GROUSE SURVEYS IN MINNESOTA DURING SPRING 2007

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SUMMARY OF FINDINGS

Surveys for ruffed grouse (*Bonasa umbellus*), sharp-tailed grouse (*Tympanuchus phasianellus*), and greater prairie-chickens (*Tympanuchus cupido pinnatus*) were conducted during April and May 2007. Mean counts of ruffed grouse drums throughout the forested regions of Minnesota were 1.3 (95% confidence interval = 1.1–1.5) drums/stop (dps). That was significantly greater than the 1.0 (0.9–1.1) dps observed during 2006.

During the spring 2007 survey 2,114 sharp-tailed grouse were observed at 180 dancing grounds. The mean number of sharp-tailed grouse per dancing ground was 9.4 (8.0–11.0) in the East Central survey region, 12.9 (11.4–14.5) in the Northwest region, and 11.7 (10.6–12.9) statewide. Index values in both regions were significantly greater during 2007 than during 2006, and the statewide index value was as high as any year since 1980.

We counted 3,294 male prairie-chickens and located 263 booming grounds. Within survey blocks we observed 0.42 (0.33–0.51) leks/mi^2 and 14.5 (12.0–17.0) males/lek. Approximately 45% more leks and males were counted in survey blocks during spring 2007 than during spring 2006. Means of annual densities observed during 1993–2002 were 0.2 leks/mi^2 and 11.5 males/lek.

INTRODUCTION

Index Surveys

The purpose of surveys of grouse populations in Minnesota is to monitor changes in the densities of grouse over time. Estimates of density, however, are difficult and expensive to obtain. Simple counts of animals, on the other hand, are convenient and, assuming that

changes in density are the major source of variation in counts among years, they can provide a reasonable index to long-term trends in populations. Other factors, such as weather and habitat conditions, observer ability, and grouse behavior, vary over time and also affect simple counts of animals. These other factors make it difficult to make inferences about potential changes in wildlife populations over short periods of time (e.g., a few annual surveys) or from small changes in index values. Over longer periods of time or when changes in index values are large, assumptions upon which grouse surveys in Minnesota depend are more likely to be valid, thereby making inferences about grouse populations more valid. For example, index values from the ruffed grouse drumming count survey have documented what is believed to be true periodic fluctuations in ruffed grouse densities (i.e., the 10-year cycle).

Ruffed Grouse

The ruffed grouse (*Bonasa umbellus*) is Minnesota's most popular game bird. It occurs throughout the forested regions of the state. Annual harvest varies from approximately 150,000 to 1.4 million birds and averages >500,000 birds. Information derived from spring drumming counts and hunter harvest statistics indicates that ruffed grouse populations fluctuate cyclically at intervals of approximately 10 years.

During spring there is a peak in the drumming behavior of male ruffed grouse. Ruffed grouse drum to communicate to other grouse the location of their territory. The purpose is to attract females for breeding and deter encroachment by competing males. Drumming makes male ruffed grouse much easier to detect, so counts of drumming males is a convenient basis for surveys to monitor changes in the densities of ruffed grouse. Ruffed grouse were first surveyed in Minnesota during the mid-1930s. Spring drumming counts have been conducted annually since the establishment of the first survey routes in 1949.

Sharp-tailed Grouse

Sharp-tailed grouse (*Tympanuchus phasianellus*) in Minnesota occur in brushlands, which often form transition zones between forests and grasslands. Sharp-tailed grouse are

considered a valuable indicator of the availability and quality of brushlands for wildlife. Although sharp-tailed grouse habitat was more widely distributed in Minnesota during the early- and mid-1900s, the range of sharp-tailed grouse is now limited to areas in the Northwest (NW) and East Central (EC) portions of the state (Figure 1). Since 1990 annual harvest of sharp-tailed grouse by hunters has varied from 8,000 to 30,000 birds, and the number of hunters has varied from 6,000 to 13,000.

During spring male sharp-tailed grouse gather at dancing grounds, or leks, in grassy areas and fields where they defend small territories and make displays to attract females for breeding. Surveys of sharp-tailed grouse populations are based on counts of grouse at dancing grounds. The first surveys of sharp-tailed grouse in Minnesota were conducted between the early 1940s and 1960. The current sharp-tailed grouse survey was initiated in 1976.

Greater Prairie-Chickens

During the early 1800s greater prairie-chickens (*Tympanuchus cupido pinnatus*) were present along the southern edge of Minnesota. Their range expanded and contracted dramatically during the next 150 years. Currently, most prairie-chickens in Minnesota occur along the beach ridges of glacial Lake Agassiz in the west (Figure 1). The population of prairie-chickens there was expanded southward to the upper Minnesota River valley by a series of relocations during 1998–2006. Hunters in Minnesota have harvested approximately 100 prairie-chickens annually since 2003 when a limited-entry hunting season was opened for the first time since 1942.

Like sharp-tailed grouse, prairie-chickens gather at leks during spring. The leks of prairie-chickens are also called booming grounds because males make a low-frequency, booming vocalization during their displays. From 1974 to 2003 the Minnesota Prairie Chicken Society coordinated annual counts of prairie-chickens. During 2004 the Minnesota Department of Natural Resources (DNR) began coordinating the annual prairie-chicken surveys, and a standardized survey design was adopted.

