; 2016: second highest success rate; 2019: third-highest success rate.

[k] In 2020, BMU 451 was broken out of BMU 45 and was an area in the quota zone with an unlimited number of licenses. The quota success rate is calculated without BMU 451 in it to make hunting success estimates comparable across years. The 2021 success rate for BMU 451 is listed in Table 6 and the success rate for the quota area with Area 451 included is 45%.

Table 2. Number of bear hunting quota area permits available, 2017–2021. Highlighted values show a change from the previous year. BMUs 26 and 44 were divided into 27/28 and 46/47, respectively, in 2016. No change occurred from 2020 to 2021.

BMU	2017	2018	2019	2020	2021
12	125	125	150	125	125
13	225	225	250	225	225
22	50	50	50	50	50
24	175	175	200	175	175
25	400	400	500	400	400
27	225	225	225	225	225
28	60	60	60	60	60
31	500	500	550	500	500
41	125	125	150	175	175
45	175	175	150	200	200
46	350	350	350	400	400
47	40	40	40	40	40
51	900	900	900	1000	1000
Total	3350	3350	3700	3575	3575

[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. Area 451 was created in 2020 to alleviate crop damage issues by having a permit area with an unlimited number of permit available (1046 in licenses sold in 451 during 2020).

Table 3. Number of quota BMU permit applicants (Apps), licenses bought (after permits drawn) and surplus licenses bought, 2016–2021[a]. Shaded values indicate undersubscribed (applications less than permits available).

BMU	2016			2017			2018			2019			2020			2021		
	Apps	Bought license	Surplus bought	Apps	Bought license	Surplus bought	Apps	Bought license	Surplus bought	Apps	Bought license	Surplus bought	Apps	Bought license	Surplus bought	Apps	Bought license	Surplus bought
12	624	133	17	774	113	12	703	109	16	711	104	21	751	107	18	891	110	15
13	716	221	29	772	200	25	682	177	47	712	199	26	734	195	30	944	198	27
22	52	37	13	47	34	16	76	36	14	61	35	14	69	32	18	73	40	10
24	884	173	27	945	158	17	928	155	20	840	153	22	909	155	20	1072	157	18
25	1443	440	60	1651	354	46	1561	355	44	1520	348	52	1627	367	33	1806	356	44
27	1224	219	31	1297	197	28	1265	204	21	1280	200	25	1338	207	18	1532	200	25
28	325	72	3	330	52	8	309	52	8	318	51	9	312	49	11	358	59	1
31	2180	489	62	2076	441	59	2074	428	71	1907	432	67	2022	444	57	2297	428	72
41	618	114	11	614	109	16	648	114	11	661	143	7	663	154	21	841	155	20
45	2046	227	23	2323	161	14	2383	160	15	2351	178	22	1978	186	14	2241	190	10
451[d]															1038			768
46	2690	370	30	2774	319	31	2769	317	33	2662	313	37	2853	364	36	3340	364	36
47	194	45	5	214	33	7	182	35	5	198	34	6	216	33	7	244	33	7
51	4321	880	121	4411	783	117	4344	779	123	3956	798	102	4058	885	115	4766	897	105
Total[c]	17317	3420	432	18228	2954	396	17924	2921	428	17177	2988	410	18577	3178	1454	20405	3187	1158

[a] Beginning in 2011, all licenses not purchased by permittees were sold as "surplus". In all cases but three (see footnote b), all of the surplus licenses were purchased. Surplus = Permits available (Table 2) minus Bought licenses (±5 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). This number also includes the permits sold in area 451 (1038 in 2020).

[d] Beginning in 2020, applicants could apply for area 451. This was an area in the quota zone with no limit on the quota and all licenses are considered surplus licenses. This is not an area for lottery or applications; only surplus licenses could be purchased.

Table 4. Percent of quota BMU lottery applicants with preference levels 1 (1st-year applicants), 2, 3, 4, and 5 who were drawn for a bear permit during 2017–2021. 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].

BMU	2017				2018					2019					2020					2021				
	Pref 1	Pref 2	Pref 3	Pref 4	Pref 1	Pref 2	Pref 3	Pref 4	Pref 5	Pref 1	Pref 2	Pref 3	Pref 4	Pref 5	Pref 1	Pref 2	Pref 3	Pref 4	Pref 5	Pref 1	Pref 2	Pref 3	Pref 4	Pref 5
12	0	0	57		0	0	41			0	0	13			0	0	0	72		0	0	58		
13	0	16			0	0	11			0	0	92			0	0	93			0	0	66		
22	100				60					76					65					56				
24	0	0	57		0	0	26			0	0	11			0	0	0	93		0	0	0	78	
25	0	6			0	0	80			0	0	58			0	0	45			0	0	32		
27[b]	0	0	2		0	0	0	36		0	0	0	66		0	0	0	49		0	0	0	20	
28[b]	0	0	0	76	0	0	0	42		0	0	0	5		0	0	0	2		0	0	0	0	77
31	0	0	67		0	0	48			0	0	38			0	0	33			0	0	9		
41	0	0	56		0	0	27			0	0	6			0	0	26			0	0	26		
46[b]	0	0	0	51	0	0	0	24		0	0	0	1		0	0	0	0	83	0	0	0	0	58
47[b]	0	0	0	49	0	0	0	29		0	0	0	50		0	0	0	18		0	0	0	0	72
45	0	0	0	16	0	0	0	0	31	0	0	0	0	42	0	0	0	0	23	0	0	0	0	5
51	0	0	54		0	0	35			0	0	0	22		0	0	24			0	0	18		

[a] As an example, in 2019: BMU 12: 0% of preference level 1 and 2 applicants were drawn, 13% of preference level 3, and 100% of preference level 4 and above were drawn for a permit; BMU 22: 76% preference level 1 applicants were selected, 100% all higher preference levels; BMU 45: no preference level 1–4 applicants were drawn, 42% of hunters with preference 5 were drawn, and 100% of hunters with preference level 6 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 2021 by Bear Management Unit (BMU)[a] and sex[b] compared to harvests during 2016–2020 and record high and low harvests (since establishment of each BMU, not counting current year).

BMU	2021 M	2021 (%M)	2021 F	2021 Total	2020	2019	2018	2017	2016	5-year mean	Record low harvest (yr)	Record high harvest (yr)
QUOTA												
12	41	58	30	71	84	62	66	54	78	69	38 (14)	263 (01)
13	68	62	42	110	126	105	119	100	147	119	71 (88)	258 (95)
22	1	33	2	3	7	3[d]	4	8	5	5	3 (03)	41 (89)
24	44	54	37	81	97	86	60	81	96	84	50 (14)	288 (95)
25	107	50	108	215	251	224	223	212	287	239	149 (96)	584 (01)
26					[186]	[169]	[141]	[162]	[171]	162	117 (14)	513 (95)
27	86	61	54	140	148	128	105	120	131	126	105 (18)	148 (20)
28	24	71	10	34	38	41	36	42	40	39	36 (18)	42 (20)
31	159	54	137	296	325	212	211	262	312	264	157 (88)	697 (01)
41	51	68	24	75	74	76	58	61	57	65	35 (15)	201 (01)
44					[256]	[203]	[154]	[158]	[215]	187	130 (11)	643 (95)
46	126	63	75	201	231	181	139	141	190	176	139 (18)	231 (20)
47	20	74	7	27	25	22	15	17	25	21	15 (18)	25(16,20)
45	71	66	37	108	85	108	51	77	102[e]	85	32 (11)	178 (01)
451	66	60	44	110	168							
51	248	52	229	477	511	411	185[d]	372	463	388	185 (18)	895 (01)
Total	1112	57	836	1948	2210	1659	1272	1547	1933	1677	1192 (88)	4288 (01)
11	257	56	129	386	487[f]	269	287	179	291	303	38 (87)	351 (05)
10	28	67	22	50	29[f]	26	21	18	15	22	15 (16)	29 (20)
52	361	61	226	587	476[f]	386	186[p]	295	402	349	105 (02)	476 (20)
60[c]	0		0	0	1	0	0	1	0			
Total	646	63	377	1023	993[e]	681	494	493	708[n]	611	198 (87)	993 (20)
STATE	1758	59	1213	2971	3203	2340	1766	2040	2641	2225	1509 (88)	4956 (95)

[a] Some tooth envelopes were received from hunters who did not register their bear. These were added to the harvest tally: 2013:6; 2014:3; 2015:6; 2016:7; 2017:4; 2018:2; 2019:18.Some hunters with no-quota licenses hunted in the quota zone, and their kills were assigned to the BMU where they apparently hunted: 2013:11; 2014:4; 2015:12; 2016:9; 2017:2; 2018:4*; 2019:4, *None were authorized NQ license-holders hunting in quota zone. 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. The only other hunter-harvested bear in this area was in 2017.

Notable harvests:

[d] Tie for record low harvest.

[e] Highest harvest since 2007.

[f] Record high harvest for these no-quota zones.

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Table 6. Bear hunting success (%) by BMU, measured as the registered harvest divided by the number of licenses sold[a], 2016–2021[a].

BMU	Max success (yr) before 2021		Mean success 2016–2020	2021	2020	2019	2018	2017	2016
12	67	(20)	53	55[c]	67[b]	53[c]	43	52	40
13	59	(95,16)	52	49	56[c]	53	45	59[b]	29
22	18	(92)	11	6	14	8	16	10	13
24	55	(20)	46	46	55[b]	34	46	48[c]	48
25	63	(20)	57	54	63[b]	56[c]	53	57[c]	45
26	65	(20)	57	61[c]	65[b]	49	57	52	34
27	66	(20)		62[c]	66[b]	47	53[c]	52	
28	70	(18)		57	63[c]	60	70[d]	53	
31	65	(20)	52	59[c]	65[b]	42	52	56[c]	56[c]
41	50	(95)	51	43	42	46	49[c]	46	23
44	58	(20)	48	52[c]	58[b]	39	41	48[c]	35
46	58	(20)		50[c]	58[b]	39	40	47	
47	63	(20)		68[b]	63[b]	38	43	50	
45	44	(18)	41	54[b]	43	29	44[c]	40	36
451				14	16				
51	51	(20)	42	47[c]	51[b]	21	41	46[c]	33
QUOTA[F]	57	(20)	47	51[C]	57[B]	38	46[C]	50	39
11[G]			24	24	23	25	17	28	20
10[G]			12	12	12	9	8	9	7
52[G]			23	23	19	10	14	19	15
NO QUOTA	32	(95)	21	22	24	15	15	21	16
STATEWIDE	40	(95)	40	33	38[C]	27	31	37	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 (or tied second highest) success.

[d] Highest success ever for any BMU.

[e] Tied record lowest success.

[f] in 2020, BMU 451 was broken out of BMU 45 and was an area in the quota zone with an unlimited number of licenses. The quota success rate is calculated without BMU 451 in it to make hunting success estimates comparable across years. The success rate for BMU 451 is listed on it's own line in the table.

[g] 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, 1 more was killed there in 2020. Table shows % indicating where they planned to hunt (number of hunters in parentheses for BMU 60 and Quota zone):

BMU	2021	2020		2019		2018		2017	
11	34.7	34.3		30.9		34.6		29.8	
10	9.3	8.6		14.3		7.4		6.6	
52	56.0	56.8		52.0		55.3		59.2	
60 (n)	0	0.3	(13)	0.3	(11)	0.1	(4)	0.1	(4)
Quota zone (n)	0	0.6	(27)	2.5	(94)	2.6	(83)	4.2	(137)

Table 7. Cumulative bear harvest (% of total harvest) by date, 1998–2021.

Year	Day of week for opener	Aug 22/23 – Aug 31	Sep 1 – Sep 7	Sep 1 – Sep 14	Sep 1 – Sep 30
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
2018	Sat		59[a]	75	91
2019	Sun		71	83	95
2020	Tues		70	83	94
2021	Wed		66	80	95

[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.

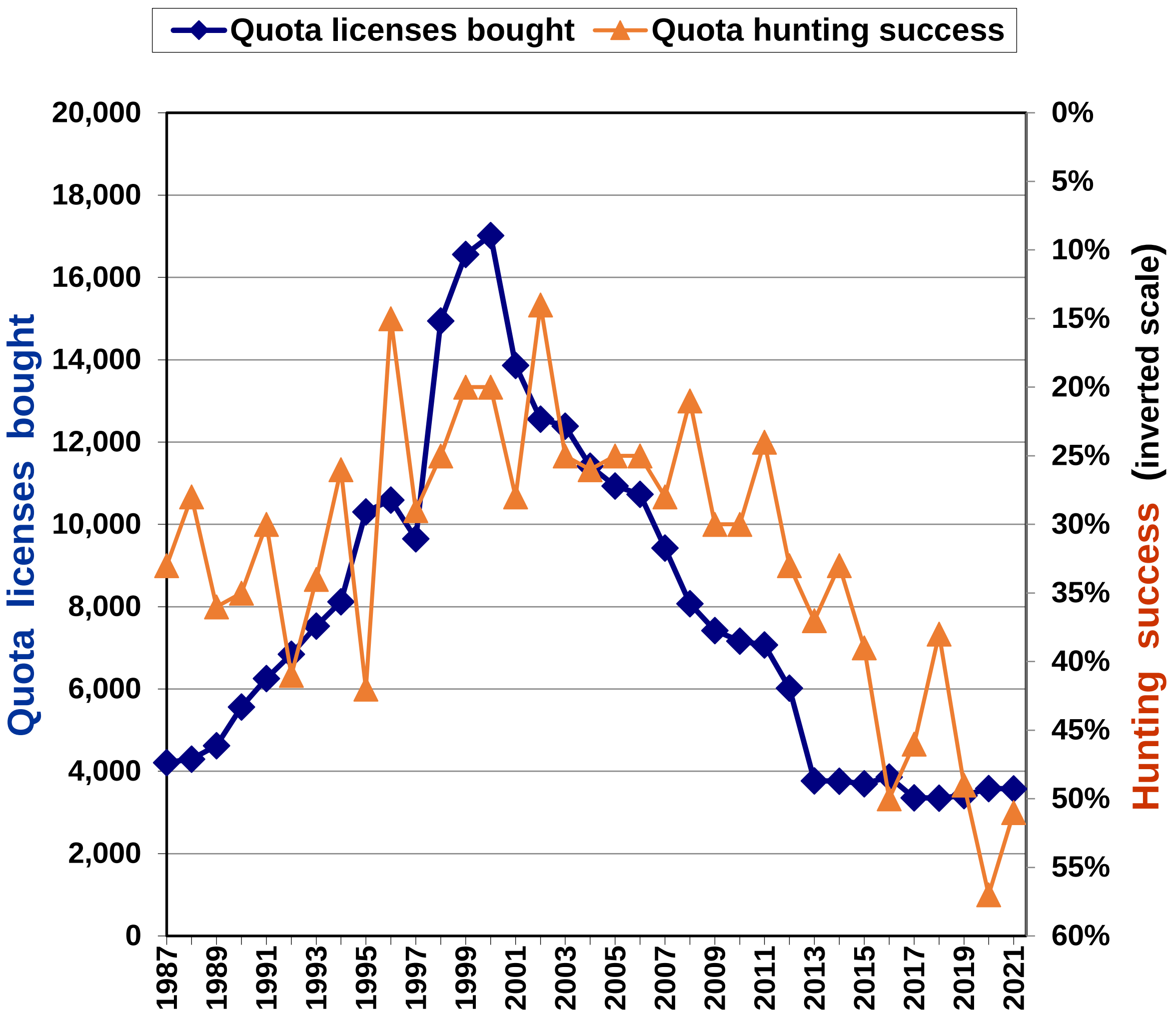


Figure 1 Relationship between licenses sold and hunting success (*note inverted scale*) in quota zone, 1987–2021 (quota and no-quota zones first partitioned in 1987). Number of licenses explains 59% of variation in hunting success during this period. Large variation in hunting success is also attributable to food conditions (e.g., during 2013–2021, when licenses were held relatively constant). Statistics from BMU 451 are not included in this graph to allow for quota zone comparisons with the past.

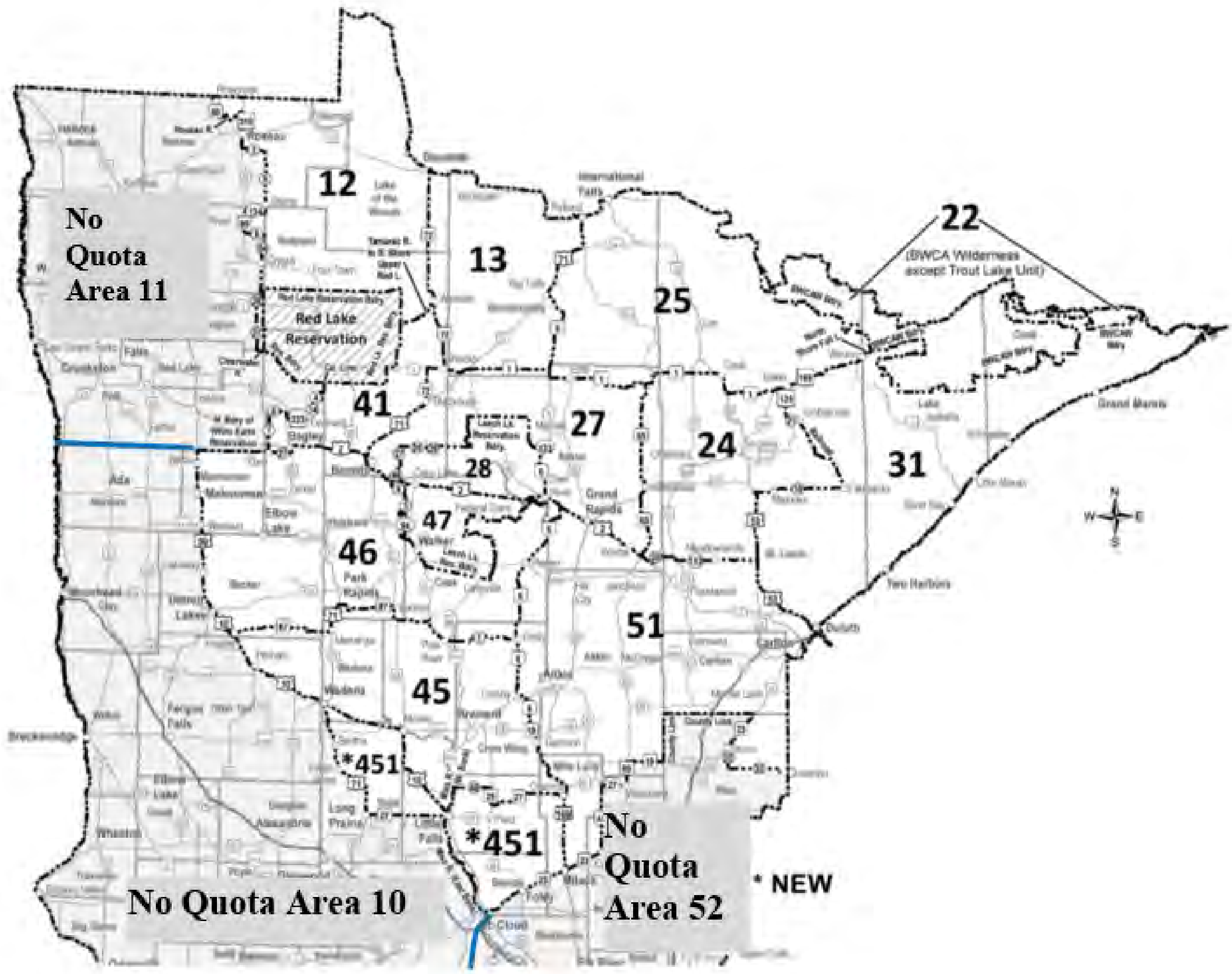


Figure 2. Bear management units (BMUs) within quota (white) and no-quota (gray) zones. Hunters in the quota zone are restricted to a single BMU. In 2016, BMU 26 was divided into 27 and 28, and BMU 44 was split into 46 and 47 (BMUs 28 and 47 comprise the Leech Lake Reservation). No-quota hunters can hunt anywhere within the gray-colored zone, including the southeast corner of Minnesota (not shown; designated area 60). In 2020, zone 451 was split from 3 deer permit areas of 45 to relieve crop damage in the area. This area is in the quota-zone, but with an unlimited number of participants.

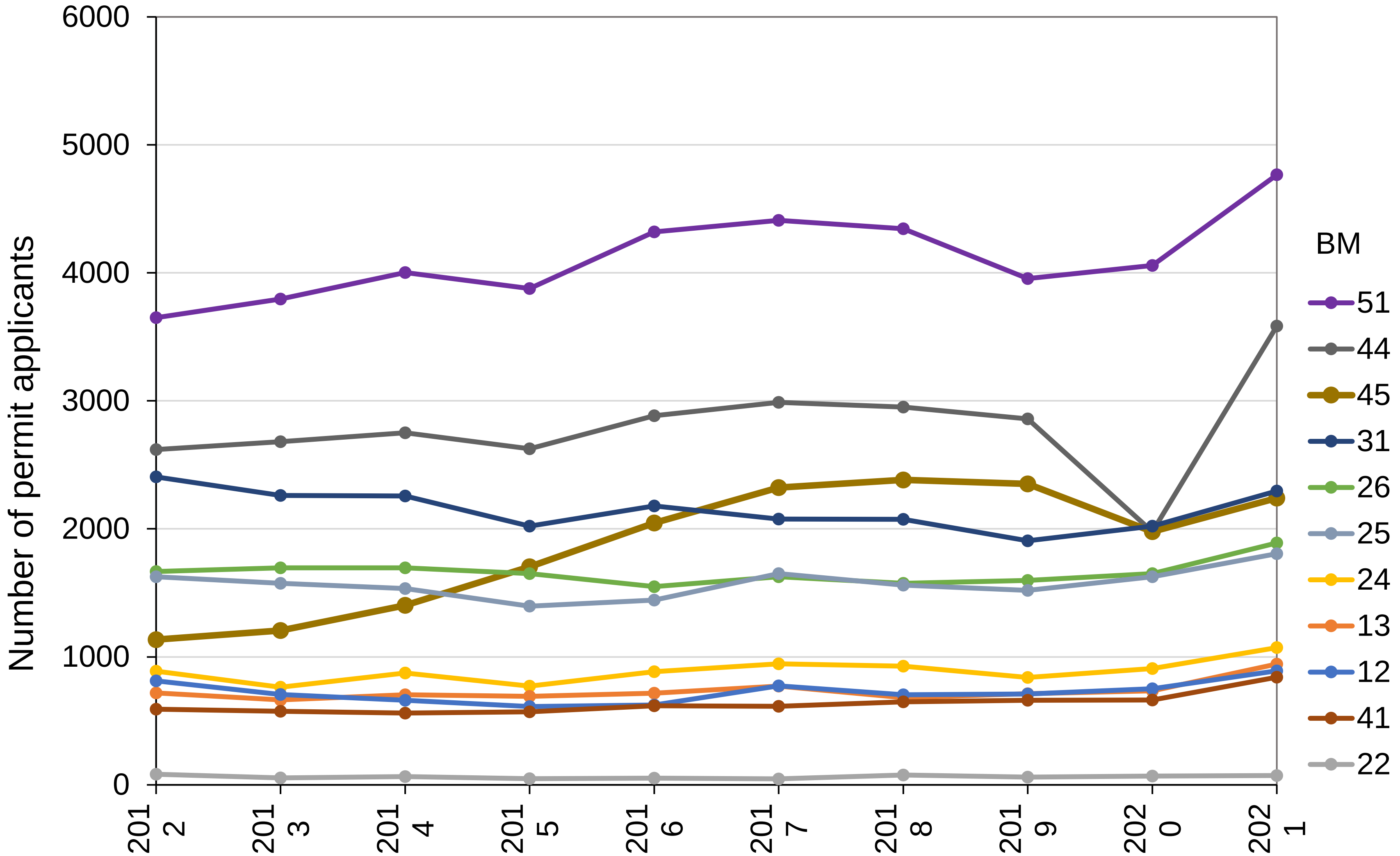


Figure 3. Trends in number of applicants for quota zone permits by BMU over past 10 years, 2012–2021. For 2016–2020, BMUs 27 and 28 were grouped into old BMU 26 and BMUs 46 and 47 were grouped into old BMU 44. BMU 45 is highlighted because applications there surged over this period. The number of applications in all areas (except 22) increased in 2021.

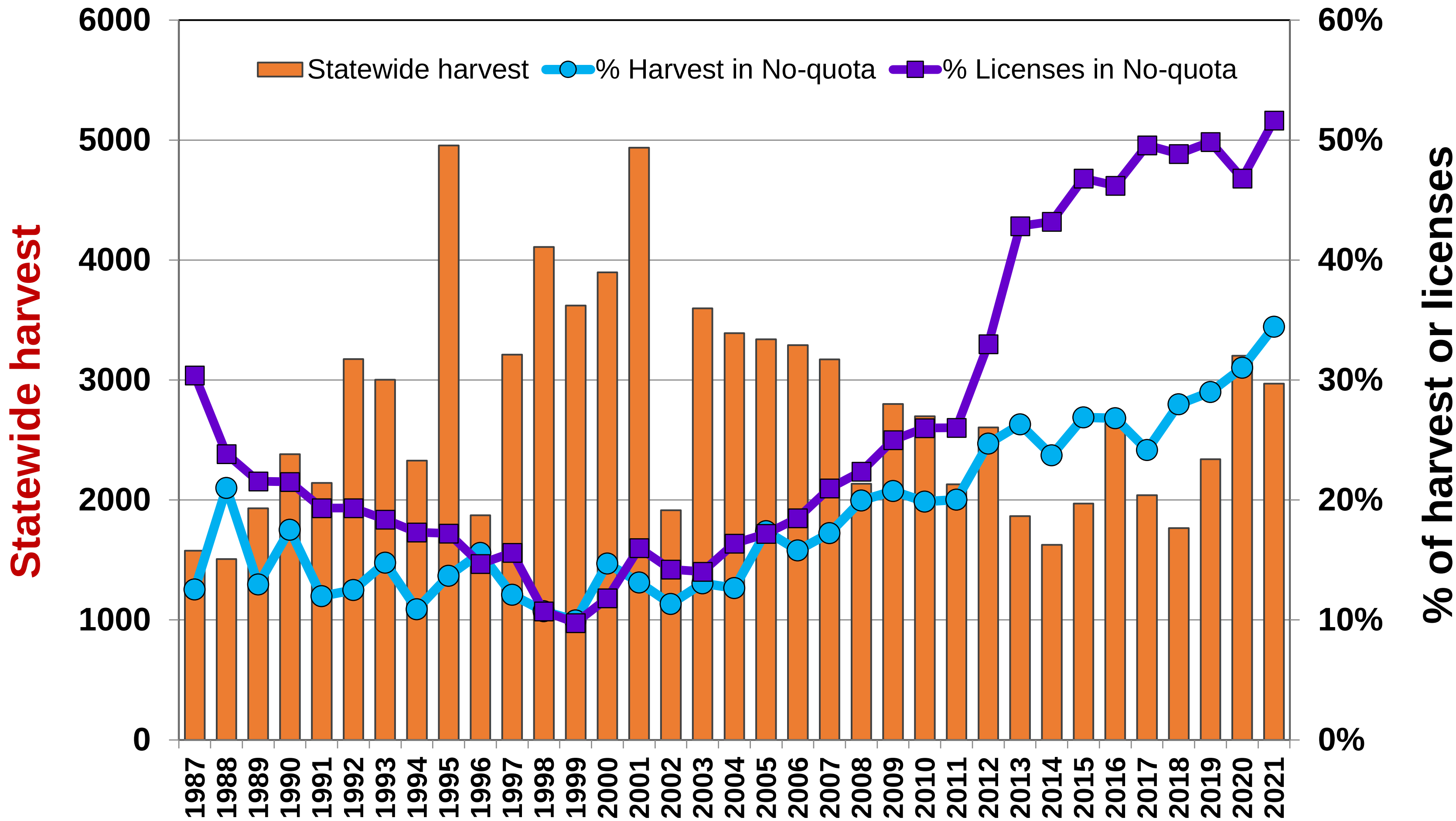


Figure 4. Trends in statewide bear harvest and proportions of harvest and licenses in the no-quota zones, 1987–2021.

