# 2021 MINNESOTA DEER HUNTER OBSERVATION SURVEY REPORT

Tyler R. Obermoller, Wildlife Research Biologist
Eric S. Michel, Ungulate Research Scientist
Adam C. Landon, Human Dimensions Scientist

## 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 |

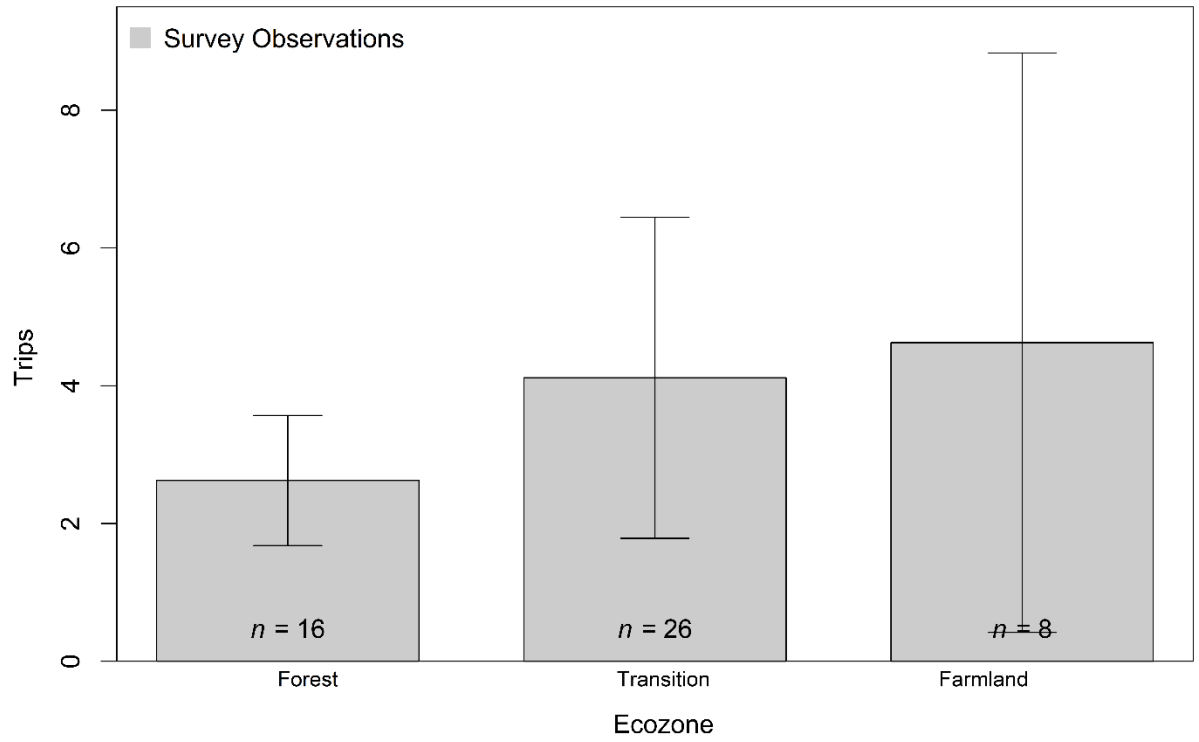


**Figure 1.** Mean hunting observation trips per deer hunter by ecozone with 95% confidence intervals during the deer hunting season (18 September – 31 December 2021) in Minnesota, USA.

