



Deposition of Lead Shot on State Lands in Minnesota

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Introduction

This report fulfills the requirements of 2017 Minnesota Session Laws, Chapter 93, Article 1, Section 3, Subdivision 6(c), which states:

Notwithstanding Minnesota Statutes, section 297A.94, \$30,000 the first year is from the heritage enhancement account in the game and fish fund for a study of lead shot deposition on state lands. By March 1, 2018, the commissioner shall provide a report of the study to the chairs and ranking minority members of the legislative committees with jurisdiction over natural resources policy and finance. This is a onetime appropriation.

Objective

The objective of this project was to evaluate lead shot deposition on state lands by small game hunters in Minnesota during the 2017 small game season. We conducted two surveys (a field-based hunter intercept survey and an online small game hunter survey) to gather the information necessary to satisfy the objective. Each survey was designed to collect information needed to estimate lead shot deposition on different types of state-owned public lands. Data from these surveys was used in combination with existing sources of information (e.g., small game license buyer reports, various human dimensions surveys) to scale estimates of lead shot deposition by small game hunters on public lands across Minnesota.

Hunter Intercept Survey

Survey sampling and data collection

We interviewed hunters across three wildlife management areas (Laq qui Parle, Swan Lake, and Talcot Lake) in the farmland region of Minnesota over three consecutive weekends in late November and early December, 2017. Hunters were interviewed by Minnesota Department of Natural Resources wildlife management staff at the end of their hunt. Staff asked a series of questions to assess activities on the Wildlife Management Area that day including target species, type of firearm used, type of ammunition used, number of shots taken, and how many boxes of lead shells they expend in a typical season. Hunters were also asked if they were aware of the Fiscal Year 2017 appropriation made by the Legislature to study lead shot deposition on state lands in Minnesota.

Results

A total of 163 hunters were interviewed across the three wildlife management areas of interest (Laq qui Parle: n=71, Swan Lake: n=50, Talcot Lake: n=42). Most hunters (77%) were not aware of the legislative appropriation to study lead shot deposition on state lands in Minnesota. Pheasants were the primary target species (99%) sought and 84% of hunters were using a 12 gauge shotgun while 15% of hunters were using a 20 gauge shotgun. Over half of the hunters intercepted were using non-toxic shot (56%). Overall, 36% of hunters exclusively used lead shot and less than 1% used a combination of lead and non-toxic. An average of 0.36 lead shells were expended per hunter intercepted at the time of interview.

Small Game Hunter Online Survey

Survey sampling and data collection

The population of interest included all Minnesota residents 18 years of age and older who purchased a 2017 small game license and had an e-mail included with their electronic licensing system (ELS) record. To account for lower response rates associated with internet surveys, we drew a random sample of 8,000 license buyers from a total 46,301 small game hunters who had records with an e-mail address.

We used Qualtrics© (2017) to develop an internet-based survey that was delivered via e-mail using a process outlined by Dillman et al. (2009). We solicited potential respondents in three waves (one initial e-mail and two reminders) on December 11, 18, and 27, 2017. Each wave consisted of a brief, personalized e-mail that explained the study and provided an individual link for the respondent to access the survey. Because the ELS system does not collect information about which small game species individuals pursue, where they pursue them (e.g., farmland vs. forest zones of Minnesota, Figure 1), or what type of lands they hunt (e.g., public or private), our questionnaire included items that addressed these issues, in addition to the type of shotgun used to hunt each species, shot type used, average boxes of shells used annually, and respondent demographics.

Survey response rate

Of the 8,000 questionnaires e-mailed, 394 were returned as undeliverable. Of the remaining 7,606 questionnaires, 2,756 were completed and returned, resulting in an adjusted response rate of 36.2%. Given the timing of the report, we opted to not conduct a non-response survey.

Respondent Demographics

The average age of respondents was 45.6 years old and they have hunted small game an average of 28.4 years. Respondents were predominantly male (96%) and white (97%).