METHODS

Ruffed Grouse

Roadside routes consisting of 10 semipermanent stops approximately 1.6 km (1 mile) apart have been established. Routes were originally located along roads with little automobile traffic that were also near apparent ruffed grouse habitat. Therefore, route locations were not selected according to a statistically valid spatial sampling design, which means that data collected along routes is not necessarily representative of the larger areas (e.g., counties, regions) in which routes occur. Approximately 50 routes were established by the mid-1950s, and approximately 70 more were established during the late-1970s and early-1980s.

Observers from the Department of Natural Resources (DNR) Area Wildlife Offices and a variety of other organizations drove along each survey route once just after sunrise during April or May. Observers were not trained but often were experienced with the survey. At each designated stop along the route the observer listened for 4 minutes and recorded the number of ruffed grouse drums (not necessarily the number of individual grouse) he or she heard. Attempts were made to conduct surveys on days near the peak of drumming activity that had little wind and no precipitation.

The survey index value was the number of drums heard during each stop along a route. The mean number of drums/stop (dps) was calculated for each of 4 survey regions and for the entire state (Figure 2). As an intermediate step to summarizing survey results by region, I calculated the mean number of dps for each route. Mean index values for survey regions were calculated as the mean of route-level means for all routes occurring within the region. Some routes crossed regional boundaries, so data from those routes were included in the means for both regions. The number of routes within regions was not proportional to any meaningful characteristic of the regions or ECS section upon which they were based. Therefore, mean index values for the Northeast region and the state were calculated as the weighted mean of index values for the 4 and 7 ECS sections, respectively, they included. The weight for each

section mean was the geographic area of the section (i.e., AAP = 11,761 km^2, MOP = 21,468 km^2, NSU = 24,160 km^2, DLP = 33,955 km^2, WSU = 14,158 km^2, MIM = 20,886 km^2, and PP = 5,212 km^2). Only approximately half of the Minnesota and Northeast Iowa Morainal (MIM) and Paleozoic Plateau (PP) sections were within the ruffed grouse range, so the area used to weight drum index means for those sections was reduced accordingly using subsection boundaries.

Stops along survey routes are a small sample of all possible stops within the range of ruffed grouse in Minnesota. Survey index values based on the sample of stops are not the same as they would be if drum counts were conducted at a different sample of stops or at all possible stops. To account for the uncertainty in index values because they are based on a sample, I calculated 95% confidence intervals (CI) for each mean. A 95% confidence interval is a numerical range in which 95% of similarly estimated intervals (i.e., from different hypothetical samples) would contain the true, unknown mean. I used 10,000 bootstrap samples of route-level means to estimate percentile CIs for mean index values for survey regions and the whole state. Limits of each CI were defined as the 2.5^{th} and 97.5^{th} percentiles of the bootstrap frequency distribution. I calculated mean index values and CIs for 1982–2007. Data from earlier years were not analyzed because they were not available in a digital form.

Sharp-tailed Grouse

Over time, DNR Wildlife Managers have recorded the locations of sharp-tailed grouse dancing grounds in their work areas. As new dancing grounds were located, they were added to the survey list. Known and accessible dancing grounds were surveyed by Wildlife Area staff and their volunteers between sunrise and 2.5 hours after sunrise during April and early-May to count sharp-tailed grouse. When possible, surveys were conducted when the sky was clear and the wind was <16 km/hr (10 mph). Attempts were made to conduct surveys on >1 day to account for variation in the attendance of male grouse at the dancing ground. Survey data consist of the maximum of daily counts of sharp-tailed grouse at each dancing ground.

The dancing grounds included in the survey were not selected according to a statistically valid spatial sampling design. Therefore, data collected during the survey were not necessarily representative of the larger areas (e.g., counties, regions) in which the dancing grounds occur. It was believed, however, that most dancing grounds within each work area were included in the sample, thereby minimizing the limitations caused by the sampling design.

I calculated the mean number of sharp-tailed grouse per dancing ground (i.e., index value), averaged across dancing grounds within the NW and EC regions and statewide for spring 2007. The number of grouse included those recorded as males and those recorded as being of unknown sex, and only leks with ≥2 grouse were included when calculating mean index values. It was not valid to compare the full survey data and results from different years because survey effort and success in detecting and observing sharp-tailed grouse was different between years and the survey samples were not necessarily representative of other dancing grounds. To estimate differences in sharp-tailed grouse index values between 2 years, therefore, I analyzed separately sets of data that included counts of birds only from dancing grounds that were surveyed during both years. Although the dancing grounds in the separate data sets were considered comparable, the counts of birds at the dancing grounds still were not. Many factors can affect the number of birds counted, so inferences based upon comparisons of survey data between years are tenuous. I used a separate data set of comparable leks to calculate the mean difference in the number of birds counted per dancing ground between 2006 and 2007.

To account for the uncertainty in index values because they are based on a sample of dancing grounds rather than all dancing grounds, I calculated 95% confidence intervals (CI) for each mean. I used 10,000 bootstrap samples of dancing ground counts to estimate percentile confidence intervals for mean index values for the NW and EC regions and the whole state.

The current delineation between the NW and EC survey regions was based on ECS section boundaries (Figure 1), with the NW region consisting of the Lake Agassiz & Aspen Parklands, Northern Minnesota & Ontario Peatlands, and Red River Valley sections and the EC

region consisting of selected subsections of the Northern Minnesota Drift & Lake Plains, Western Superior Uplands, and Southern Superior Uplands sections. The 2005 Grouse Survey Report detailed the transition from the former to the current delineation of regions.