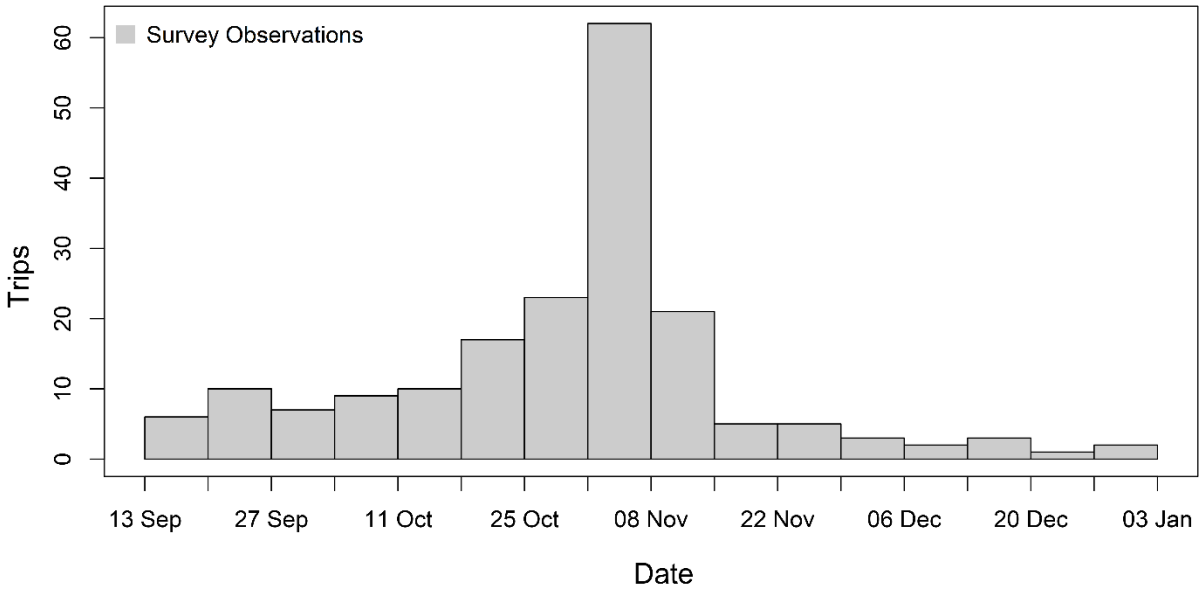


**Figure 2.** Date of hunting observation trips for respondents during the deer hunting season (18 September – 31 December 2021) in Minnesota, USA.

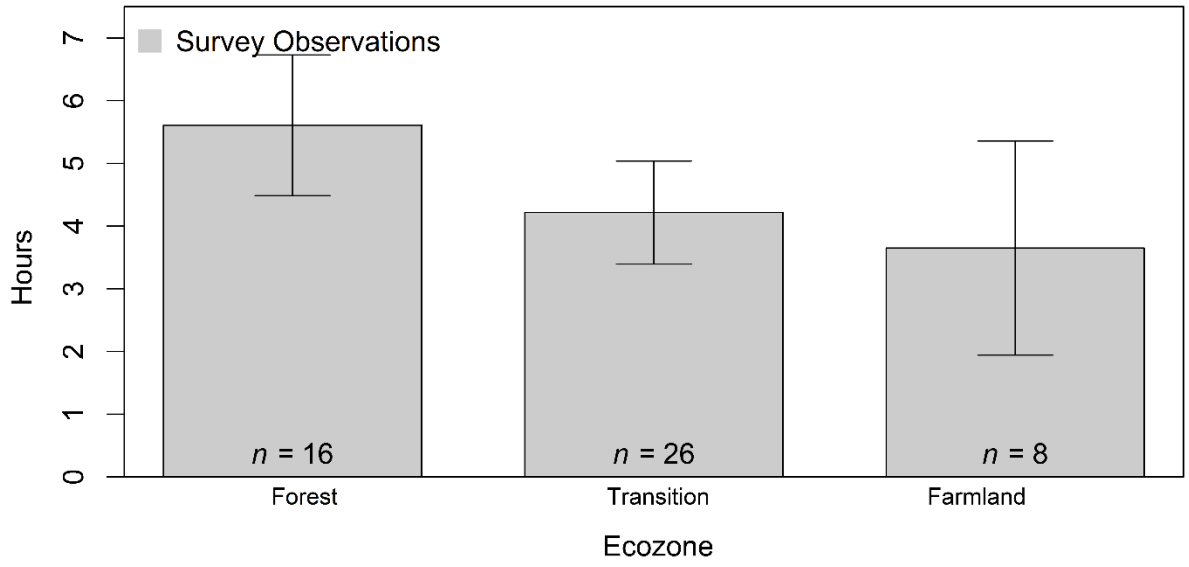


**Figure 3.** Mean hours hunted per trip with 95% confidence intervals during the deer hunting season (18 September – 31 December 2021) in Minnesota, USA.