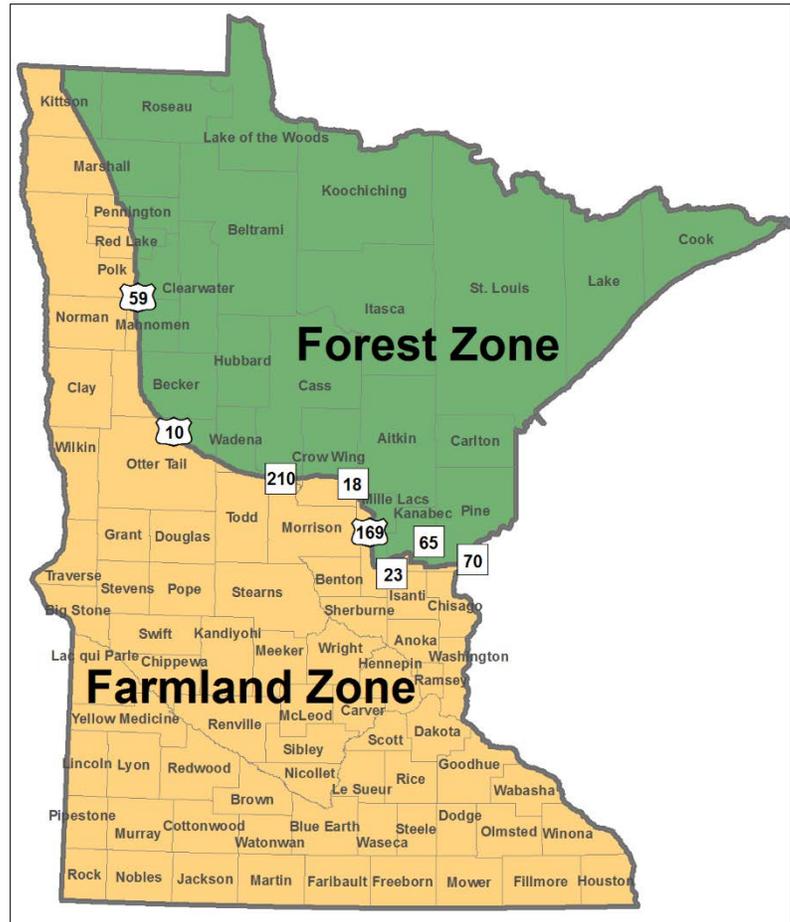


Figure 1. Map delineating farmland and forest zones as presented to online survey participants.

Regional hunter participation

Over half (62%) of respondents hunted small game on state-owned lands in 2017 with 23.3% of respondents hunting small game on state lands in the farmland zone only, 21.8% of respondents hunting small game on state lands in the forest zone only, and 16.9% of respondents hunting small game on state lands in both the farmland and forest zones (Figure 2).

In the farmland zone, the vast majority of respondents who hunted public lands targeted pheasants (82.5%). Almost half of respondents who hunted public lands in the farmland zone targeted grouse (48.4%). Squirrel (20.0%), rabbit (18.4%), woodcock (17.9%), and dove (11.7%) were each targeted by fewer than one-quarter of respondents. Nearly all respondents who hunted small game on state lands in the forest zone targeted grouse (91.5%) while almost half targeted pheasant (42.4%). One-third of respondents targeted woodcock (32.4%) while rabbit (18.7%), squirrel (17.6%), and dove (6.0%) were each targeted by fewer than one-quarter of respondents (Figure 3).