Greater Prairie-Chickens

During the few hours near sunrise from late-March until mid-May cooperating biologists and numerous volunteers counted prairie-chickens at leks in western Minnesota. They attempted to locate and observe multiple times all prairie-chicken leks within 17 designated survey blocks (Figure 3). Each block was approximately 4 miles $\times$ 4 miles square (4,144 ha) and was selected nonrandomly based upon the spatial distribution of leks and the presence of relatively abundant grassland habitat. Ten survey blocks were located in what was considered the core of the prairie-chicken range in Minnesota. The other 7 blocks were located in the periphery of the range. The permit areas for the fall hunting season roughly coincide with the core of the range (Figure 3).

Observations of leks outside the survey blocks were also recorded. They contribute to the known minimum abundance of prairie-chickens and may be of historical significance. These observations, however, were only incidental to the formal survey. Bird counts from areas outside the survey blocks cannot be used to make inferences about the relative abundance of prairie-chickens among different geographic areas (e.g., counties, permit areas) or points in time (e.g., years) because the amount of effort expended to obtain the observations was not standardized or recorded.

Observers counted prairie-chickens at leks from a distance using binoculars. If vegetation or topography obscured the view of a lek, the observer attempted to flush the birds to obtain an accurate count. Observed prairie-chickens were classified by sex as either male, female, or unknown. Male prairie-chickens were usually obvious due to their display behavior. Birds were classified as unknown sex when none of the birds at a lek were observed displaying or when the birds had to be flushed to be counted. Most birds classified as unknown likely were

males because most birds at leks are males. Although most male prairie-chickens attend leks most mornings, female attendance at leks is much more limited and sporadic. Females are also more difficult to detect because they do not vocalize or display like males. Counts of males and unknowns, rather than females, therefore, were used to make comparisons between core and peripheral ranges and between years.

RESULTS & DISCUSSION

Ruffed Grouse

Observers from 15 cooperating organizations surveyed 131 routes between 10 April and 14 May 2007. Most routes (52%) were run between 23 and 29 April. There was a secondary peak of survey effort (15% of routes) during 8–9 May. Cooperators included the DNR Divisions of Fish & Wildlife and Ecological Services; Chippewa and Superior National Forests (USDA Forest Service); Fond du Lac, Grand Portage, Leech Lake, Red Lake, and White Earth Reservations; Agassiz and Tamarac National Wildlife Refuges (U.S. Fish & Wildlife Service); Vermilion Community College; Beltrami and Cass County Land Departments; and UPM Blandin Paper Mill. Observers reported survey conditions as Excellent, Good, and Fair on 62%, 34%, and 4% of 124 routes, respectively. Survey conditions during 2006 were Excellent, Good, and Fair on 52%, 35%, and 13% of routes, respectively.

Mean counts of ruffed grouse drums throughout the forested regions of Minnesota were 1.3 (95% confidence interval = 1.1–1.5) drums/stop (dps) during 2007. That was significantly greater than the 1.0 (0.9–1.1) dps observed last year and similar to the long-term mean between low and high points in the population cycle (Figure 4). The Northeast survey region was the only one in which counts increased. Drum counts during 2007 by survey region were 1.5 (1.3–1.7) dps in the Northeast (n = 107 routes), 0.9 (0.5–1.4) dps in the Northwest (n = 8), 0.8 (0.4–1.1) dps in the Southwest (n = 14), and 0.5 (0.2–0.9) dps in the Southeast (n = 8) (Figures 4 & 5). Median index values for bootstrap samples were similar to observed means, so no bias-correction was necessary.

Based upon the drum count index, ruffed grouse densities in northeastern Minnesota during spring 2007 were likely greater than spring densities during 2001–2006. It appears that this is the second year of a cyclical increase in the population. The lack of changes in drum counts in the periphery of ruffed grouse range in Minnesota, however, indicates that the increase will not be noticeable in all areas.

Sharp-tailed Grouse

A total of 2,114 sharp-tailed grouse was observed at 180 dancing grounds with ≥2 male grouse (or grouse of unknown sex) during spring 2007. The resulting index value (11.7 grouse/lek) was greater than any index value since 1980 (Figure 6). Index values in both survey regions increased from 2006 to 2007 (Table 1). Among dancing grounds visited both years, index values in the NW and EC regions increased by 37% (95% CI = 18–60%) and 17% (95% CI = 1–37%), respectively. Leks with ≥2 grouse were visited a mean of 1.8 times, and 151 historic lek sites with ≤1 male were also surveyed at least once.

Table 1. Number of sharp-tailed grouse observed per dancing ground in Minnesota during spring.

	Statewide			Northwest[a]			Eastcentral[a]		
Year[b]	Mean	95% CI[c]	*n*[d]	Mean	95% CI[c]	*n*[d]	Mean	95%CI[c]	*n*[d]
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	11.7	10.6–12.9	180	12.9	11.4–14.5	120	9.4	8.0–11.0	60
$\text{Difference}_{04\text{-}05}$	-1.3	-2.2– -0.3	186	-2.1	-3.5– -0.8	112	0.0	-1.0– 1.1	74
$\text{Difference}_{05\text{-}06}$	-2.5	-3.7– -1.3	126	-3.6	-5.3– -1.9	70	-1.1	-2.6– 0.6	56
$\text{Difference}_{06\text{-}07}$	2.6	1.5– 3.8	152	3.3	1.7– 5.1	99	1.2	0.1– 2.3	53

[a] Survey regions; see Figure 1.
[b] Year or consecutive years for the mean difference between comparable leks.
[c] 95% CI = 95% confidence interval for the mean. It is an estimate of the uncertainty in the value of the mean.
[d] *n* = number of dancing grounds in the sample.