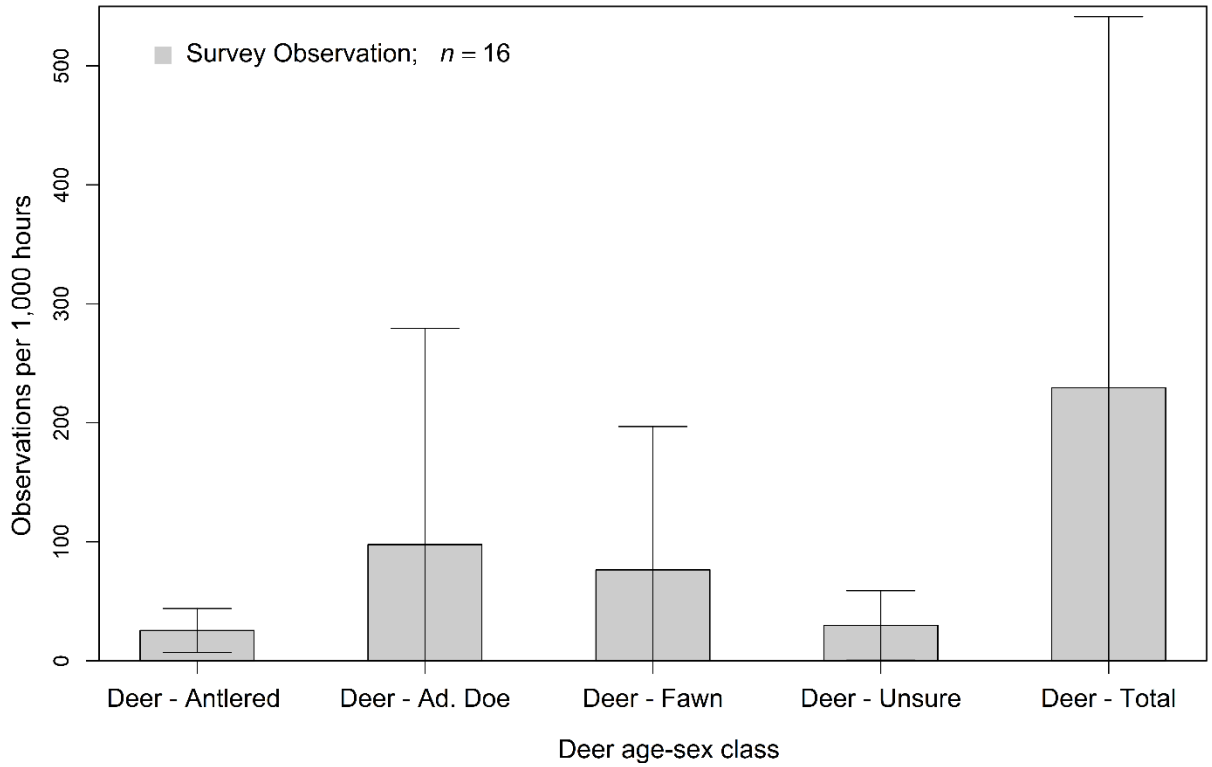


**Figure 4.** Mean deer observation rates per 1,000 hours with 95% confidence intervals in the forest ecozone during the deer hunting season (18 September – 31 December 2021) in Minnesota, USA.

