



Effects of Road and Trail Characteristics on Mountain Grouse Observations in Western Montana

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Anthropogenic features such as roads and trails, and human activity may affect space use, demography, abundance, and other wildlife population parameters. Human infrastructure and activity may result in biased population estimates by influencing habitat use of a species and thus abundance estimates within a localized area or the ability of biologist to detect individuals during standard population surveys. To evaluate the effects of anthropogenic features on mountain grouse detections, we developed and conducted replicated surveys throughout western Montana during 2020. Biologists and volunteers collected count data for dusky, ruffed, and spruce grouse during point counts surveys conducted at 582 sites and transect surveys conducted for 291 transects located throughout Montana Fish, Wildlife, and Parks Regions 1-5. Survey transects occurred along two types of human infrastructure: U.S. Forest Service roads with minimal traffic during the survey period and U.S. Forest Service trails. As a first step, we compared count data for road and trail transect surveys for each species of grouse. Overall, raw counts of dusky grouse were higher for transects located along trails (0.59 ± 1.07 SD grouse per transect) than roads (0.33 ± 0.91 SD). Raw counts of ruffed grouse were similar for transects located along trails (0.75 ± 1.42 SD) and roads (0.69 ± 1.55 SD). We did not have a sufficient sample size to evaluate spruce grouse counts.

Introduction:

Upland game species, such as ruffed (*Bonasa umbellus*), spruce (*Canachites canadensis*), and dusky grouse (*Dendragapus obscurus*), are hunted annually across Montana. However, for the past few decades, mountain grouse have had limited to no population monitoring (Newell 2016). The drumming, fluttering, and hooting of a variety of grouse species during breeding seasons are often used for acoustic grouse surveys (Reed 2017). The distribution and habitat of dusky grouse within North America are closely related to the distribution of true fir and Douglas fir. Dusky grouse occupy western mountains, breed in lower elevations such as the foothills, and inhabit near the timberline and above during winter and fall (Johnsgard 2016, Zwickel et al. 2020). The ruffed grouse distribution across North America covers a variety of forest types, from temperate coniferous rain forests to arid deciduous forest types (Johnsgard 2016, Rusch et al. 2020). Spruce grouse are widely found in boreal coniferous forests following distribution patterns of balsam fir and black and white spruces

(Johnsgard 2016, Schroeder et al. 2021). Of the mountain grouse species in Montana, dusky grouse hooting (male nonvocal sounds signifying the desire to mate or territory) can be heard up to 100 m, ruffed grouse can be heard up to 200 m, and spruce grouse can be heard up to 183 m (Ellison 1971, Johnsgard 2016, Sumanik 1966; Table 1). Raw counts along systematic or randomized survey routes are often used as indices of relative abundance (Gregory 2004); however, the utility of relative abundance indices in population estimates require that they are proportional to true abundance and this proportion is constant across all areas (Norvell 2003). Preliminary analyses will focus on evaluating patterns in raw counts of mountain grouse collected during population surveys throughout western Montana. Raw counts depend on the number of grouse along survey routes and the probability of detecting them and may or may not reflect true spatial patterns in abundance (Gregory 2004). Current research is evaluating and developing survey designs for population monitoring that account for imperfect detection. For logistics and ease

of access, anthropogenic features such as roads and trails are often utilized for survey routes. However, the levels of human activity along these routes may deter grouse presence, influence detections, and possibly result in biased count data. In this preliminary study we aim to 1) broadly evaluate whether the type of transect (road or trail) affect survey count data which consequently affects relative abundance estimates and 2) assess whether there is a notable difference in maximum counts between road and trail transects and if the counts differ between species. We predicted that roads will have higher amounts of human activity and disturbance, and consequently have lower grouse counts than trails.