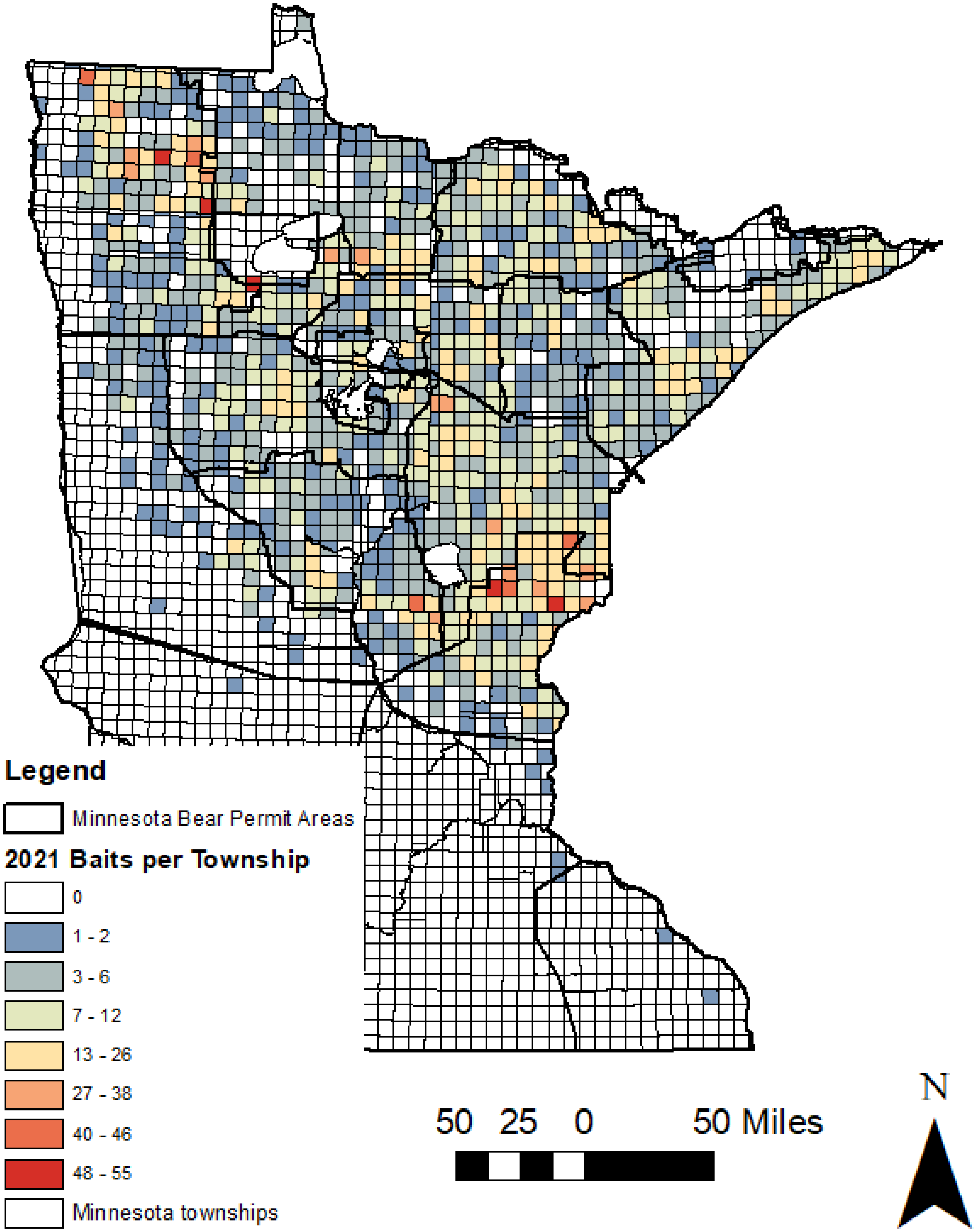
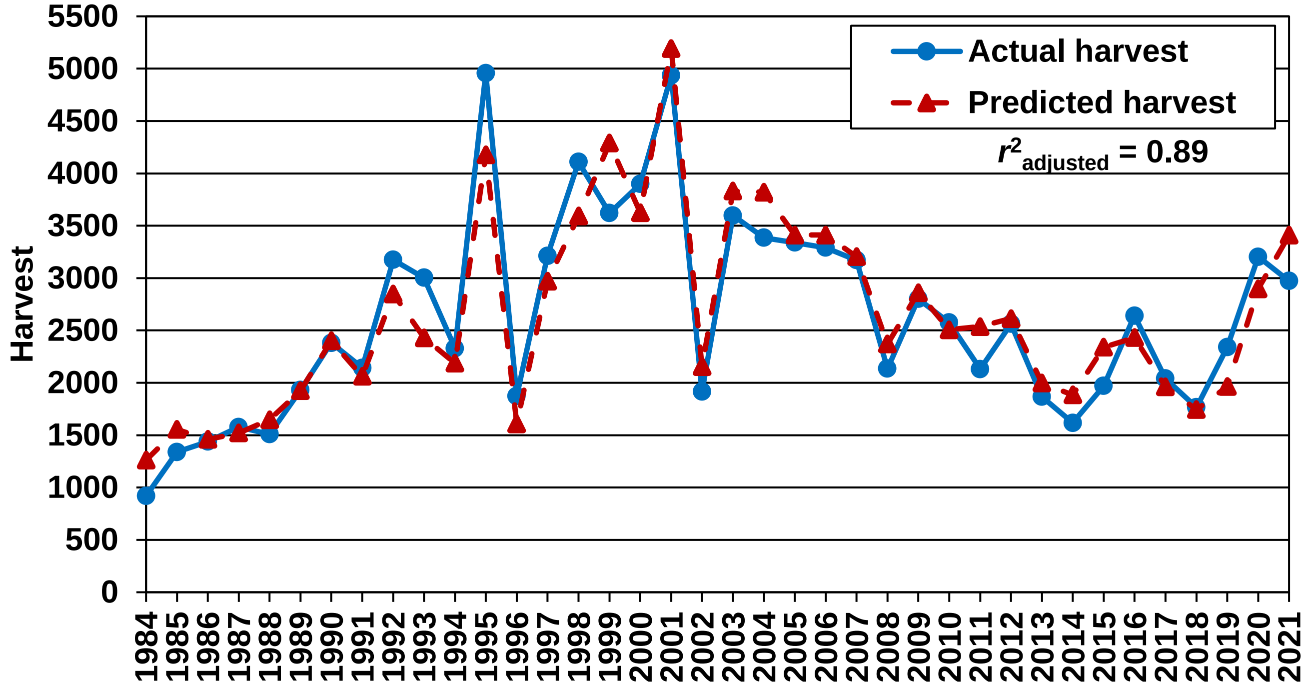


Figure 5. Number of hunters' baits per township within each BMU (7,893 total baits) in 2021.



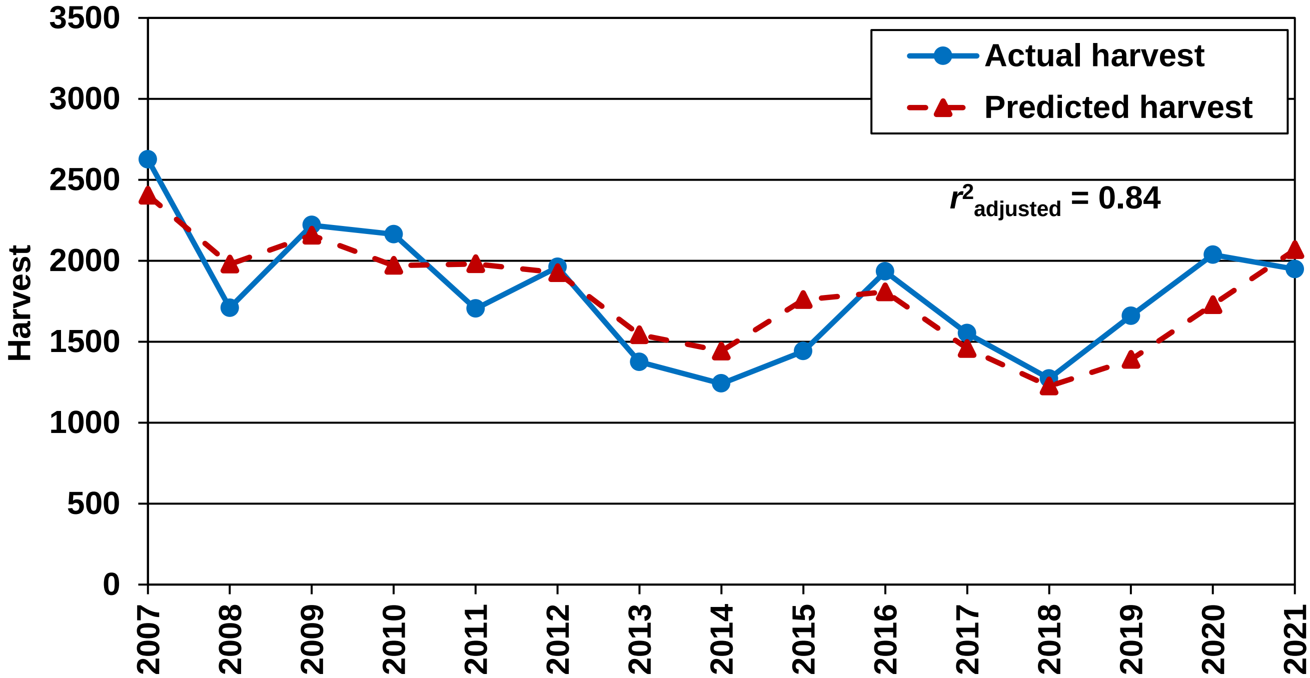


Figure 6. Number of bears harvested vs. number predicted to be harvested based on number of hunters and fall food production — top panel: statewide 1984–2021; bottom panel: quota zone only (including area 451 hunters and harvest), most recent 15 years. Regression for both datasets included an interaction term between food and hunters to better predict the drastic changes in harvest when fall foods were extremely high or low.

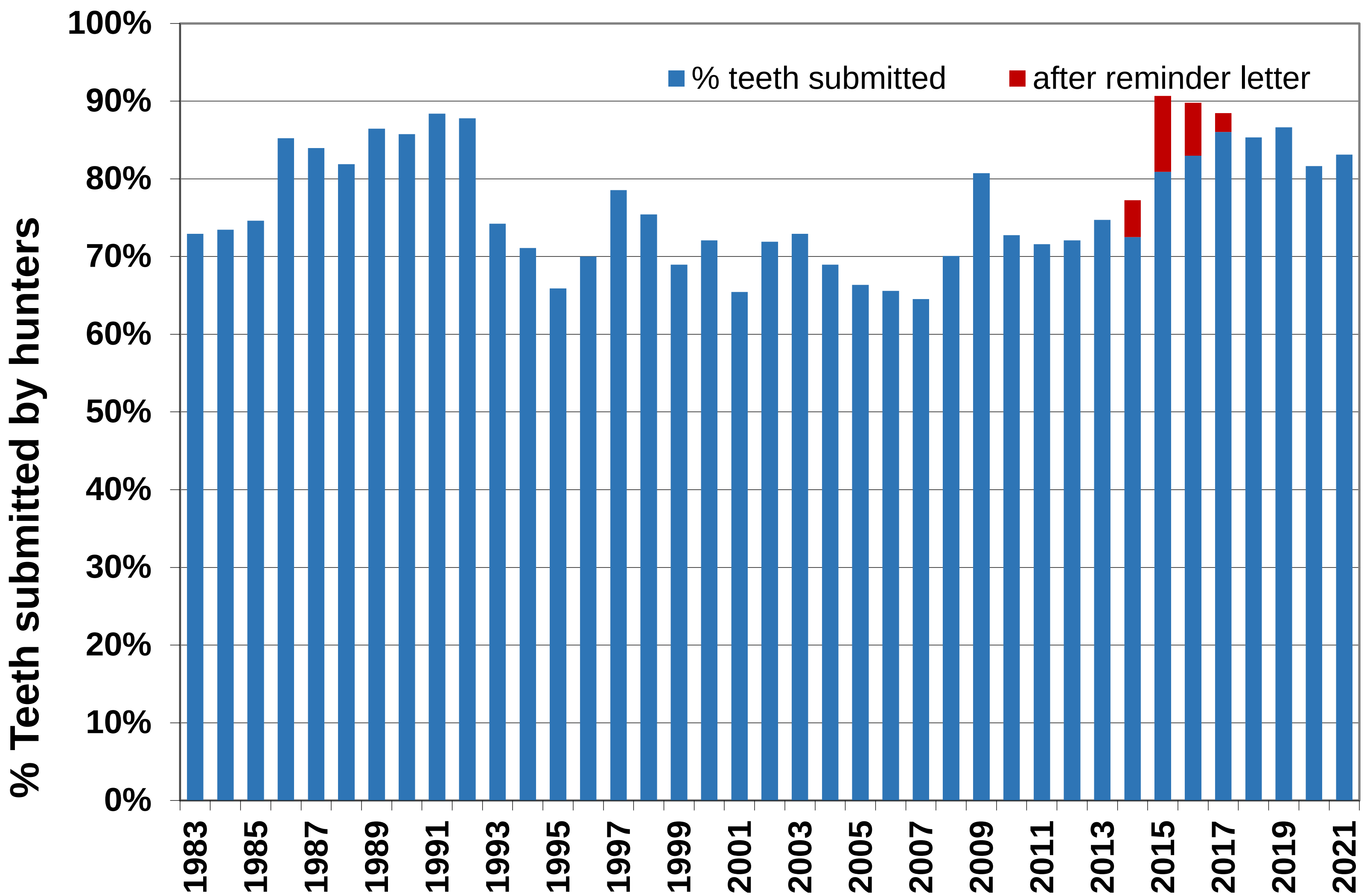


Figure 7. Percent of hunters submitting useable bear teeth for aging (vital for population monitoring, see Population report). Cooperation levels exceeded 80% when registration stations were paid to extract teeth (this practice ended in 1993), and in recent years after a series of reminder letters (no letter was sent after 2017).

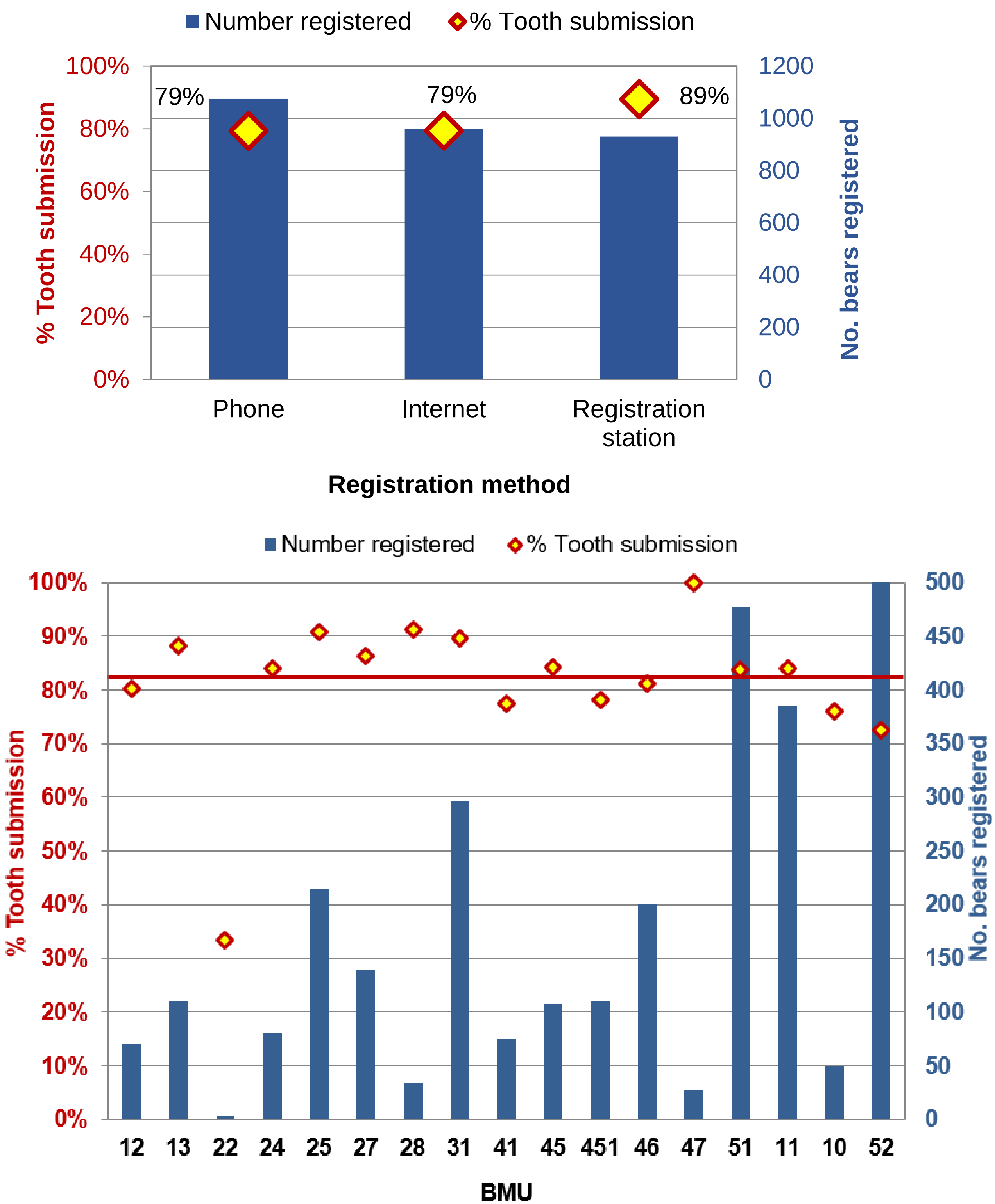


Figure 8. Percent of hunters who submitted a bear tooth in 2021 by method of registration (top panel) and by BMU (bottom panel). Beginning in 2013, hunters could register their bear by phone or internet, as well as in person at a station. The 2021 statewide submission average (83%) was above the long-term average (76%).

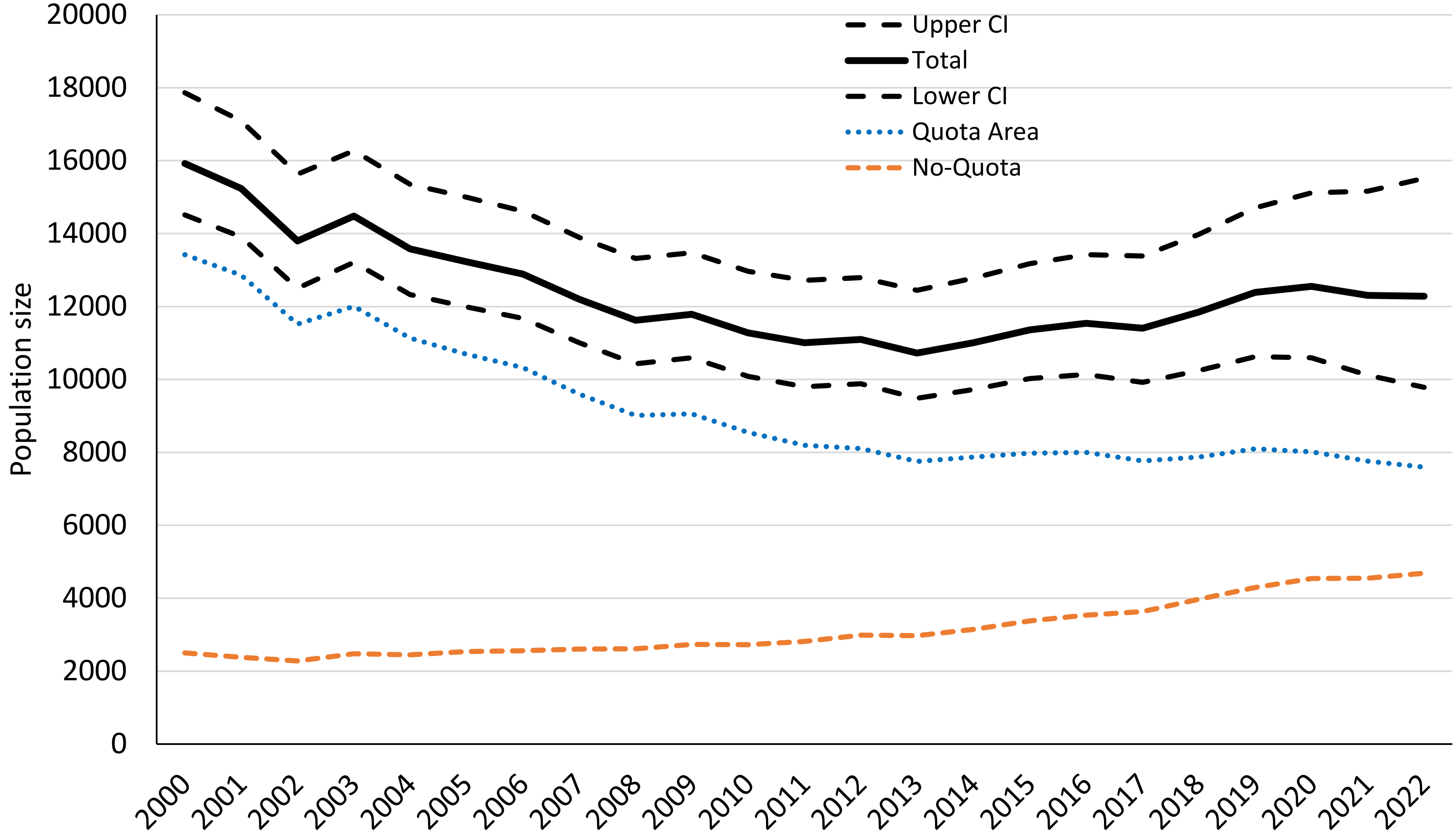


Figure 9. Population trends during 2000s derived from Allen model statewide estimates (± 95% credible intervals) and population estimates for quota and no-quota zones. Note the actual scale of the population estimates is an underestimate to true population size (based on previous tetracycline estimates), but population trend seems consistent with the BMU-level models and the Downing.

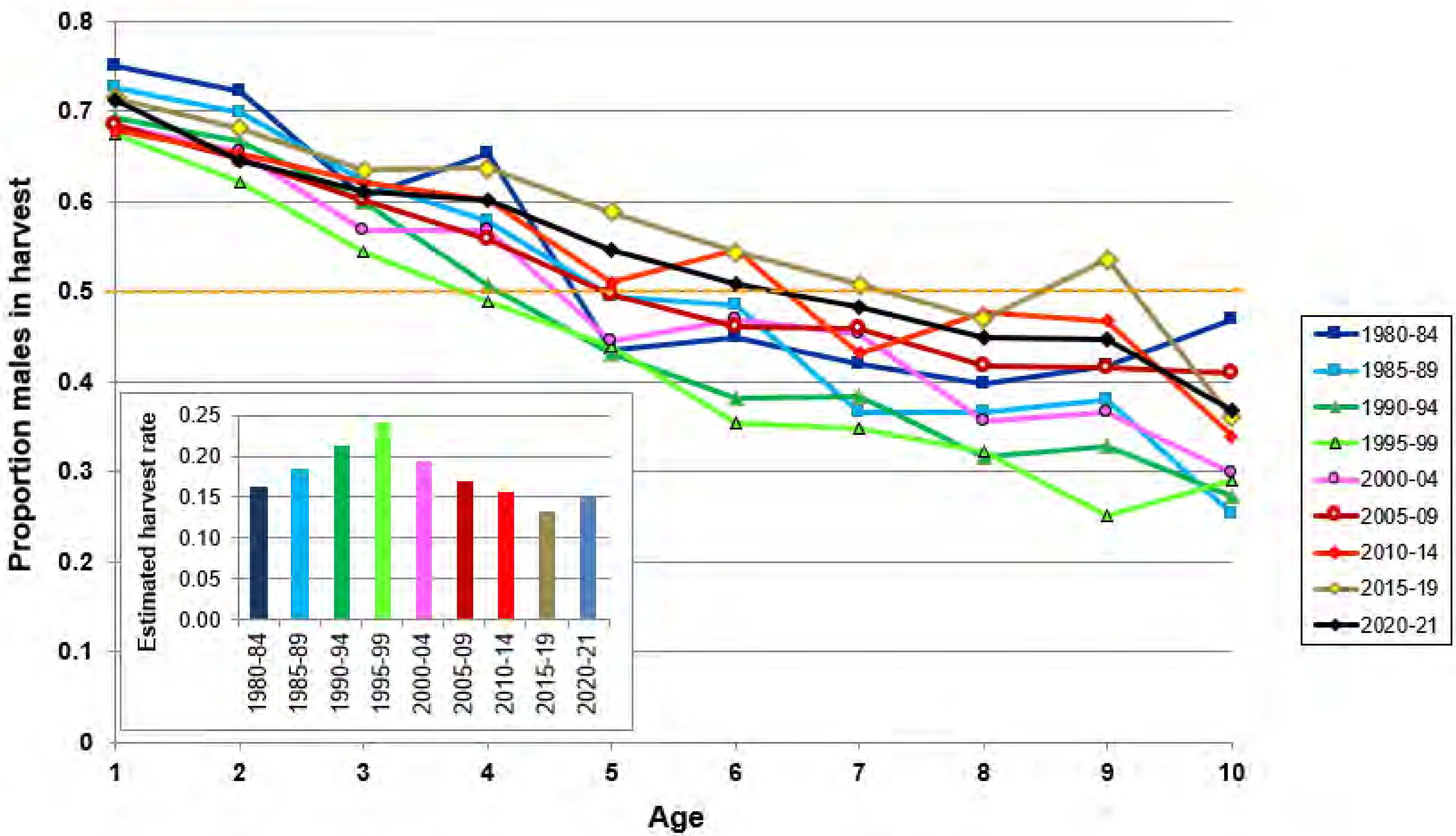


Figure 10. Trends in proportion of male bears in statewide harvest at each age, 1–10 years, grouped in 5-year time blocks, 1980–2020. Higher harvest rates result in steeper curves because males in the living population are reduced faster than females. Fitting a line to the data for each time block and predicting the age at which 50% of the harvest is male (dashed orange horizontal line) yields approximately the inverse of the harvest rate (derived rates are shown in inset). Flatter curves in recent years indicate lower harvest rates (e.g., 2015–20 lower than 1980–84), but a slight increase in recent years.

2021 MINNESOTA DEER HARVEST REPORT

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INTRODUCTION

The white-tailed deer may be considered Minnesota's most popular wildlife species. In 2021, more than 465,000 hunters participated in the season. Harvest opportunities in 2021 were generally mixed, with about 21% of permit areas with increased bag limits, 20% with decreased bag limits, and 59% with the same opportunities as in 2020. The season was designed to stabilize or reduce deer population growth across much of central Minnesota along the transition zone and in southeastern Minnesota where there is exceptional deer habitat provided by deciduous forests interspersed with prairie and agriculture, and to grow populations in the northeast and southwest. The southeastern portion of the state, known as the driftless region, provides exceptional deer habitat and ample hunting opportunities. Management of deer populations in the coniferous forests of the northcentral and northeastern portions of the state remained conservative, this is an area where populations tend to have slower population growth rates. Likewise, the southwestern portion of the state, an area in an agriculturally dominated landscape had a conservative management strategy. During the archery, firearms and muzzleloader seasons, hunters registered 184,698 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. Beginning 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 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, Chronic Wasting Disease (CWD) was first detected in three wild deer in Fillmore County during routine surveillance efforts. From 2016 to 2020, CWD was detected in six farmed cervid facilities and in the wild deer herd in three new counties (Dakota, Crow Wing, and Houston counties) During the 2021 fall hunting seasons mandatory surveillance was implemented for the opening weekend of firearms A and B seasons in the CWD Management Zone, known as 600-series DPAs, in the control zone surrounding the southeast CWD DPAs, and in four surveillance areas. MNDNR's CWD management response within the management and control zones allowed for increased harvest through liberalized hunting opportunities to reduce deer densities, and control the movement of deer carcasses through carcass movement restrictions, which helps to prevent further spread of disease to new areas of the state, and deer feeding and attractant bans in counties where both wild and farmed deer have tested positive.

RESULTS

Outcomes of the 2021 deer harvest are presented in the following tables.

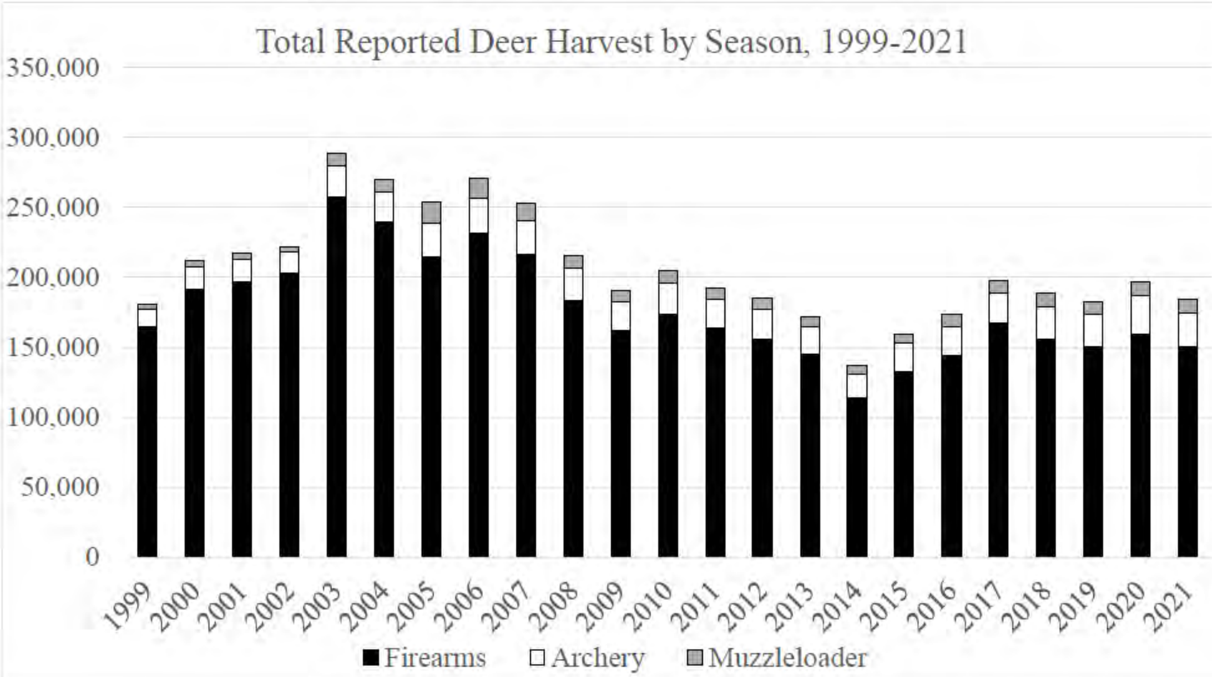

Figure 1. Total deer harvest by season, 1999-2021.