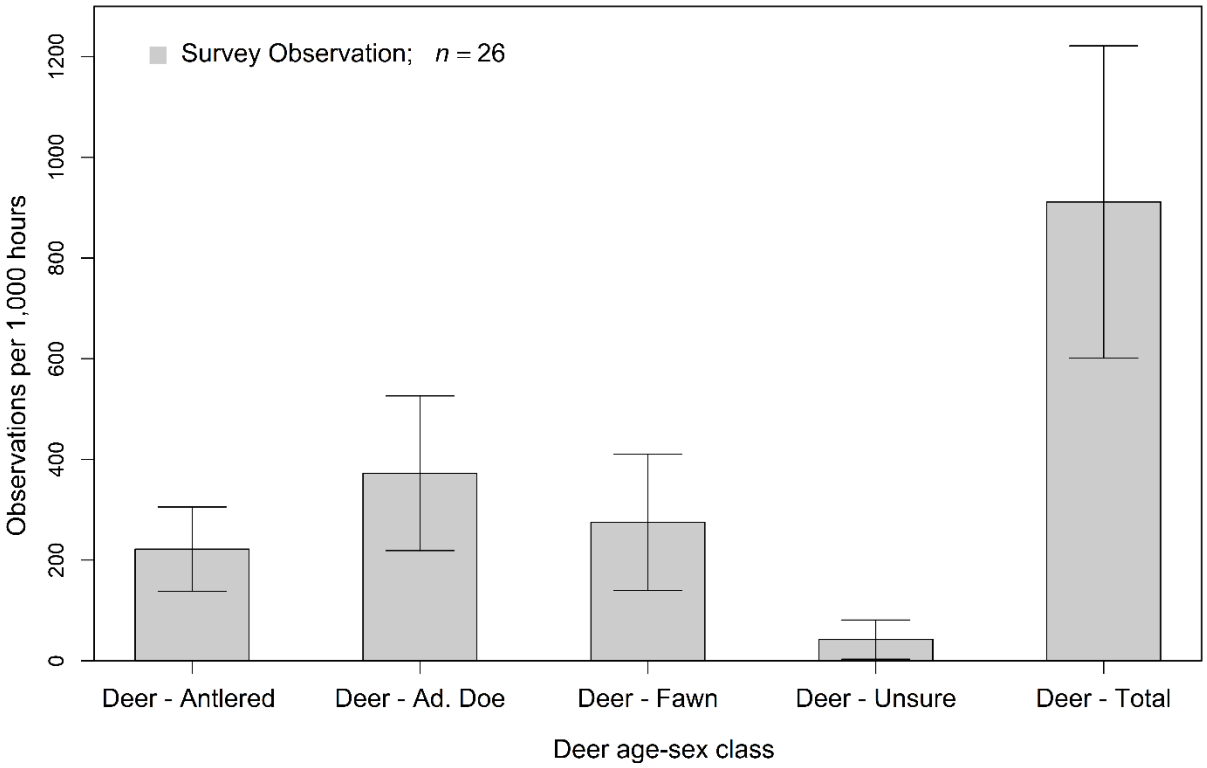


**Figure 5.** Mean deer observation rates per 1,000 hours with 95% confidence intervals in the transition ecozone during the deer hunting season (18 September – 31 December 2021) in Minnesota, USA.