Methods:

Field Methods

We generated potential survey transects using ArcGIS and a dusky grouse habitat model for four categories: trails within areas predicted to have high relative probability of use by dusky grouse, trails in areas predicted to have medium-high relative probability of use by dusky grouse, roads within areas predicted to have high relative probability of use by dusky grouse, and roads within areas predicted to have medium-high relative probability of use by dusky grouse (Figure 1.; (McNew et al. 2018, unpublished). Within Montana Fish, Wildlife & Parks (MFWP) regions 1-5, more than 100 possible transects were generated along roads or trails for each region. We classified a transect as a trail or road using US Forest Service geospatial data (U.S. Forest Service 2020a, b, c, d). To ensure independence of transects and grouse observations, the randomly generated transects were placed at a minimum of 1000 m apart. Montana Fish, Wildlife & Parks biologists and wildlife personnel selected transects to survey.

Multiple survey methods were tested during data collection including transect surveys and point counts (Figure 2). Transects were a minimum of 2.5km and were often longer depending on the how much the road or trail meandered (McNew 2020). Transects were walked, and every 400m (calculated as direct distance, not distance walked) two 4-minute point counts were conducted with the use of electronic playback of female dusky grouse calls to increase detection (Figure 2). Each transect was surveyed twice and each point count location four times during spring 2020. During the surveys, individual grouse observed (aurally or visually) and were recorded, with grouse observations for transects and point count surveys independent of each other. Field surveys documented three different grouse species: dusky grouse, ruffed grouse, spruce grouse. While

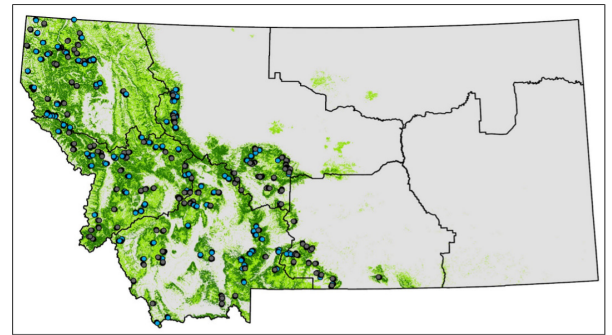


FIGURE 1
Transect locations surveyed (n = 291).
 Transects were randomly located across FWP Regions 1-5 along roads and trails in areas categorized as medium-high or high relative probability of use by dusky grouse from a previous created habitat model (E. Leipold, personal communication).

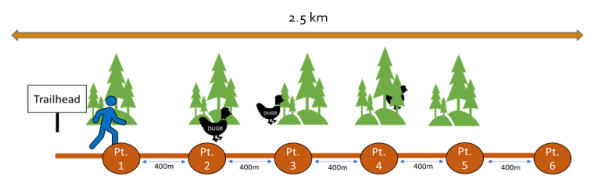


FIGURE 2
Transect selection criteria
 Transects were approximately 2.5 km transects, with point counts conducted every 400 m using electronic playback of female dusky grouse calls to elicit higher detection of dusky grouse (E. Leipold, personal communication).



both transect count data and point count data were collected, for this study we only analyzed the transect count data.

Statistical Analyses

We compared the number of grouse counted during each transect visit, and we used the maximum number of grouse counted for each species per transect for our statistical analysis. Initially, we evaluated two modes of analysis, a parametric model or a non-parametric model. In a parametric model, four assumptions need to be met which are normality, independence of observation, equal variance, and no outliers. Non-parametric tests have fewer assumptions and do not require the assumptions of normality and equal variance, which our data violated (“Nonparametric Tests.” n.d.). To avoid violating parametric test assumptions, we used a nonparametric test, Kruskal-Wallis to compare differences in the mean and the standard deviation (SD) of raw counts between the treatments (trail and road) per mountain grouse species (Heumann and Schomaker 2016). If the p-value obtained was <0.05, we concluded that mean differences of raw counts between transect type were significant.