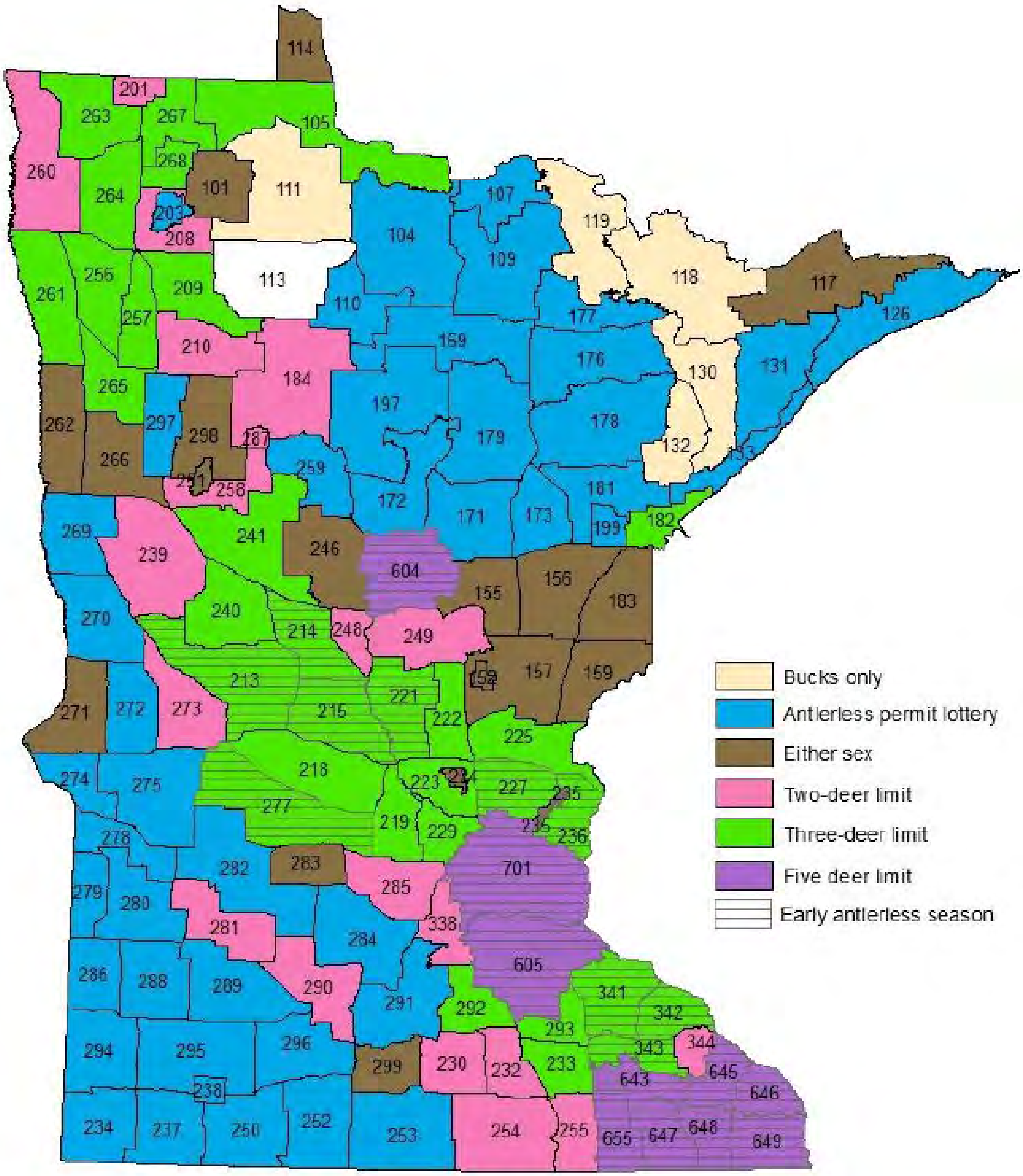

Figure 2. Figure 1. Bag limit designations for deer permit areas in Minnesota for the 2021 deer season.

Table 1. Statewide firearms, archery, and muzzleloader harvest, license sales, and success rates, 2010 – 2021

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
REGULAR FIREARMS												
Resident License Sales	379,866	382,668	391,822	391,967	374,314	371,612	372,645	368,407	360,873	351,659	354,023	349,387
Non-Resident License Sales	11,908	11,955	12,483	12,496	11,674	13,501	12,540	12,923	12,928	12,239	12,576	13,392
Bonus Permit Sales[1]	143,763	142,049	89,750	97,402	29,642	31,065	44,365	93,309	117,640	131,804	168,814	166,864
Youth License Sales[2]	59,726	60,943	62,949	64,748	62,488	62333	61138	58779	56,989	57,575	58,601	57,320
Total License Sales[3]	595,263	597,615	557,004	566,613	478,118	478,511	490,688	533,418	548,430	553,277	594,014	586,963
Registered Buck Harvest	88,027	76,003	84,729	70,627	69,851	83,939	87,855	88,467	81,772	83,772	85,564	85,737
Antlerless Permits Offered	60,083	15,525	32,854	36,816	26,332	31,065	39,646	20,540	14,023	14,111	20,021	20,773
Antlerless Permits Issued	60,083	15,525	32,854	36,816	26,332	31,065	39,646	20,385	13,971	13,777	20,021	20,773
Antlerless Permits App.	86,783	21,071	67,308	68,811	96,580	95,656	97,056	45,001	29,302	33,191	39,821	42,156
Registered AL Harvest	86,077	88,197	71,140	67,885	44,038	48,758	52,338	79,033	74,203	66,971	74,198	64,399
Registered Total Harvest	174,104	164,200	155,869	145,449	113,889	132,697	144,470	167,500	155,975	150,743	159,762	150,136
Registered % Successful[4]	35.9	32.9	32.0	29.7	25.3	28.9	31.2	33.7	31.7	31.2	33.1	31.8
ARCHERY												
Resident License Sales	91,156	90,252	95,259	92,717	92,301	93,462	92,076	91,875	89,292	85,343	97,399	93,376
Non-Resident License Sales	1,638	1,718	1,814	1,952	1,946	2,032	2,062	2,016	2,020	2,129	2,592	2,668
Youth Archery Sales	9,577	10,306	11,276	12,212	11,965	11,905	10,846	9,961	9,052	8,267	9,312	8,667
Total License Sales	102,371	102,276	108,349	106,881	106,212	107399	104984	103852	100,364	95,739	109,303	104,711
Total Archery Harvest	22,057	20,444	21,605	19,388	17,119	20,074	20,360	21,058	22,665	24,250	27,803	24,443
Registered % Successful[4]	17.8	17.0	18.8	14.5	15.3	16.5	18.5	18.7	20.3	21.1	21.6	19.9
MUZZLELOADER												
Total Muzzleloader License Sales	55,640	59,384	58,363	51,092	43,946	50,176	53,097	51,961	48,589	43,126	55,523	49,833
Total Muzzleloader Harvest	9,023	7,416	7,779	7,045	5,847	6,572	8,383	9,210	10,066	8,644	9,750	10,119
Registered % Successful[4]	14.4	11.6	12.4	12.7	12.7	12.0	15.2	16.6	19	20.0	15.9	18
Antlerless Permits Offered	5,792	1,997	1,626	2,144	1,593	1,434	1,352	935	874	689	724	907
Antlerless Permits App.	7,260	2,615	3,743	3,544	4,588	3,393	2,930	1,902	1,592	1,485	1,281	1,511
TOTAL Registered Harvest	207,313	192,331	186,634	172,781	139,442	159,343	173,213	197,768	188,706	183,637	197,315	184,698

1 Bonus permits includes disease management and early antlerless permits.
2 Youth license sales include nonresident youth licenses.
3 Total license sales includes bonus permit sales, but does not include free landowner permits.
4 Percentage of unique hunters that harvested at least one deer, calculated by MNDNR number.

Table 2. Deer harvest by season, 2021.

Season	Total Hunters	Antlered Buck Harvest	Antlerless Harvest	Total Harvest	Successful Hunters[3]	Overall Success
Archery	104,711	10,623	13,820	24,443	20,800	19.9%
100 Series A	150,702	24,378	13,441	37,819	36,292	24.1%
200 Series A	226,234	48,266	35,034	83,300	74,439	32.9%
300-600 Series A[1]	31,473	6,306	4,088	10,394	9,068	28.8%
300-600 Series B[1]	7,025	1,405	2,662	4,067	3,433	N/A
Metro Firearms (701)	1,752	464	262	726	654	37.3%
Muzzleloader	49,833	3668	6451	10119	9,035	18.1%
Youth[2]	N/A	4,413	3,935	8,348	8,254	N/A
Early Antlerless	13,677	0	3,744	3,744	3,014	22.0%
Special Firearms Hunts	2,859	293	445	738	567	19.8%
Late CWD[2]	N/A	212	788	1,000	815	N/A
Total	**465,414**	**100,028**	**84,670**	**184,698**	**157,384**	**33.8%**

[1]Does not include deer harvested in permit area 604 (included in 100 Series); in 2021 a person could hunt the A or B season in the 600 series regardless of license type and thus hunter numbers and success rates for A season are only an estimate, and not reported for B season; [2] cannot estimate hunter numbers for youth and late cwd hunts because licenses are not exclusive to those seasons; [3]number of hunters that harvested at least one deer.

Table 3. Total deer harvest per permit area, 2021.

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	491	26	134	16	667	496	0.99	0.36	1.35	84
104	371	6	55	7	439	1,414	0.26	0.05	0.31	123
105	1436	238	1076	177	2927	1,199	1.20	1.24	2.44	50
107	590	37	184	10	821	472	1.25	0.49	1.74	62
109	323	6	59	10	398	1,182	0.27	0.06	0.34	122
110	885	42	207	29	1163	529	1.67	0.53	2.20	55
111	390	2	14	0	406	1,384	0.28	0.01	0.29	124
114	17	0	9	0	26	116	0.15	0.08	0.22	125
117	9	0	2	0	11	927	0.01	0.00	0.01	130
118	494	1	5	1	501	1,220	0.40	0.01	0.41	121
119	366	2	5	1	374	770	0.48	0.01	0.49	119
126	154	4	34	9	201	942	0.16	0.05	0.21	126
130	150	0	4	1	155	746	0.20	0.01	0.21	127
131	55	3	8	1	67	899	0.06	0.01	0.07	129
132	233	0	5	0	238	482	0.48	0.01	0.49	117
133	361	8	61	3	433	352	1.03	0.20	1.23	88
152	75	7	28	1	111	61	1.23	0.59	1.82	59
155	741	107	456	71	1375	499	1.48	1.27	2.76	44
156	1365	153	741	79	2338	825	1.65	1.18	2.83	42
157	2707	302	1207	190	4406	888	3.05	1.91	4.96	21
159	1249	142	647	83	2121	571	2.19	1.53	3.71	31
169	934	46	175	18	1173	940	0.99	0.25	1.25	87
171	746	73	277	36	1132	740	1.01	0.52	1.53	78
172	1324	121	509	64	2018	688	1.92	1.01	2.93	39
173	343	30	137	15	525	471	0.73	0.39	1.11	93
176	681	21	148	13	863	921	0.74	0.20	0.94	96
177	497	37	188	23	745	480	1.04	0.52	1.55	76
178	1301	53	320	31	1705	1,195	1.09	0.34	1.43	81
179	1490	134	667	96	2387	1,024	1.46	0.88	2.33	52
181	697	46	300	18	1061	629	1.11	0.58	1.69	66
182	518	68	344	55	985	278	1.86	1.68	3.54	35
183	1164	157	703	80	2104	663	1.76	1.42	3.17	38
184	2259	436	1590	282	4567	1,235	1.83	1.87	3.70	32
197	780	33	171	18	1002	973	0.80	0.23	1.03	95
199	94	5	20	3	122	153	0.62	0.18	0.80	103

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
201	140	16	93	11	260	161	0.87	0.74	1.61	72
203	73	7	15	1	96	118	0.62	0.20	0.82	102
208	323	27	167	33	550	379	0.85	0.60	1.45	79
209	766	94	471	92	1423	640	1.20	1.03	2.23	54
210	944	107	491	92	1634	615	1.53	1.12	2.66	47
213	3014	691	2469	514	6688	1,057	2.85	3.48	6.33	12
214	2103	581	1862	466	5012	554	3.80	5.25	9.05	1
215	2067	464	1684	380	4595	701	2.95	3.61	6.55	10
218	1552	263	1148	202	3165	884	1.76	1.82	3.58	34
219	874	159	623	97	1753	391	2.23	2.25	4.48	26
221	2037	485	1690	371	4583	642	3.17	3.97	7.14	6
222	1447	296	948	213	2904	413	3.50	3.52	7.02	7
223	1048	165	782	136	2131	376	2.79	2.88	5.68	14
224	133	15	43	8	199	47	2.81	1.40	4.21	29
225	2232	385	1368	276	4261	618	3.61	3.28	6.90	9
227	1754	277	1139	208	3378	472	3.72	3.44	7.16	5
229	420	69	285	47	821	284	1.48	1.41	2.89	41
230	334	69	211	37	651	452	0.74	0.70	1.44	80
232	332	44	222	45	643	377	0.88	0.83	1.71	65
233	320	38	211	33	602	381	0.84	0.74	1.58	73
234	278	20	71	7	376	636	0.44	0.15	0.59	113
235	121	12	46	9	188	34	3.59	1.99	5.58	15
236	1106	162	591	84	1943	370	2.99	2.26	5.25	16
237	304	17	82	6	409	608	0.50	0.17	0.67	111
238	90	5	25	2	122	95	0.95	0.34	1.28	85
239	2067	316	1239	246	3868	919	2.25	1.96	4.21	28
240	2463	442	1749	369	5023	643	3.83	3.98	7.82	3
241	3717	692	3103	558	8070	996	3.73	4.37	8.10	2
246	2013	278	1138	181	3610	784	2.57	2.04	4.60	25
248	543	102	353	72	1070	214	2.53	2.46	4.99	19
249	1429	292	1058	215	2994	496	2.88	3.16	6.04	13
250	396	21	106	9	532	713	0.56	0.19	0.75	105
251	78	7	26	5	116	55	1.42	0.69	2.11	56
252	375	25	134	15	549	715	0.52	0.24	0.77	104

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
253	510	34	162	16	722	974	0.52	0.22	0.74	106
254	713	82	405	64	1264	924	0.77	0.60	1.37	83
255	327	59	193	31	610	392	0.83	0.72	1.56	75
256	595	65	367	42	1069	654	0.91	0.73	1.64	69
257	544	64	353	54	1015	412	1.32	1.14	2.46	49
258	826	174	605	137	1742	343	2.41	2.67	5.08	18
259	1076	118	445	75	1714	490	2.20	1.30	3.50	36
260	370	26	127	18	541	1,055	0.35	0.16	0.51	114
261	292	18	172	33	515	795	0.37	0.28	0.65	112
262	290	33	119	19	461	677	0.43	0.25	0.68	109
263	681	63	458	55	1257	706	0.96	0.82	1.78	60
264	982	139	617	98	1836	669	1.47	1.28	2.74	45
265	616	111	534	84	1345	494	1.25	1.48	2.72	46
266	469	31	189	30	719	617	0.76	0.41	1.17	91
267	387	57	321	46	811	472	0.82	0.90	1.72	64
268	420	57	240	37	754	228	1.84	1.46	3.30	37
269	347	12	93	6	458	650	0.53	0.17	0.70	107
270	275	8	50	6	339	748	0.37	0.09	0.45	120
271	345	23	137	14	519	632	0.55	0.28	0.82	101
272	300	3	51	6	360	531	0.57	0.11	0.68	110
273	677	66	402	35	1180	571	1.18	0.88	2.07	57
274	329	11	86	6	432	354	0.93	0.29	1.22	89
275	694	21	131	10	856	957	0.73	0.17	0.89	97
277	2325	416	2036	307	5084	1,058	2.20	2.61	4.81	22
278	477	22	144	17	660	402	1.19	0.46	1.64	68
279	259	16	99	19	393	344	0.75	0.39	1.14	92
280	270	5	53	6	334	675	0.40	0.09	0.50	116
281	721	74	467	57	1319	575	1.25	1.04	2.30	53
282	180	7	17	2	206	1,127	0.16	0.02	0.18	128
283	371	30	131	17	549	337	1.10	0.53	1.63	71
284	434	17	121	9	581	838	0.52	0.18	0.69	108
285	568	66	366	38	1038	549	1.04	0.86	1.89	58
286	339	18	155	9	521	446	0.76	0.41	1.17	90
287	40	9	15	6	70	46	0.88	0.66	1.53	77
288	453	37	158	16	664	625	0.73	0.34	1.06	94
289	253	18	115	10	396	815	0.31	0.18	0.49	118

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
290	603	71	426	50	1150	662	0.91	0.83	1.74	63
291	844	64	322	29	1259	800	1.05	0.52	1.57	74
292	530	63	321	41	955	362	1.46	1.17	2.64	48
293	442	49	251	37	779	278	1.59	1.21	2.80	43
294	379	28	163	30	600	686	0.55	0.32	0.88	99
295	605	38	187	27	857	959	0.63	0.26	0.89	98
296	426	15	132	9	582	667	0.64	0.23	0.87	100
297	189	4	25	3	221	438	0.43	0.07	0.50	115
298	585	50	205	40	880	618	0.95	0.48	1.42	82
299	372	45	200	25	642	386	0.96	0.70	1.66	67
338	286	38	158	33	515	316	0.91	0.72	1.63	70
341	1488	257	1062	199	3006	603	2.47	2.52	4.99	20
342	881	144	615	186	1826	350	2.52	2.70	5.22	17
343	637	115	473	93	1318	320	1.99	2.13	4.12	30
344	438	93	273	77	881	186	2.35	2.38	4.74	23
604	1684	502	1723	398	4307	673	2.50	3.90	6.40	11
605	1269	279	1050	199	2797	1192	1.06	1.28	2.35	51
643	625	122	435	93	1275	351	1.78	1.85	3.63	33
645	711	163	460	130	1464	330	2.15	2.28	4.44	27
646	1150	271	778	259	2458	319	3.61	4.10	7.71	4
647	640	109	424	84	1257	434	1.47	1.42	2.90	40
648	766	158	499	134	1557	332	2.31	2.38	4.69	24
649	1580	392	1130	318	3420	492	3.21	3.74	6.95	8
655	253	46	147	41	487	387	0.65	0.60	1.26	86
701	1194	195	831	111	2331	1324	0.90	0.86	1.76	61
Total	**99,515**	**14,310**	**58,557**	**10,562**	**182,944**	**78,843**	**1.26**	**1.06**	**2.32**	

Table 4. Archery season harvest by DPA, excluding special hunts, 2021.

Permit Area	Land Area	Archery Hunters	Archery hunters per sq. mile	Adult Male Harvest	Fawn Male Harvest	Adult Female Harvest	Fawn Female Harvest	Total Harvest
101	496	213	0.43	5	0	7	1	13
104	1,414	94	0.07	10	0	3	0	13
105	1,199	704	0.59	42	12	74	3	131
107	472	294	0.62	19	7	20	0	46
109	1,182	129	0.11	8	0	12	0	20
110	529	316	0.60	18	3	15	3	39
111	1,384	97	0.07	6	0	0	0	6
114	116	29	0.25	2	0	1	0	3
117	927	22	0.02	1	0	0	0	1
118	1,220	234	0.19	25	0	1	0	26
119	770	81	0.11	11	1	1	0	13
126	942	159	0.17	10	0	8	1	19
130	746	109	0.15	5	0	1	1	7
131	899	77	0.09	4	0	3	0	7
132	482	138	0.29	8	0	1	0	9
133	352	358	1.02	22	2	24	2	50
152	61	116	1.90	7	0	2	0	9
155	499	767	1.54	35	4	22	2	63
156	825	1097	1.33	60	2	48	1	111
157	888	2135	2.41	129	14	93	10	246
159	571	1097	1.92	79	6	47	1	133
169	940	580	0.62	20	5	33	2	60
171	740	667	0.90	29	2	19	2	52
172	688	1138	1.65	63	11	56	3	133
173	471	396	0.84	9	2	15	3	29
176	921	572	0.62	23	2	31	3	59
177	480	329	0.69	21	0	19	2	42
178	1,195	899	0.75	54	7	43	3	107
179	1,024	1523	1.49	101	15	84	5	205
181	629	635	1.01	36	3	19	1	59
182	278	1218	4.38	110	24	108	17	259
183	663	928	1.40	61	4	36	3	104
184	1,235	1996	1.62	153	25	160	11	349
197	973	500	0.51	25	1	20	2	48

Permit Area	Land Area	Archery Hunters	Archery hunters per sq. mile	Adult Male Harvest	Fawn Male Harvest	Adult Female Harvest	Fawn Female Harvest	Total Harvest
199	153	61	0.40	6	0	0	1	7
201	161	72	0.45	3	1	5	3	12
203	118	24	0.20	2	0	0	0	2
208	379	140	0.37	6	2	10	2	20
209	640	372	0.58	45	2	44	2	93
210	615	508	0.83	34	6	29	4	73
213	1,057	2770	2.62	349	51	401	50	851
214	554	1753	3.16	136	33	268	34	471
215	701	2584	3.69	284	65	380	43	772
218	884	2004	2.27	211	38	284	28	561
219	391	1778	4.54	149	26	179	13	367
221	642	1964	3.06	198	56	282	26	562
222	413	1476	3.57	118	32	137	23	310
223	376	2513	6.69	239	38	311	46	634
224	47	291	6.15	22	2	8	1	33
225	618	2734	4.42	218	53	319	35	625
227	472	2956	6.27	390	58	382	52	882
229	284	964	3.39	97	15	97	13	222
230	452	478	1.06	40	6	38	3	87
232	377	450	1.19	57	3	39	4	103
233	381	455	1.19	69	9	74	8	160
234	636	262	0.41	32	2	10	0	44
235	34	323	9.58	28	4	21	5	58
236	370	2096	5.67	309	49	241	30	629
237	608	321	0.53	32	1	16	1	50
238	95	72	0.76	10	0	8	1	19
239	919	1644	1.79	144	27	153	21	345
240	643	1841	2.86	185	38	278	27	528
241	996	3320	3.33	268	35	440	39	782
246	784	1345	1.72	88	4	56	4	152
248	214	670	3.13	78	14	50	6	148
249	496	1239	2.50	97	17	131	11	256
250	713	352	0.49	47	1	16	0	64
251	55	49	0.89	1	0	1	0	2
252	715	381	0.53	48	1	23	2	74

Permit Area	Land Area	Archery Hunters	Archery hunters per sq. mile	Adult Male Harvest	Fawn Male Harvest	Adult Female Harvest	Fawn Female Harvest	Total Harvest
253	974	544	0.56	75	5	32	5	117
254	924	739	0.80	98	10	73	9	190
255	392	592	1.51	70	15	60	9	154
256	654	326	0.50	22	2	34	2	60
257	412	275	0.67	27	4	35	2	68
258	343	643	1.88	53	12	62	7	134
259	490	743	1.52	37	5	31	1	74
260	1,055	165	0.16	7	0	10	1	18
261	795	224	0.28	37	3	22	2	64
262	677	240	0.35	49	2	15	3	69
263	706	305	0.43	25	2	40	1	68
264	669	465	0.70	41	6	44	7	98
265	494	395	0.80	34	8	72	6	120
266	617	374	0.61	24	2	11	5	42
267	472	212	0.45	12	3	21	1	37
268	228	182	0.80	18	1	30	1	50
269	650	376	0.58	37	1	16	0	54
270	748	225	0.30	25	2	10	0	37
271	632	226	0.36	34	0	19	1	54
272	531	188	0.35	18	0	4	0	22
273	571	732	1.28	77	6	88	7	178
274	354	241	0.68	29	3	13	1	46
275	957	496	0.52	64	3	22	2	91
277	1,058	2784	2.63	295	46	427	38	806
278	402	362	0.90	45	5	22	2	74
279	344	170	0.49	18	1	5	3	27
280	675	275	0.41	26	1	7	0	34
281	575	692	1.20	87	7	84	7	185
282	1,127	202	0.18	20	1	1	0	22
283	337	312	0.93	36	2	20	1	59
284	838	506	0.60	54	3	28	0	85
285	549	971	1.77	95	12	76	3	186
286	446	207	0.46	17	0	13	0	30
287	46	2	0.04	2	0	0	0	2
288	625	547	0.88	48	2	27	6	83

Permit Area	Land Area	Archery Hunters	Archery hunters per sq. mile	Adult Male Harvest	Fawn Male Harvest	Adult Female Harvest	Fawn Female Harvest	Total Harvest
289	815	229	0.28	19	2	10	0	31
290	662	657	0.99	77	7	87	4	175
291	800	1288	1.61	138	8	76	8	230
292	362	905	2.50	91	12	67	5	175
293	278	496	1.78	84	2	59	10	155
294	686	226	0.33	34	2	17	2	55
295	959	586	0.61	51	7	36	4	98
296	667	371	0.56	43	0	16	0	59
297	438	97	0.22	2	0	2	1	5
298	618	329	0.53	20	4	15	1	40
299	386	544	1.41	58	4	35	4	101
338	316	682	2.16	46	7	48	7	108
341	603	2146	3.56	289	51	250	24	614
342	350	1214	3.47	154	24	126	24	328
343	320	1342	4.19	161	19	152	25	357
344	186	742	3.99	54	10	28	13	105
604	673	2548	3.79	178	60	381	63	682
605	1192	3157	2.65	321	75	348	57	801
643	351	1035	2.95	162	25	145	18	350
645	330	965	2.92	134	17	89	14	254
646	319	1296	4.06	187	29	152	24	392
647	434	765	1.76	96	11	74	11	192
648	332	943	2.84	92	20	104	22	238
649	492	1834	3.73	294	46	180	31	551
655	387	276	0.71	35	7	35	2	79
701	1324	4054	3.06	693	124	600	78	1495
Total	**78,843**	**104,576**	**1.33**	**10,420**	**1589**	**10,363**	**1,205**	**23,577**

Table 5. Total 2021 firearms season harvest by DPA. Does not include youth, early antlerless, late CWD, or special firearms 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	1871	3.8	442	26	101	12	581	0.89	0.28	1.17
104	1,414	1729	1.2	349	2	40	5	396	0.25	0.03	0.28
105	1,199	5534	4.6	1255	201	888	157	2501	1.05	1.04	2.09
107	472	2174	4.6	532	28	137	8	705	1.13	0.37	1.49
109	1,182	1960	1.7	300	5	35	8	348	0.25	0.04	0.29
110	529	3530	6.7	814	35	164	22	1035	1.54	0.42	1.96
111	1,384	1330	1.0	362	2	13	0	377	0.26	0.01	0.27
114	116	85	0.7	13	0	7	0	20	0.11	0.06	0.17
117	927	133	0.1	7	0	2	0	9	0.01	0.00	0.01
118	1,220	2527	2.1	449	1	4	1	455	0.37	0.00	0.37
119	770	1905	2.5	350	1	3	1	355	0.45	0.01	0.46
126	942	1249	1.3	140	3	25	7	175	0.15	0.04	0.19
130	746	1296	1.7	142	0	2	0	144	0.19	0.00	0.19
131	899	740	0.8	49	2	4	1	56	0.05	0.01	0.06
132	482	1606	3.3	223	0	4	0	227	0.46	0.01	0.47
133	352	1868	5.3	332	4	31	1	368	0.94	0.10	1.05
152	61	615	10.1	67	7	24	1	99	1.10	0.52	1.62
155	499	4918	9.9	671	99	389	66	1225	1.34	1.11	2.45
156	825	8046	9.8	1264	142	653	72	2131	1.53	1.05	2.58
157	888	12245	13.8	2457	269	1019	169	3914	2.77	1.64	4.41
159	571	6443	11.3	1115	123	566	80	1884	1.95	1.35	3.30
169	940	6109	6.5	878	34	116	14	1042	0.93	0.17	1.11
171	740	5588	7.6	698	65	235	30	1028	0.94	0.45	1.39
172	688	8530	12.4	1209	100	408	54	1771	1.76	0.82	2.57
173	471	3089	6.6	325	27	110	10	472	0.69	0.31	1.00
176	921	5011	5.4	632	13	85	7	737	0.69	0.11	0.80
177	480	3493	7.3	458	28	149	21	656	0.95	0.41	1.37
178	1,195	7811	6.5	1193	39	235	19	1486	1.00	0.25	1.24
179	1,024	9273	9.1	1319	110	516	74	2019	1.29	0.68	1.97
181	629	4916	7.8	643	41	254	17	955	1.02	0.50	1.52
182	278	2150	7.7	384	41	203	38	666	1.38	1.01	2.40
183	663	6888	10.4	1065	144	617	73	1899	1.61	1.26	2.86
184	1,235	12204	9.9	2009	384	1302	257	3952	1.63	1.57	3.20
197	973	4684	4.8	732	24	136	15	907	0.75	0.18	0.93
199	153	526	3.4	86	5	15	2	108	0.56	0.14	0.71

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
201	161	468	2.9	119	14	77	7	217	0.74	0.61	1.35
203	118	190	1.6	63	4	9	1	77	0.54	0.12	0.65
208	379	1148	3.0	265	23	126	30	444	0.70	0.47	1.17
209	640	2503	3.9	612	87	349	74	1122	0.96	0.80	1.75
210	615	3830	6.2	808	91	400	78	1377	1.31	0.92	2.24
213	1,057	10368	9.8	2378	406	1220	278	4282	2.25	1.80	4.05
214	554	7536	13.6	1766	383	1007	276	3432	3.19	3.01	6.19
215	701	7463	10.6	1571	269	783	200	2823	2.24	1.79	4.03
218	884	5662	6.4	1178	177	658	136	2149	1.33	1.10	2.43
219	391	3454	8.8	647	108	338	63	1156	1.65	1.30	2.95
221	642	6631	10.3	1644	283	925	216	3068	2.56	2.22	4.78
222	413	5358	13.0	1206	233	688	163	2290	2.92	2.62	5.54
223	376	3555	9.5	720	107	371	69	1267	1.92	1.46	3.37
224	47	566	12.0	106	12	32	7	157	2.24	1.08	3.32
225	618	7830	12.7	1864	289	883	217	3253	3.02	2.25	5.26
227	472	4968	10.5	1241	154	523	107	2025	2.63	1.66	4.29
229	284	1552	5.5	291	43	155	30	519	1.02	0.80	1.83
230	452	1459	3.2	261	56	131	30	478	0.58	0.48	1.06
232	377	1408	3.7	254	31	144	30	459	0.67	0.54	1.22
233	381	920	2.4	214	21	88	17	340	0.56	0.33	0.89
234	636	792	1.2	226	15	54	7	302	0.36	0.12	0.47
235	34	425	12.6	86	6	22	4	118	2.55	0.95	3.50
236	370	2982	8.1	741	86	248	39	1114	2.00	1.01	3.01
237	608	1044	1.7	239	13	58	5	315	0.39	0.13	0.52
238	95	298	3.1	73	5	11	1	90	0.77	0.18	0.95
239	919	7919	8.6	1749	250	935	198	3132	1.90	1.51	3.41
240	643	7925	12.3	2062	355	1215	305	3937	3.21	2.92	6.13
241	996	13746	13.8	3094	562	2210	459	6325	3.11	3.24	6.35
246	784	9871	12.6	1790	247	957	158	3152	2.28	1.74	4.02
248	214	1894	8.8	418	82	256	59	815	1.95	1.85	3.80
249	496	5795	11.7	1229	260	813	181	2483	2.48	2.53	5.01
250	713	1338	1.9	303	16	78	9	406	0.43	0.14	0.57
251	55	400	7.3	68	6	24	5	103	1.24	0.64	1.87
252	715	1343	1.9	289	22	95	10	416	0.40	0.18	0.58
253	974	1832	1.9	391	24	95	6	516	0.40	0.13	0.53
254	924	2502	2.7	538	60	257	40	895	0.58	0.39	0.97

