2022 MINNESOTA SPRUCE GROUSE SURVEY

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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 ≥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., ≥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 ≥400 m apart. Each route has ≥1 point with ≥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 ≤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 & 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.

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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.

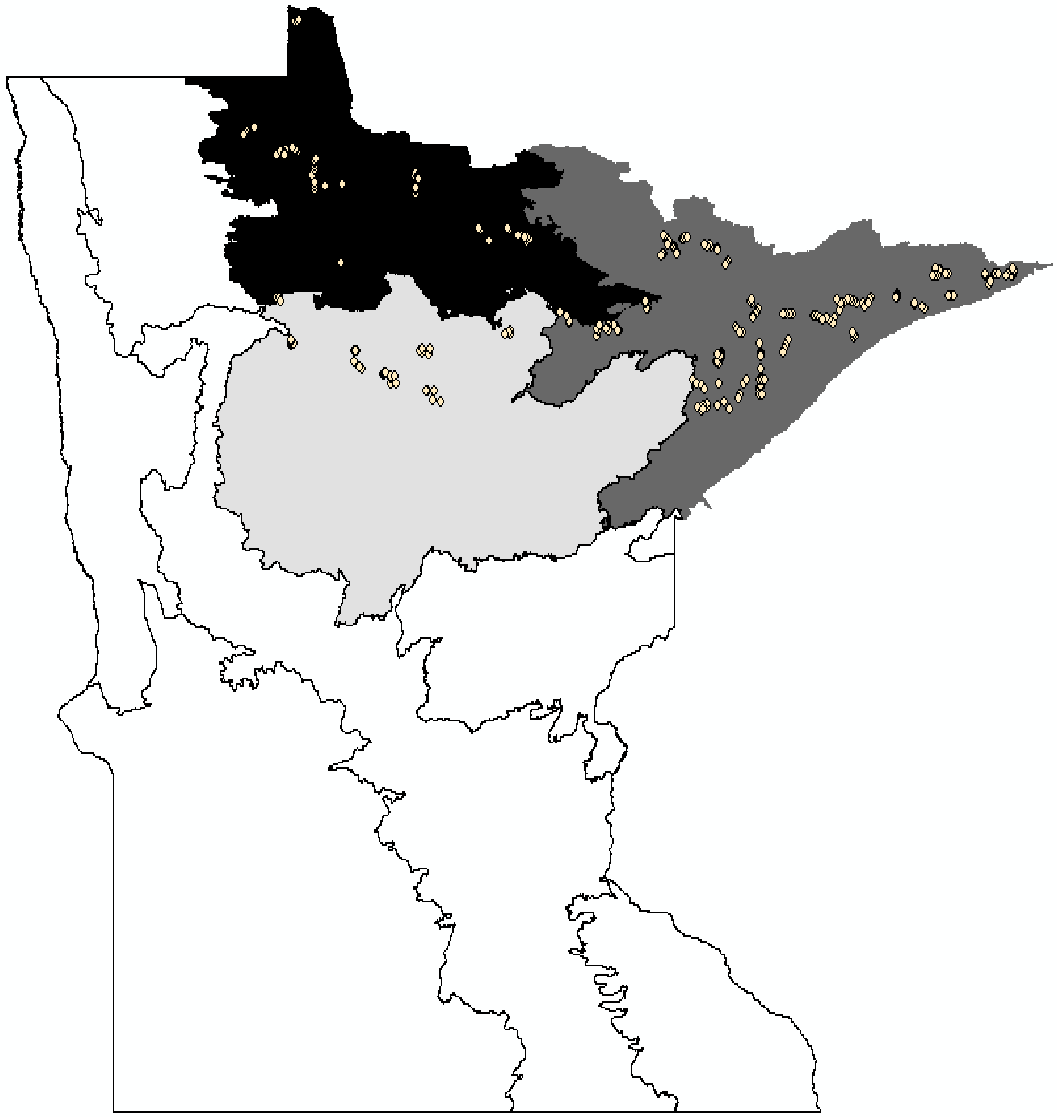

Figure 1. Distribution of sampling sites in northern Minnesota. Ecological Classification System sections included the Northern Minnesota and Ontario Peatlands (n = 17 routes and 85 sites) in the northwest, the Northern Superior Uplands (n = 40 routes and 190 sites) in the east, and the Northern Minnesota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