Greater Prairie-Chickens

Observers from at least 3 cooperating organizations and several unaffiliated volunteers counted prairie-chickens during spring 2007. Cooperators included the DNR Division of Fish and Wildlife, Fergus Falls and Detroit Lakes Wetland Management Districts (U.S. Fish & Wildlife

Service), and The Nature Conservancy. Observers located 263 booming grounds and counted 3,294 male prairie-chickens (Table 2). Within hunting permit areas we observed 0.09 leks/mi^2 (0.03 leks/km^2) and 13.7 males/lek. Minimum counts in Table 2 and the densities calculated from them are not comparable among permit areas or years because they included surveys that were conducted outside of the survey blocks and did not follow a spatial sampling design.

Table 2. Minimum abundance of prairie-chickens within and outside of hunting permit areas in western Minnesota during spring 2007. Counts of leks and birds are not comparable among permit areas or years.

Permit Area	Area (sq. mi.)	Leks	Males	Unk.[a]
801A	233	0	0	0
802A	319	19	157	0
803A	258	11	98	0
804A	168	0	0	0
805A	103	28	474	0
806A	289	17	172	6
807A	170	32	372	33
808A	161	34	579	0
809A	287	27	466	0
810A	195	26	400	0
811A	272	16	165	54
PA subtotal[b]	2,454	210	2,883	93
Outside PAs[c]	NA[d]	53	411	51
Grand total	NA	263	3,294	144

[a] Unk. = prairie-chickens of unknown sex. It is likely that most were males.
[b] Sum among the 11 permit areas.
[c] Counts from outside the permit areas.
[d] NA = not applicable. The size of the area outside permit areas was not defined.

Each booming ground was observed on a median of 2 (mean = 1.9) different days, but 46% of leks were observed only once. Attendance of males at prairie-chicken leks varies among days and by time of day. Single counts of males at a booming ground, therefore, may be an unreliable indication of true abundance. Similar counts on multiple days, on the other hand, demonstrate that the counts may be a good indicator of true abundance. Even multiple counts, however, cannot overcome the problems associated with the failure to estimate the probability of detecting leks and individual birds at leks. Without estimates of detection

probability, the prairie-chicken survey is an index to, not an estimate of, prairie-chicken abundance within the survey blocks. The credibility of the index for monitoring changes in abundance among years is dependent upon the untested assumption that a linear relationship exists between counts of male prairie-chickens and true abundance. In other words, we assume that (the expected value of) the probability of detection does not change among years.

Within survey blocks we counted 1,618 males (includes birds of unknown sex) on 114 leks (Table 3). That was 46% more males and 43% more leks than were counted in survey blocks during spring 2006 (Figure 7). Leks were defined as having ≥2 males, so observations of single males were excluded from summaries by survey block. During spring 2007 we observed 0.41 (0.30–0.53) leks/mi^2 and 17.4 (15.2–19.6) males/lek in survey blocks in the core of the

Table 3. Counts of prairie-chickens within survey blocks in Minnesota.

		Area	2007		Change from 2006[a]	
Range[b]	Survey Block	(miles^2)	Leks	Males[c]	Leks	Males[c]
Core	Polk 2	16.2	9	143	5	78
	Norman 1	16.1	2	19	-1	-23
	Norman 3	16.0	9	154	3	64
	Clay 1	17.6	9	182	0	27
	Clay 2	16.0	4	91	2	-10
	Clay 3	16.1	9	157	0	14
	Clay 4	14.9	5	91	0	34
	Wilkin 1	15.4	9	161	0	68
	Wilkin 3	16.1	8	122	2	51
	Otter Tail 1	15.9	2	40	-1	10
	Core subtotal	160.2	66	1,160	10	313
Periphery	Polk 1	15.9	11	101	7	53
	Norman 2	16.3	9	59	4	-3
	Mahnomen	16.1	7	97	4	49
	Becker 1	16.0	10	82	7	58
	Becker 2	16.1	3	56	-1	14
	Wilkin 2	16.1	3	25	1	9
	Otter Tail 2	15.7	5	38	2	15
	Periphery subtotal	112.2	48	458	24	195
Grand total		272.4	114	1,618	34	508

[a] The 2006 count was subtracted from the 2007 count, so a negative value indicates a decline.
[b] Survey blocks were classified as either mostly within the original (i.e., 2003–2005) hunting permit areas (core) or mostly outside those permit areas (periphery).
[c] Includes birds recorded as being of unknown sex but excludes lone males not observed at a booming ground.

range, whereas we observed 0.43 (0.28–0.58) leks/mi^2 and 10.3 (7.1–13.6) males/lek in peripheral blocks (Table 3). The densities of prairie-chickens observed during 2007 were greater than the means of 0.2 leks/mi^2 and 11.5 males/lek observed in survey blocks from 1993 until 2002.

ACKNOWLEDGEMENTS

I sincerely appreciate the efforts of all the DNR staff and volunteer cooperators who conducted and helped coordinate the grouse surveys. The ruffed grouse survey data for 1982–2004 were entered into a database by Doug Mailhot and another volunteer through a special effort organized by Gary Drotts, John Erb, and Rick Horton. I also thank Laura Gilbert for helping with data entry and archiving and Mark Lenarz for reviewing earlier drafts of this report.