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
255	392	1109	2.8	217	37	107	15	376	0.55	0.41	0.96
256	654	2097	3.2	493	58	285	35	871	0.75	0.58	1.33
257	412	1847	4.5	452	53	267	48	820	1.10	0.89	1.99
258	343	4111	12.0	717	150	474	117	1458	2.09	2.16	4.25
259	490	6137	12.5	986	104	364	70	1524	2.01	1.10	3.11
260	1,055	1189	1.1	303	24	84	14	425	0.29	0.12	0.40
261	795	837	1.1	194	9	102	19	324	0.24	0.16	0.41
262	677	869	1.3	202	14	50	8	274	0.30	0.11	0.40
263	706	2356	3.3	563	55	322	37	977	0.80	0.59	1.38
264	669	3523	5.3	799	106	444	77	1426	1.19	0.94	2.13
265	494	2262	4.6	510	87	366	68	1031	1.03	1.05	2.09
266	617	1859	3.0	372	24	132	20	548	0.60	0.29	0.89
267	472	1346	2.8	298	45	234	38	615	0.63	0.67	1.30
268	228	1350	5.9	331	49	165	30	575	1.45	1.07	2.52
269	650	1289	2.0	243	8	57	5	313	0.37	0.11	0.48
270	748	1019	1.4	213	3	33	3	252	0.28	0.05	0.34
271	632	1154	1.8	258	21	87	10	376	0.41	0.19	0.60
272	531	1083	2.0	247	3	36	3	289	0.47	0.08	0.54
273	571	2732	4.8	538	51	253	24	866	0.94	0.57	1.52
274	354	1034	2.9	272	7	52	4	335	0.77	0.18	0.95
275	957	2552	2.7	548	13	79	6	646	0.57	0.10	0.68
277	1,058	9124	8.6	1764	243	945	164	3116	1.67	1.28	2.95
278	402	1826	4.5	366	13	94	13	486	0.91	0.30	1.21
279	344	1188	3.5	195	13	79	10	297	0.57	0.30	0.86
280	675	1206	1.8	225	2	38	6	271	0.33	0.07	0.40
281	575	2645	4.6	542	51	286	40	919	0.94	0.66	1.60
282	1,127	801	0.7	137	6	15	2	160	0.12	0.02	0.14
283	337	1267	3.8	293	23	89	12	417	0.87	0.37	1.24
284	838	1739	2.1	327	13	70	7	417	0.39	0.11	0.50
285	549	2312	4.2	427	51	236	28	742	0.78	0.57	1.35
286	446	1450	3.3	281	17	119	8	425	0.63	0.32	0.95
287	46	327	7.2	35	6	13	5	59	0.77	0.53	1.29
288	625	1843	3.0	350	30	102	7	489	0.56	0.22	0.78
289	815	1180	1.4	195	14	87	9	305	0.24	0.13	0.37
290	662	2473	3.7	465	46	265	33	809	0.70	0.52	1.22
291	800	3415	4.3	617	49	198	14	878	0.77	0.33	1.10

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
292	362	2492	6.9	389	43	198	30	660	1.07	0.75	1.82
293	278	1326	4.8	310	40	144	22	516	1.12	0.74	1.86
294	686	1282	1.9	316	21	119	24	480	0.46	0.24	0.70
295	959	2284	2.4	468	24	104	21	617	0.49	0.16	0.64
296	667	1536	2.3	334	11	84	8	437	0.50	0.15	0.66
297	438	921	2.1	166	4	20	1	191	0.38	0.06	0.44
298	618	3263	5.3	527	39	169	34	769	0.85	0.39	1.24
299	386	1604	4.2	277	32	139	17	465	0.72	0.49	1.20
338	316	1366	4.3	220	25	95	22	362	0.70	0.45	1.15
341	603	5101	8.5	1086	164	623	136	2009	1.80	1.53	3.33
342	350	3279	9.4	631	93	347	123	1194	1.80	1.61	3.41
343	320	2213	6.9	404	72	208	46	730	1.26	1.02	2.28
344	186	2319	12.5	353	67	210	59	689	1.90	1.81	3.70
604	673	8626	12.8	1414	374	1056	272	3116	2.10	2.53	4.63
605	1192	4866	4.1	841	154	473	108	1576	0.71	0.62	1.32
643	351	1923	5.5	401	72	205	60	738	1.14	0.96	2.10
645	330	2620	7.9	503	106	242	82	933	1.52	1.30	2.83
646	319	3413	10.7	853	160	456	162	1631	2.67	2.44	5.11
647	434	2407	5.5	473	70	259	54	856	1.09	0.88	1.97
648	332	2890	8.7	610	101	282	77	1070	1.84	1.39	3.22
649	492	5323	10.8	1146	265	713	217	2341	2.33	2.43	4.76
655	387	778	2.0	190	28	78	33	329	0.49	0.36	0.85
701	1324	1752	1.3	464	57	180	25	726	0.35	0.20	0.55
Total	**78,843**	**417,186**	**5.3**	**80,819**	**10,325**	**37,760**	**7,399**	**136,308**	**1.03**	**0.70**	**1.73**

Table 6. Muzzleloader season harvest by DPA, excluding special hunts.

Permit Area	Muzzleloader hunters	Hunters per sq mile	Adult Male Harvest	Fawn Male Harvest	Adult Female Harvest	Fawn Female Harvest	Total Harvest
101	141	0.28	16	0	8	1	25
104	67	0.05	7	1	1	0	9
105	483	0.40	24	10	43	9	86
107	106	0.22	7	0	3	0	10
109	66	0.06	6	0	2	0	8
110	171	0.32	17	0	8	1	26
111	53	0.04	7	0	0	0	7
114	11	0.09	0	0	1	0	1
117	9	0.01	1	0	0	0	1
118	119	0.10	7	0	0	0	7
119	98	0.13	2	0	0	0	2
126	60	0.06	3	0	0	0	3
130	45	0.06	2	0	0	0	2
131	28	0.03	2	0	0	0	2
132	41	0.09	1	0	0	0	1
133	96	0.27	3	0	1	0	4
152	55	0.90	1	0	0	0	1
155	243	0.49	6	0	19	1	26
156	332	0.40	10	3	8	2	23
157	617	0.70	30	7	40	3	80
159	248	0.43	17	2	14	0	33
169	221	0.24	11	0	2	0	13
171	255	0.34	3	5	5	2	15
172	358	0.52	17	4	9	1	31
173	104	0.22	4	0	2	0	6
176	183	0.20	7	0	5	1	13
177	137	0.29	6	2	2	0	10
178	298	0.25	12	0	4	0	16
179	484	0.47	14	1	14	6	35
181	224	0.36	2	0	8	0	10
182	171	0.62	6	1	12	0	19
183	257	0.39	8	1	11	1	21
184	758	0.61	31	14	53	5	103
197	169	0.17	5	2	5	0	12
199	22	0.14	2	0	0	0	2
201	72	0.45	12	0	7	0	19
203	26	0.22	7	3	5	0	15
208	166	0.44	17	1	21	1	40

Permit Area	Muzzleloader hunters	Hunters per sq mile	Adult Male Harvest	Fawn Male Harvest	Adult Female Harvest	Fawn Female Harvest	Total Harvest
209	306	0.48	40	1	41	14	96
210	331	0.54	33	8	33	5	79
213	1828	1.73	149	62	274	32	517
214	1016	1.83	63	24	167	29	283
215	1461	2.08	99	39	193	30	361
218	1128	1.28	94	35	154	24	307
219	774	1.98	44	14	84	17	159
221	890	1.39	49	32	119	24	224
222	678	1.64	38	14	68	14	134
223	777	2.07	53	16	74	15	158
224	46	0.97	3	0	0	0	3
225	1020	1.65	55	28	116	13	212
227	1023	2.17	74	23	125	19	241
229	347	1.22	18	9	24	2	53
230	277	0.61	18	1	24	4	47
232	324	0.86	10	9	31	8	58
233	255	0.67	25	6	44	5	80
234	124	0.19	18	1	5	0	24
235	82	2.43	5	1	2	0	8
236	560	1.51	28	19	56	5	108
237	251	0.41	20	2	2	0	24
238	56	0.59	3	0	4	0	7
239	1039	1.13	66	20	91	15	192
240	969	1.51	75	26	147	23	271
241	1791	1.80	113	47	301	42	503
246	683	0.87	42	6	57	7	112
248	246	1.15	23	4	29	4	60
249	497	1.00	35	7	63	18	123
250	268	0.38	32	2	5	0	39
251	29	0.53	5	1	1	0	7
252	256	0.36	27	2	11	1	41
253	432	0.44	30	3	25	3	61
254	506	0.55	50	8	61	13	132
255	263	0.67	28	4	20	7	59
256	247	0.38	25	1	29	2	57
257	201	0.49	21	3	33	3	60
258	381	1.11	15	7	35	7	64
259	387	0.79	27	2	22	3	54
260	153	0.15	23	1	16	1	41

Permit Area	Muzzleloader hunters	Hunters per sq mile	Adult Male Harvest	Fawn Male Harvest	Adult Female Harvest	Fawn Female Harvest	Total Harvest
261	140	0.18	20	0	20	1	41
262	131	0.19	15	0	9	0	24
263	427	0.60	48	3	70	9	130
264	537	0.80	47	17	83	7	154
265	364	0.74	30	7	67	7	111
266	356	0.58	46	4	27	4	81
267	208	0.44	28	6	42	6	82
268	217	0.95	30	5	28	5	68
269	317	0.49	53	2	14	0	69
270	184	0.25	32	2	6	0	40
271	235	0.37	35	2	25	1	63
272	153	0.29	22	0	3	0	25
273	456	0.80	43	6	48	4	101
274	227	0.64	23	0	12	0	35
275	442	0.46	48	2	13	0	63
277	2094	1.98	160	36	304	41	541
278	405	1.01	47	3	24	1	75
279	280	0.81	33	1	13	4	51
280	187	0.28	15	1	4	0	20
281	671	1.17	61	12	81	9	163
282	104	0.09	11	0	0	0	11
283	224	0.66	25	1	14	3	43
284	335	0.40	33	1	11	1	46
285	436	0.79	23	1	42	4	70
286	291	0.65	28	1	18	1	48
287	19	0.42	2	3	1	1	7
288	370	0.59	29	2	23	2	56
289	245	0.30	30	1	11	1	43
290	579	0.87	43	10	56	9	118
291	672	0.84	49	3	18	4	74
292	575	1.59	27	7	41	6	81
293	305	1.10	29	4	38	4	75
294	244	0.36	18	3	16	2	39
295	530	0.55	60	2	32	0	94
296	316	0.47	36	1	25	0	62
297	78	0.18	10	0	1	0	11
298	219	0.35	17	2	10	2	31
299	311	0.81	23	6	21	1	51
338	208	0.66	10	3	7	3	23

Permit Area	Muzzleloader hunters	Hunters per sq mile	Adult Male Harvest	Fawn Male Harvest	Adult Female Harvest	Fawn Female Harvest	Total Harvest
341	715	1.19	43	15	85	13	156
342	523	1.49	49	12	78	8	147
343	370	1.16	22	7	34	4	67
344	316	1.70	19	12	28	0	59
604	641	0.95	33	10	58	9	110
605	604	0.51	36	7	55	6	104
643	282	0.80	22	3	22	3	50
645	352	1.07	21	9	44	5	79
646	448	1.40	39	19	45	19	122
647	267	0.62	18	5	35	1	59
648	256	0.77	14	6	25	4	49
649	693	1.41	56	18	74	10	158
655	103	0.27	11	2	10	2	25
701	255	0.19	22	8	24	5	59
Total	**48,813**	**0.62**	**3,653**	**838**	**4,794**	**675**	**9,960**

Table 7. Youth deer season harvest by DPA, 2021. Special hunts excluded.

Permit Area	Adult Male Harvest	Fawn Male Harvest	Adult Female Harvest	Fawn Female Harvest	Total Harvest
101	28	0	18	2	48
104	5	3	11	2	21
105	115	15	71	8	209
107	32	2	24	2	60
109	9	1	10	2	22
110	36	4	20	3	63
111	15	0	1	0	16
114	2	0	0	0	2
117	0	0	0	0	0
118	13	0	0	0	13
119	3	0	1	0	4
126	1	1	1	1	4
130	1	0	1	0	2
131	0	1	1	0	2
132	1	0	0	0	1
133	4	2	5	0	11
152	0	0	2	0	2
155	29	4	26	2	61
156	31	6	32	4	73
157	91	12	55	8	166
159	38	11	20	2	71
169	25	7	24	2	58
171	16	1	18	2	37
172	35	6	36	6	83
173	5	1	10	2	18
176	19	6	27	2	54
177	12	7	18	0	37
178	42	7	38	9	96
179	56	8	53	11	128
181	16	2	19	0	37
182	18	2	21	0	41
183	30	8	39	3	80
184	66	13	75	9	163
197	18	6	10	1	35

Permit Area	Adult Male Harvest	Fawn Male Harvest	Adult Female Harvest	Fawn Female Harvest	Total Harvest
199	0	0	5	0	5
201	6	1	4	1	12
203	1	0	1	0	2
208	35	1	10	0	46
209	69	4	37	2	112
210	69	2	29	5	105
213	138	31	78	17	264
214	138	41	74	25	278
215	113	26	78	23	240
218	69	13	52	14	148
219	34	11	22	4	71
221	146	34	95	26	301
222	85	17	55	13	170
223	36	4	26	6	72
224	2	1	3	0	6
225	95	15	50	11	171
227	49	11	23	6	89
229	14	2	9	2	27
230	15	6	18	0	39
232	11	1	8	3	23
233	12	2	5	3	22
234	2	2	2	0	6
235	2	1	1	0	4
236	28	3	10	1	42
237	13	1	6	0	20
238	4	0	2	0	6
239	108	19	60	12	199
240	141	23	109	14	287
241	242	48	152	18	460
246	93	21	68	12	194
248	24	2	18	3	47
249	68	8	51	5	132
250	14	2	7	0	23
251	4	0	0	0	4
252	11	0	5	2	18
253	14	2	10	2	28
254	27	4	14	2	47
255	12	3	6	0	21

Permit Area	Adult Male Harvest	Fawn Male Harvest	Adult Female Harvest	Fawn Female Harvest	Total Harvest
256	55	4	19	3	81
257	44	4	18	1	67
258	41	5	34	6	86
259	26	7	28	1	62
260	37	1	17	2	57
261	22	0	6	1	29
262	14	2	4	0	20
263	45	3	26	8	82
264	95	10	46	7	158
265	42	9	29	3	83
266	27	1	19	1	48
267	49	3	24	1	77
268	41	2	17	1	61
269	14	1	6	1	22
270	5	1	1	3	10
271	18	0	6	2	26
272	13	0	8	3	24
273	19	3	13	0	35
274	5	1	9	1	16
275	34	3	17	2	56
277	106	25	57	21	209
278	19	1	4	1	25
279	13	1	2	2	18
280	4	1	4	0	9
281	31	4	16	1	52
282	12	0	1	0	13
283	17	4	8	1	30
284	20	0	12	1	33
285	23	2	12	3	40
286	13	0	5	0	18
287	1	0	1	0	2
288	26	3	6	1	36
289	9	1	7	0	17
290	18	8	18	4	48
291	40	4	30	3	77
292	23	1	15	0	39
293	19	3	10	1	33
294	11	2	11	2	26
295	26	5	15	2	48

Permit Area	Adult Male Harvest	Fawn Male Harvest	Adult Female Harvest	Fawn Female Harvest	Total Harvest
296	13	3	7	1	24
297	11	0	2	1	14
298	21	5	11	3	40
299	14	3	5	3	25
338	10	3	8	1	22
341	70	7	30	5	112
342	47	3	18	8	76
343	35	6	13	2	56
344	12	4	7	5	28
604	59	7	56	5	127
605	46	9	26	7	88
643	23	3	11	0	37
645	30	8	10	1	49
646	46	10	13	6	75
647	34	4	8	0	46
648	29	4	13	10	56
649	56	11	24	5	96
655	9	1	8	0	18
701	15	3	8	1	27
Total	**4,413**	**717**	**2,749**	**469**	**8,348**

Table 8. Early Antlerless Season harvest by DPA, 2021.

Permit Area	Fawn Male Harvest	Adult Female Harvest	Fawn Female Harvest	Total Harvest
213	141	496	137	774
214	100	346	102	548
215	65	250	84	399
221	80	269	79	428
227	31	86	24	141
236	5	36	9	50
277	66	303	43	412
341	20	74	21	115
342	12	46	23	81
343	4	32	6	42
604	51	172	49	272
605	13	61	10	84
643	6	19	4	29
645	6	27	12	45
646	20	51	27	98
647	6	18	9	33
648	14	35	15	64
649	26	63	31	120
655	3	4	2	9
701	3	19	2	24
Total	**672**	**2,407**	**689**	**3,744**

Table 9. 300 Series A and B Season Harvest by DPA, 2021.

Permit Area	Zone	Adult Male	Fawn Male	Adult Female	Fawn Female	Total
338	3A	184	20	78	19	301
	3B	36	5	17	3	61
341	3A	893	103	376	74	1,446
	3B	193	61	247	62	563
342	3A	505	49	211	79	844
	3B	126	44	136	44	350
343	3A	348	53	156	36	593
	3B	56	19	52	10	137
344	3A	296	44	139	32	511
	3B	57	23	73	27	180
605	3A	718	122	328	77	1,245
	3B	123	32	145	32	332
643	3A	321	49	121	45	536
	3B	80	23	84	15	202
645	3A	401	69	131	54	655
	3B	102	37	111	28	278
646	3A	682	86	242	80	1,090
	3B	171	74	214	82	541
647	3A	378	38	137	31	584
	3B	95	32	122	23	272
648	3A	525	73	187	55	840
	3B	85	28	95	22	230
649	3A	891	131	343	101	1,466
	3B	255	134	370	116	875
655	3A	164	24	70	25	283
	3B	26	4	8	8	46
Total		**7,711**	**1,377**	**4,193**	**1,180**	**14,461**

Table 10. Harvest by DPA during first late CWD hunt, Dec 17-19, 2021.

Permit Area	Adult Male Harvest	Fawn Male Harvest	Adult Female Harvest	Fawn Female Harvest	Total Harvest
261	13	4	15	2	34
262	8	13	26	6	53
343	6	4	15	4	29
605	7	9	37	8	61
643	7	7	16	3	33
645	8	10	20	5	43
646	10	23	34	14	81
647	9	7	16	7	39
648	9	6	21	4	40
649	11	21	40	14	86
655	4	5	3	0	12
Total	**92**	**109**	**243**	**67**	**511**

Table 11. Harvest by DPA during second late CWD hunt, Dec 31, 2021 – Jan 2, 2022.

Permit Area	Adult Male Harvest	Fawn Male Harvest	Adult Female Harvest	Fawn Female Harvest	Total Harvest
261	6	2	7	8	23
262	2	2	15	2	21
343	9	3	19	6	37
605	18	12	50	3	83
643	10	6	17	5	38
645	15	7	28	11	61
646	15	12	28	7	62
647	12	6	19	2	39
648	12	7	19	2	40
649	17	7	36	10	70
655	4	0	9	2	15
Total	**120**	**64**	**247**	**58**	**489**

Table 12. Free landowner permit harvest by DPA, 2021.

Permit Area	Fawn Male	Adult Female	Fawn Female	Total
101	0	5	1	6
105	2	10	1	13
155	0	4	0	4
156	4	9	1	14
157	6	38	7	51
159	1	6	0	7
183	0	2	0	2
184	3	16	2	21
197	0	1	0	1
201	1	2	0	3
208	1	4	0	5
209	1	12	4	17
210	2	13	3	18
213	18	82	13	113
214	15	76	16	107
215	12	42	16	70
218	1	10	2	13
219	0	2	0	2
221	7	39	7	53
222	4	19	0	23
223	0	3	1	4
225	7	9	2	18
227	2	4	0	6
229	0	1	0	1
230	1	2	0	3
232	0	3	0	3
233	0	4	0	4
236	0	2	1	3
239	6	33	4	43
240	10	44	18	72
241	24	100	16	140
246	3	21	6	30
248	1	10	0	11
249	13	47	9	69
254	1	6	0	7
255	0	5	1	6
256	2	15	1	18
257	2	14	4	20

Permit Area	Fawn Male	Adult Female	Fawn Female	Total
258	2	7	3	12
260	1	3	0	4
261	1	6	0	7
262	1	5	1	7
263	0	6	0	6
264	5	21	3	29
265	2	11	2	15
266	1	9	0	10
267	4	9	2	15
268	0	5	0	5
271	0	3	0	3
273	1	1	0	2
277	3	17	3	23
281	3	3	0	6
282	0	1	0	1
285	0	1	0	1
290	0	3	0	3
292	2	7	0	9
293	1	3	0	4
297	0	1	0	1
298	1	4	0	5
299	0	1	0	1
338	0	2	0	2
341	4	26	4	34
342	5	20	2	27
343	0	3	2	5
344	1	9	1	11
604	1	0	0	1
605	1	8	0	9
643	0	2	1	3
645	1	7	1	9
646	1	6	8	15
647	1	4	1	6
648	1	4	0	5
649	9	13	4	26
655	1	2	0	3
701	0	1	0	1
Total	**204**	**949**	**174**	**1,327**

Table 13 Summary of special firearms hunt deer harvest, 2021.

Area	Dates	Permits Available	Harvest[1] Adult Male	Fawn Male	Adult Female	Fawn Female	Total
893 - Carver Park Reserve	11/13-11/14	110*	16	1	11	1	29
900 - Cascade River State Park	11/6-11/21	100*	5	2	10	2	19
901 - Rice Lake NWR	11/13-11/21	40*	3	1	2	0	6
902 - St. Croix State Park	11/18-11/21	350*	35	6	36	9	86
903 - Lake Louise State Park	11/13-11/14	25*	13	8	5	3	29
904 - Gooseberry Falls State Park	11/6-11/21	55*	1	3	2	0	6
905 - Split Rock Lighthouse State Park	11/6-11/21	30*	3	0	1	1	5
906 - Tettegouche State Park	11/6-11/21	125*	4	1	2	0	7
907 - Scenic State Park	11/6-11/21	15*	2	0	1	0	3
908 - Hayes Lake State Park	11/6-11/21	50*	3	0	4	1	8
909 - Lake Bemidji State Park	11/6-11/9	30***	0	7	3	0	10
910 - Zippel Bay State Park	11/6-11/21	75***	5	4	11	5	25
911 - Judge CR Magney State Park	11/6-11/21	75*	4	0	1	0	5
913 - Lake Carlos State Park	11/6-11/9	20**	0	0	6	0	6
914 - William O'Brien State Park	11/13-11/14	50*	19	4	6	2	31
915 - Lake Bronson State Park	11/6-11/14	30***	5	0	10	3	18
916 - Maplewood State Park	11/6-11/9	100*	28	1	10	2	41
917 - Miesville Ravine Park Reserve	11/6-11/14	40***	16	8	27	9	60
918 - Beaver Creek Valley State Park	11/6-11/7	25*	5	0	0	0	5
919 - Glacial Lakes State Park	11/11-11/14	20**	0	1	8	1	10
920 - Zumbro Falls Woods SNA	11/6-11/14	12*	3	2	2	1	8
921 - Lawrence Unit Minnesota Valley State Recreation Area	11/13-11/14	25*	10	3	13	1	27
922 - Old Mill State Park	11/6-11/9	10*	3	1	0	0	4

[1] Special hunt harvests are frequently misreported as DPA-level harvest and totals are estimates; Key: *Either-sex, **Antlerless-only, ***Earn-a-buck

Table 13., Continued.

Area	Dates	Permits Issued	Harvest: Adult Male	Fawn Male	Adult Female	Fawn Female	Total
923 - Zumbro Falls Woods SNA	11/20-11/28	12*	0	0	1	1	2
925 - Vermillion Highlands Research, Recreation and WMNA	11/6-11/19	20*	5	0	1	0	6
927 - Whitewater State Park	11/20-11/21	50*	4	5	13	0	22
928 - Mille Lacs - Kathio State Park	11/6-11/8	50***	20	2	21	2	45
931 - City of Grand Rapids	11/6-11/21	N/A*	7	8	12	2	29
933 - Forestville/ Mystery Cave State Park	11/6-11/7	75*	25	2	13	5	45
934 - Whitewater State Game Refuge	11/20-11/28	100**	0	3	16	7	26
940 - Frontenac State Park	11/20-11/21	60*	13	5	8	4	30
962 - Great River Bluffs State Park	11/20-11/21	50*	2	0	0	0	2
999- Rosemoen Island Lac qui Parle Wildlife Management Area[1]	10/2-10/10	20*	5	0	3	0	8
Total			**264**	**78**	**258**	**62**	**662**

Key: [1]Accessible hunt, firearms or archery; *Either-sex; **Antlerless-only; ***Earn-a-buck

Table 14. Summary of special muzzleloader hunt deer harvest, 2021.

Area	Dates	Permits Issued	Harvest[1] Adult Male	Fawn Male	Adult Female	Fawn Female	Total
894 - Sakatah State Park	12/4-12/5	15**	0	0	3	0	3
929 - McCarthy Beach State Park	11/27-12/12	15*	0	1	6	0	7
930 - Nerstrand Big Woods State Park	12/4-12/5	50***	4	5	11	2	22
932 - Rice Lake State Park	12/4-12/5	20**	0	6	7	3	16
935 - Jay Cooke State Park	12/4-12/8	80*	2	2	7	0	11
936 - Crow Wing State Park	12/4-12/8	25*	2	0	4	1	7
937 - Lake Vermillion - Soudan Underground Mine State Park	11/27-12/12	25*	1	1	3	1	6
938 - City of Tower	11/27-12/12	20*	2	0	2	2	6
939 - Myre-Big Island State Park	12/4-12/5	50**	0	5	24	14	43
942 - Sibley State Park	11/27-11/28	60**	0	1	5	2	8
943 - Miesville Ravine Park Reserve	12/4-12/12	40***	2	3	5	5	15
944 - Vermillion Highlands Research, Recreation and WMA	11/27-12/12	20*	0	0	0	0	0
946 - City of Grand Rapids	11/27-12/12	N/A*	0	1	3	1	5
947 - Lake Bemidji State Park	12/3 - 12/5	30*	0	0	0	0	0
948 - Savanna Portage State Park	11/27-12/5	30*	1	0	1	1	3
949 - St. Croix State Park	12/1-12/5	100*	1	0	5	1	7
		Totals	**15**	**25**	**86**	**33**	**159**

[1] Special hunt harvests are frequently misreported as DPA-level harvest and totals are estimates; *Either- sex; **Antlerless-only; ***Earn-a-buck

Table 15. Summary of youth special deer hunts, 2021.

Area	Dates	Permits Issued	Harvest[1] Adult Male	Fawn Male	Adult Female	Fawn Female	Total
899 - Minneopa State Park	11/20-11/21	12*	1	0	2	0	3
951 - Afton State Park	11/6-11/7	30*	8	2	14	0	24
952 - Sibley State Park	10/30-10/31	10*	4	0	0	0	4
953 - Zippel Bay State Park	10/16-10/17	20*	1	0	0	0	1
954 - Lake Bemidji State Park	10/15-10/17	20*	0	0	0	0	0
956 - St. Croix State Park	10/30-10/31	90*	9	3	1	0	13
957 - Rydell National Wildlife Refuge	10/23-10/24	15*	0	0	0	0	0
958 - Savanna Portage State Park	10/23-10/24	25*	1	0	0	0	1
959 - Buffalo River State Park	10/30-10/31	12***	1	0	3	0	4
963 - Kilen Woods State Park	10/30-10/31	6*	1	0	0	0	1
965 - Banning State Park	10/30-10/31	6*	0	2	0	1	3
966 - Blue Mounds State Park	11/20-11/21	10***	1	0	3	0	4
967 - Camden State Park	10/30-10/31	12***	2	2	9	0	13
968 - Lake Shetek State Park	11/20-11/21	12**	0	1	6	1	8
969 - Lake Bronson State Park	10/23-10/24	10*	0	0	0	0	0
		Total	**28**	**10**	**36**	**2**	**76**

[1] Special hunt harvests are frequently misreported as DPA-level harvest and totals are estimates; *Either- sex; **Antlerless-only; ***Earn-a-buck

Table 16. Summary of special archery deer hunts, 2021.

Area	Dates	Permits Available	Harvest[1] Adult Male	Fawn Male	Adult Female	Fawn Female	Total
895 - Minnesota Landscape Arboretum	10/23 -11/7	5***	0	0	0	0	0
896 - City of Two Harbors	9/18 -12/31	25***	1	0	13	1	15
897 - City of Blue Earth	9/18 -12/31	26***	1	0	10	1	12
898 - City of Aurora	9/18 -12/31	15*	0	0	12	1	13
924 - City of Lake Benton	9/18 -12/31	40***	0	3	14	0	17
926 - Pin Oak Prairie SNA	9/18 -12/16	8*	1	0	0	0	1
971 - Camp Ripley Second Hunt	10/29 - 10/31	2,500*	110	16	79	19	224
972 - Carlton Game Refuge	11/25 -12/31	40***	2	2	4	2	10
973 - City of Austin	10/16 -12/31	50***	1	7	23	7	38
974 - City of Warroad	9/18 -12/31	10*	0	0	4	0	4
975 - Vermillion Highlands Wildlife Management Area	9/18-10/29 12/13-12/31	20*	0	0	2	0	2
976 - City of New Ulm	10/9 -12/31	56***	0	5	37	6	48
977 - City of Red Wing	9/18 -12/31	N/A*	5	1	7	3	16
978 - City of Redwood Falls	9/18 -12/31	20*	0	1	16	0	17
980 - City of Duluth	9/18 -12/31	400***	65	31	124	35	255
981 - City of Mankato	9/18 -12/31	40***	5	3	14	6	28
982 - City of Granite Falls	9/18 -12/31	10**	0	0	3	0	3
983 - City of Ortonville	9/18 -12/31	30***	1	0	20	2	23
984 - City of Canby	9/18 -12/31	20*	0	2	4	0	6

[1] Special hunt harvests are frequently misreported as DPA-level harvest and totals are estimates; Key: *Either-sex, **Antlerless-only, ***Earn-a-buck

Table 16., Continued.

