Retrieval and loss rates of white-tailed deer by Minnesota bowhunters

Wendy J. Krueger, Jay B. McAninch, and David E. Samuel

Abstract Controversy regarding bowhunting has increased in recent years. Bowhunting opponents have primarily been concerned with the reported number of deer wounded and left in the field. Data on the topic have been limited and of variable quality, with wounding rates ranging from 7-62%. We interviewed bowhunters and examined harvested white-tailed deer (*Odocoileus virginianus*) during the 1992 and 1993 bowhunts at Camp Ripley, Minnesota to determine the number and outcome of all shots taken by hunters. Approximately 7,300 bowhunters participated in 4, 2-day hunts (1,307-2,107 archers per hunt). Retrieval rates averaged 87% of total deer hit during the hunts. The average percentage of total deer known to have been hit that could not be accounted for was 13%. The 13% loss rate was considered a maximum estimate of unretrieved mortality since deer that were lost could have been hit by more than 1 hunter. Also, it is likely that some unretrieved deer did not die. The results of this study suggest bowhunting can be an efficient and effective means of managing some deer populations.

Key words bowhunting, interviews, *Odocoileus virginianus*, white-tailed deer, wounding

Efforts to restrict bowhunting have been successful in New Jersey, Colorado and California, among other states (Samuel et al. 1991). Bowhunting opponents have reported that archers wound an excessive number of deer and claim that most die painful and lingering deaths (Pacelle 1990). The claims that bowhunting is inefficient and inhumane led to a request to ban bowhunting in Minnesota in 1991. Although the Minnesota Department of Natural Resources (MN DNR) denied the ban request, the need to investigate the wounding of deer by bowhunters had been established.

Common terms found in the bow wounding literature include "crippling loss" (Lohfeld 1979), "crippling rate" (Gladfelter et al. 1983), "wounding loss" (Herron 1984) and "wounding rate" (McPhillips et al. 1985). The following equation has been commonly cited for calculating a reported "wounding" rate and used to present wounding data collected from hunters:

Reported Wounding Rate = (Hits/(Tagged + Hits)) x 100

Where: Hits = number of reported hits (unretrieved); Tagged = number of legally harvested deer.

Use of this equation assumes that there is 1 wounded deer for every reported hit.

The majority of bow wounding data have been taken from hunter responses to personal interviews or mail questionnaires about their hunting experiences (Samuel et al. 1991). Wounding rates of 7% (Severinghaus 1963), 44% (Croft 1963), 48% (McPhillips et al. 1985) and 62% (Langenau 1986) have been reported from questionnaire studies. In Minnesota, mail surveys by Landwehr (1982) and Schultz (1983) found that 54% and 49%, respectively, of the deer reportedly hit by bowhunters were not retrieved. Boydston and Gore (1987), Lohfeld (1979) and Herron (1984) found wounding rates of

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50%, 55% and 35%, respectively, based on interviews conducted at the study sites.

In 2 studies where ground searches for unretrieved deer were conducted after a hunt, Lohfeld (1979), in New Jersey, found that 11% of the total bow hunting mortalities were left in the field. Herron (1984), in Wisconsin, found that 9% of the total deer reportedly hit by bowhunters were unretrieved losses.

The survey methodology used in past questionnaire studies did not classify the severity or certainty of reported hits. The main objective in our study was to determine the number and fate of shots taken by bowhunters.

Study area

Camp Ripley is a 21,417-ha (52,921-ac) National Guard and Army Reserve training post located in Morrison County in central Minnesota. The Camp lies in the transition zone between the northern forest and southern prairie and ranges from rolling hills and valleys to flat areas. The Mississippi River and Crow Wing River border the Camp on the east and north, respectively, and a 1.2-m (4-ft) barbed wire fence extends around the perimeter of the Camp on the south and west. A well-developed network of roads exists throughout the 29.0 km length (18 mi) and 11.3 km width (7 mi) of the Camp. Approximately 16,092 ha (62 mi²) are accessible for hunting within Camp Ripley.