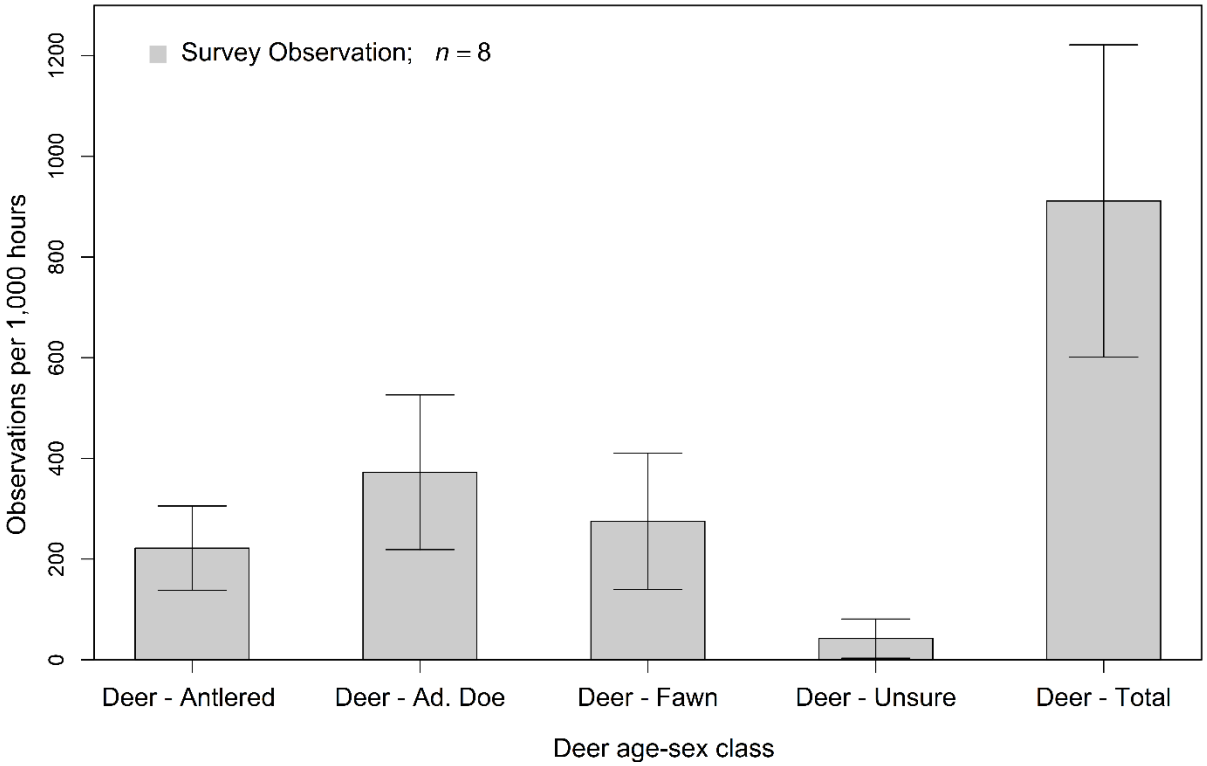


**Figure 6.** Mean deer observation rates per 1,000 hours with 95% confidence intervals in the farmland ecozone during the deer hunting season (18 September – 31 December 2021) in Minnesota, USA

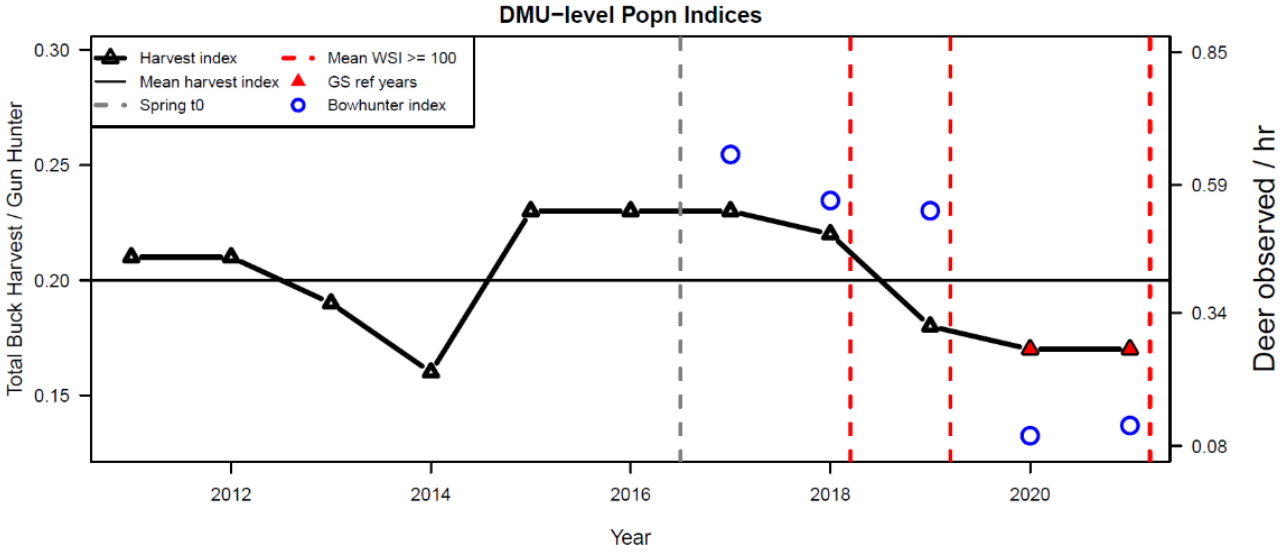


**Figure 7.** The number of bucks harvested per gun hunter (triangles) and total deer observed per hour (circles) to assess deer population trends over time per deer permit area. Spring t0 indicates the starting year used the deer population model (e.g., spring 2017). GS ref years indicates the year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