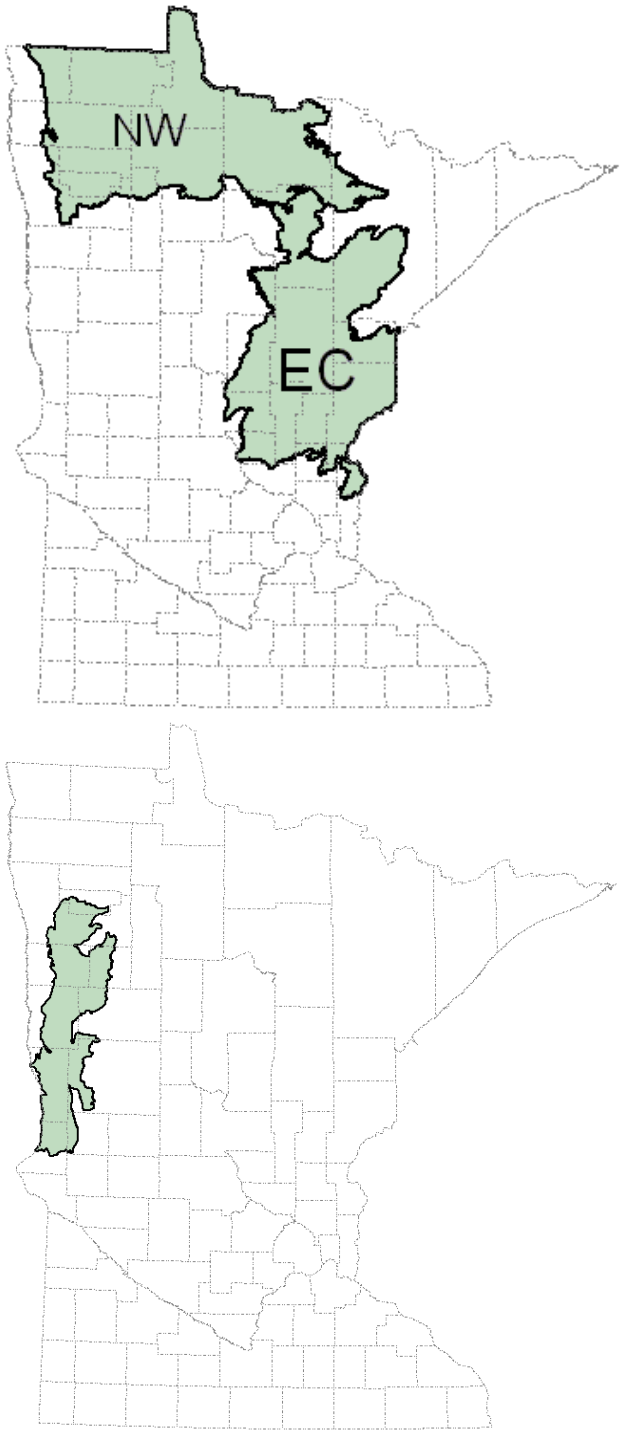

Figure 1. Northwest (NW) and East Central (EC) survey regions for **sharp-tailed grouse** (top panel) and primary range of **greater prairie-chickens** (bottom panel) relative to county boundaries in Minnesota. The sharp-tailed grouse regions were based largely on boundaries of ECS Subsections, whereas the prairie-chicken range was based on ECS Land Type Associations.