Fall archery hunts for white-tailed deer (*Odocoileus virginianus*) have taken place at Camp Ripley almost every year since 1954. No hunting was allowed in 1971, 1976 or 1980. With the exception of firearms hunts in 1957 and 1960, and a limited Disabled Veteran's firearms hunt initiated in 1992, only bowhunting has been allowed. Annual

Figure 1. Conceptual framework for the fate of deer reportedly hit by bowhunters.

bowhunts have ranged from 45 continuous days to the present pair of 2-day hunts. The Camp Ripley hunts attract hunters from across the country, primarily due to the Camp's reputation as a renowned trophy hunting area that has produced over 50 Pope and Young Record Book bucks.

Camp Ripley was chosen as the site for this research because the high concentration of bowhunters and strictly controlled access (1 entry and exit point) facilitated the collection of data on deer and from hunters. The high density of the deer population at Camp Ripley (8-15 deer per km²) and the large hunter population (1,500-2,000 hunters per hunt) were considered essential to ensuring that significant harvest and wounding would actually occur in the field. In addition, a 1991 pilot study established excellent cooperation among the MN DNR and Camp Ripley staff and the bowhunter population.

Methods

Terminology

Although the terms wounding and crippling are used in the literature, problems arise when these terms are taken literally. For example, the word wound is defined as "an injury to the body consisting of a laceration or breaking of a membrane (as the skin) usually by a hard or sharp instrument forcefully driven or applied" (Webster's Seventh New Collegiate Dictionary 1965). Cripple is defined as "to deprive the use of a limb and especially a leg; to deprive of strength, efficiency, wholeness or capability for service" (Webster's Seventh New Collegiate Dictionary 1965).

If hunters are not asked specific questions regarding hits on deer that were not retrieved, the assumption cannot be made that a deer reported hit by a bowhunter was wounded or crippled in the true definition of the words. For example, an archer whose arrow clips hair off a deer might report that he "hit" the deer, even though he does not consider the deer to be "wounded". Further, hunters may have their own interpretations of these terms which can lead to improper reporting of the fate of deer presumed to have been hit. Our methodology was designed to focus especially on the fates of deer known to have been hit by an arrow.

We developed a conceptual framework for this study that summarized the fate of deer reportedly hit by bowhunters (Figure 1). Langenau and Aho (1983) illustrated the potential fate of a deer hit during hunting season. However, many of the potential outcomes they described cannot be easily measured, such as illegal kills and abandonment of
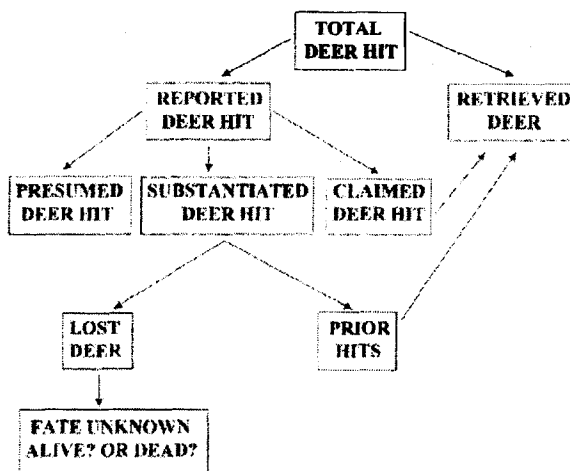
a deer by a hunter. Our framework was intended for operational use in the field and thus, we sought to quantify the terms shown.

McCaffery (1985) recognized the terminology problems associated with wounding literature and offered definitions for commonly used terms. McCaffery's work provided the basis for development of the following definitions used in this study.

TOTAL DEER HIT: Reported Deer Hit (Unretrieved) + Retrieved Deer

REPORTED DEER HIT: A deer that the hunter reported as having hit, but the hunter did not retrieve the deer. Reported deer hit were categorized as follows:

PRESUMED DEER HIT: The hunter reported hitting a deer and observing that the deer limped, jumped, walked or ran abnormally or otherwise exhibited behavior presumed to be associated with an arrow wound. No direct evidence that the deer had been hit was reported by the hunter. This category was used to isolate and further define known hits (Substantiated, below).