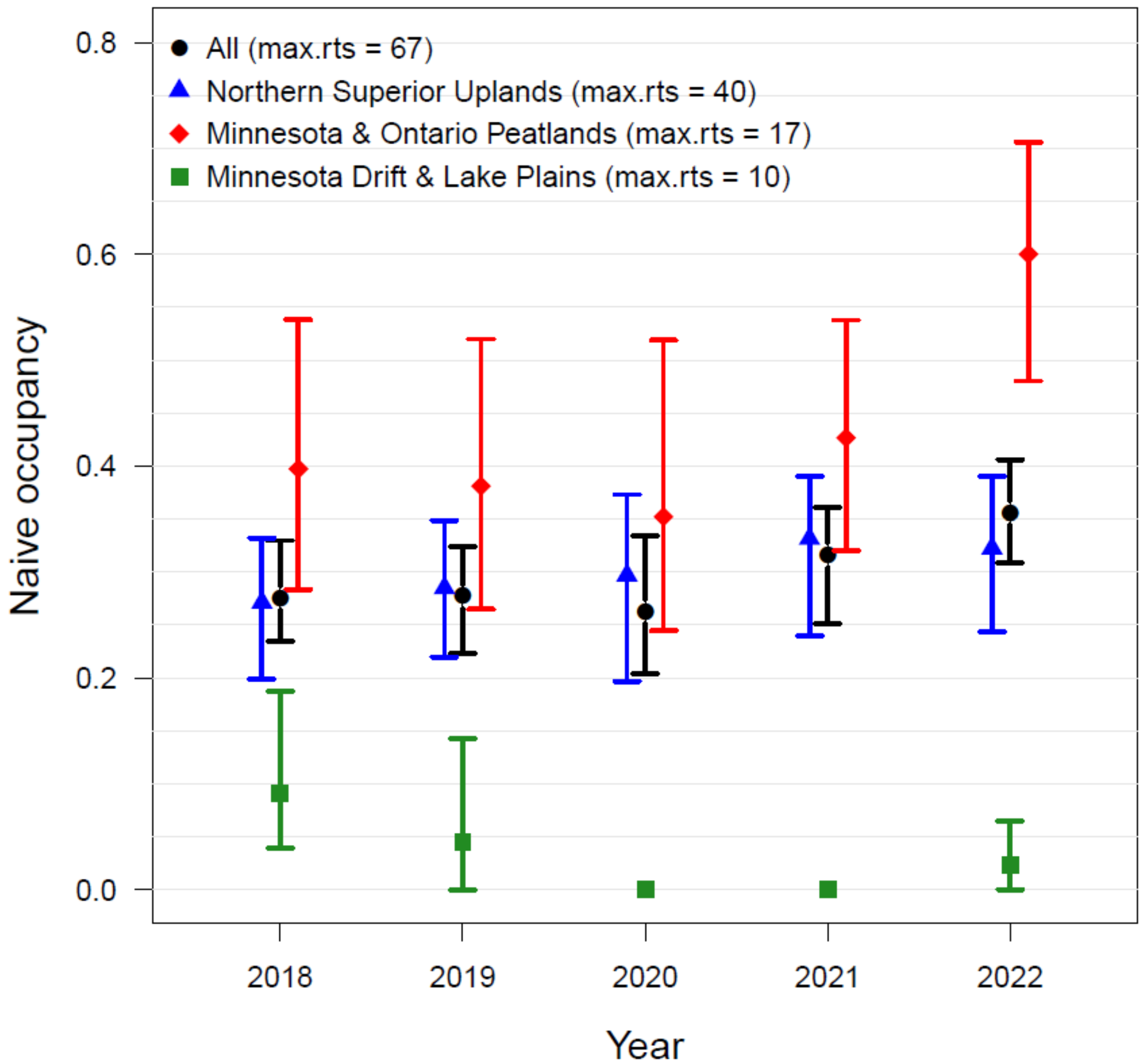

Figure 2. Spruce grouse naïve occupancy rates by Ecological Classification System section and across all sections in northern Minnesota during 2018–2022. Error bars denote 85% bootstrapped confidence intervals.