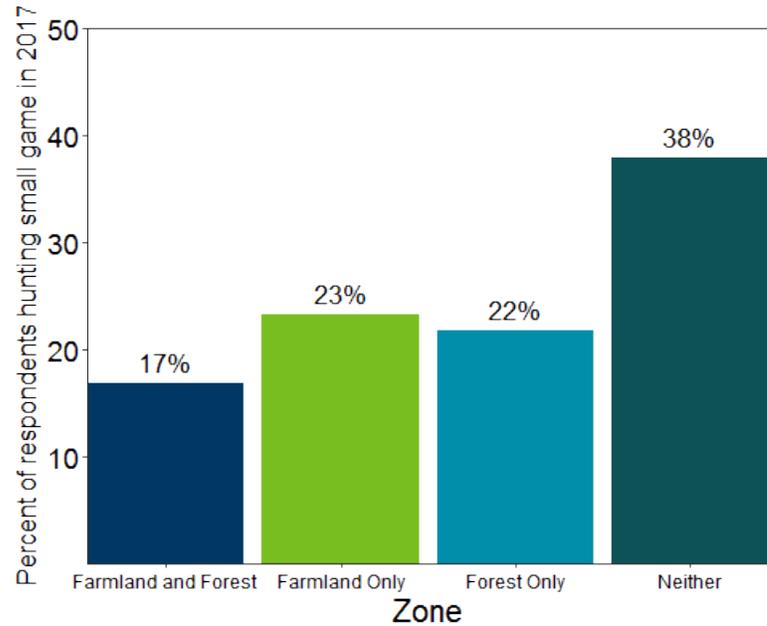


Figure 2. Percent of online survey respondents hunting small game in 2017 by zone (forest, farmland, both forest and farmland, or neither zone).

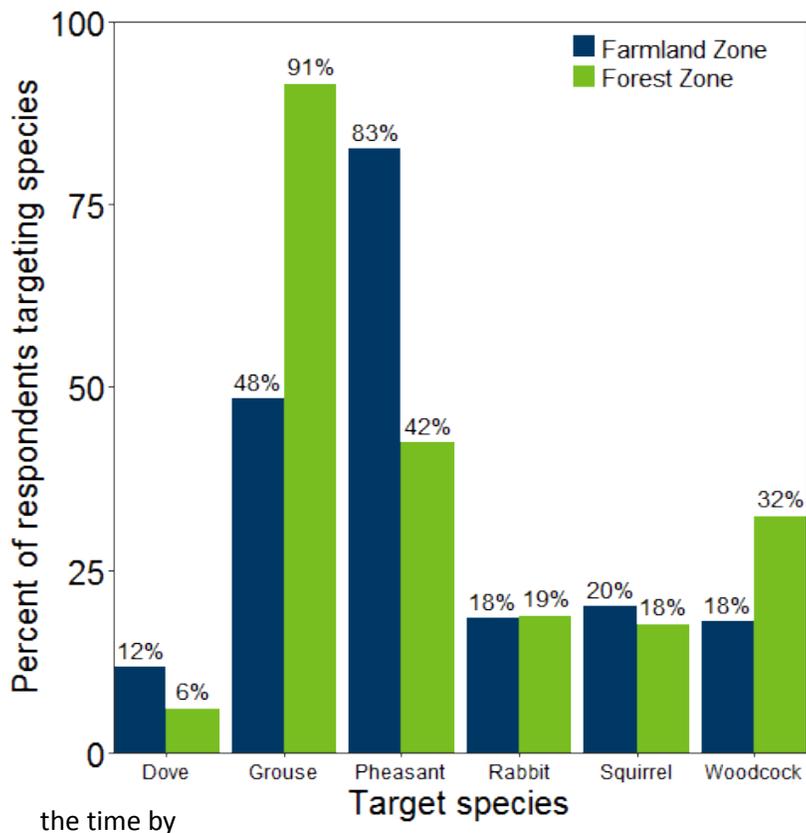


Figure 3. Percent of online survey respondents targeting small game species in the farmland and forest zones. Note that the cumulative percentages are greater than 100% for each zone as survey respondents were asked to select all species they target in each zone

all or most of the time on State Forest lands (39.6% of the respondents). Respondents reported hunting small game a total of 4,603 days on State Forest lands, which was 45.0% of the total days respondents reported hunting small game on public lands. Another 13.9% of respondents hunted on WMAs all or most of the time (21.6% of total days hunted; 2,215 days). Other state lands in the forest zone were hunted all or most of the time by 13.0% of respondents (20.6% of the total days; 2,111 days), and WIA lands were hunted all or most of the time by 8.0% of forest zone public lands hunters (12.8% of the total days; 1,307 days) (Figure 4).