SUBSTANTIATED DEER HIT: The hunter reported hitting a deer and finding the arrow with blood or hair on it, finding blood or hair near the location of the hit, seeing a wound or arrow in the deer, or other direct evidence that the deer was hit.

CLAIMED DEER HIT: The hunter reported hitting a deer and claimed it was retrieved and/or tagged by another hunter.

RETRIEVED DEER: A killed deer removed from the field by a hunter.

PRIOR HITS: The arrow hits found on a retrieved deer that were not inflicted by the hunter who retrieved the deer, but from the current year's hunt. Prior hits are assumed to represent a portion of substantiated deer hit.

LOST DEER: Reported deer known to have been hit that could not be accounted for after subtracting prior hits. The fate of these lost deer is unknown; they could have died or survived; Lost Deer = Substantiated Deer Hit - Prior Hits

RETRIEVAL RATE: The percentage of deer hit that were retrieved by hunters; Retrieval Rate = (Retrieved Deer/(Retrieved Deer + Lost Deer)) x 100

LOSS RATE: The percentage of deer hit that were unretrieved by hunters; Loss Rate = 100 - Retrieval Rate

Camp Ripley hunt program

Two-day hunts were conducted during 31 October-1 November 1992, 21-22 November 1992, 21-22 October 1993, and 30-31 October 1993. Individuals (or hunting parties of up to 6 members who hunt together) applied to hunt during 1 of the 2-day seasons in each year. Hunting permits were awarded based on a preferential lottery system. Typically, a hunter who applied every year was selected every other year.

All state archery regulations were in effect during the Camp Ripley hunts. Deer taken from Camp Ripley had to be registered and tagged at a MN DNR check station located at the Camp Ripley hunter entry and exit point. The Minnesota archery hunting license necessary to hunt the Camp was also valid throughout Minnesota during the regular archery season.

In early September, hunters received a permit that allowed tagging of 1 deer of either sex (party hunting, i.e., killing a deer for another member of the hunting party who has an unused tag, was allowed). Maps of Camp Ripley delineating areas open to hunting were provided, but no scouting was permitted prior to the hunts. Access to hunting areas was allowed after 0500 hours, and hunting could start 30 minutes before sunrise on each day of all hunts. Vehicle license plate numbers and the names of all occupants in each vehicle were collected as hunters entered through the MN DNR check station. Hunters were allowed to

Table 1. Hunters participating, retrieved deer, success rates and hunter density during the 4 Camp Ripley, Minnesota bowhunts from 1992-93.

| | Date of hunt | | | | |
| | 1992 | | 1993 | | |
Variable	31 Oct-1 Nov	21-22 Nov	21-22 Oct	30-31 Oct	Mean
Total hunters (N)	1,859	1,307	2,107	2,020	1,823.3
Retrieved deer (N)	248	158	190	97	173.3
Success rate (%)	13.3	12.1	9.0	4.8	9.8
Hunter density (hunters/km^2)	11.0	7.7	12.5	11.7	10.7

hunt until sunset and they were instructed to exit the check station each day by 1 hour after sunset.

Data collection personnel

Data collection teams were maintained as consistently as possible during the 4 hunts of the study. Hunter interviews and deer examinations at Camp Ripley involved 13 staff in 1992 and over 20 staff in 1993. Personnel consisted of wildlife biologists, student interns and temporary staff from the MN DNR, and wildlife/biology student volunteers recruited from local colleges.

Training was provided for data collection staff during a 3-hour orientation session prior to the Camp Ripley hunts. Inexperienced interviewers "shadowed" an experienced interviewer to learn the style and flow of the interview process. Once trained, new interviewers were allowed to conduct interviews independently.

Data collection from hunters

Hunters were interviewed as they exited the hunting area each day through the MN DNR check station. To maximize the number of hunters interviewed, exiting vehicles were organized into lanes, which also maintained a smooth traffic flow. Since hunters who harvested deer were not allowed to exit until their deer were registered, we interviewed successful hunters while they registered their deer.