Area	Dates	Permits Available	Harvest Adult Male	Fawn Male	Adult Female	Fawn Female	Total
985 - City of Bemidji	9/18 -12/31	78*	2	0	11	1	14
986 - Bemidji Regional Airport	10/1-11/30	20*	3	0	7	1	11
988 - City of Tower	11/27-12/31	10*	0	1	2	0	3
990 - City of Owatonna	10/24-11/21; 11/22-12/19	36***	1	4	16	4	25
992- City of Hallock	9/18-10/22; 10/23-11/26; 11/27-12/31	5**	0	0	3	0	3
995 - City of Grand Rapids	9/18 -12/31	N/A*	1	7	33	4	45
996 - Side Lake Community	9/18 -12/31	40*	1	1	6	1	9
997 - River Bend Nature Center	10/16-10/17	35***	2	5	10	1	18
998 - City of Red Lake Falls	9/18 -12/31	10**	0	0	3	1	4
		Total	**202**	**89**	**477**	**96**	**864**

Key: *Either-sex, **Antlerless-only, ***Earn-a-buck

Table 17. Firearms antlerless permit lottery distribution report.

Permit Area Number	Preference Level	Applications		Unsuccessful	Winners	Permits Available
		Total	Rejected			
104	1	143	1	143	0	49
	2	354	4	354	0	
	3	104	1	64	40	
	4	8	0	0	8	
	5	1	0	0	1	
	Total	**610**	**6**	**561**	**49**	
107	1	345	1	178	167	495
	2	146	0	0	146	
	3	95	0	0	95	
	4	39	0	0	39	
	5	25	0	0	25	
	6	22	0	0	22	
	7	1	0	0	1	
	Total	**673**	**1**	**178**	**495**	
109	1	100	0	100	0	25
	2	99	0	99	0	
	3	93	0	93	0	
	4	53	1	53	0	
	5	65	0	65	0	
	6	56	0	56	0	
	7	30	0	5	25	
	Total	**496**	**1**	**471**	**25**	
110	1	584	1	584	0	497
	2	392	2	183	209	
	3	258	3	0	258	
	4	29	3	0	29	
	5	1	1	0	1	
	Total	**1,264**	**10**	**767**	**497**	
126	1	122	0	122	0	98
	2	131	2	94	37	
	3	60	0	0	60	
	4	1	0	0	1	
	Total	**314**	**2**	**216**	**98**	

Permit Area Number	Preference Level	Applications		Unsuccessful	Winners	Permits Available
		Total	Rejected			
131	1	71	1	71	0	25
	2	54	0	42	12	
	3	12	0	0	12	
	9	1	0	0	1	
	Total	**138**	**1**	**113**	**25**	
133	1	288	2	288	0	97
	2	174	1	80	94	
	3	2	0	0	2	
	4	1	0	0	1	
	Total	**465**	**3**	**368**	**97**	
169	1	623	4	623	0	247
	2	645	2	645	0	
	3	806	3	806	0	
	4	523	4	279	244	
	5	1	3	0	1	
	6	1	0	0	1	
	7	1	0	0	1	
	Total	**2,600**	**16**	**2,353**	**247**	
171	1	1217	9	528	689	1483
	2	425	4	0	425	
	3	286	3	0	286	
	4	80	0	0	80	
	9	3	0	0	3	
	Total	**2,011**	**16**	**528**	**1,483**	
172	1	1602	8	1217	385	1970
	2	773	6	0	773	
	3	574	4	0	574	
	4	234	1	0	234	
	5	4	0	0	4	
	Total	**3,187**	**19**	**1217**	**1,970**	
173	1	999	1	851	148	491
	2	320	2	0	320	
	3	19	2	0	19	
	4	4	0	0	4	
	7	0	1	0	0	
	Total	**1,342**	**6**	**851**	**491**	

Permit Area Number	Preference Level	Applications		Unsuccessful	Winners	Permits Available
		Total	Rejected			
176	1	499	2	499	0	149
	2	565	4	565	0	
	3	705	4	591	114	
	4	35	0	0	35	
	Total	**1,804**	**10**	**1,655**	**149**	
177	1	696	4	696	0	593
	2	573	3	30	543	
	3	39	2	0	39	
	4	7	0	0	7	
	5	3	0	0	3	
	9	1	0	0	1	
	Total	**1,319**	**9**	**726**	**593**	
178	1	805	4	805	0	397
	2	795	4	795	0	
	3	841	2	728	113	
	4	283	0	0	283	
	9	1	0	0	1	
	Total	**2,725**	**10**	**2,328**	**397**	
179	1	2722	6	1366	1356	2472
	2	509	9	0	509	
	3	468	1	0	468	
	4	135	1	0	135	
	5	3	0	0	3	
	6	1	0	0	1	
	Total	**3,838**	**17**	**1,366**	**2,472**	
181	1	1708	7	326	1382	1484
	2	83	1	0	83	
	3	12	2	0	12	
	4	7	3	0	7	
	Total	**1,810**	**13**	**326**	**1,484**	
197	1	766	3	766	0	493
	2	678	0	648	30	
	3	441	1	0	441	
	4	21	1	0	21	
	5	1	2	0	1	
	Total	**1,907**	**7**	**1,414**	**493**	

Permit Area Number	Preference Level	Applications		Unsuccessful	Winners	Permits Available
		Total	Rejected			
199	1	101	0	35	66	99
	2	33	0	0	33	
	Total	**134**	**0**	**35**	**99**	
203	1	27	0	27	0	23
	2	17	0	5	12	
	3	11	0	0	11	
	Total	**55**	**0**	**32**	**23**	
234	1	123	0	1	122	235
	2	94	2	0	94	
	3	18	0	0	18	
	4	1	0	0	1	
	Total	**236**	**2**	**1**	**235**	
237	1	84	0	84	0	190
	2	86	0	19	67	
	3	70	1	0	70	
	4	51	2	0	51	
	5	2	0	0	2	
	Total	**293**	**3**	**103**	**190**	
238	1	56	0	10	46	98
	2	44	0	0	44	
	3	6	0	0	6	
	4	2	0	0	2	
	Total	**108**	**0**	**10**	**98**	
250	1	266	1	147	119	369
	2	242	0	0	242	
	3	7	1	0	7	
	4	1	0	0	1	
	Total	**516**	**2**	**147**	**369**	
252	1	362	3	29	333	475
	2	138	1	0	138	
	3	4	0	0	4	
	Total	**504**	**4**	**29**	**475**	
253	1	317	1	257	60	442
	2	270	0	0	270	
	3	112	1	0	112	
	Total	**699**	**2**	**257**	**442**	

Permit Area Number	Preference Level	Applications		Unsuccessful	Winners	Permits Available
		Total	Rejected			
259	1	1873	7	716	1157	1951
	2	644	2	0	644	
	3	143	2	0	143	
	4	7	3	0	7	
	Total	**2,667**	**14**	**716**	**1,951**	
269	1	303	1	115	188	323
	2	128	1	0	128	
	3	4	0	0	4	
	4	3	0	0	3	
	5	0	1	0	0	
	Total	**438**	**3**	**115**	**323**	
270	1	154	0	154	0	138
	2	117	1	6	111	
	3	24	0	0	24	
	4	3	0	0	3	
	Total	**298**	**1**	**160**	**138**	
272	1	168	2	168	0	146
	2	183	1	83	100	
	3	43	0	0	43	
	4	3	0	0	3	
	Total	**397**	**3**	**251**	**146**	
274	1	230	1	230	0	226
	2	193	0	12	181	
	3	45	1	0	45	
	Total	**468**	**2**	**242**	**226**	
275	1	349	3	349	0	238
	2	240	1	240	0	
	3	210	1	44	166	
	4	71	0	0	71	
	5	1	0	0	1	
	Total	**871**	**5**	**633**	**238**	
278	1	623	2	339	284	542
	2	220	0	0	220	
	3	35	1	0	35	
	4	3	0	0	3	
	6	0	1	0	0	

Permit Area Number	Preference Level	Applications		Unsuccessful	Winners	Permits Available
		Total	Rejected			
	Total	**881**	**4**	**339**	**542**	
279	1	465	1	20	445	525
	2	64	0	0	64	
	3	11	1	0	11	
	4	4	0	0	4	
	5	0	1	0	0	
	9	1	0	0	1	
	Total	**545**	**3**	**20**	**525**	
280	1	97	0	97	0	46
	2	106	0	106	0	
	3	93	0	93	0	
	4	60	0	14	46	
	Total	**356**	**0**	**310**	**46**	
282	1	73	0	73	0	24
	2	46	1	46	0	
	3	42	0	35	7	
	4	17	0	0	17	
	Total	**178**	**1**	**154**	**24**	
284	1	183	1	183	0	24
	2	233	2	233	0	
	3	188	0	188	7	
	4	134	0	39	17	
	Total	**738**	**3**	**643**	**24**	
286	1	388	1	70	318	451
	2	127	0	0	127	
	3	5	1	0	5	
	4	1	0	0	1	
	Total	**521**	**2**	**70**	**451**	
288	1	456	1	284	172	456
	2	271	0	0	271	
	3	10	0	0	10	
	4	2	0	0	2	
	6	1	0	0	1	
	Total	**740**	**1**	**284**	**456**	

Permit Area Number	Preference Level	Applications		Unsuccessful	Winners	Permits Available
		Total	Rejected			
289	1	284	1	104	180	321
	2	130	0	0	130	
	3	10	0	0	10	
	4	1	0	0	1	
	Total	**425**	**1**	**104**	**321**	
291	1	902	4	613	289	917
	2	602	1	0	602	
	3	21	0	0	21	
	4	5	3	0	5	
	6	0	1	0	0	
	Total	**1,530**	**9**	**613**	**917**	
294	1	382	0	6	376	453
	2	72	1	0	72	
	3	5	0	0	5	
	Total	**459**	**1**	**6**	**453**	
295	1	403	1	379	24	455
	2	291	0	0	291	
	3	127	1	0	127	
	4	12	0	0	12	
	5	1	0	0	1	
	Total	**834**	**2**	**379**	**455**	
296	1	337	1	161	176	444
	2	239	0	0	239	
	3	28	0	0	28	
	4	1	0	0	1	
	Total	**605**	**1**	**161**	**444**	
297	1	84	1	60	24	97
	2	42	0	0	42	
	3	31	0	0	31	
	Total	**157**	**1**	**60**	**97**	
	Total	**42,022**	**217**	**21,277**	**20,674**	**20,773**

Table 18. Muzzleloader lottery distribution report.

Permit Area Number	Preference Level	Applications		Unsuccessful	Winners	Permits Available
		Total	Rejected			
104	1	7	0	7	0	1
	2	5	0	5	0	
	3	2	0	1	1	
	Total	14	0	13	1	
107	1	6	0	2	4	5
	2	1	0	0	1	
	Total	7	0	2	5	
09	**2**	4	0	4	0	0
	3	1	0	1	0	
	4	1	0	0	0	
	Total	6	0	5	0	
110	1	7	0	4	3	3
	Total	**7**	**0**	**4**	**3**	
126	1	**3**	**0**	**0**	**0**	2
	2	4	0	1	2	
	Total	**7**	**0**	**1**	**2**	
131	1	7	0	7	0	2
	2	2	0	0	2	
	Total	**9**	**0**	**7**	**2**	
131	1	0	1	0	0	0
	2	**1**	**0**	**1**	**0**	
	Total	**1**	**1**	**1**	**0**	
133	**1**	**8**	**0**	**8**	**0**	3
	2	8	0	5	3	
	Total	**16**	**0**	**13**	**3**	
169	1	15	0	15	0	3
	2	5	0	5	0	
	3	10	0	7	3	
	Total	**30**	**0**	**27**	**3**	
171	1	16	0	6	10	17
	2	6	0	0	6	
	9	1	0	0	1	
	Total	**23**	**0**	**6**	**17**	
172	1	30	0	19	11	30
	2	16	0	0	16	
	3	2	0	0	2	
	4	1	0	0	1	
	Total	**49**	**0**	**19**	**30**	

Permit Area Number	Preference Level	Applications		Unsuccessful	Winners	Permits Available
		Total	Rejected			
173	1	22	0	16	6	9
	2	3	0	0	3	
	Total	**25**	**0**	**16**	**9**	
176	1	7	0	7	0	1
	2	5	0	4	1	
	Total	**12**	**0**	**11**	**1**	
177	1	8	0	8	0	7
	2	6	0	0	6	
	3	1	0	0	1	
	Total	**15**	**0**	**8**	**7**	
178	1	12	0	12	0	3
	2	6	0	6	0	
	3	6	0	3	3	
	Total	**24**	**0**	**21**	**3**	
179	1	38	0	16	22	28
	2	4	0	0	4	
	3	2	0	0	2	
	Total	**44**	**0**	**16**	**28**	
181	1	20	0	4	16	16
	Total	**20**	**0**	**4**	**16**	
197	1	19	0	19	0	7
	2	6	0	2	4	
	3	2	0	0	2	
	4	1	0	0	1	
	Total	**28**	**0**	**21**	**7**	
199	1	1	0	0	1	1
	Total	**1**	**0**	**0**	**1**	
203	1	3	0	3	0	2
	2	2	0	0	2	
	Total	**5**	**0**	**3**	**2**	
234	1	11	0	0	11	15
	2	4	0	0	4	
	Total	**15**	**0**	**0**	**15**	
237	1	3	0	3	0	10
	2	7	0	3	4	
	3	6	0	0	6	
	Total	**16**	**0**	**6**	**10**	

Permit Area Number	Preference Level	Applications		Unsuccessful	Winners	Permits Available
		Total	Rejected			
238	1	1	0	0	1	2
	2	1	0	0	1	
	Total	**2**	**0**	**0**	**2**	
250	1	25	0	13	22	25
	2	17	0	0	2	
	3	2	0	0	1	
	Total	**44**	**0**	**13**	**25**	
252	1	23	0	1	22	25
	2	2	0	0	2	
	3	1	0	0	1	
	Total	**26**	**0**	**1**	**25**	
253	1	44	0	33	11	58
	2	44	0	0	44	
	3	3	0	0	3	
	Total	**91**	**0**	**33**	**58**	
259	1	48	0	33	11	58
	2	13	0	0	44	
	3	6	0	0	3	
	Total	**67**	**0**	**33**	**58**	
269	1	28	0	10	18	27
	2	9	0	0	9	
	Total	**37**	**0**	**10**	**27**	
270	1	15	0	15	0	12
	2	11	0	0	11	
	4	1	0	0	1	
	Total	**27**	**0**	**15**	**12**	
272	1	11	0	8	3	4
	3	1	0	0	1	
	Total	**12**	**0**	**8**	**4**	
274	1	28	0	26	2	24
	2	19	0	0	19	
	3	3	0	0	3	
	Total	**50**	**0**	**26**	**24**	
275	1	21	0	21	0	12
	2	14	0	11	3	
	3	9	0	0	9	
	Total	**44**	**0**	**32**	**12**	

Permit Area Number	Preference Level	Applications		Unsuccessful	Winners	Permits Available
		Total	Rejected			
278	1	68	0	37	31	58
	2	24	0	0	24	
	3	3	0	0	3	
	Total	**95**	**0**	**37**	**58**	
279	1	73	0	3	70	75
	2	5	0	0	5	
	Total	**78**	**0**	**3**	**75**	
280	1	7	0	7	0	4
	2	8	0	8	0	
	3	7	0	7	0	
	4	5	0	1	4	
	Total	**27**	**0**	**23**	**4**	
282	1	6	0	6	0	1
	2	2	0	2	0	
	3	1	0	0	1	
	Total	**9**	**0**	**8**	**1**	
284	1	6	0	6	0	1
	2	2	0	2	0	
	3	1	0	0	1	
	Total	**9**	**0**	**8**	**1**	
286	1	47	0	8	39	49
	2	10	0	0	10	
	Total	**57**	**0**	**8**	**49**	
288	1	44	0	28	16	44
	2	28	0	0	28	
	Total	**72**	**0**	**28**	**44**	
289	1	24	0	9	15	29
	2	12	0	0	12	
	3	1	0	0	1	
	9	1	0	0	1	
	Total	**38**	**0**	**9**	**29**	
291	1	87	0	56	31	83
	2	52	0	0	52	
	Total	**139**	**0**	**56**	**83**	
294	1	42	0	1	41	47
	2	6	0	0	6	
	Total	**48**	**0**	**1**	**47**	

Permit Area Number	Preference Level	Applications		Unsuccessful	Winners	Permits Available
		Total	Rejected			
295	1	44	0	38	6	45
	2	28	0	0	28	
	3	11	0	0	11	
	Total	**83**	**0**	**38**	**45**	
296	1	48	0	21	27	56
	2	28	0	0	28	
	3	1	0	0	1	
	Total	**77**	**0**	**21**	**56**	
297	1	4	0	2	2	3
	2	1	0	0	1	
	Total	**5**	**0**	**2**	**3**	
	Total	**1511**	**1**	**617**	**907**	**907**

Table 19. Special firearms hunts lottery distribution report.

Permit Area Number	Preference Level	Applications		Unsuccessful	Winners	Permits Available
		Total	Rejected			
900 - Cascade River SP	1	34	0	0	34	100
	2	7	0	0	7	
	3	1	0	0	1	
	Total	42	0	0	42	
901 - Rice Lake Wildlife Refuge	1	51	0	31	20	40
	2	19	0	0	19	
	3	1	0	0	1	
	Total	71	0	31	40	
902 - St.Croix SP	1	346	0	105	241	350
	2	99	0	0	99	
	3	9	0	0	9	
	9	1	0	0	1	
	Total	455	0	105	350	
903 - Lake Louise SP	1	39	0	39	0	25
	2	37	0	26	11	
	3	14	0	0	14	
	Total	90	0	65	25	
904 - Gooseberry Falls SP	1	39	0	0	39	55
	2	6	0	0	6	
	Total	45	0	0	45	
905 - Split Rock Lighthouse SP	1	36	0	11	25	30
	2	5	0	0	5	
	Total	41	0	11	30	
906 - TettegoucheSP	1	68	0	0	68	100
	2	2	0	0	2	
	Total	70	0	0	70	
907 -Scenic SP	1	21	0	15	6	15
	2	8	0	0	8	
	3	1	0	0	1	
	Total	30	0	15	15	
908 -Hayes Lake SP	1	41	0	2	39	50
	2	10	0	0	10	
	3	1	0	0	1	
	Total	52	0	2	50	

Table 19., Continued.

Permit Area Number	Preference Level	Applications		Unsuccessful	Winners	Permits Available
		Total	Rejected			
909 - Lake Bemidji SP	1	18	0	0	18	30
	2	1	0	0	1	
	Total	19	0	0	19	
910 - Zippel Bay SP	1	74	0	8	66	75
	2	9	0	0	9	
	Total	83	0	8	75	
911 – Judge C. R. Magney SP	1	16	0	0	16	75
	Total	16	0	0	16	
913 - Lake Carlos SP	1	14	0	0	14	20
	2	7	0	0	7	
	Total	21	0	0	21	
914 -William O'Brien SP	1	90	0	90	0	50
	2	73	0	38	35	
	3	13	0	0	13	
	5	1	0	0	1	
	9	2	0	0	2	
	Total	179	0	128	51	
915 - Lake Bronson SP	1	26	0	26	0	30
	2	28	0	1	27	
	3	2	0	0	2	
	9	1	0	0	1	
	Total	57	0	27	30	
916 - Maplewood SP	1	143	0	143	0	100
	2	105	0	105	0	
	3	104	0	37	67	
	4	30	0	0	30	
	9	3	0	0	3	
	Total	385	0	285	100	
917 -Miesville Ravine SP	1	119	0	116	2	40
	2	34	0	0	34	
	3	4	0	0	4	
	Total	157	0	116	40	
918 -Beaver Creek Valley S.P.	1	30	0	30	0	25
	2	34	0	10	24	
	3	1	0	0	1	
	Total	65	0	40	25	

Table 19., Continued.

Permit Area Number	Preference Level	Applications		Unsuccessful	Winners	Permits Available
		Total	Rejected			
919 - Glacial Lakes SP	1	19	0	7	12	20
	2	9	0	0	9	
	3	1	0	0	1	
	Total	29	0	7	22	
920 - Zumbro Falls SNA	1	20	0	20	0	12
	2	15	0	4	11	
	3	2	0	0	2	
	Total	37	0	24	13	
921 - Lawrence Unit MN Valley Rec. Area	1	9	0	3	6	25
	2	14	0	0	14	
	3	7	0	0	7	
	Total	30	0	3	27	
922 – Old Mill SP	1	4	0	4	0	10
	2	12	0	0	12	
	Total	16	0	4	12	
923 - Zumbro Falls SNA	1	4	0	0	4	12
	2	4	0	0	4	
	9	1	0	0	1	
	Total	9	0	0	9	
925 - Vermillion Highlands Research, Recreation, and Wildlife Management Area A Season	1	27	0	27	0	19
	2	18	0	18	0	
	3	23	0	3	20	
	Total	68	0	48	20	
925 -Vermillion Highlands Research, Recreation, and Wildlife Management Area B Season	2	3	0	3	0	1
	3	1	0	0	1	
	Total	4	0	3	1	

Table 19., Continued.

Permit Area Number	Preference Level	Applications		Unsuccessful	Winners	Permits Available
		Total	Rejected			
927 – Whitewater SP	1	64	0	22	42	50
	2	8	0	0	8	
	3	1	0	0	1	
	Total	73	0	22	51	
928 - Wild River SP	1	70	0	51	19	50
	2	23	0	0	23	
	3	7	0	0	7	
	9	1	0	0	1	
	Total	101	0	51	50	
930- Carver Park Reserve	1	128	0	128	0	110
	2	91	0	26	65	
	3	46	0	0	46	
	Total	265	0	154	111	
931 - Grand Rapids	1	40	0	0	40	43
	2	3	0	0	3	
	Total	43	0	0	43	
933 – Forestville Mystery Cave SP	1	84	0	13	71	75
	2	5	0	0	5	
	Total	89	0	13	76	
934 - Whitewater State Game Refuge	1	78	0	0	78	100
	Total	78	0	0	78	
940 – Frontenac SP	1	63	0	8	55	60
	2	4	0	0	4	
	3	1	0	0	1	
	Total	68	0	8	60	
962 - Great River Bluffs SP	1	39	0	0	39	50
	2	1	0	0	1	
	Total	40	0	0	40	
	Total	**2,563**	**0**	**1,170**	**1,657**	**1,847**

Table 20. Muzzleloader special hunts lottery distribution report.

Permit Area Number	Preference Level	Applications		Unsuccessful	Winners	Permits Available
		Total	Rejected			
894 - Sakatah Lake SP	1	15	0	4	11	15
	2	4	0	0	4	
	3	1	0	0	1	
	Total	20	0	4	16	
929 - McCarthy Beach SP	1	10	0	4	11	15
	2	2	0	0	4	
	3	1	0	0	1	
	Total	13	0	4	16	
930 - Nerstrand Big Woods SP	1	54	0	54	0	50
	2	71	0	38	33	
	3	16	0	0	16	
	4	3	0	0	3	
	Total	144	0	92	52	
932 - Rice Lake SP	1	45	0	34	11	20
	2	10	0	0	10	
	Total	55	0	34	21	
935 – Jay Cooke SP	1	105	0	62	43	80
	2	37	0	0	37	
	Total	142	0	62	80	
936 - Crow Wing SP	1	43	0	43	0	25
	2	39	0	21	18	
	3	7	0	0	7	
	Total	89	0	64	25	
937 - Lake Vermillion-Soudan Underground Mine SP	1	26	0	3	23	25
	2	2	0	0	2	
	Total	28	0	3	25	
938 - City of Tower	1	12	0	0	12	20
	2	2	0	0	2	
	Total	14	0	0	14	
939 - Myre- Big Island SP	1	54	0	54	0	50
	2	36	0	1	35	
	3	13	0	0	13	
	6	1	0	0	1	
	9	1	0	0	1	
	Total	105	0	55	50	

Permit Area Number	Preference Level	Applications		Unsuccessful	Winners	Permits Available
		Total	Rejected			
942 - Sibley SP	1	75	0	67	8	60
	2	46	0	0	46	
	3	6	0	0	6	
	9	1	0	0	1	
	Total	128	0	67	61	
943 - Miesville Ravine Park Reserve	1	61	0	36	25	40
	2	15	0	0	15	
	Total	76	0	36	40	
944 - Vermillion Highlands Research, Recreation, and WMA	1	43	0	38	5	20
	2	14	0	0	14	
	3	1	0	0	1	
	Total	58	0	38	20	
946 - City of Grand Rapids	1	15	0	0	15	15
	Total	15	0	0	15	
947 – Lake Bemidji SP	1	13	0	0	13	30
	Total	13	0	0	13	
948 – Savanna Portage SP	1	14	0	0	14	30
	2	5	0	0	5	
	Total	19	0	0	19	
949 – St Croix SP	1	94	0	0	94	100
	2	5	0	0	5	
	3	3	0	0	3	
	Total	102	0	0	102	
Total		**1,021**	**0**	**459**	**569**	**595**

2021 MINNESOTA ELK HARVEST REPORT

Jason Wollin, Acting Karlstad Area Wildlife Supervisor

Kyle Arola, Thief Lake Wildlife Area Supervisor

Barbara Keller, Big Game Program Leader

INTRODUCTION

Legislation passed in 2016 (MN Statute 97B.516b) directed the Department of Natural Resources (DNR) to "…not manage an elk herd in Kittson, Roseau, Marshall, or Beltrami counties in a manner that would increase the size of the herd, including adoption or implementation of an elk management plan designed to increase an elk herd, unless the commissioner of agriculture verifies that crop and fence damages paid under section 3.7371 and attributed to the herd have not increased for at least two years." In response, DNR adopted an Interim Strategic Management Plan for Elk in 2016 that will maintain a status quo in elk numbers at the current population estimates. This plan set herd goals at 50 – 60 elk for the Kittson Central herd, 30-38 elk for the Grygla herd, and 150-200 elk for the Caribou Vita herd. Plans will be made to update the Strategic Management Plan for Elk in the near future.

The DNR conducts an annual aerial elk population survey each winter using a fixed-wing aircraft to fly over survey blocks consistent with the range of each elk herd. Due to COVID restrictions, we were unable to complete an aerial elk survey in 2021. Normally DNR staff use a single fixed-wing aircraft to conduct aerial elk surveys for the Grygla and Kittson elk herds. The last aerial elk survey was done in 2020. Survey results for 2020 are presented in Table 1 and Figure 1 for the Kittson Central herd. Total elk recorded within the Kittson Central block was 102 and included 69 antlerless elk and 33 bulls. In the Grygla survey block, 24 total elk were observed including 10 bulls and 14 antlerless elk. A survey was not conducted over the Caribou-vita herd since Manitoba was unable to conduct a joint-survey at the same time.

This year, due to the lack of available data on elk numbers from an aerial survey, less licenses were offered to Minnesota hunters. There were two established zones open for elk hunting in Minnesota in 2021: 1) Zone 20 - Kittson Central and 2) Zone 30 - Kittson Northeast (Figure 2). Elk hunting in Zone 10 - Grygla, has been closed since 2013 because the population is below goal (Figure 3). In an effort to move the Kittson Central herd towards goal range, this year the number of seasons held in Zone 20 was four regular season hunts. Another change in 2020 required hunters to apply for both the specific license type (either-sex, bull-only, or antlerless-only) and season dates. For the Zone 20 - Kittson Central there were eight license/season date options: 1) Season A/E – August 28 through September 5, 2) Season B/F - September 11 through September 19, 3) Season C/G – September 25 through October 3, 4) Season D/H - October 9 through October 17. There was one regular season hunt in Zone 30 – Kittson Northeast for two bull-only licenses: 1) Season I - September 11 through September 19. All of the seasons were 9 days in length, including two weekends. These dates were also chosen to avoid conflict with the Youth Firearm Deer Season on October 21 through October 24 and the

Regular Firearm Deer Season November 6 through November 14. Overall, hunter success rates were high this year.

HUNTING SEASON OPTIONS AND LICENSE LOTTERY

A total of 30 licenses were available and 4,448 individuals or parties (up to two hunters) applied for the opportunity to hunt elk in Minnesota (Table 2). Applicants were given the opportunity to select both zone and season in which to hunt. Seasons in Zone 20 were also split between either-sex and antlerless-only licenses. This allowed applicants to choose the type of license desired during their application.

The Minnesota elk lottery is a three-step process. First, a lottery for qualifying landowner applicants is held for Zone 20 (20% = 5 licenses offered). Once landowner applicants were selected, the second round was for applicants that had applied for 10 years or more (20% = 5 licenses offered). All remaining applicants not selected in the first two steps were then placed into the general drawing with all the other applicant names for the remaining elk licenses (60%) available in the zone and season they had selected on their application. Zone 30 only had two bull-only licenses available, so no landowner licenses or 10 year history licenses were offered.

METHODS

All elk hunters are required to attend a mandatory orientation session the Friday before a given hunt. At this session, DNR staff go over the logistics of the elk hunt and explain how we collect biological samples from their harvested animal. Hunters must register their animal in person within 24 hours at the local DNR office and provide biological samples. DNR staff help map the harvest location, provide a possession tag, and collect biological samples. DNR staff collect lymph nodes, the obex (brain stem), muscle, hair, and a tooth so an accurate age can be determined via cementum annuli. 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 the DNR Wildlife Health Program for disease testing and other monitoring projects.

RESULTS

In 2021, a total of 25 elk were harvested in Zones 20 and 30 (Table 3), for an overall hunter success rate of 82% for Zone 20 and 100% for Zone 30. Although success rates were generally high, there was a gradual decrease in success rates for Zone 20 as the seasons progressed. Seven bull elk were taken from hunters using either-sex licenses for Zone 20, and 16 antlerless elk were taken by hunters using antlerless-only licenses. Two bull elk were taken by hunters using bull-only licenses for Zone 30. Long-term elk harvest for all zones is depicted in Tables 4, 5, and 6.