Preliminary Results:

During spring 2020, grouse surveys were conducted along 291 transects of which 153 were along roads and 138 along trails. Within our road transects, 94 were in areas of high relative probability of use for dusky grouse compared to 89 trail transects and 59 road transects were in areas of medium- high relative probability of use compared to 49 trail transects. Across all the road transects, we counted a total of

51 dusky grouse, 105 ruffed grouse, and 12 spruce grouse (Figure 3). Across the trail transects, we counted a total of 82 dusky grouse, 103 ruffed grouse, and 4 spruces grouse (Figure 3). We found a significant difference in the maximum number of dusky grouse counted ($\chi^2= 9.6925$, $df = 1$, $P < 0.00185$) and no significant difference in the maximum number of ruffed grouse counted between road and trail transects. ($\chi^2= 0.55091$, $df = 1$, $p\text{-value} = 0.4579$) Sample sizes for spruce grouse were not sufficient to conduct analysis. Dusky grouse had had higher maximum counts for transects located along trails (0.59 ± 1.07 SD grouse per transect) than roads (0.33 ± 0.91 SD). Ruffed grouse displayed more similarity of maximum counts for transects located along trails (0.75 ± 1.42 SD) and roads (0.69 ± 1.55 SD).

Study Implications:

Notable mean differences in raw counts between road and trail transects may bias relative abundance estimates. These notable mean differences could be caused by the infrastructure type or amount of human activity, with trails being potentially less intrusive and less used than roads. We found that road transects had lower counts than trail transects for dusky grouse. Detection of dusky grouse drumming/hooting is greatly decreased when dusky grouse locations are greater than 100m away. Because of this, a potential cause for the difference in dusky grouse maximum counts could be a localized decrease in abundance within close distances of a road (< 100m) that does not occur, or the localized decrease is not as strong within close distances of trails (<100m). This bias could lead to inaccurate estimates of population size for dusky

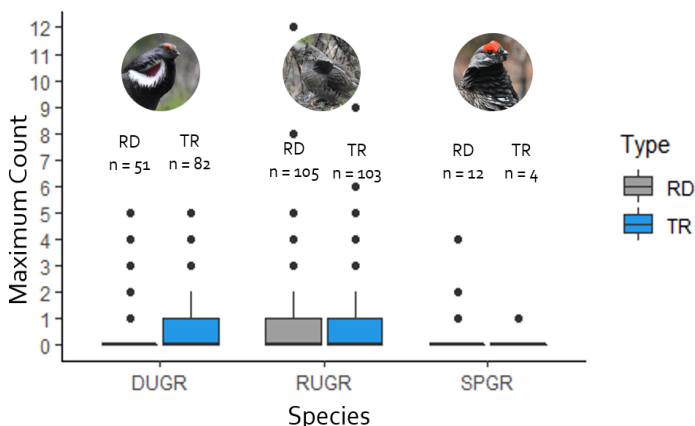


FIGURE 3

Grouse Observation Data

Box plots of maximum counts for each grouse species for road(153) transects and trail (138) transects. Maximum counts = the maximum number of grouse counted over two visits for each transect. DUGR = dusky grouse, RUGR = ruffed grouse; SPGR = spruce grouse. Total number of observations per transect type are noted above respective boxplot. (Photos by Chris Smith)

grouse. The similarity between raw counts between road and trail transects for ruffed grouse provides support that transect type (road vs trail) will not bias potential population estimates for ruffed grouse. Ruffed grouse drumming is audible and noticeable by the human ear up to distances of 400m (Sumanik 1966). Anthropogenic features, such as road and trails, may possibly be less impactful for the ruffed grouse counts even if they have an overall lower abundance within close distances of roads because their drumming can be heard over great distances. Our results provide the preliminary evidence needed to further investigate the causes of these mean differences of maximum counts in dusky grouse surveys on roads versus trails. To further explore the impacts of transect type, future analyses may use hierarchical models to evaluate whether counts are different due to differences in probability of detection or abundance. If grouse counts are biased due to the use of road and trail transect type, this could profoundly impact population estimates. Because surveying methods are still being developed and evaluated, the results of our study could have significant implications for population monitoring efforts of mountain grouse.

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Olivia Gervacio Jakobosky is a junior majoring in conservation biology and ecology with minors in sociology and global studies at Montana State University. Olivia's research and academic experiences have charged her passion to serve and empower rural communities through socio-ecological research rooted in community-led conservation management. Apart from her career pursuits, Olivia, as second-generation Filipinx American, spearheaded MSU's first Pan-Asian association and has dedicated her time to uplifting diversity, equity, and inclusion efforts on campus. As for the future, she intends to pursue a master's in Tropical Ecology followed by a Ph.D. in Interdisciplinary Ecology.