We used a stratified 2-stage sampling design, similar to the access point survey method used by fisheries creel clerks (Pollock et al. 1994) to interview hunters who did not retrieve a deer. This group of hunters was interviewed in their vehicles at interview stations set up along the exit route. Individual hunters within each vehicle were interviewed separately. When the wait for any vehicle exceeded 30 minutes, those vehicles were allowed to exit without the occupants being interviewed.

Since wounding of deer is a sensitive issue, hunters were not asked directly if they "wounded" a deer. Instead, hunters were allowed to discuss their activities for the day and the number and outcome of all shots taken was recorded for each hunter.

When hunters reported hitting a deer that they did not retrieve, more details were obtained regarding the circumstances of the reported deer hit. Based on information provided by the hunter, the reported deer hit was classified as either a presumed, substantiated, or claimed deer hit (see Terminology).

Data collection from retrieved deer

Retrieved deer were examined at the MN DNR check station. Successful hunters verified the location of their shot(s) on the deer and helped identify prior hits.

Statistical analysis

Data collected during hunter interviews were summarized by hunter on a daily basis. Since each hunt lasted 2 days, days were considered to be strata and the hunt totals and proportions were computed over the 2 strata, for each hunt (Levy and Lemeshow 1991). First days of hunts were different than second days (reduced number of hunters, different weather conditions, etc.), so we increased precision and reduced variability by treating days as strata. In some cases, the means of these estimates were computed over the 4 hunts to yield a single summary statistic. In such cases, the hunts themselves were treated as an additional level of stratification.

All estimators required the assumption that samples of n hunters were independently and randomly selected from N hunters who entered Camp Ripley daily, during each hunt. Formulae were modified from Thompson (1992). Estimates were generated for total numbers of reported deer hit, substantiated deer hit, presumed deer hit and claimed deer hit. Likewise, based on the sample of retrieved deer, estimates were generated for prior hits.

Retrieval and loss rates were calculated for each hunt. Since these rates involved ratios of sums, differences, or products of random variables estimated from the interview data, their variances were sometimes complex. The first order Taylor series approximation (delta method; Seber 1982) was used to obtain the variance estimator for each of the rates. From these, we used expressions for the standard errors to form 95% confidence intervals about the rate estimates. Data were analyzed using SAS software (SAS Institute, Inc. 1989).

Results and discussion

General hunt information

Weather varied between days and hunts producing a variety of hunting conditions. In 1992, all hunting days were cloudy with minimum temperatures around -1.1° C (30° F) and winds over 16 km/hr (10 mph). All but the last day of hunting in 1992 (22 Nov) had snowfall or snow on the ground. In 1993, daily temperatures ranged from -10.6 to +18.3° C (13-65° F) with only a trace of snow on 30 October. Conditions varied from clear to cloudy with winds up to 40.3 km/hr (25 mph).

Tree stand hunting (>83% of hunters) with compound bows (98% of hunters) was the predominant choice by hunters during each hunt of the study. Antlered deer composed 52% of harvested deer over all hunts and 61% of reported deer hit

with known identity were adult bucks. The affinity for antlered bucks was apparent at Camp Ripley and was likely due to the Camp's reputation as a trophy buck area.

The number of Camp Ripley archery permits available for each 2-day hunt in 1992 and 1993 was 2,250 and 2,500, respectively. Approximately 7,300 archers hunted during the entire study (Table 1). Hunt success rates ranged from 5-13% and averaged 10% over all hunts (Table 1). The presence of snow seemed to be the primary weather factor enhancing hunter success. Hunter density in the huntable area of Camp Ripley ranged from 7.7-12.5 hunters/km^2 (20-33 hunters/mi^2) and averaged 10.7 hunters/km^2 over the 4 hunts (Table 1).

Although 1 weekday hunt occurred, there is no evidence to support that the weekday hunt was any different than the weekend hunts. The Camp Ripley hunt is highly desired, so if hunters are chosen, they will generally participate whether it is a weekday or weekend hunt.

An average of 63% of all hunters were interviewed per day and 99% of retrieved deer were examined (Table 2). A higher percentage of hunters were interviewed on second days of hunts because hunters left the field throughout the day as compared to first days of hunts when most hunters exited after sunset.