Table 1. Kittson Central (Zone 20) elk survey count, 2008-2021

Year	Number of bulls surveyed	Number of antlerless surveyed	Total number surveyed
2008	14	46	60
2009	16	29	45
2010	NO SURVEY	NO SURVEY	NO SURVEY
2011	12	31	43
2012	NO SURVEY	NO SURVEY	NO SURVEY
2013	17	28	45
2014	17	20	37
2015	18	16	34
2016	18	34	52
2017	16	45	61
2018	18	57	75
2019	33	61	94
2020	33	69	102
2021	NO SURVEY	NO SURVEY	NO SURVEY

Table 2. License allocation and application numbers of the 2021 Minnesota elk seasons

Zone	Season Dates	Bull-Only	Either-Sex	Antlerless-Only	Total	Total Applicants
Zone 20	A: Aug 28 Sept 5	0	2	0	**2**	655
Zone 20	E: Aug 28-Sept 5	0	0	5	**4**	93
Zone 20	B: Sept 11-19	0	2	0	**2**	1126
Zone 20	F: Sept 11-19	0	0	5	**5**	129
Zone 20	C: Sept 25-Oct 3	0	2	0	**2**	793
Zone 20	G: Sept 25-Oct 3	0	0	5	**5**	189
Zone 20	D: Oct 9-17	0	2	0	**2**	570
Zone 20	H: Oct 9-17	0	0	5	**5**	146
Zone 30	I: Sept 11-19	2	0	0	**2**	747
OVERALL	**TOTAL**	**2**	**8**	**20**	**30**	**4,448**

Table 3. Distribution of the 2021 Minnesota elk harvest.

Kittson County Central Hunt

Zone 20

Season	Either-Sex Licenses	Antlerless Licenses	Bulls taken	Antlerless taken	Total elk taken	Success rate
Season A & E (Aug 28-Sept 5)	2	5	2	4	**6**	86%
Season B & F (Sept 11-19)	2	5	2	5	**7**	100%
Season C & G (Sept 25-Oct 3)	2	5	2	4	**6**	86%
Season D & H (Oct 9-17)	2	5	1	3	**4**	57%
Total	**8**	**20**	**7**	**16**	**23**	**82%**

Kittson County Northeast Hunt
Zone 30

Season	Bulls-only Licenses	Antlerless Licenses	Bulls taken	Antlerless taken	Total elk taken	Success rate
Season I (Sept 11-19)	2	0	2	0	**2**	100%
Total	**2**	**0**	**2**	**0**	**2**	**100%**

Table 4. Grygla (Zone 10) elk harvests, 1987-2012

Year	Total Bull or Either-Sex Licenses	Total Bulls Harvested	Total Antlerless Licenses	Total Antlerless Harvested	Total Harvest	Hunter Success Rate
1987	2	1	2	1	2	50%
1996	2	2	7	6	8	89%
1997	5	1	5	2	3	30%
1998	4	2	0	0	2	50%
2004	1	1	4	2	3	60%
2005	1	0	4	0	0	0%
2006	2	2	6	2	4	50%
2007	0	0	6	6	6	100%
2008	2	2	10	6	8	67%
2009	2	2	12	12	14	100%
2010	2	1	5	3	4	57%
2011	2	2	3	0	2	40%
2012	2	1	3	0	1	20%

Table 5. Kittson Central (Zone 20) elk harvests, 2008-2021

Year	Total Bull or Either-Sex Licenses	Total Bulls Harvested	Total Antlerless Licenses	Total Antlerless Harvested	Total Harvest	Hunter Success Rate
2008	1	1	10	10	11	100%
2009	12	9	4	5	14	88%
2010	1	1	3	3	4	100%
2011	2	3	6	4	7	88%
2012	3	3	13	3	6	38%
2013	6	4	15	6	10	48%
2014	7	4	0	0	4	57%
2015	5	3	0	0	3	60%
2016	5	3	0	0	3	60%
2017	6	5	2	1	6	75%
2018	4	3	16	12	15	75%
2019	4	4	21	10	14	56%
2020	18	15	24	20	35	83%
2021	8	7	20	16	23	82%

Table 6. Kittson Northeast (Zone 30) elk harvests, 2012-2021

Year	Total Bull Licenses	Total Bulls Harvested	Hunter Success Rate
2012	2	1	50%
2013	2	2	100%
2014	2	2	100%
2015	2	2	100%
2016	2	2	100%
2017	5	4	80%
2018	2	2	100%
2019	2	1	50%
2020	2	2	100%
2021	2	2	100%

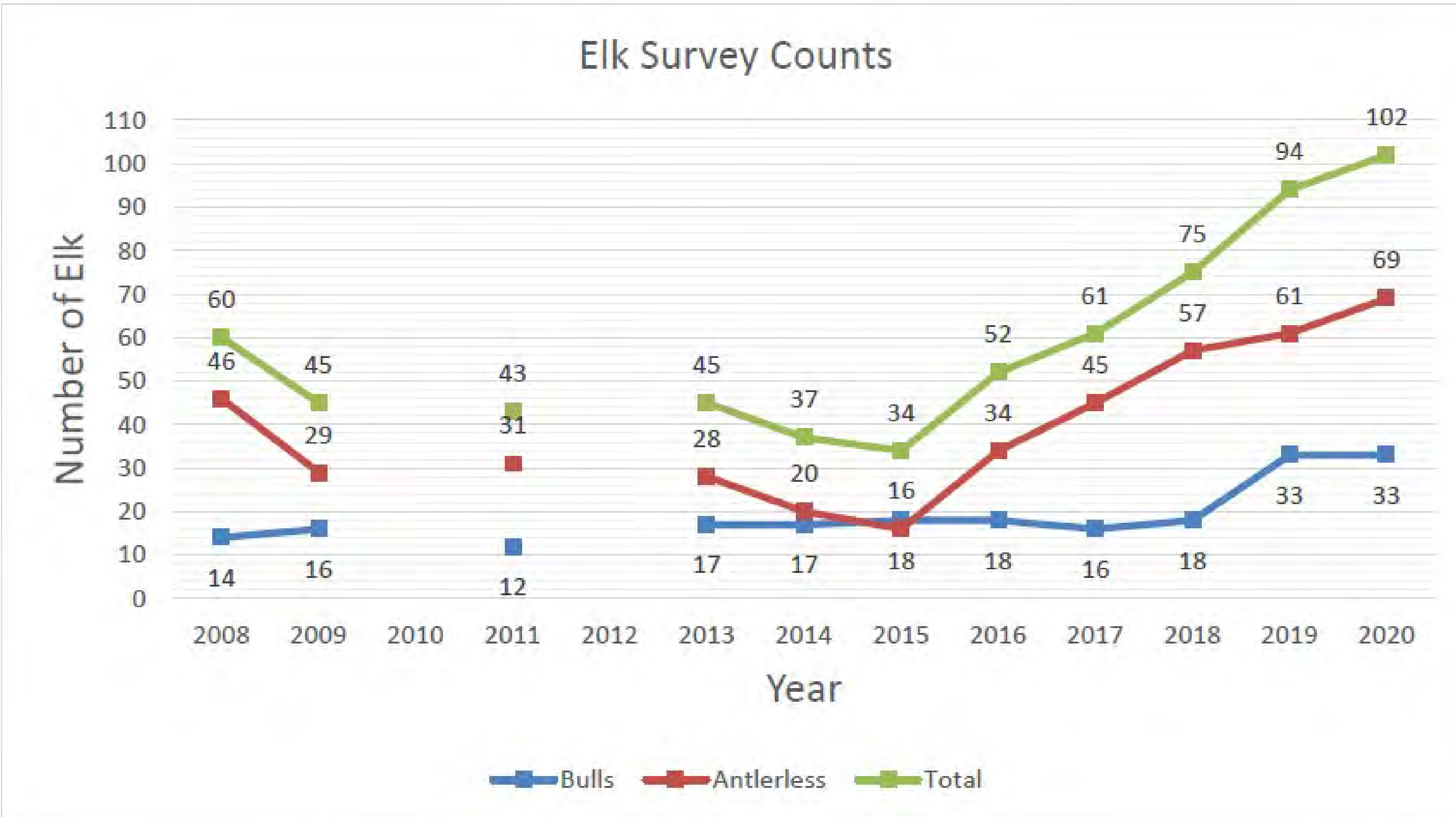

Figure 1. Kittson Central (Zone 20) elk survey count, 2008-2021

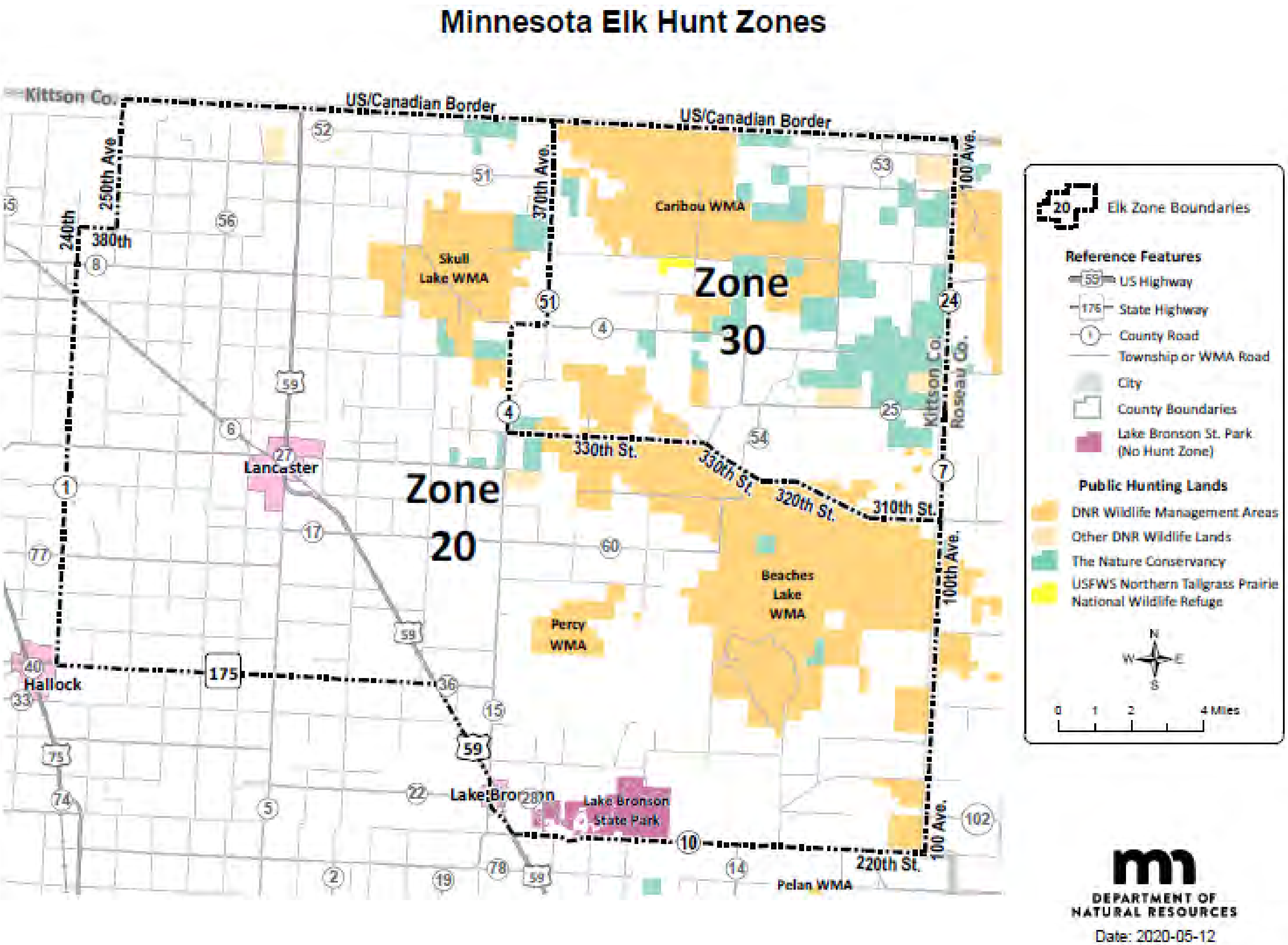

Figure 2. Kittson County Elk Hunt zones.

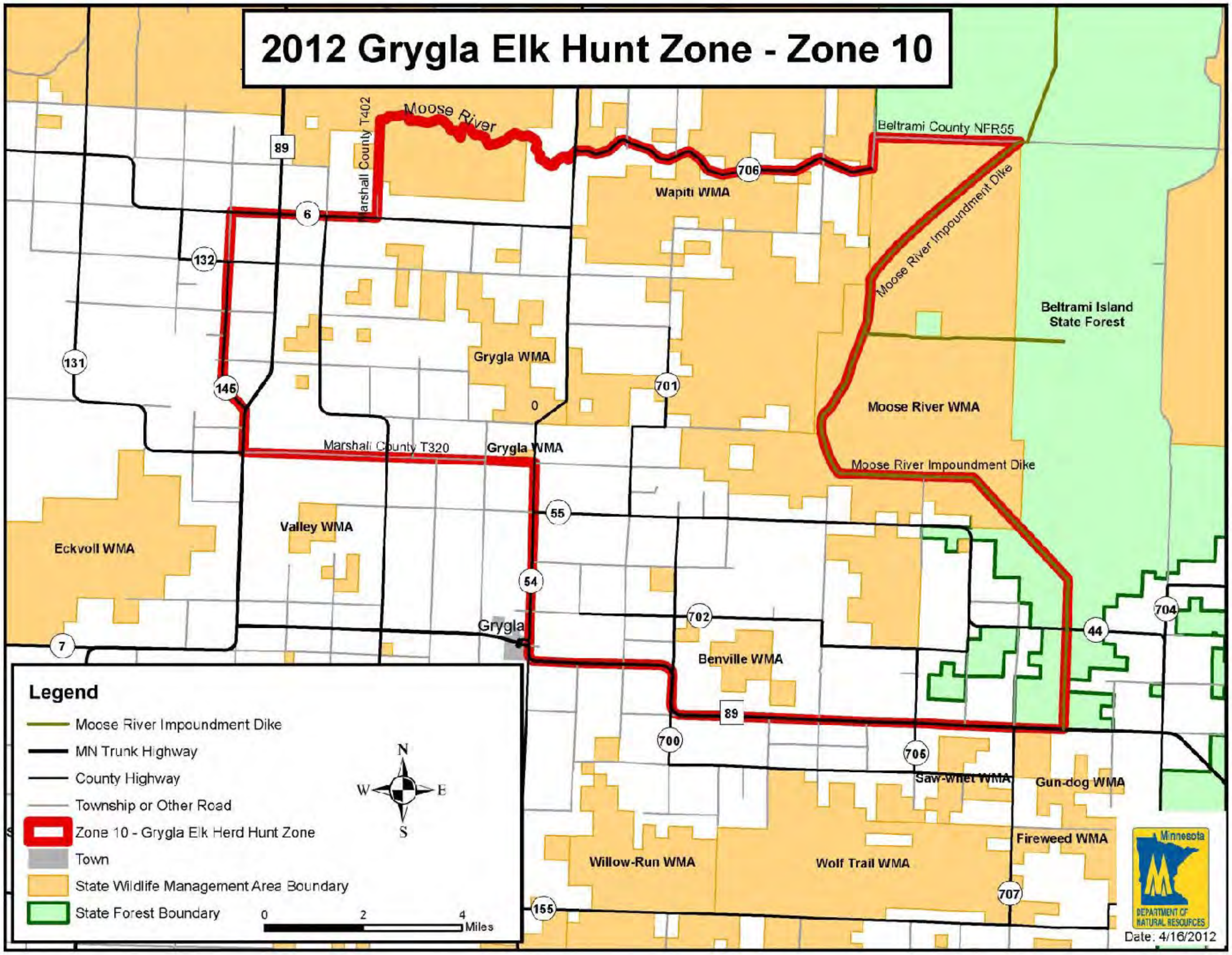

Figure 3. Grygla Elk Hunt zone.

MINNESOTA SANDHILL CRANE HARVEST REPORT, 2021

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. In 2017 the season was shifted to open the third Saturday in September and close the fourth Sunday in October with no changes to the daily and possession limits. This remained the same for the 2018 thru 2021 seasons. 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.

Seamans, M.E. 2021. 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. 16pp.) http://www.fws.gov/migratorybirds/NewReportsPublications/PopulationStatus.html

Table 1. Sandhill Crane season dates and limits in Minnesota, 2010 – 2021.

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
2018	15 Sept – 21 Oct	1	3
2019	14 Sept – 20 Oct	1	3
2020	19 Sept – 25 Oct	1	3
2021	18 Seot – 24 Oct	1	3

Table 2. Sandhill crane permit sales, estimated number of active hunters and harvest for NW Minnesota, 2010-2021. (Seamans, M.E. 2022)

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
2018	1,091	383	129
2019	1,073	333	179
2020	1,288	480	472
2021	1,479	632	563

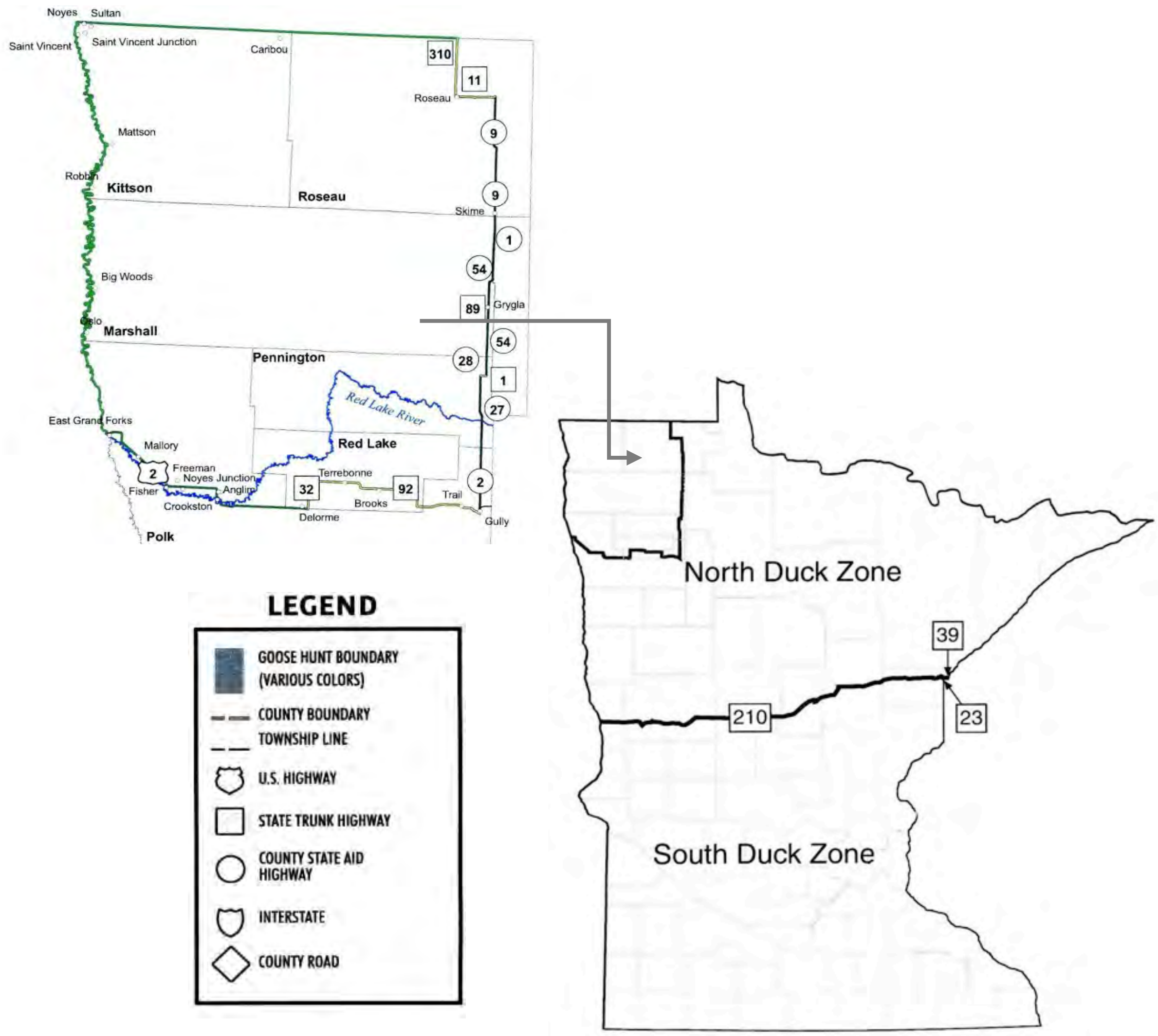

Figure 1. Sandhill crane hunting zone in Minnesota, 2010-2021.

TRAPPING HARVEST STATISTICS

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

2021 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, we excluded license holders <18 years old at the time of the survey, which represents ~3% of license sales. 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 2022. There were 6,435 active trapping licenses in the ELS database, which consisted of 4,402 Resident Regular Trappers, 23 age - eligible Resident Junior Trappers, 1,252 Resident Senior Trappers, 575 “active” Lifetime Trappers, and 23 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 = 67%, range: 49–79%). 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 (>=18-yr old) 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 were tabulated using Viking Data Entry VDE+ software, and then summarized using the R programming language (R version 4.1.3 (2022-03-10); R Development Core Team 2022).

RESULTS

We mailed out 6,275 surveys, 79 surveys were undeliverable and 3,207 were returned for an adjusted response rate of 51.8%. Among respondents, 60% 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.

Dear Trapper:

You are being asked as a trapping license buyer to assist us in evaluating the 2021-2022 trapping season (**March 2021-February 2022**). For Spring Beaver, please report only animals taken between March 1, 2021 and May 15, 2021. 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

Wildlife Research Program Manager

Division of Fish and Wildlife

Department of Natural Resources

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

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 SAINT PAUL, MN

POSTAGE WILL BE PAID BY ADDRESSEE

MN DEPT OF NATURAL RESOURCES - WILDLIFE
STATE OF MINNESOTA
395 JOHN IRELAND BLVD
SAINT PAUL MN 55101-9799

2021 Trapper Report

1. Did you set traps / snares in Minnesota during the 2021-2022 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.

		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 '21)	81				
Beaver (Oct '21-Feb '22)	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				

Figure 1. Trapper survey card, 2021.

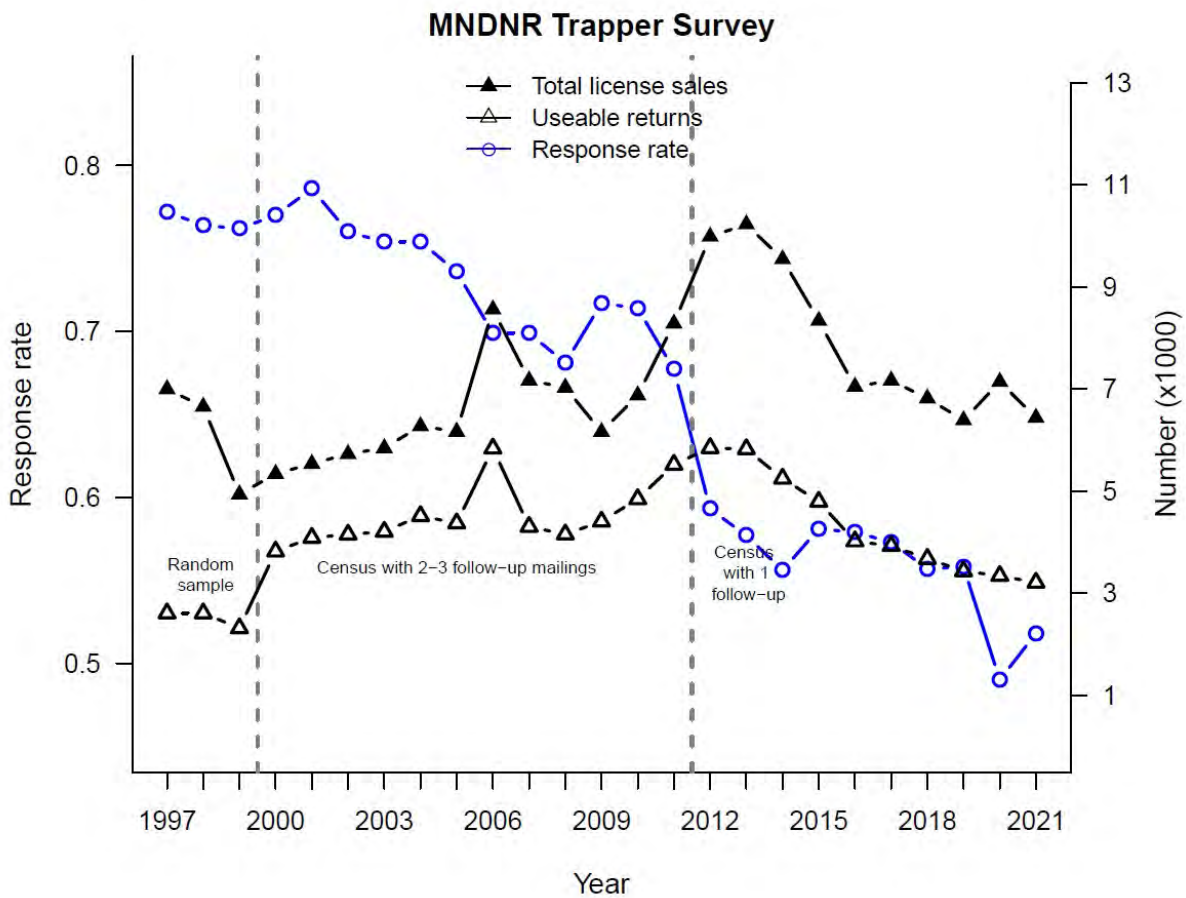

Figure 2. Trapper annual license sales and mail survey response, 1997-98 through 2021-22.

Table 1. Use of trapper licenses, 2010-11 through 2021-22.

Year		Returns from mail survey	Projections from license sales
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]
2018-19	Trapped Did not trap	2,382 (64.8%) 1,292 (35.2%) 3,674 (100%)	4,326 2,350 6,676[a]
2019-20	Trapped Did not trap	2,182 (63.6%) 1,249 (36.4%) 3,431 (100%)	3,954 2,263 6,217[a]
2020-21	Trapped Did not trap	2,214 (66.3%) 1,125 (33.7%) 3,339 (100%)	4,607 2,341 6,948[a]
2021-22	Trapped Did not trap	1,938 (60.4%) 1,269 (39.6%) 3,207 (100%)	3,790 2,485 6,275[a]

[a] excludes duplicates.

Table 2. Estimated number of trappers of various furbearers, 2010-11 through 2021-22.

	Estimated number of trappers											
	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22
Muskrat	2760	4,320	4,110	3,410	2,902	2,218	1,797	1,882	1,583	1,225	1,296	998
Mink	1847	2,470	3,110	2,780	2,158	1,587	1,049	1,084	995	795	905	598
Short-tailed weasel	546	800	690	510	666	289	195	283	166	261	345	171
Long-tailed weasel	333	560	540	480	519	265	174	190	151	168	238	139
Raccoon	2567	4,060	4,680	4,660	4,182	2,781	2,032	2,168	1,952	1,806	1,925	1,435
Striped skunk	1130	1,800	1,940	1,610	1,541	1,234	907	840	798	739	789	683
Badger	229	310	360	390	284	247	193	167	164	161	146	147
Opossum	645	830	1,100	1,110	575	463	469	785	646	548	606	498
Red fox	1068	1,900	2,240	2,080	2,012	1,434	1,048	1,258	1,091	955	1,181	875
Gray fox	555	970	1,180	1,060	1,035	684	446	458	381	241	261	181
Coyote	998	1,720	2,360	2,200	2,396	1,981	1,479	1,781	1,586	1,344	1,683	1,321
Beaver (Oct - Feb)	1722	2,360	2,620	2,710	2,189	1,894	1,642	1,495	1,535	1,333	1,561	1,379
Beaver (previous Spring)	1367	1,510	1,810	1,150	1,305	1,145	1,130	1,194	1,000	1,153	1,347	1,214

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, 2010-11 through 2021-2022.