Types of state land hunted [e.g., Wildlife Management Area (WMA), Walk-in Access (WIA), State Forest] varied between zones. In the farmland zone, WMAs were hunted all or most of the time by 48.0% of survey respondents who hunted public lands in the farmland zone. These respondents reported hunting WMAs a total of 5,027 days (46.3% of the total hunting days reported for the farmland zone) in 2017. WIA lands in the farmland zone were hunted all or most of the time by 11.6% of farmland zone hunters and received 36.0% of the total hunting days reported (3,910 days). State Forests in the farmland zone were hunted all or most of the time by 9.4% of farmland zone hunters and received 9.4% of the total hunting days (1,023 days). Other state lands in the farmland zone were hunted all or most of the time by 5.9% of farmland zone hunters for 8.3% of the total small game hunting days on public lands in the farmland zone (907 days).

Alternatively, in the forest zone, small game hunters hunting public lands hunted

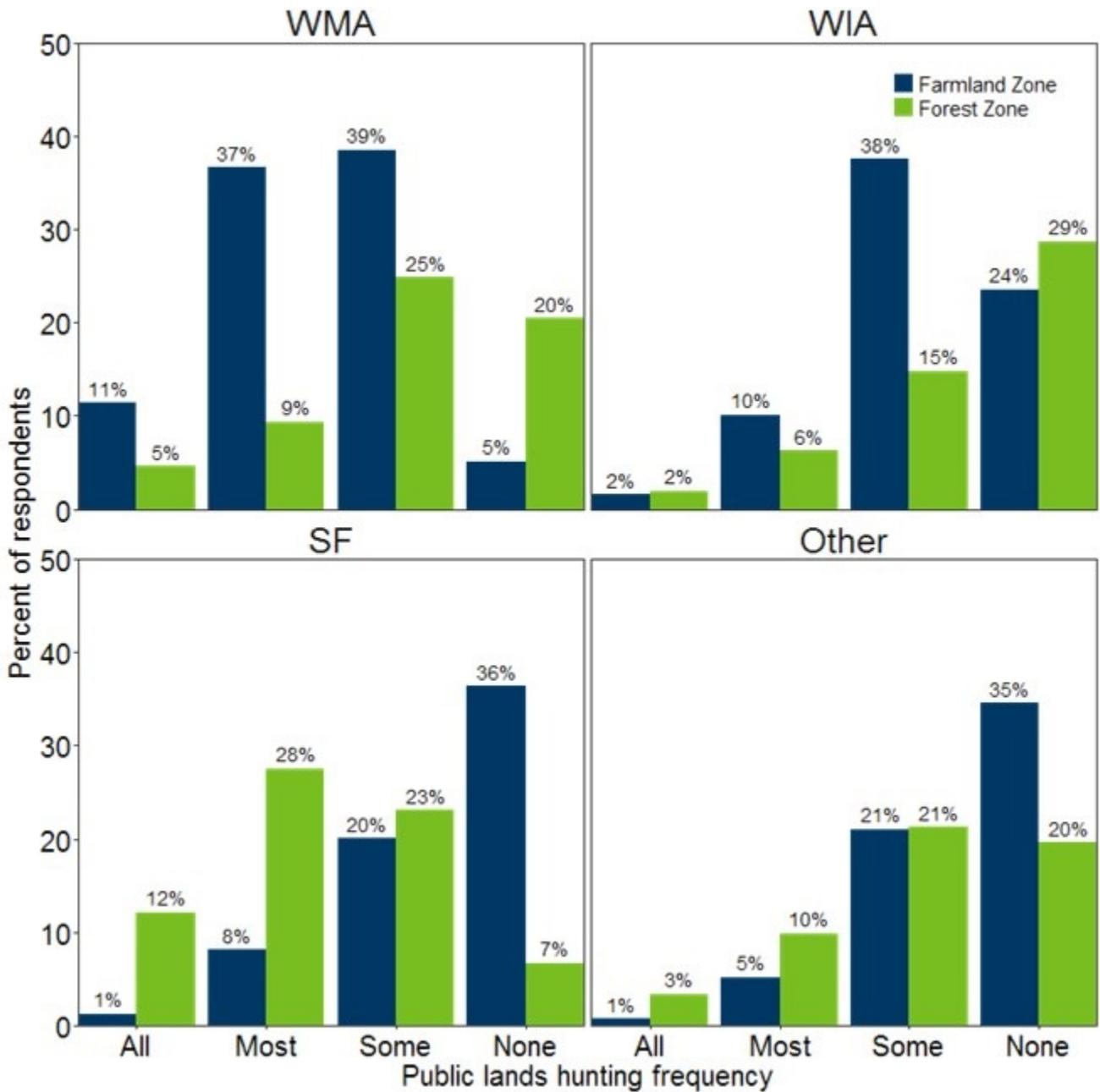


Figure 4. Percent of online survey respondents by frequency of public lands use by type (Wildlife Management Area (WMA), Walk-in Access (WIA), State Forest (SF), and Other) in the farmland and forest zones.

Shotguns and ammunition type used for small game hunting

Survey respondents were asked if they always, mostly, occasionally, or never used lead shot for hunting small game. More than half (57.7%) of respondents always (except for waterfowl) or mostly use lead shot while 21.3% never use lead. Although the results presented here are similar to results from a study of lead shot use in Minnesota conducted by Schroeder et al. (2008), hunters always or mostly using lead seem to be declining (66.7% in 2008) and those never using lead seem to be increasing (13.6% in 2008). Use of lead shot varied by target species (Figure 5); however, for the six small game species of interest, the majority of respondents reported they generally used lead while pursuing each of those species. Respondents pursuing grouse had the