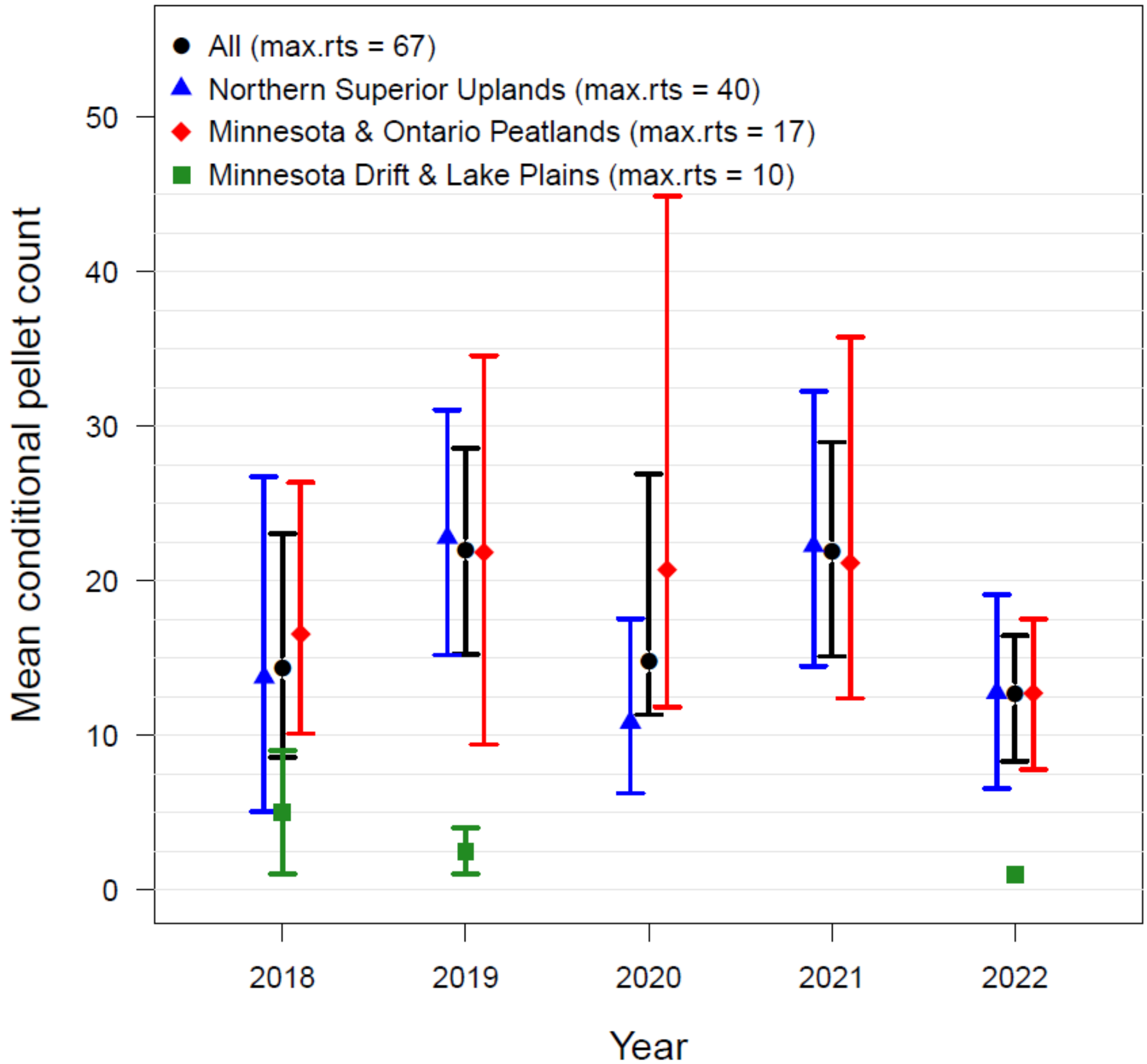

Figure 3. Mean spruce grouse pellet-group counts at used sites ($\geq$1 pellet detected) by Ecological Classification System section and across all sections in northern Minnesota during 2018–2022. Error bars denote 85% bootstrapped confidence intervals.