	Estimated take per successful trapper reporting that species											
	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22
Muskrat	66	82	59	36	39	51	49	45	40	32	36	36
Mink	8	7	6	6	5	5	6	5	5	5	4	4
Short-tailed weasel	10	10	7	5	8	4	5	5	6	5	4	3
Long-tailed weasel	6	6	4	3	5	3	3	3	3	3	3	3
Raccoon	23	25	18	16	15	11	12	14	13	17	11	9
Striped skunk	8	7	7	6	6	6	7	6	5	6	6	6
Badger	2	2	2	2	2	2	2	2	2	2	2	2
Opossum	7	6	7	7	7	4	5	8	9	7	6	6
Red fox	4	4	4	3	4	3	3	4	4	4	4	3
Gray fox	2	3	3	2	2	2	2	2	2	2	2	2
Coyote	5	6	5	5	5	6	5	7	8	7	7	6
Beaver (Oct –Feb)	10	12	10	9	8	8	8	8	9	8	11	9
Beaver (previous Spring)	22	20	20	9	16	14	17	19	19	23	20	21

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, 2010-11 through 2021-2022[a]

	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22
Trapper license sales [b]	6,885	8,280	9,998	10,224	9,540	8,334	7,044	7,163	6,815	6,386	7,139	6,435
Estimated harvest [c, d, e]												
Muskrat	180,480	352,030	242,120	120,500	111,998	112,219	87,958	83,844	63,021	38,777	46,224	35,310
Mink	13,837	15,770	18,460	14,710	10,211	7,745	5,439	5,218	4,412	3,483	3,024	2,066
Short-tailed weasel	4,939	7,300	4,500	2,360	4,806	1,083	930	1,305	995	1,245	1,359	513
Long-tailed weasel	1,728	3,020	2,030	1,410	2,568	734	466	554	340	379	689	287
Raccoon	57,189	98,240	79,800	70,380	58,868	29,963	22,874	28,899	24,845	29,297	19,740	12,571
Striped skunk	7,979	12,250	12,620	9,430	7,956	6,349	5,458	4,476	3,961	4,078	4,023	3,665
Badger	337	490	570	600	347	376	286	278	221	231	280	230
Opossum	4,194	4,400	6,780	6,720	3,524	1,814	2,124	6,160	5,248	3,548	3,143	2,942
Red fox	3,303	7,250	7,540	5,710	6,040	4,061	2,707	4,500	3,530	2,896	3,953	2,401
Gray fox	1,093	2,100	2,550	1,940	1,902	1,161	715	736	611	336	321	200
Coyote	4,264	8,780	11,130	9,010	11,703	10,084	7,308	12,303	11,359	8,630	10,183	7,157
Beaver (Oct- Feb)	17,114	26,620	24,590	23,220	15,671	14,181	13,070	11,223	12,937	9,900	15,823	11,188
Beaver (previous Spring)	29,148	29,500	34,600	10,110	20,820	15,966	19,004	22,293	18,649	26,368	26,464	24,911
Registered harvest [e, f]												
Otter	1,814	2,294	3,171	2,824	2,148	1,955	1195	1,295	1,351	1,050	1,304	1,155
Bobcat [g]	1,012	1,711	1,875	1,038	1,380	766	485	731	1,015	695	1,325	724
Fisher	903	1,473	1,293	1,146	919	756	399	477	510	463	712	577
Marten	1,842	2,525	1,472	1,014	1,055	877	551	979	665	585	765	434
Wolf [h]	Closed	Closed	413	238	272	Closed	Closed	Closed	Closed	Closed	Closed	Closed

[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, 2021- 6,435 trapping licenses were sold in 2021: 163 (2.5%) were junior licenses, 4,405 (68.5%) were regular adult licenses, 1,253 (19.5%) were senior licenses, 591 (9.2%) were Lifetime licenses, and 16 (<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] There has been no open season in Minnesota on Eastern spotted skunk (Threatened) since 1996 or Lynx (Special Concern) since 1984. They are fully protected.
[f.] Registered harvest information as reported from annual, mandatory registration.
[g] Registered harvest for bobcat includes animals taken by hunting.
[h] A wolf season was opened in 2012, 2013, and 2014. The season was closed pre-2012 and post-2014. Registered harvest includes animals taken by hunting.

MINNESOTA FUR BUYERS SURVEY FOR THE 2021-2022 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 2022, questionnaires were mailed to 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 10 usable surveys were received, for a return rate of 36 percent.

Calculations of average pelt price for each species were weighted according to the number of pelts purchased by each buyer. Total estimated value of the furbearer harvest to trappers and hunters in 2021-22 was $162,244.86.

Table 1. Minnesota fur prices as reported by licensed fur dealers, 2021-22.

Species	Number Pelts	Minimum Price	Maximum Price	Weighted Mean
Muskrat	8368	1.75	3.43	2.66
Mink Female	109	2.47	5.00	3.87
Mink male	138	2.47	8.00	5.50
Raccoon	1871	2.59	6.00	4.39
Red Fox	276	5.00	12.00	10.74
Gray Fox	22	10.00	15.00	14.77
Coyote	667	4.00	25.00	10.96
Bobcat	60	40.00	100.00	55.38
River Otter	163	9.25	30.00	19.72
Beaver 10-12	1505	4.90	13.87	8.11
Beaver 3-4	7602	2.00	15.71	10.63
L.T. Weasel	1	0.00	1.00	0.00
S.T. Weasel	59	0.50	5.00	4.35
Striped Skunk	180	3.73	10.00	9.24
Badger	10	9.00	30.00	19.50
Opossum	5	2.20	2.20	2.20
Fisher Male	31	20.00	30.00	26.61
Fisher Female	27	20.00	25.00	24.63
Marten Male	23	20.00	30.00	28.91
Marten Female	22	15.00	25.00	24.09
Deer Hides	7977	2.00	3.46	2.30
Bear Hides	18	25.00	35.00	30.56

Table 2. Average price per pelt paid to hunters and trappers in Minnesota, 2011-12 through 2021-22

	Average pelt prices paid hunters and trappers in Minnesota (dollars)										
Species	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21*	2021-22
Muskrat	5.86	7.91	8.72	4.85	2.28	2.65	2.59	2.38	2.84	NA	2.66
Mink (female)	11.54	17.53	13.72	7.45	4.99	6.20	5.80	6.02	3.07	NA	3.87
Mink (male)	14.68	18.27	18.11	10.50	6.18	7.47	7.29	7.61	3.46	NA	5.50
Raccoon	12.57	16.60	16.58	8.64	5.11	4.92	5.76	7.30	6.66	NA	4.39
Red Fox	22.87	33.52	30.90	20.41	11.86	10.52	13.30	10.93	9.95	NA	10.74
Gray Fox	15.11	19.20	21.27	14.17	10.64	10.33	11.32	13.42	12.70	NA	14.77
Coyote	17.99	22.04	21.30	25.10	21.48	17.39	25.15	36.20	38.71	NA	10.96
Bobcat	98.18	144.79	88.63	66.67	57.46	35.88	63.52	60.33	61.97	NA	55.38
Otter	51.40	72.12	61.32	34.57	30.03	21.05	21.98	25.07	20.64	NA	19.72
Beaver (fall-winter)	14.29	18.47	16.52	12.40	8.77	8.14	8.32	8.30	7.66	NA	8.11
Beaver (spring)	19.96	12.80	14.77	10.69	8.24	7.33	10.39	8.95	7.86	NA	10.63
L.T. Weasel	4.02	4.10	2.35	1.78	1.46	1.41	0.00	0.00	0.00	NA	0.00
S.T. Weasel	2.10	2.51	0.00	2.00	1.41	0.00	2.79	2.45	2.08	NA	4.35
Striped Skunk	3.55	5.00	4.14	3.86	3.65	4.00	7.12	5.25	6.30	NA	9.24
Badger	13.47	14.54	13.72	9.52	9.57	7.86	9.09	7.94	8.14	NA	19.50
Opossum	5.80	1.52	1.52	1.17	1.98	1.32	1.34	0.96	0.83	NA	2.20
Fisher (male)	47.69	62.38	61.32	41.76	34.88	28.00	29.87	43.03	21.02	NA	26.61
Fisher (female)	39.59	63.02	67.73	50.87	34.39	37.07	36.75	39.57	19.84	NA	24.63
Marten (male)	42.32	56.57	74.10	38.92	30.83	29.94	36.90	41.81	27.35	NA	28.91
Marten (female)	39.49	54.29	70.94	32.20	28.89	30.41	33.96	33.06	23.75	NA	24.09
Deer Hides	3.95	5.18	6.09	5.59	5.62	4.00	4.14	3.18	2.91	NA	2.30
Bear Hides	28.79	30.28	42.63	32.94	46.03	32.97	25.91	32.33	32.72	NA	30.56

*No pelt price survey was conducted.

REGISTERED FURBEARER HARVEST STATISTICS

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REGISTERED FURBEARER HARVEST STATISTICS 2021-22

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 monitoring the effects of changes in harvest seasons, harvest techniques, and habitat. The level of detail or accuracy necessary in harvest information varies across species, depending on factors such as population density, harvest pressure, habitat 'sensitivity' of the species, and reproductive potential.

In Minnesota, detailed harvest information is collected on 4 carnivores – fishers (*Pekania pennanti*), martens (*Martes americana*), bobcats (*Lynx rufus*), and river otters (*Lontra canadensis*). 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 has been collected on these species for the past 44 years to help ensure sustainable harvests and populations.

METHODS

Hunters and trappers are required to bring pelts from harvested animals (fishers, martens, bobcats, and river 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) for each animal, 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 river otter harvest is allowed statewide (Figure 1). There were no changes to season structures for any of the four registered species this year compared to the 2020-21 season. Bobcat harvest decreased 45%, fisher harvest decreased 19%, marten harvest decreased 43%, and otter harvest decreased 11%. Detailed harvest summaries are provided in the following tables and graphs. Data for years prior to those presented in this report are 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 and entry of data contained in this report. This work was funded in part by the Wildlife Restoration Program (Pittman-Robertson).

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

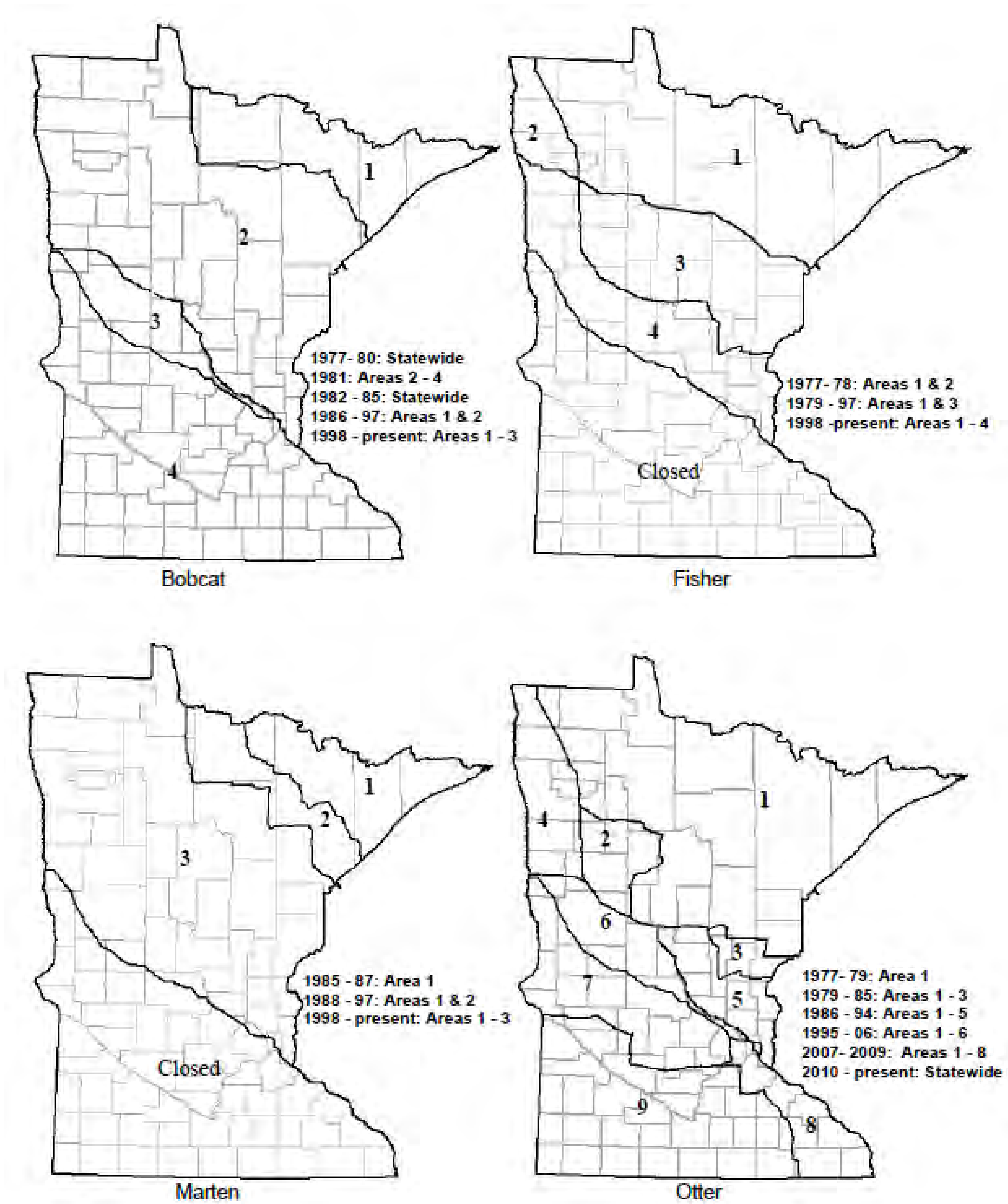

Figure 1. Open trapping areas in Minnesota for fisher, marten, bobcat, and river otter, 1977 - present.

Table 1. Registered furbearer seasons and harvests, 1991-2021.

	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
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
2018-19	11/24-1/6	44	5	1015	11/24-11/29	6	2	510	11/24-11/29	6	2	665	10/27-1/6	78	4	1351
2019-20	12/21-1/26	37	5	695	12/21-12/29	9	2	463	12/21-12/29	9	2	585	10/26-1/26	99	4	1050
2020-21	12/19-1/24	37	5	1325	12/19-12/27	9	2	712	12/19-12/27	9	2	765	10/24-1/24	99	4	1304
2021-22	12/18-1/23	37	5	724	12/18-12-26	9	2	577	12/18-12/26	9	2	434	10/23-1/23	99	4	1155

[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 than the south zone. Otter season dates in this table reflect the start of the north zone.

[c] From 2007-2009, otter limits differed between a southeast zone (limit=2; Area 8, Fig. 1) and the remainder of the open area (limit=4).

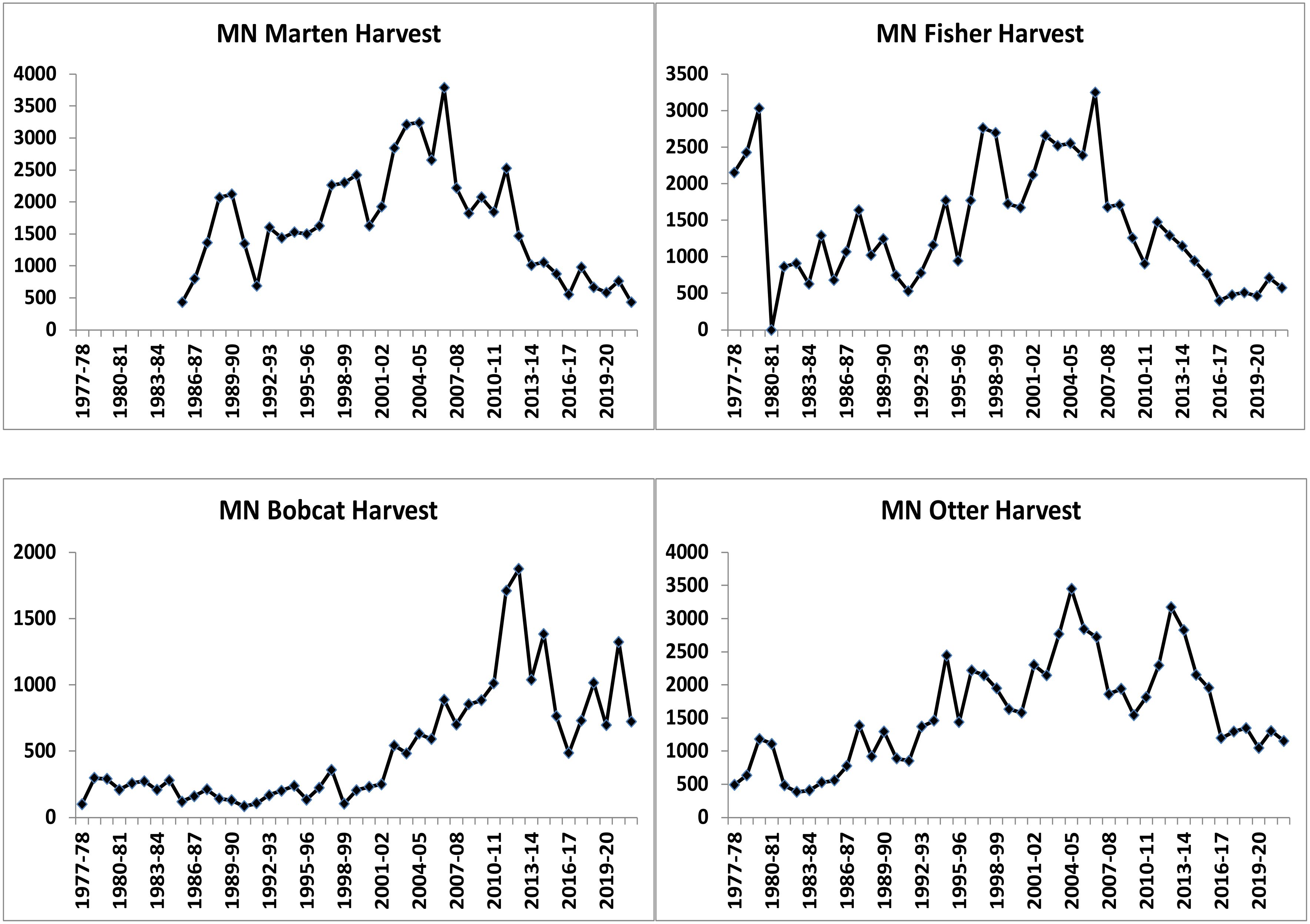

Figure 2. Harvest of registered furbearers in Minnesota, 1977-present.

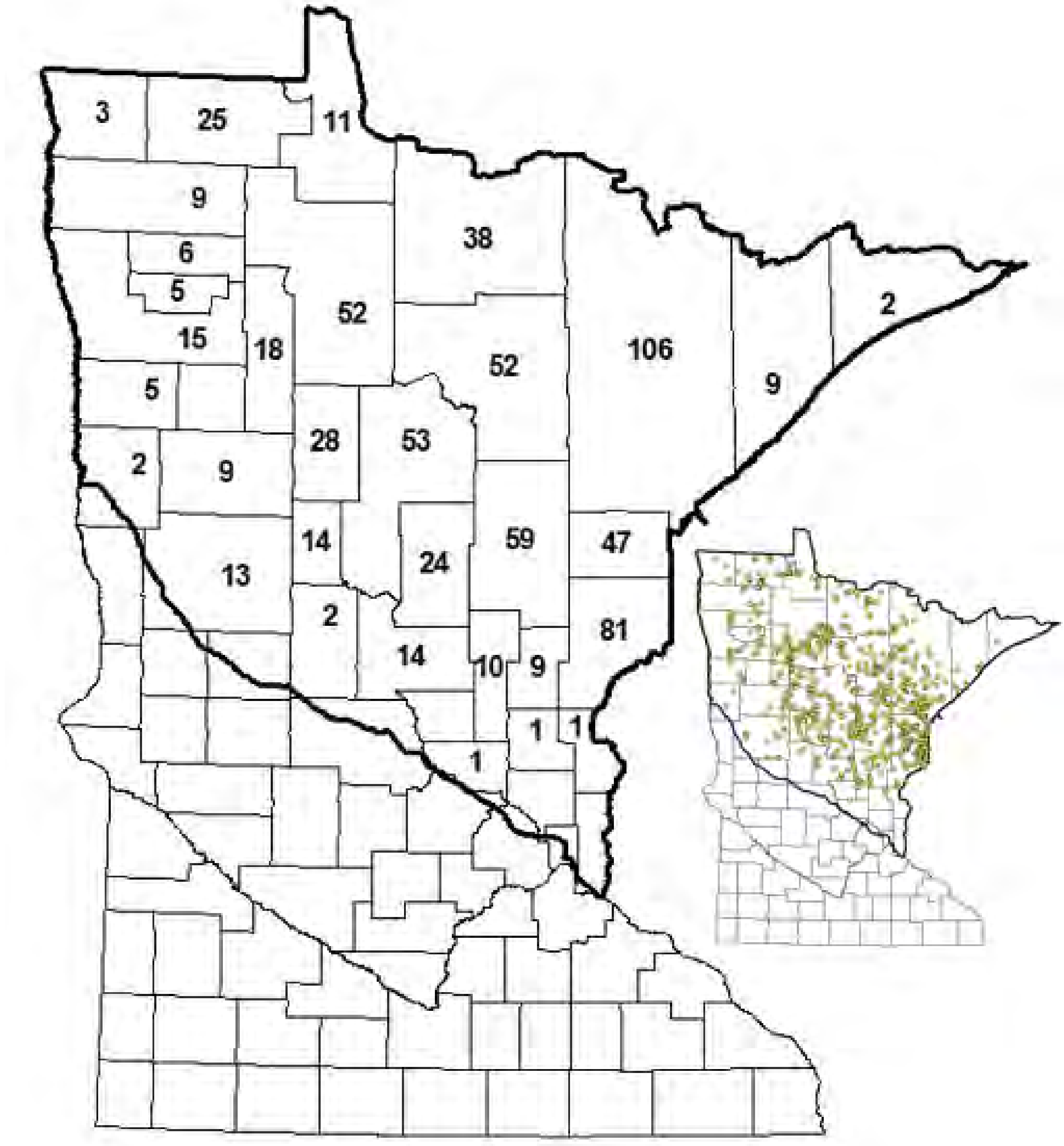

Figure 3. Bobcat harvest by county, 2021-22. Inset shows spatial distribution of harvest locations.

Table 2. Bobcat harvest by county and sex, 2021-22.

County	Sex* Female	Male	Unknown	Total	Harvest/ 100 Mile^2
Aitkin	31	28		59	2.96
Anoka	0	0		0	0.00
Becker	3	6		9	0.62
Beltrami	26	26		52	1.70
Benton	0	0		0	0.00
Carlton	32	15		47	5.37
Cass	21	31	1	53	2.20
Chisago	0	1		1	0.23
Clay	0	2		2	0.19
Clearwater	7	11		18	1.75
Cook	2	0		2	0.12
Crow Wing	13	8	3	24	2.08
Douglas	0	0		0	0.00
Hubbard	12	14	2	28	2.80
Isanti	1	0		1	0.22
Itasca	33	18	1	52	1.78
Kanabec	4	5		9	1.69
Kittson	0	3		3	0.27
Koochiching	27	9	2	38	1.21
Lake	7	2		9	0.39
Lake of the Woods	5	5	1	11	0.62
Mahnomen	0	0		0	0.00
Marshall	6	3		9	0.50
Mille Lacs	1	9		10	1.47
Morrison	9	5		14	1.21
Norman	3	2		5	0.57
Otter Tail	7	6		13	0.58
Pennington	5	1		6	0.97
Pine	35	43	3	81	5.65
Polk	11	4		15	0.75
Red Lake	1	4		5	1.15
Roseau	10	15		25	1.49
Sherburne	1	0		1	0.22
St. Louis	56	48	2	106	1.57
Stearns	0	0		0	0.00
Todd	0	2		2	0.20
Wadena	8	6		14	2.58
Unknown	0	0	0	0	
Total	377	332	15	724	

* 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, 2011-2021.

County	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22
Aitkin	121	142	65	105	39	22	41	51	55	109	59
Anoka	1	0	0	1	0	0	0	0	0	0	0
Becker	70	58	36	48	36	10	31	22	14	32	9
Beltrami	139	139	59	73	49	30	37	60	34	94	52
Benton	4	3	3	0	0	1	2	3	1	2	0
Carlton	94	63	42	88	25	16	33	42	27	68	47
Cass	164	150	76	126	73	44	72	91	52	113	53
Chisago	0	3	1	1	3	4	2	5	3	4	1
Clay	1	3	2	3	1	0	0	2	0	1	2
Clearwater	58	40	19	29	15	13	14	18	14	41	18
Cook	3	3	9	17	1	0	2	0	2	4	2
Crow Wing	64	65	19	32	21	7	24	28	15	38	24
Douglas	0	1	1	0	0	0	0	1	0	0	0
Hubbard	129	105	51	50	45	21	44	41	19	66	28
Isanti	0	0	1	0	1	1	0	0	0	1	1
Itasca	186	194	93	110	50	19	54	86	57	114	52
Kanabec	21	46	16	46	12	11	16	24	12	18	9
Kittson	10	7	5	5	7	6	3	3	10	8	3
Koochiching	66	82	50	40	22	25	26	62	24	47	38
Lake	15	21	13	15	8	4	8	24	8	21	9
Lake of the Woods	28	13	20	26	10	7	5	14	13	14	11
Mahnomen	9	7	4	4	3	5	2	4	2	10	0
Marshall	42	44	15	21	19	14	12	30	25	13	9
Mille Lacs	13	23	7	14	5	2	10	19	8	21	10
Morrison	25	35	15	25	16	17	19	37	22	28	14
Norman	3	6	3	8	4	1	4	7	2	4	5
Otter Tail	21	38	18	17	16	15	22	12	6	21	13
Pennington	4	13	7	3	4	1	4	8	7	6	6
Pine	94	135	54	87	56	37	43	46	47	62	81
Polk	17	20	10	16	15	10	9	5	3	14	15
Red Lake	20	25	6	11	3	1	15	10	10	25	5
Roseau	46	60	38	27	20	23	23	45	20	21	25
Sherburne	3	0	0	0	0	0	0	0	1	0	1
St. Louis	202	283	255	307	156	91	123	182	154	275	106
Stearns	0	0	2	0	1	0	0	0	0	0	0
Todd	14	16	5	8	8	9	13	10	7	7	2
Wadena	17	23	18	18	10	18	18	23	21	23	14
Unknown	7	9	0	3	12	0	0	0	0	0	0
Total	1711	1875	1038	1384	766	485	731	1015	695	1325	724

Table 4. Bobcat harvest by sex and week, 2021-22 season.

	Sex*				% of	Cumulative
Date	Female	Male	Unknown	Total	Total	%
Dec.18 - Dec.24	123	113	8	244	33.70	33.70
Dec.25 - Dec.31	75	71	3	149	20.58	54.28
Jan.1 - Jan.7	51	42		93	12.85	67.13
Jan.8 - Jan.14	61	52	1	114	15.75	82.87
Jan.15 - Jan.23**	67	53	2	122	16.85	99.72
Unknown	0	1	1	2	0.28	100.00
Total	377	332	15	724	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, 1996-2021.

Number (%) of Takers	Number Taken					Total Takers
	1	2	3	4	5	
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
2018-19	260 (53)	87 (18)	59 (12)	42 (8)	47 (9)	495
2019-20	214 (57)	77 (21)	37 (10)	19 (5)	27 (7)	374
2020-21	319 (50)	138 (22)	67 (11)	35 (6)	76 (12)	635
2021-22	215 (57)	71 (19)	41 (11)	24 (6)	29 (8)	380

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

Table 6. Bobcat harvest by method of take, 1994-2021.

	Total	Trapping					Hunting				
Year	Harvest[a]	Harvest	% of Total	# Takers	Ave. Take	% Males[b]	Harvest	% of Total	# Takers	Ave. Take	% Males[b]
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
2018-19	1015	865	85	406	2.1	48	150	15	98	1.5	58
2019-20	692	570	82	297	1.9	36	122	18	84	1.5	66
2020-21	1325	1124	85	512	2.2	43	201	15	126	1.6	56
2021-22	724	580	80	305	1.9	42	144	20	82	1.8	67

[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

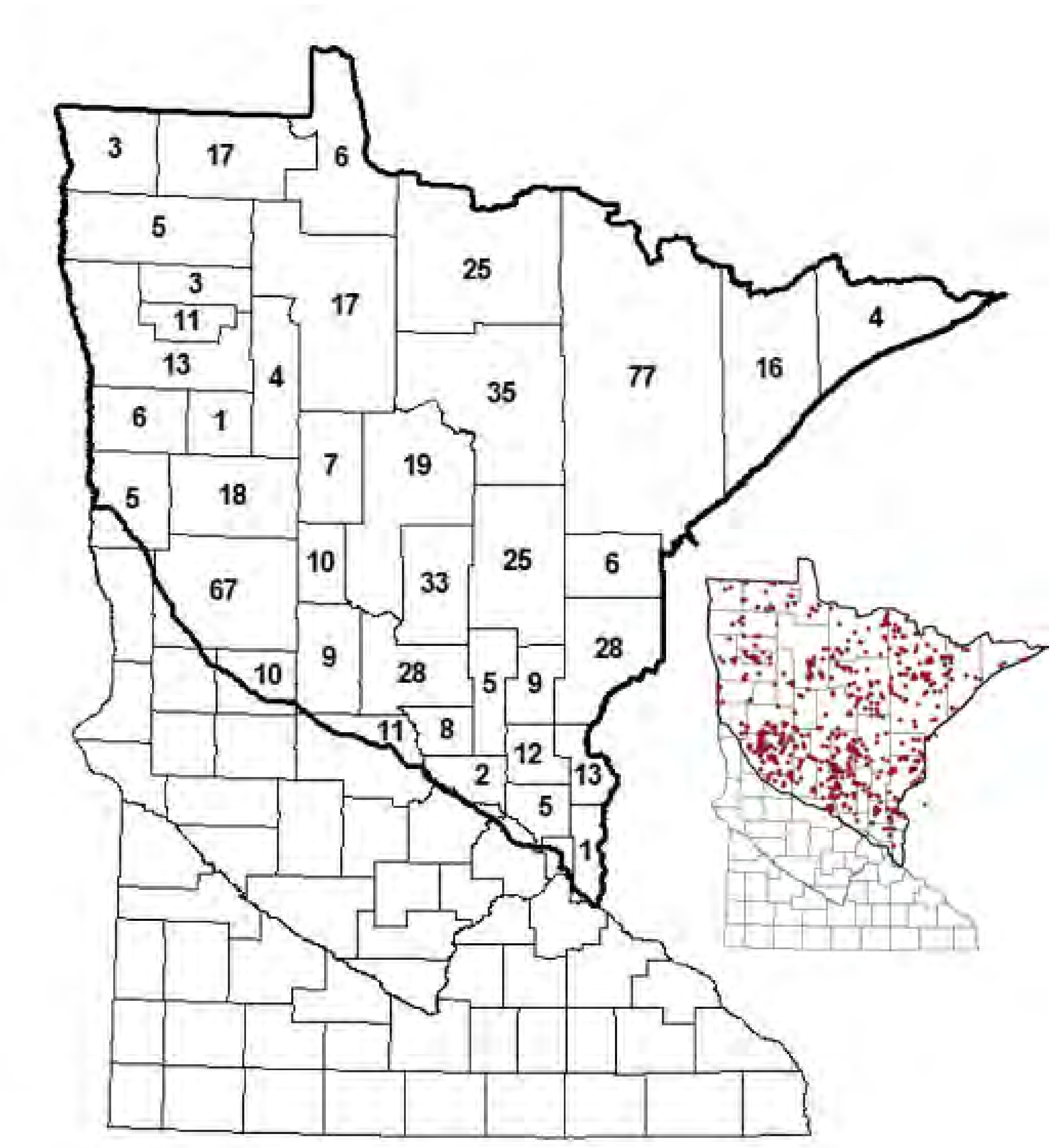

Figure 4. Fisher harvest by county, 2021. Inset shows spatial distribution of harvest locations.