References

1. Ellison, L.N., 1971. Territoriality in Alaskan spruce grouse. *The Auk*, 88(3), pp.652-664.
2. Gregory, Richard D., David W. Gibbons, and Paul F. Donald. "Bird census and survey techniques." *Bird ecology and conservation* (2004): 17-56.
3. Heumann, Christian, and Michael Schomaker. *Introduction to statistics and data analysis*. Springer International Publishing Switzerland, 2016.
4. Johnson, Douglas H. "In Defense of Indices: The Case of Bird Surveys." *Journal of Wildlife Management* 72, no. 4 (2008): 857-68. <https://doi.org/10.2193/2007-294>.
5. Johnsgard, Paul A., "The North American Grouse: Their Biology and Behavior" (2016). *Zea E-Books*. Book 41. <http://digitalcommons.unl.edu/zeabook/41>
7. Kéry Marc. *Introduction to WinBUGS for Ecologists: a Bayesian Approach to Regression, ANOVA, Mixed Models and Related Analyses*. Amsterdam: Elsevier, 2010.
8. McNew, L., Leipold, E., Gower, C., Berkeley, L., and H. Burt. 2019. Estimating the occupancy, abundance, and density of dusky grouse: developing methods of unbiased population monitoring in Montana. Montana State University, Bozeman, Montana.
9. Newell, J. 2016. Survey & inventory protocols in Montana: upland game birds. Montana Department of Fish, Wildlife, and Parks technical report.
10. "Nonparametric Tests." When to Use a Nonparametric Test. Accessed November 26, 2020. https://sphweb.bumc.bu.edu/otlt/mph-modules/bs/bs704_nonparametric/BS704_Nonparametric2.html.
11. Norvell, R.E., Howe, F.P. and Parrish, J.R., 2003. A seven-year comparison of relative-abundance and distance-sampling methods. *The Auk*, 120(4), pp.1013-1028.
12. R Core Team (2020). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing, Vienna, Austria. URL <https://www.R-project.org/>.
13. Reed, S.E. and Dertien, J., 2017. A pilot study of potential effects of human recreation activity on Abert's squirrel (*Sciurus aberti*) and dusky grouse (*Dendragapus obscurus*) in Boulder County.
14. "Residual Diagnostics." R. Accessed November 19, 2020. https://cran.r-project.org/web/packages/olsrr/vignettes/residual_diagnostics.html.
15. Rusch, D. H., S. Destefano, M. C. Reynolds, and D. Lauten (2020). Ruffed Grouse (*Bonasa umbellus*), version 1.0. In *Birds of the World* (A. F. Poole and F. B. Gill, Editors). Cornell Lab of Ornithology, Ithaca, NY, USA. <https://doi.org/10.2173/bow.rufgro.01>
16. Schroeder, M. A., E. J. Blomberg, D. A. Boag, P. Pyle, and M. A. Patten (2021). Spruce Grouse (*Canachites canadensis*), version 1.1. In *Birds of the World* (P. G. Rodewald, Editor).
17. Cornell Lab of Ornithology, Ithaca, NY, USA. <https://doi.org/10.2173/bow.sprgro.01.1>
18. Sumanik, K. M. 1966. The drumming sites and drumming activity of territorial Ruffed Grouse in southwestern Alberta. Unpublished M.S. thesis, Edmonton, Univ. Alberta.
19. U.S Forest Service. 2020a. MVUM Roads and Trails. Vector digital data, Access. January 2020
20. U.S Forest Service. 2020b. MVUM Trails. Vector digital data, Access. January 2020
21. U.S Forest Service. 2020c. NFS Trails.. Vector digital data, Access. January 2020
22. U.S Forest Service. 2020d. Road Core - FS. Vector digital data, Access. January 2020
23. Zwickel, F. C. and J. F. Bendell (2020). Dusky Grouse (*Dendragapus obscurus*), version 1.0. In *Birds of the World* (P. G. Rodewald, Editor). Cornell Lab of Ornithology, Ithaca, NY, USA. <https://doi.org/10.2173/bow.dusgro.01>