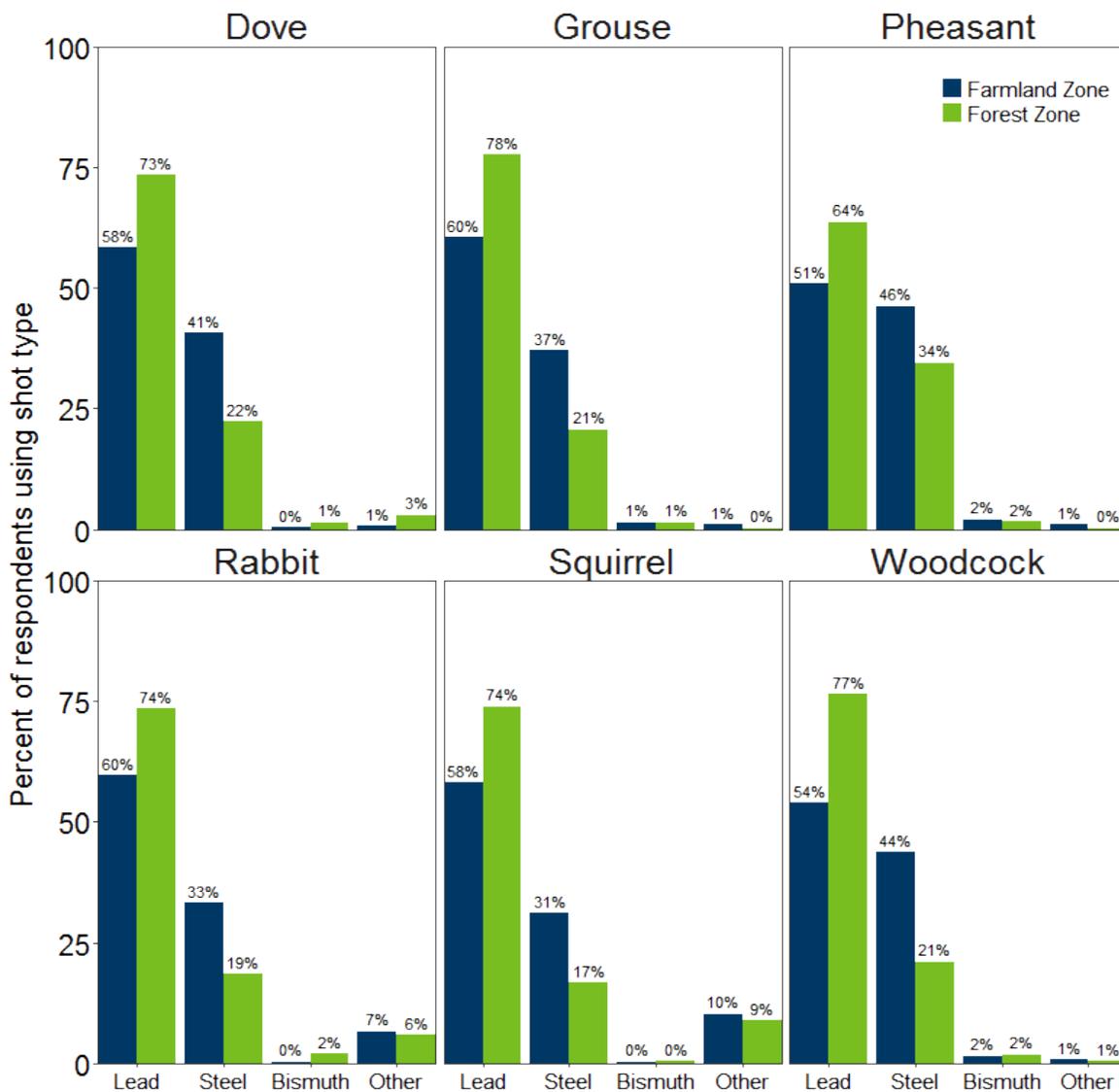


Figure 5. Percent of respondents in the farmland and forest zones most often using lead, steel, bismuth, or other shot types when pursuing dove, grouse, pheasant, rabbit, squirrel, and woodcock.

highest rate of lead use at 71.6%, followed by those hunting woodcock (63.9%), squirrel (62.5%), rabbit (62.2%), dove (61.2%), and pheasant (54.5%).

Shotgun type varied slightly by species targeted but regardless of target species, 12 and 20 gauge shotguns were the most frequently used, respectively (Table 1).

Table 1. Shotgun type generally used by online survey respondents when targeting small game species in Minnesota.

	n	% of respondents who used the following shotgun:					
		.410	28 gauge	20 gauge	16 gauge	12 gauge	10 gauge
Pheasant	1293	0.2%	0.1%	12.5%	1.2%	85.8%	0.2%
Grouse	1256	2.9%	1.6%	27.8%	1.8%	65.7%	0.2%
Woodcock	641	1.7%	3.1%	29.5%	2.5%	63.0%	0.2%
Dove	429	3.3%	1.4%	22.8%	1.2%	71.3%	0%
Rabbit	411	10.7%	0.7%	24.6%	1.5%	62.0%	0.5%
Squirrel	317	14.5%	0.9%	21.5%	0.9%	61.8%	0.3%

Respondents were asked at two levels to estimate the number of boxes of lead shotgun shells used in a typical season in the farmland and forest zones. First, respondents were asked to estimate their overall lead shot use (total for both public and private lands) over the course of a typical season when hunting pheasant, grouse, woodcock, dove, rabbit, and squirrel. Grouse hunters in the forest zone had the highest rate of lead shotgun shell use at 25 shells/hunter/season, followed by pheasant hunters in the farmland zone (24 shells/hunter/season) (Table 2).