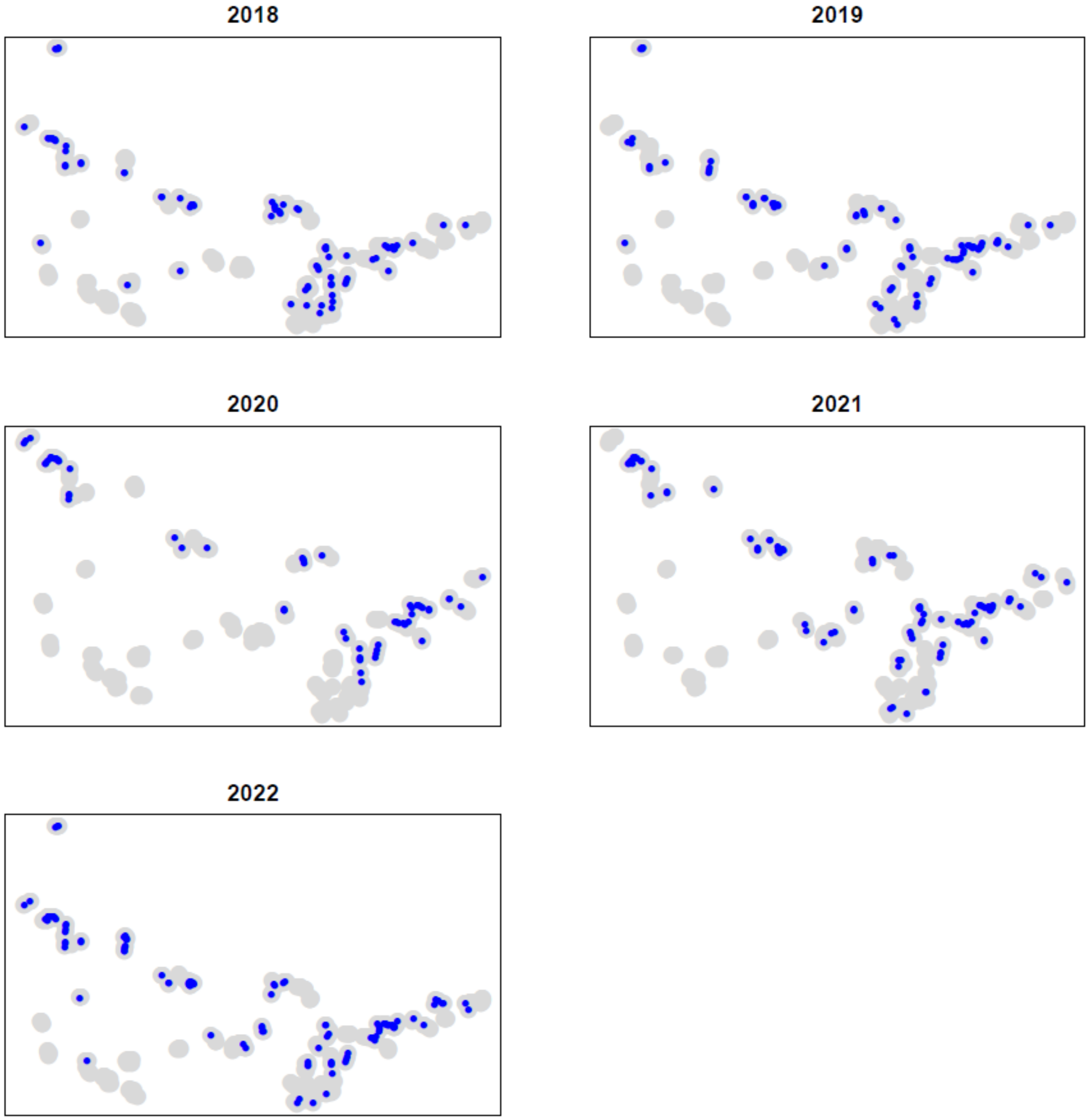

Figure 4. Spatial distribution of spruce grouse survey sites (gray dots) and used sites ($\geq$1 pellet detected; blue dots) in Northern Minnesota during 2018-2022.