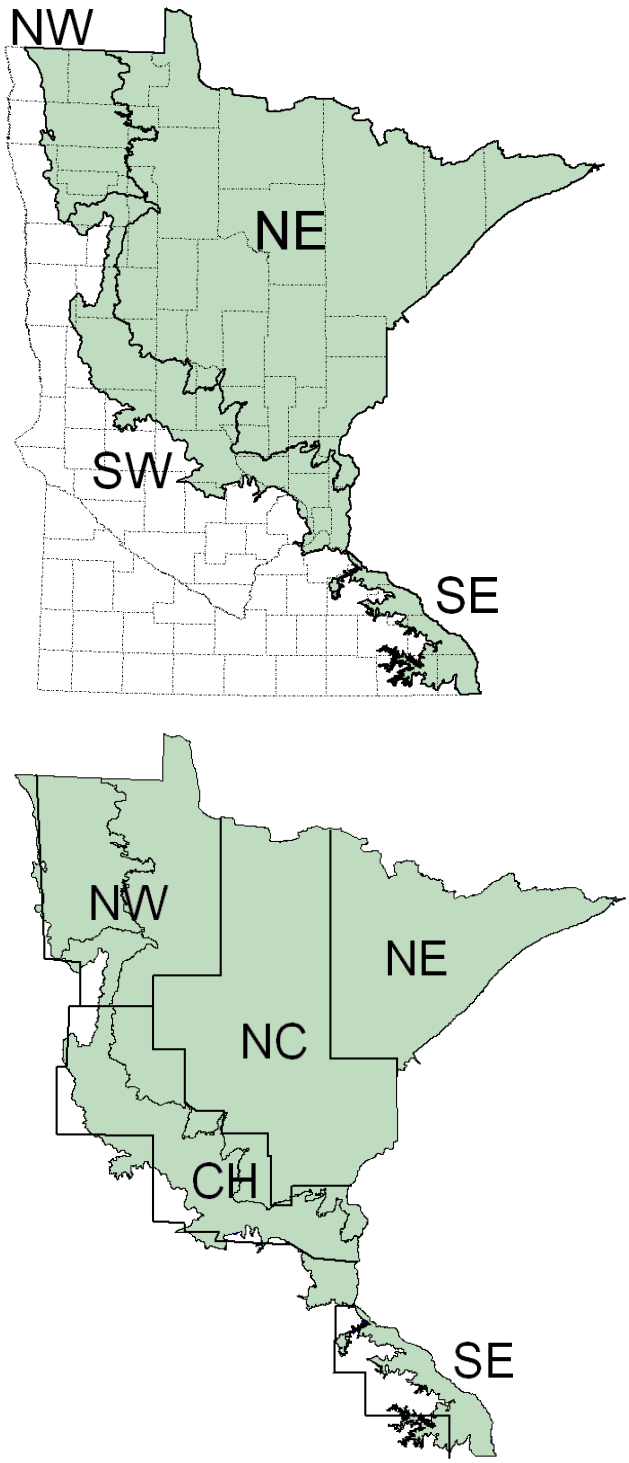

Figure 2. **Ruffed grouse** survey regions (shaded, curved boundaries) are based on the Ecological Classification System. Top panel: regions are labeled and overlaid on counties (dashed lines). Bottom panel: former survey zones (straight boundaries) are labeled and overlaid on regions.

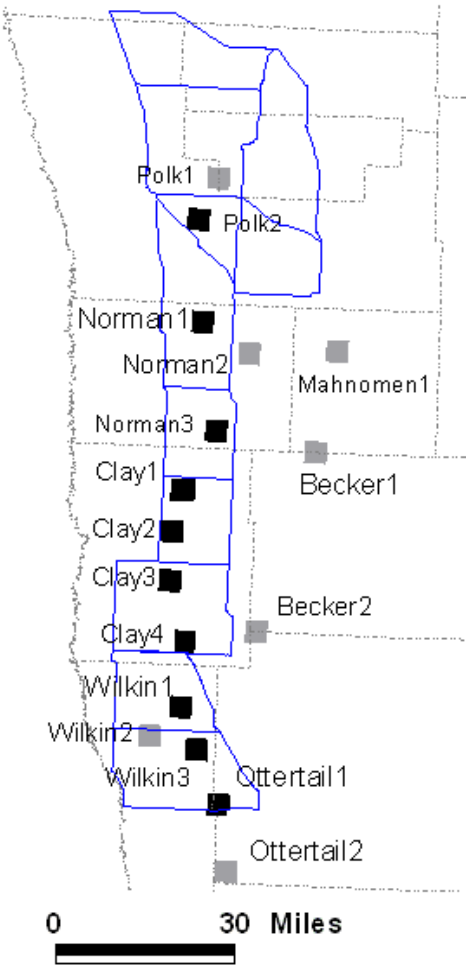

Figure 3. Survey blocks (labeled squares) and hunting permit area boundaries (solid lines) for **prairie-chickens** in western Minnesota. Survey blocks were designated as being in either the core (black) or periphery (gray) of the range. Blocks were named after the counties (dashed lines) in which they were primarily located. Permit areas were labeled sequentially from 801A in the north to 811A in the south.