Second, respondents were also asked to report the total number of boxes of lead shotgun shells they use in a typical season on various state land types (regardless of target species) in the farmland and forest zones (Table 3). Respondents hunting State Forest lands in the forest zone had the highest rate of lead shotgun shell use at 18.0 shells/hunter/season followed by WMA hunters in the farmland zone at 15.4 shells/hunter/season.

Table 2. Lead shot use in a typical season by online survey respondents by target species in total boxes (25 shells/box) and average number of shells per hunter per season in the farmland and forest zones in Minnesota (public and private lands combined).

Estimated lead shotgun shells used in a typical season (public and private lands combined)						
	Farmland Zone			Forest Zone		
	n	Total # of boxes	Average shells/hunter/season	n	Total # of boxes	Average shells/hunter/season
Pheasant	927	890	24.0	525	181	8.6
Grouse	585	223	9.5	882	893.5	25.0
Woodcock	445	69.5	3.9	509	230	11.3
Dove	449	298.5	16.6	373	42.5	2.8
Squirrel	444	97.5	5.5	412	133	8.1
Rabbit	446	121	6.8	424	123	7.3

Table 3. Lead shot use in a typical season by online survey respondents by public lands type in total boxes (25 shells/box) and average number of shells per hunter per season in the farmland and forest zones in Minnesota.

Estimate of lead shotgun shells used in a typical season on state lands only						
	Farmland Zone			Forest Zone		
	n	Total # of boxes	Average shells/hunter/season	n	Total # of boxes	Average shells/hunter/season
WMA	1093	672	15.4	826	353	10.7
WIA	826	250.5	7.6	706	164.5	5.8
State Forest	735	209.5	7.1	966	695.5	18.0
Other	687	104.5	3.8	730	315.5	10.8

Estimating lead shot deposition on state lands in Minnesota

Information collected through the hunter intercept and online surveys summarized here was extrapolated with information known about licensed 2017 small game hunters to estimate lead shot deposition on state lands in Minnesota. Although these estimations are data-based, there are assumptions and constraints that must be acknowledged:

1. Respondents to the online small game hunter survey are assumed to be representative of the small game hunting population in Minnesota. It is important to note that the online survey in particular may contain biased information as small game hunters are not required to provide an e-mail address when purchasing a license through the electronic licensing system. Thus, individuals with e-mail address on file may not represent the small game hunting population as a whole. However, demographic information provided by survey respondents is similar to the demographics of the population buying a small game license age 18 or older. The average age of respondents to the online survey was 45.6 years old and the average age of small game license holders age 18 or older is 45.9 years old. Male respondents accounted for 96% of online surveys submitted. Minnesota small game license holders age 18 and older are comprised of 94.8% male and 5.2% female buyers. Due to time constraints associated with this report, a non-response survey was not conducted.
2. Responses to the hunter intercept survey are biased toward pheasant hunters, specifically on large wildlife management areas. Companion interviews of grouse hunters on state forests were not conducted, nor were the data replicated on smaller, more dispersed areas. Consequently, estimates of lead deposition using this method cannot be extrapolated beyond the parcels where the interviews occurred. Thus, we do not present these results in this report.

Lead deposited on state lands by small game hunters in 2017

Extrapolation of results from the online small game hunter survey summarized above allows for an estimate of lead deposited in 2017 on state lands by small game hunters. Survey respondents indicated the number of boxes of lead shotgun shells (25 shells to a box) they use in a typical season while hunting on wildlife management area, walk-in access, State Forest, and other state lands in the farmland and forest zones.