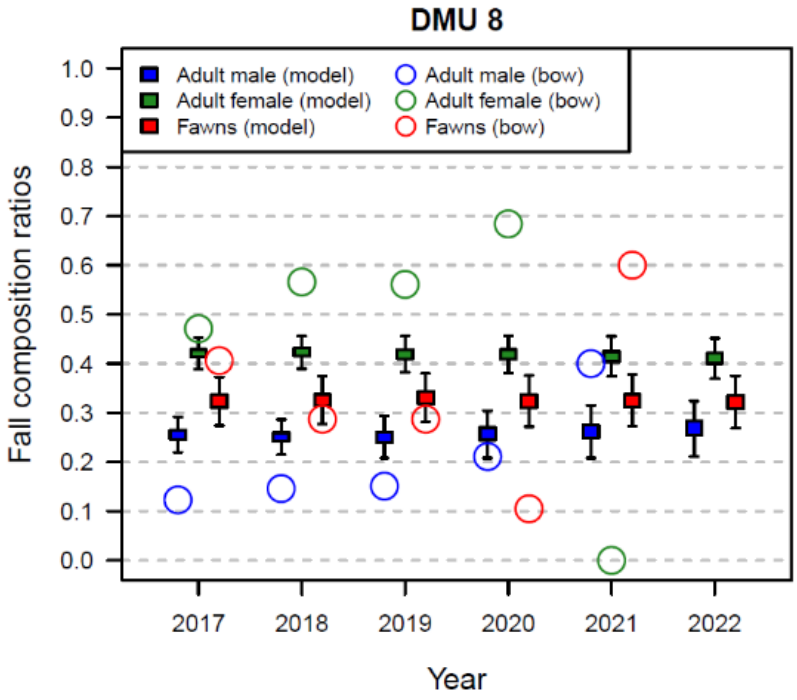


**Figure 8.** Age and sex proportions derived from the deer population model (squares) and from the deer hunter survey (circles). Age and sex proportions are used in the deer population model to estimate deer density for each deer permit area.

## LITERATURE CITED


Bauder, J. M., M. L. Allen, T. J. Benson, C. A. Miller, and K. W. Stodola, Biodiversity and Conservation. doi: 10.1007/s10531-021-02259-8.

Haroldson, B. S. 2014. 2014 white-tailed deer surveys. Pages 29-34 *in* M. H. Dexter, editor. Status of wildlife populations, fall 2014. Unpub. Rep., Division of Fish and Wildlife, Minn. Dept. Nat. Res., St. Paul, Minnesota. 328 pp.

Lumley, T. 2004. Analysis of complex survey samples. Journal of Statistical Software 9:1–19.

Norton, A. S., and W. R. Clark. 2016. 2016 Bow Hunter Observation Survey. Unpub. Rep, Iowa Dept. of Nat. Res., Boone, Iowa.

Michel, E. S., and J. H. Giudice. 2022. Monitoring population trends of white-tailed deer in Minnesota – 2021. Unpub. Rep., Division of Fish and Wildlife, Minn. Dept. Nat. Res., St. Paul, Minnesota.

Norton, A. S. T. R. Obermoller, and L. Cornicelli. 2017. 2017 Bowhunter Observation Survey Report. Unpub. Rep., Division of Fish and Wildlife, Minn. Dept. Nat. Res., St. Paul, Minnesota.

Office of Legislative Auditor (OLA). 2016. Evaluation report, Department of Natural Resources: Deer population management. Program Evaluation Division, St. Paul, Minnesota.

R Development Core Team. 2016. R: A language and environment for statistical computing. Vienna, Austria: R Foundation for Statistical Computing. Retrieved from https://www.R-project.org/ (accessed 1 March 2018).

Rolley, R. E., D. J. Storm, K. B. Wallenfang, and M. J. Tonkovich. 2016. Midwest deer metrics: What, how, and why we measure. Unpub. Rep, Wisc. Dept. of Nat. Res., Madison, Wisconsin 22 pp.

**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 |