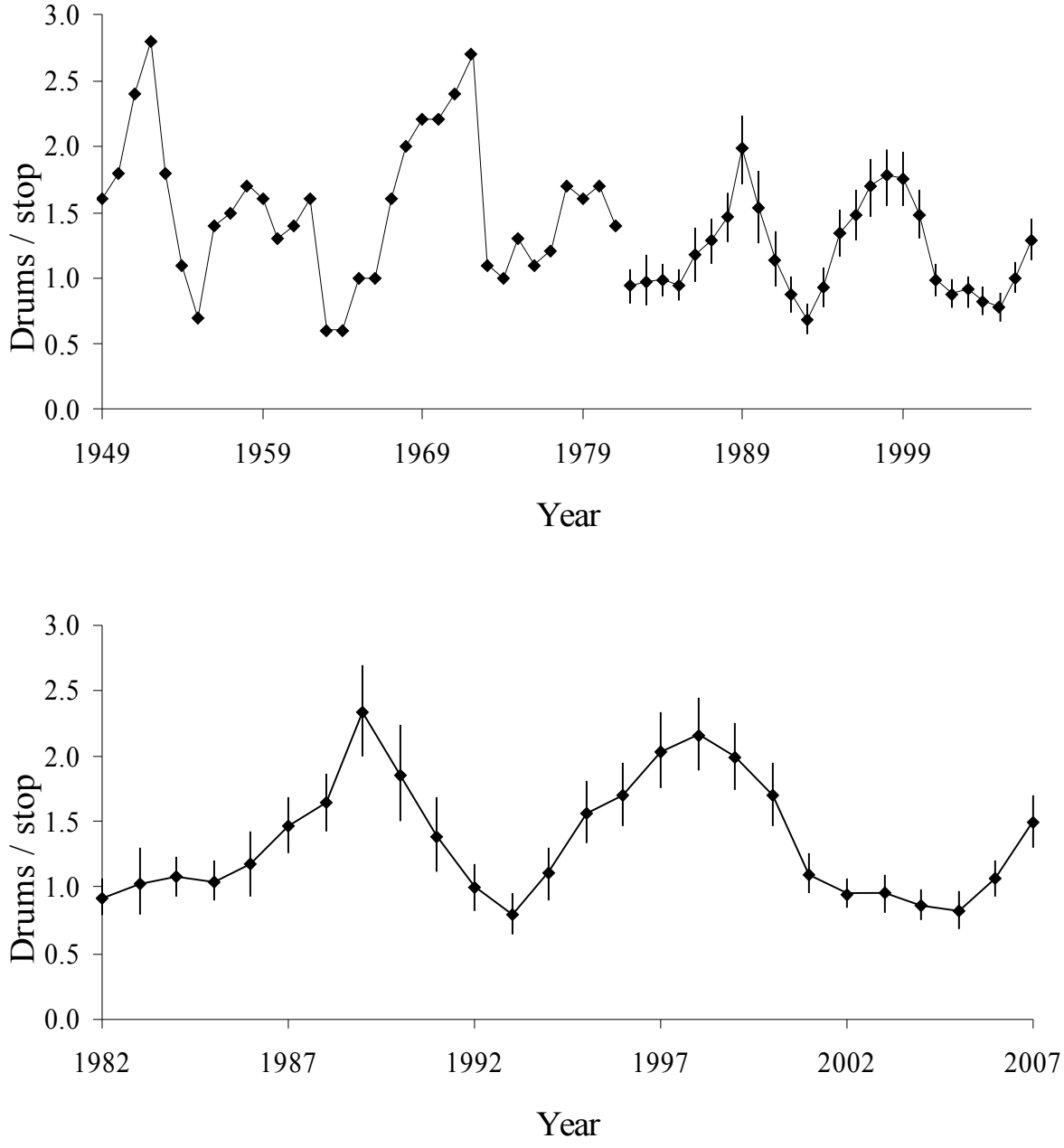

Figure 4. Ruffed grouse drum count index values in **Minnesota** (top) and just the **Northeast** region (bottom). Vertical error bars represent 95% confidence intervals based on bootstrap samples. Statewide means before 1982 were not re-analyzed with the current methods, so confidence intervals were not available. The difference in index values between 1981 and 1982 reflected a real decrease in drums counted, not an artifact of the change in analysis methods.

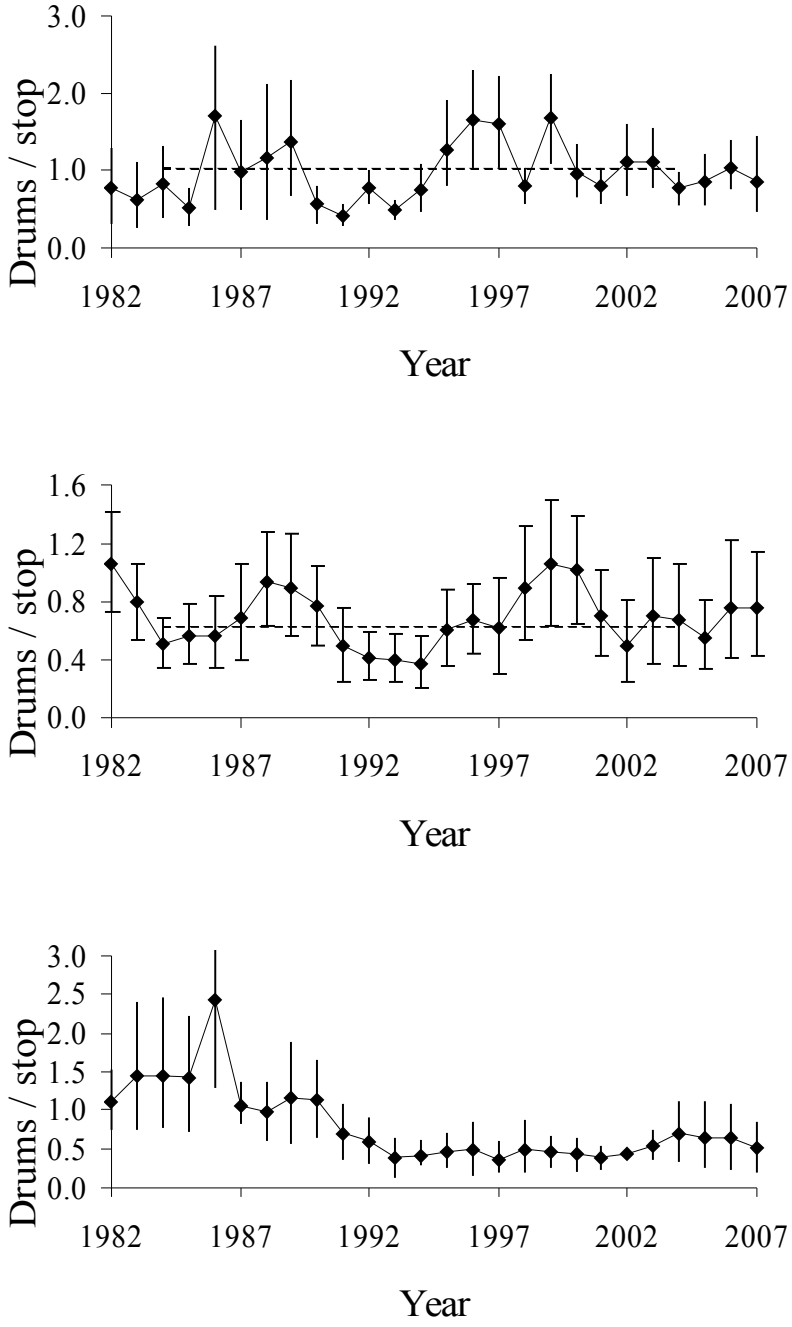

Figure 5. Ruffed grouse drum count index values in the **Northwest** (top), **Southwest** (middle), and **Southeast** (bottom) survey regions of Minnesota. Dashed horizontal lines indicate the mean from 1984 to 2004. Vertical error bars represent 95% confidence intervals based on bootstrap samples. One error bar in the bottom panel was truncated.