We estimated lead deposition on state lands using the following information:

- We calculated the average number of shells used per hunter per season from the number of boxes of lead shotgun shells survey respondents estimated they used in a typical season.
- We estimated the number of hunters using each public land type in each zone by multiplying the proportion of survey respondents who reported expending lead shotgun shells on each public lands type in each zone by the total number of small game license purchasers in 2017 who were 18 or older.
- We estimated the total number of lead shotgun shells expended on each public land type in each zone by multiplying the estimate of hunters by public land type and zone by the average number of lead shotgun shells expended per hunter per season.
- Given information on popular loads for shotgun shells typically used while hunting small game species, we estimated each shotgun shell held 1oz of lead.

- We multiplied 1oz by the estimated total shotgun shells expended to produce an estimate of tons of lead deposited on state lands by small game hunters in 2017.

In total, we estimated that 178 tons (357,048 pounds) of lead were deposited on state lands during the 2017 small game hunting season. State Forests in the forest zone and WMAs in the farmland zone were the public lands types where the most lead was deposited (44.9 and 43.3 tons, respectively) (Figure 6).

For context, a cubic yard (yd³) of lead weighs 19,089 pounds, so the estimated 2017 deposition represents approximately 18.7 yd³ of lead deposited on state lands. In looking at lead pellets by volume, rather than weight, the amount equals 36.7 yd³ of number 6 shot:

$$\frac{(\text{pounds deposited} * \text{pellets per pound})}{\left(\left(\frac{12}{\text{pellet diameter}}\right)^3\right) * 27} = 36.7$$

We also acknowledge a large degree of uncertainty in this estimate and because we used percentages to generate a total, we cannot apply confidence intervals around the estimate. For example, we used 1 ounce of shot as an average, even though shot weight varies by species hunted and gauge of shotgun used. We also had to estimate participation on various land types, along with the estimates individuals provided for lead shot use.

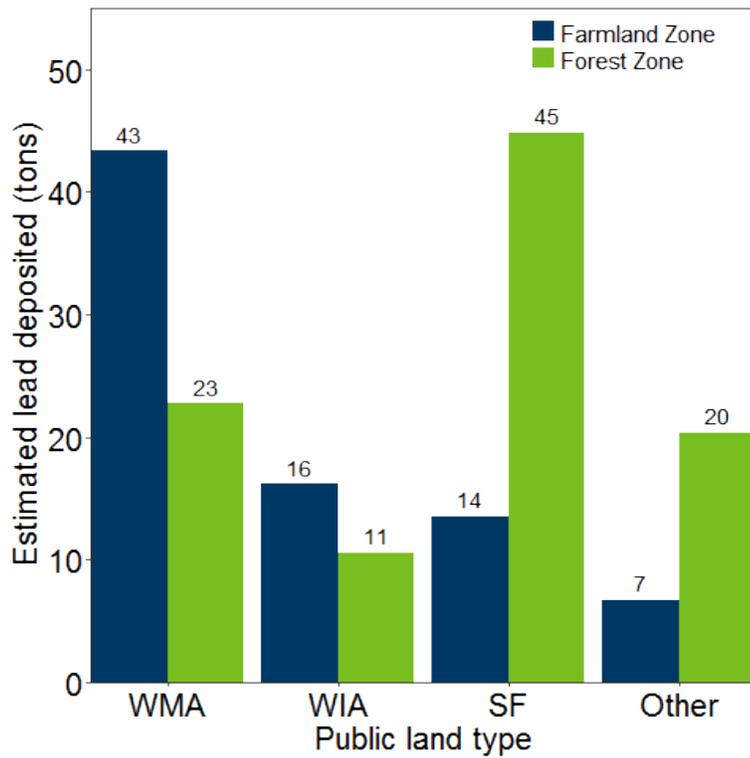


Figure 6. Estimated lead deposited (tons) by small game hunters on public lands in 2017 by public lands type (Wildlife Management Area (WMA), Walk-in access (WIA), State Forest (SF) and other public lands) in the farmland and forest zones of Minnesota.

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