Table 7. Fisher harvest by county and sex, 2021 season.

County	Sex			Total	Harvest/
	Female	Male	Unknown		100 Mile^2
Aitkin	13	12		25	1.25
Anoka	2	3		5	1.12
Becker	4	14		18	1.25
Beltrami	4	13		17	0.56
Benton	3	5		8	1.94
Carlton	3	3		6	0.69
Cass	4	15		19	0.79
Chisago	5	8		13	2.94
Clay	2	3		5	0.47
Clearwater	2	2		4	0.39
Cook	3	2		5	0.31
Crow Wing	16	17		33	2.85
Douglas	3	7		10	1.39
Grant	0	0		0	0.00
Hubbard	3	2	2	7	0.70
Isanti	5	7		12	2.66
Itasca	16	18	1	35	1.20
Kanabec	3	6		9	1.69
Kittson	1	2		3	0.27
Koochiching	11	14		25	0.79
Lake	11	5		16	0.70
Lake of the Woods	3	3		6	0.34
Mahnomen	1	0		1	0.17
Marshall	0	5		5	0.28
Mille Lacs	2	3		5	0.73
Morrison	13	15		28	2.43
Norman	4	2		6	0.68
Otter Tail	33	34		67	3.01
Pennington	2	1		3	0.49
Pine	9	19		28	1.95
Polk	9	4		13	0.65
Red Lake	4	7		11	2.54
Roseau	9	8		17	1.01
Sherburne	1	1		2	0.44
St. Louis	36	41		77	1.14
Stearns	4	7		11	0.79
Todd	1	7	1	9	0.92
Wadena	4	6		10	1.84
Washington	1	0		1	0.24
Wilkin	0	0		0	0.00
Unknown	0	2		2	
Total	250	323	4	577	

Table 8. Comparison of fisher harvest by county, 2010-2021.

County	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Aitkin	35	55	52	47	24	38	16	10	15	17	24	25
Anoka	0	1	2	1	2	7	4	0	4	3	6	5
Becker	30	32	45	38	21	23	3	18	10	11	21	18
Beltrami	10	25	21	17	4	8	9	6	6	15	24	17
Benton	0	5	5	2	4	3	7	4	7	8	5	8
Carlton	12	12	14	8	14	13	6	1	9	8	10	6
Cass	43	41	37	23	30	24	11	12	16	10	29	19
Chisago	6	10	3	4	16	18	11	8	23	12	11	13
Clay	6	10	6	5	6	4	4	2	8	4	5	5
Clearwater	6	8	5	12	3	2	3	0	7	3	9	4
Cook	17	28	11	13	11	5	4	3	8	4	8	5
Crow Wing	48	64	55	51	34	31	13	17	17	19	39	33
Douglas	6	15	24	8	20	12	6	2	8	9	14	10
Grant	1	0	0	0	0	0	0	0	0	0	0	0
Hubbard	13	10	11	10	8	6	5	6	8	4	10	7
Isanti	1	4	6	11	11	12	3	13	6	1	8	12
Itasca	88	142	105	116	78	47	13	34	30	31	44	35
Kanabec	13	21	27	30	9	10	6	2	6	7	11	9
Kittson	7	5	9	11	2	3	5	7	6	8	4	3
Koochiching	51	116	80	51	67	45	23	40	31	42	40	25
Lake	45	56	53	35	28	14	14	12	16	10	15	16
Lake of the Woods	9	33	21	13	12	15	6	9	3	3	1	6
Mahnomen	0	3	0	4	2	0	0	0	0	0	4	1
Marshall	7	13	14	17	22	22	6	5	12	7	12	5
Mille Lacs	18	17	20	17	12	6	13	7	8	3	13	5
Morrison	8	10	24	25	23	15	16	11	25	15	41	28
Norman	4	10	19	21	12	5	9	3	6	8	14	6
Otter Tail	100	138	121	117	102	77	41	53	59	43	105	67
Pennington	4	8	8	11	19	11	4	9	10	7	6	3
Pine	26	22	42	46	44	35	18	17	7	10	27	28
Polk	25	54	58	45	32	22	11	9	11	3	12	13
Red Lake	10	17	16	24	18	6	8	18	14	5	6	11
Roseau	20	79	61	42	32	26	15	24	18	29	23	17
Sherburne	1	6	2	2	2	2	0	0	6	0	5	2
St. Louis	186	350	233	220	171	125	61	72	66	73	58	77
Stearns	0	4	1	4	2	3	3	5	2	2	8	11
Todd	18	15	29	22	15	19	12	20	7	12	15	9
Wadena	23	31	25	23	21	26	9	17	11	16	25	10
Washington	0	1	1	0	2	2	1	1	4	1	0	1
Wilkin	0	1	0	0	0	0	0	0	0	0	0	0
Unknown	6	1	27	0	8	14	0	0	0	0	0	2
Total	903	1,473	1,293	1,146	943	756	399	477	510	463	712	577

Table 9. Fisher harvest by date and sex, 2021 season.

	Sex				% of Known	Cumulative
Date	Female	Male	Unknown	Total	Total	%
Dec. 18	3	5		8	1.39	1.39
Dec. 19	33	42		75	13.00	14.38
Dec. 20	42	54	4	100	17.33	31.72
Dec. 21	32	39		71	12.31	44.02
Dec. 22	18	32		50	8.67	52.69
Dec. 23	31	39		70	12.13	64.82
Dec. 24	26	41		67	11.61	76.43
Dec. 25	22	26		48	8.32	84.75
Dec. 26	39	43		82	14.21	98.96
Unknown	4	2		6	1.04	100%
Total	250	323	4	577	100%	

Table 10. Distribution of fisher harvest* among trappers, 1995-2021.

Number (%) of Takers	Number Taken						
	1	2	3	4	5	Total Takers	Ave. Take
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
2018	253 (66)	128 (34)	----	----	----	381	1.3
2019	259 (72)	101 (28)	----	----	----	360	1.3
2020	337 (65)	185 (35)	----	----	----	522	1.4
2021	279 (65)	148 (35)	----	----	----	427	1.3

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

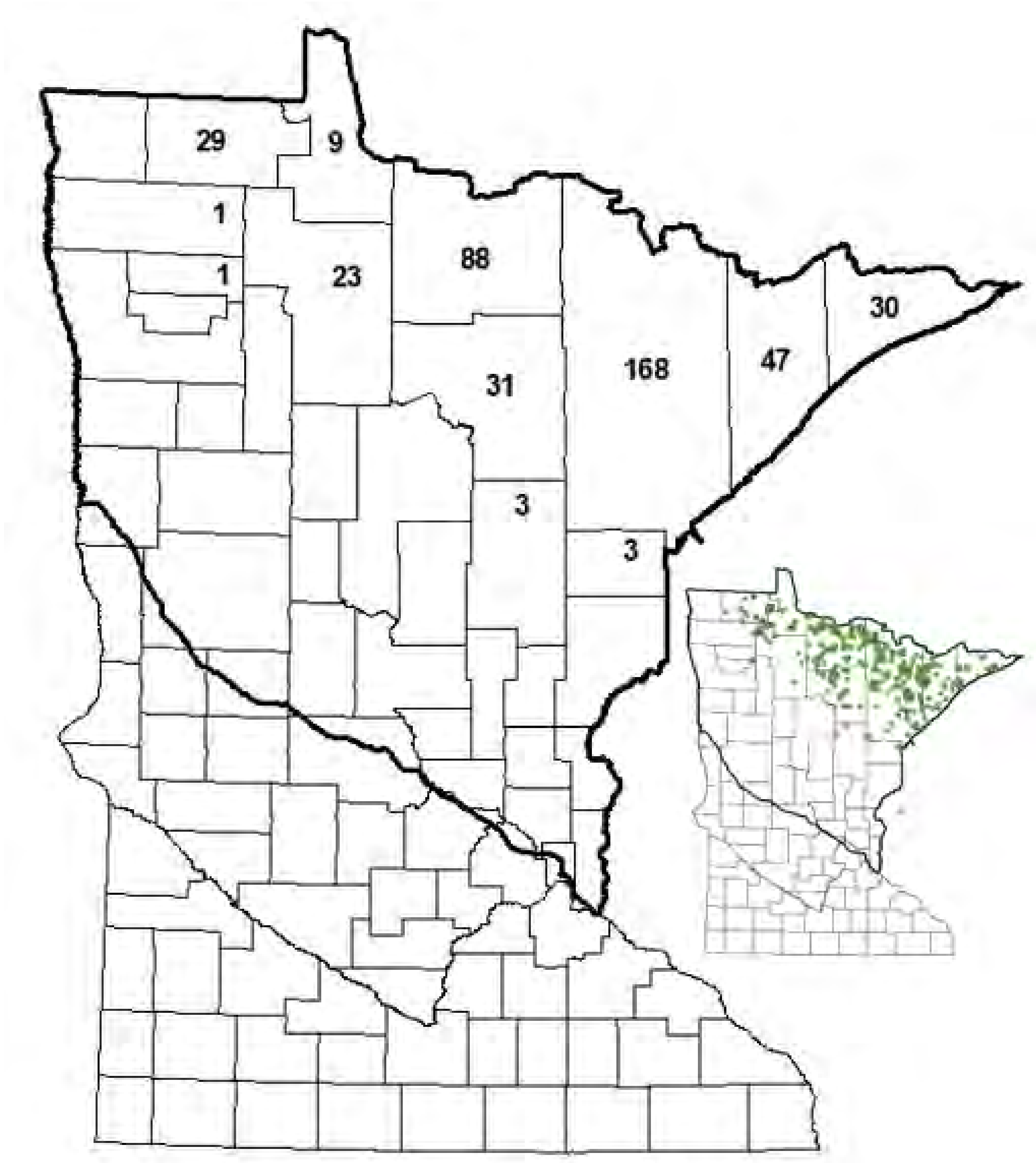

Figure 5. Marten harvest by county, 2021. Inset shows spatial distribution of harvest locations.

Table 11. Marten harvest by county and sex, 2021 season.

County	Sex: Female	Sex: Male	Sex: Unknown	Total	Harvest/ 100 Mile^2
Aitkin	1	2		3	0.15
Becker	0	0		0	0.00
Beltrami	5	18		23	0.75
Carlton	1	2		3	0.34
Cass	0	0		0	0.00
Clearwater	0	0		0	0.00
Cook	4	26		30	1.87
Crow Wing	0	0		0	0.00
Hubbard	0	0		0	0.00
Itasca	8	22	1	31	1.06
Kanabec	0	0		0	0.00
Kittson	0	0		0	0.00
Koochiching	31	56	1	88	2.79
Lake	18	28	1	47	2.05
Lake of the Woods	1	8		9	0.51
Mahnomen	0	0		0	0.00
Marshall	1	0		1	0.06
Otter Tail	0	0		0	0.00
Pennington	0	1		1	0.16
Pine	0	0		0	0.00
Polk	0	0		0	0.00
Red Lake	0	0		0	0.00
Roseau	11	18		29	1.73
St. Louis	64	104		168	2.49
Unknown	1	0		1	
Total	146	285	3	434	

Table 12. Comparison of marten harvest by county in Minnesota, 2010-2021.

County	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Aitkin	4	13	10	8	12	4	1	7	2	0	5	3
Becker	0	0	0	0	0	1	0	0	0	0	0	0
Beltrami	2	11	20	15	7	15	7	16	2	9	40	23
Carlton	5	6	3	1	1	0	0	7	7	1	1	3
Cass	1	2	0	0	3	2	2	2	2	2	1	0
Clearwater	0	0	0	0	0	0	0	0	0	0	0	0
Cook	191	205	148	78	43	39	23	40	44	15	22	30
Crow Wing	0	1	0	0	1	0	2	0	0	0	0	0
Hubbard	0	0	0	0	0	1	0	0	0	1	0	0
Itasca	73	118	46	62	79	64	28	52	35	35	66	31
Kanabec	0	0	0	0	0	0	0	0	0	0	0	0
Kittson	1	0	4	0	1	0	0	3	1	0	1	0
Koochiching	336	516	276	218	265	169	107	176	117	146	155	88
Lake	491	577	290	185	149	138	109	172	131	78	99	47
Lake of the Woods	13	49	32	18	23	25	21	32	16	45	28	9
Mahnomen	0	0	0	0	0	0	0	0	0	0	0	0
Marshall	0	3	3	5	5	3	1	1	1	3	2	1
Otter Tail	0	0	0	0	1	0	0	0	0	0	0	0
Pennington	0	0	0	0	0	1	0	0	0	0	0	1
Pine	1	0	0	0	1	0	0	0	0	0	0	0
Polk	0	0	0	0	0	0	0	0	0	0	1	0
Red Lake	0	0	1	1	0	0	0	0	0	0	0	0
Roseau	13	98	77	37	40	33	31	74	41	79	84	29
St. Louis	709	926	562	386	421	377	219	397	266	171	260	168
Unknown	2	0	0	0	7	5	0	0	0	0	0	1
Total	1,842	2,525	1,472	1,014	1,059	877	551	979	665	585	765	434

Table 13. Marten harvest by date and sex, 2021 season.

	Sex				% of Known	Cumulative
Date	Female	Male	Unknown	Total	Total	%
Dec. 18	0	2		2	0.46	0.46
Dec. 19	23	44		67	15.44	15.90
Dec. 20	24	57	1	82	18.89	34.79
Dec. 21	18	44		62	14.29	49.08
Dec. 22	18	35		53	12.21	61.29
Dec. 23	27	41	2	70	16.13	77.42
Dec. 24	17	25		42	9.68	87.10
Dec. 25	8	11		19	4.38	91.47
Dec. 26	10	26		36	8.29	99.77
Unknown	1	0		1	0.23	100%
Total	146	285	3	434	100%	

Table 14. Distribution of marten harvest* among trappers, 1995-2021.

Number (%) of Takers	Number Taken						
	1	2	3	4	5	Total Takers	Ave. Take
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
2018	200 (46)	231 (54)	----	----	----	431	1.5
2019	200 (51)	191 (49)	----	----	----	391	1.5
2020	221 (45)	268 (55)	----	----	----	489	1.5
2021	162 (54)	136 (46)	----	----	----	298	1.5

* 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, 2021.
(Combined limit = 2)

Number of Takers		Number of Marten 0	1	2	3	4	5
Number of Fisher	0		83	136			
	1	202	79				
	2	148					
	3						
	4						
	5				Total takers of at least 1 fisher or marten		648

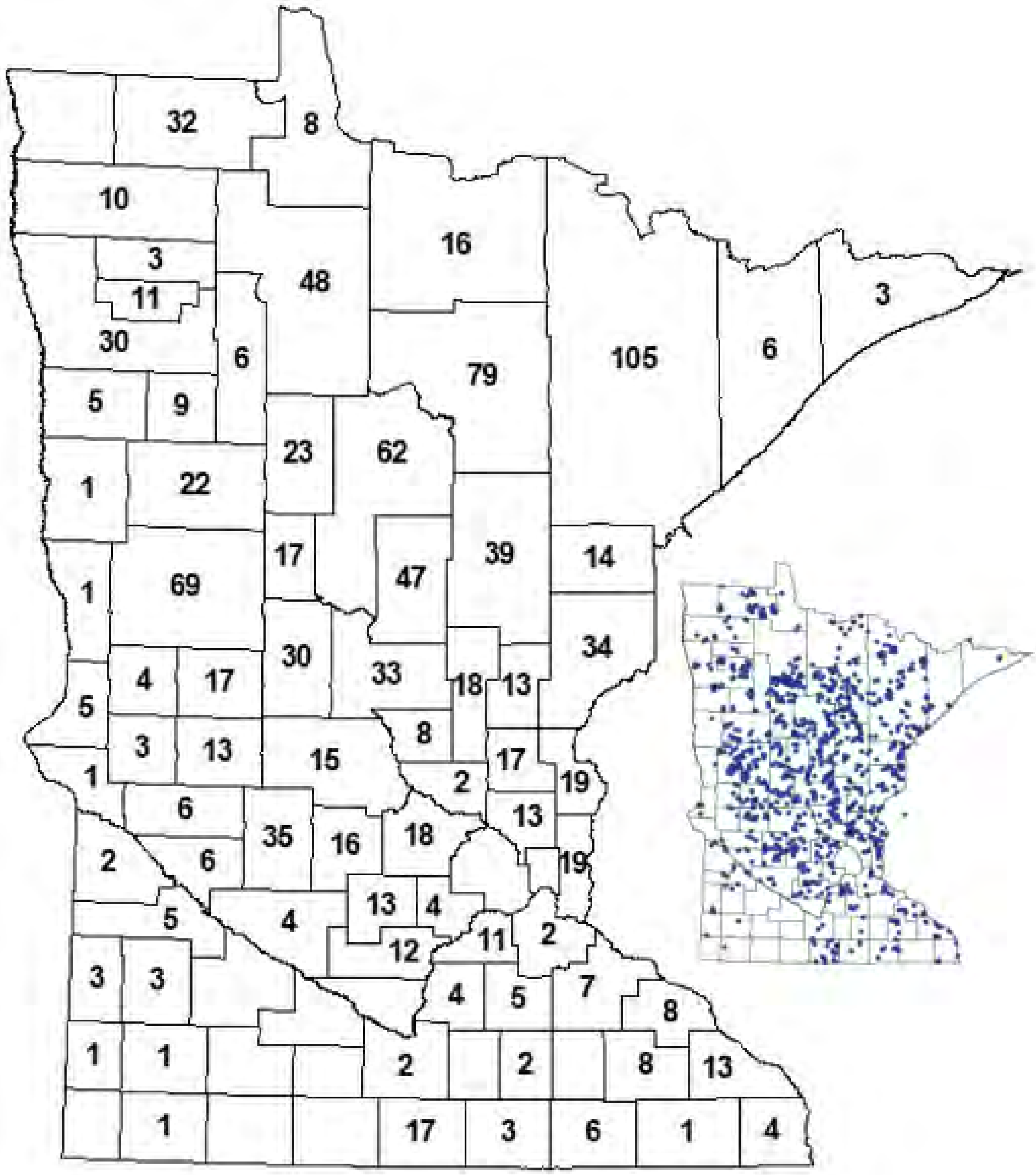

Figure 6. Otter harvest by county, 2021-22. Inset shows spatial distribution of harvest locations.

Table 16. Otter harvest by county and sex, 2021-22 season.

County	Sex			Total	Harvest/
	Female	Male	Unknown		100 Mile^2
Aitkin	21	18		39	1.96
Anoka	5	8		13	2.92
Becker	12	10		22	1.52
Beltrami	19	29		48	1.57
Benton	2	6		8	1.94
Big Stone	1	0		1	0.19
Blue Earth	2	0		2	0.26
Brown	0	0		0	0.00
Carlton	5	9		14	1.60
Carver	2	2		4	1.06
Cass	18	42	2	62	2.57
Chippewa	2	4		6	1.02
Chisago	7	12		19	4.30
Clay	1	0		1	0.09
Clearwater	4	2		6	0.58
Cook	1	2		3	0.19
Cottonwood	0	0		0	0.00
Crow Wing	20	26	1	47	4.07
Dakota	0	2		2	0.34
Dodge	0	0		0	0.00
Douglas	5	10	2	17	2.36
Faribault	10	7		17	2.36
Fillmore	0	1		1	0.12
Freeborn	1	1	1	3	0.42
Goodhue	3	4		7	0.90
Grant	2	2		4	0.69
Hennepin	0	0		0	0.00
Houston	2	2		4	0.70
Hubbard	8	15		23	2.30
Isanti	7	10		17	3.77
Itasca	26	49	4	79	2.70
Jackson	0	0		0	0.00
Kanabec	5	8		13	2.44
Kandiyohi	17	18		35	4.06
Kittson	0	0		0	0.00
Koochiching	6	8	2	16	0.51
Lac Qui Parle	1	1		2	0.26
Lake	3	3		6	0.26
Lake of the Woods	2	4	2	8	0.45
Le Sueur	1	2	1	4	0.84
Lincoln	0	3		3	0.55
Lyon	3	0		3	0.42
Mahnomen	5	4		9	1.54
Marshall	2	8		10	0.55
Martin	0	0		0	0.00
McLeod	6	7		13	2.57
Meeker	9	7		16	2.48
Mille Lacs	8	10		18	2.64
Morrison	8	25		33	2.86
Mower	4	2		6	0.84
Murray	1	0		1	0.14
Nicollet	0	0		0	0.00
Nobles	0	1		1	0.14
Norman	3	2		5	0.57
Olmsted	4	4		8	1.22
Otter Tail	30	39		69	3.10

Table 16 (continued). Otter harvest by county and sex, 2021-22 season.

County	Sex			Total	Harvest/
	Female	Male	Unknown		100 Mile^2
Pennington	1	2		3	0.49
Pine	14	18	2	34	2.37
Pipestone	0	1		1	0.21
Polk	7	23		30	1.50
Pope	5	8		13	1.81
Ramsey	0	0		0	0.00
Red Lake	4	7		11	2.54
Redwood	0	0		0	0.00
Renville	3	1		4	0.41
Rice	1	4		5	0.97
Rock	0	0		0	0.00
Roseau	5	27		32	1.91
Scott	4	7		11	2.99
Sherburne	0	2		2	0.44
Sibley	4	8		12	2.00
St. Louis	33	72		105	1.56
Stearns	6	9		15	1.08
Steele	0	2		2	0.46
Stevens	1	0	2	3	0.52
Swift	1	5		6	0.80
Todd	12	18		30	3.06
Traverse	1	4		5	0.85
Wabasha	3	5		8	1.46
Wadena	9	8		17	3.13
Waseca	0	0		0	0.00
Washington	7	12		19	4.49
Watonwan	0	0		0	0.00
Wilkin	1	0		1	0.13
Winona	3	10		13	2.03
Wright	12	6		18	2.52
Yellow Medicine	2	3		5	0.65
Unknown	1	1		2	
Total	444	692	19	1,155	

Table 17. Comparison of otter harvest by county, 2010-2021.

County	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22
Aitkin	59	107	111	90	67	74	61	33	34	25	22	39
Anoka	8	13	31	25	23	20	12	18	15	13	9	13
Becker	53	95	127	87	77	83	21	27	42	24	19	22
Beltrami	77	112	120	98	74	76	43	40	51	34	67	48
Benton	13	13	21	17	8	1	3	3	6	8	3	8
Big Stone	0	3	3	9	8	3	1	6	3	0	10	1
Blue Earth	0	2	3	1	2	1	3	3	2	4	8	2
Brown	0	0	0	0	0	2	2	0	0	1	0	0
Carlton	35	29	38	37	26	42	32	9	12	9	18	14
Carver	5	15	8	9	17	11	8	8	12	8	3	4
Cass	135	140	183	161	193	172	74	92	98	63	56	62
Chippewa	5	7	8	12	6	4	3	8	8	7	6	6
Chisago	23	19	24	32	26	20	12	18	12	10	20	19
Clay	23	42	23	16	14	18	10	10	11	1	3	1
Clearwater	38	41	46	47	23	38	21	33	21	11	12	6
Cook	19	36	55	57	28	9	4	0	4	1	1	3
Cottonwood	0	0	0	0	0	0	0	0	1	0	0	0
Crow Wing	66	107	117	96	83	59	35	41	55	36	52	47
Dakota	1	0	11	10	6	13	3	8	10	4	6	2
Dodge	3	1	1	3	4	2	0	3	2	3	6	0
Douglas	14	34	37	23	33	22	21	15	15	13	18	17
Faribault	0	1	12	3	1	3	5	9	3	11	10	17
Fillmore	5	5	10	6	13	3	3	4	1	4	8	1
Freeborn	5	10	10	1	7	6	2	11	7	20	10	3
Goodhue	11	7	18	2	2	11	4	9	0	2	7	7
Grant	1	8	12	6	13	4	3	5	2	2	7	4
Hennepin	2	3	4	5	6	3	2	2	9	4	7	0
Houston	11	10	26	22	14	9	2	8	10	6	14	4
Hubbard	52	42	67	61	36	32	26	39	30	23	31	23
Isanti	14	9	18	28	23	13	17	13	10	9	14	17
Itasca	247	281	346	345	184	159	67	84	123	76	79	79
Jackson	0	0	0	0	0	1	0	0	1	0	0	0
Kanabec	17	22	52	45	34	26	20	29	7	8	20	13
Kandiyohi	8	8	10	20	20	23	17	18	19	23	17	35
Kittson	8	2	9	7	4	0	8	8	5	5	2	0
Koochiching	81	62	127	115	55	68	19	16	13	20	12	16
Lac Qui Parle	2	6	15	6	1	7	0	8	0	2	10	2
Lake	28	36	66	67	45	26	23	12	13	11	22	6
Lake of the Woods	15	27	27	27	31	31	8	16	20	11	9	8

Table 17 (continued). Comparison of otter harvest by county, 2010-2021.

County	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22
Le Sueur	3	0	9	5	2	2	4	3	4	6	3	4
Lincoln	0	0	4	0	0	0	0	2	0	0	1	3
Lyon	0	0	0	0	0	0	0	1	0	0	4	3
Mahnomen	9	20	15	25	7	6	3	9	16	9	12	9
Marshall	13	13	15	15	4	9	12	15	10	5	7	10
Martin	0	0	1	0	0	1	1	1	1	1	1	0
McLeod	12	18	19	22	18	16	14	16	26	16	25	13
Meeker	12	28	19	32	35	23	11	26	29	32	18	16
Mille Lacs	19	15	30	39	28	16	13	26	14	12	14	18
Morrison	29	29	52	52	50	31	22	24	35	33	32	33
Mower	8	20	14	9	8	2	13	7	11	13	14	6
Murray	0	0	0	0	0	1	0	0	0	0	0	1
Nicollet	2	1	5	7	1	0	0	4	3	0	6	0
Nobles	0	0	0	0	4	0	0	0	0	0	0	1
Norman	12	21	45	27	19	13	9	8	5	2	2	5
Olmsted	2	3	0	7	7	5	3	5	4	8	8	8
Otter Tail	65	109	173	154	97	87	92	100	82	71	89	69
Pennington	4	2	12	5	8	8	11	2	7	2	4	3
Pine	38	44	66	98	59	86	48	20	36	35	24	34
Pipestone	0	0	0	0	0	0	1	1	0	0	1	1
Polk	36	49	83	71	47	37	20	12	14	12	38	30
Pope	11	20	22	14	19	8	19	8	14	19	4	13
Ramsey	0	0	3	1	1	1	0	0	0	0	0	0
Red Lake	22	19	26	11	10	14	13	1	3	3	13	11
Redwood	0	2	4	6	8	3	0	2	4	3	1	0
Renville	0	1	6	0	3	1	1	6	1	1	6	4
Rice	1	9	4	8	1	2	6	3	8	4	8	5
Rock	0	0	2	0	0	0	2	0	2	0	2	0
Roseau	32	33	64	48	44	23	24	22	20	20	39	32
Scott	4	2	4	3	2	4	5	4	7	8	14	11
Sherburne	7	19	12	9	10	10	11	8	9	3	7	2
Sibley	6	6	6	3	2	3	2	2	5	10	7	12
St. Louis	253	239	363	293	258	260	109	146	127	105	134	105
Stearns	13	41	53	53	41	50	45	28	34	22	29	15
Steele	1	0	3	1	0	1	3	3	4	6	4	2
Stevens	6	1	3	12	4	2	1	1	3	2	0	3
Swift	2	11	10	10	9	3	7	7	13	4	12	6

Table 17 (continued). Comparison of otter harvest by county, 2010-2021.

County	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22
Todd	41	63	55	55	19	28	22	24	18	14	12	30
Traverse	0	1	4	1	0	3	7	4	11	3	4	5
Wabasha	7	8	20	21	19	9	11	11	17	9	10	8
Wadena	16	20	43	30	30	19	5	8	8	11	27	17
Waseca	0	0	0	0	2	2	0	0	1	1	2	0
Washington	16	18	12	24	27	9	12	20	13	5	11	19
Watonwan	0	0	0	1	0	0	0	0	1	0	0	0
Wilkin	0	0	3	2	0	3	1	2	2	4	2	1
Winona	15	20	21	17	5	17	6	13	7	16	15	13
Wright	11	17	23	26	21	21	11	22	33	7	14	18
Yellow Medicine	0	0	7	9	0	3	0	2	2	1	6	5
Unknown	2	17	40	2	18	18	0	0	0	0	0	2
Totals	1,814	2,294	3,171	2,824	2,154	1,955	1,195	1,295	1,351	1,050	1,304	1,155

Table 18. Otter harvest by sex and week, 2021-22 season.

Date	Sex			Total Harvest	% of Total	Cumulative %
	Female	Male	Unknown			
Oct.23 - Oct.29	19	27	3	49	4.24	4.24
Oct.30 - Nov.5	63	119	5	187	16.19	20.43
Nov.6 - Nov.12	66	104	2	172	14.89	35.32
Nov.13 - Nov.19	52	98	1	151	13.07	48.40
Nov.20 - Nov.26	50	72	1	123	10.65	59.05
Nov.27 - Dec.3	60	74	2	136	11.77	70.82
Dec.4 - Dec.10	35	50		85	7.36	78.18
Dec.11 - Dec.17	25	49	1	75	6.49	84.68
Dec.18 - Dec.24	36	49		85	7.36	92.03
Dec.25 - Dec.31	14	26	2	42	3.64	95.67
Jan.1 - Jan.7	12	4	1	17	1.47	97.14
Jan.8 - Jan.14	6	6	1	13	1.13	98.27
Jan.15 - Jan.23*	6	14		20	1.73	100.00
Unknown	0	0	0	0	0.00	100.00
Total	444	692	19	1,155	100%	

* 9-day interval.

Table 19. Distribution of otter harvest* among trappers, 1995-2021.

Number (%) of Takers	Number Taken 1	2	3	4	Total Takers	Ave. Take
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
2018-19	276 (44)	134 (21)	78 (12)	142 (23)	630	2.1
2019-20	206 (42)	107 (22)	59 (12)	113 (23)	485	2.2
2020-21	258 (42)	135 (22)	90 (15)	126 (21)	609	2.1
2021-22	178 (36)	109 (22)	81 (16)	128 (26)	496	2.3

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