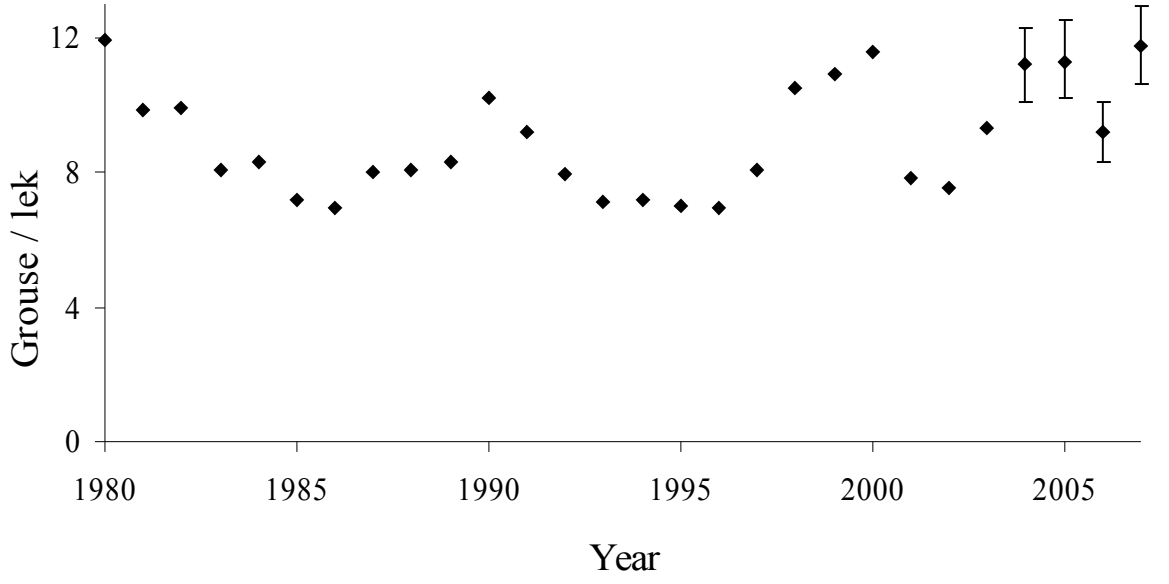

Figure 6. Mean number of **sharp-tailed grouse** observed in Minnesota during spring surveys of dancing grounds, 1980–2007. Vertical error bars, which were calculated only for recent years, represent 95% confidence intervals based on bootstrap samples. No line connects the annual means because they are not based on comparable samples of leks.

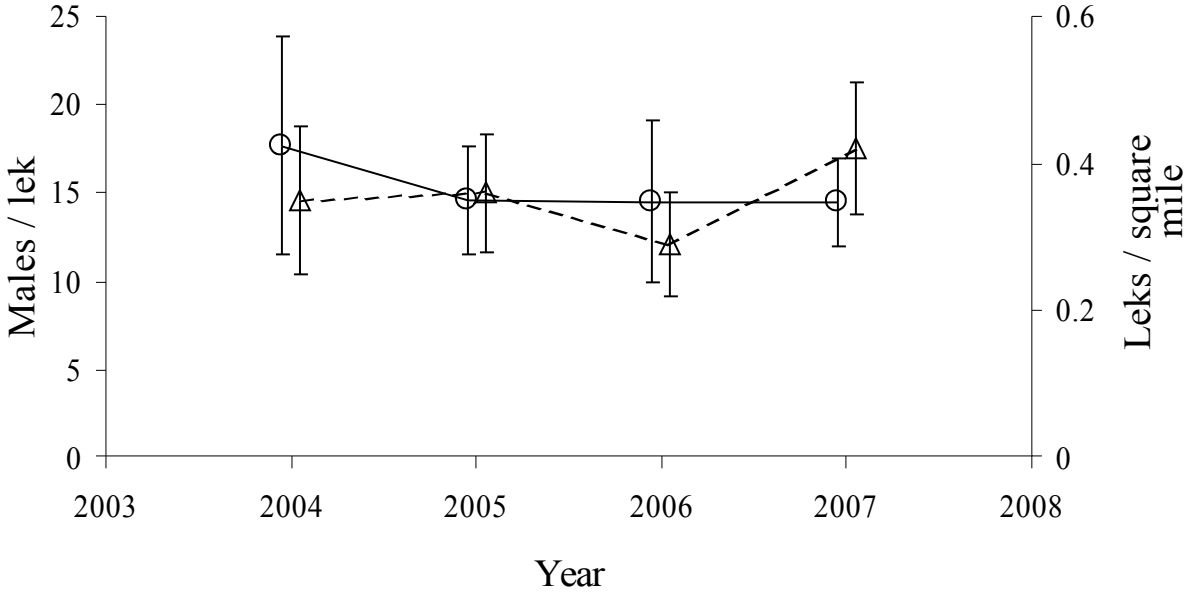

Figure 7. Number of **prairie-chicken** males/lek (circles) and leks/mi^2 (triangles) observed in western Minnesota. Vertical error bars represent 95% confidence intervals based on n = 17 survey blocks.