Face-to-face interviews proved to be an effec-

tive means of collecting reliable and precise hunting information. Camp Ripley hunters were accessible and extremely cooperative throughout the study. Only 3 hunters refused to be interviewed. The immediacy and style of the hunter interview process was important for eliminating or reducing memory and prestige biases. In most other studies, hunter surveys were completed days, weeks, or even months after the hunt without follow-up questioning.

Outcome of shots taken

Estimated total deer hit during the 4 hunts ranged from 139-331 (Table 3). The proportion of total deer hit that were retrieved each hunt ranged from 70%-75% and averaged 72%. Alternatively, the mean proportion of reported deer hit (unretrieved) estimated from the interview data was 28% of total deer hit (Table 3).

"Substantiated deer hit" accounted for an average of 68% of reported deer hit over all hunts (Table 3). An average of 28% of reported deer hit were "claimed deer hit" and an average of 4% were classified as "presumed deer hit" (Table 3). Clearly, most Camp Ripley hunters were able to determine if a shot they took resulted in a hit (i.e., found sign). Similar results were found in Michigan by Westcott and Peyton (1986) where only 1% of questionnaire respondents were uncertain if their shot hit or

Table 2. Successful and unsuccessful hunters interviewed and retrieved deer examined during each day of the 4 Camp Ripley, Minnesota bowhunts from 1992-1993.

	Date of hunt								
	1992				1993				
Variable	31 Oct	1 Nov	21 Nov	22 Nov	21 Oct	22 Oct	30 Oct	31 Oct	Mean
Total hunters (N)	1,859	1,696	1,307	1,173	2,107	1,937	2,020	1,766	1,733.1
Successful hunters interviewed[a]	159 (95%)	79 (98%)	90 (100%)	67 (99%)	119 (100%)	71 (100%)	47 (100%)	50 (100%)	85.3 (98.9%)
Unsuccessful hunters interviewed	401 (24%)	1,219 (76%)	389 (32%)	783 (71%)	1,105 (56%)	1,379 (74%)	1,371 (70%)	1,556 (91%)	1,025.4 (61.5%)
Retrieved deer (N)	167	81	90	68	119	71	47	50	86.6
Deer examined	159 (95%)	79 (98%)	90 (100%)	67 (99%)	119 (100%)	71 (100%)	47 (100%)	50 (100%)	85.3 (98.9%)

[a]Hunters who retrieved >1 deer.
[b]Hunters who did not retrieve a deer.

missed the deer.

Claimed deer hit complicated the data and were likely a function of the party hunting rule and of the high hunter densities at Camp Ripley. In future studies, we recommend that the claimed deer hit category be eliminated and the claimed deer hit be included with either the presumed or substantiated deer hit based on the criteria established, or verified as retrieved deer. In lower hunter density locations, hunters would typically have no idea if another hunter retrieved a deer they had hit.

The mean number of prior hits found on retrieved deer during the 4 hunts was 21 per hunt. An average of 45% of substantiated deer hit were accounted for as prior hits over the 4 hunts (Table 3). Approximately 10% of all retrieved deer bore evidence of a prior hit. More than 1 prior hit was found on 10 retrieved deer (<2%).

Two other bowhunting studies, both completed on national wildlife refuges in Michigan, have investigated the presence of prior hits using mail questionnaires. Westcott and Peyton (1986) reported 16% of retrieved deer had evidence of a previous wound on a study site with higher than normal hunter densities. However, the respondents were not required to report on the type of wound or the degree of healing. Therefore, archery wounds were not differentiated from other wounds or able to be associated with a particular hunt, so no wounding rate adjustment could be applied.

Langenau (1986) reported evidence of former wounding for 15% of harvested deer. An adjustment for wounding rates was estimated based on reported multiple hits on single deer. However, no evidence was required from the bowhunters to confirm reported deer hit, so the adjusted wounding rates may still be inflated.

Evaluating shots taken by bowhunters is a complicated process. Past studies have tended to oversimplify this process by not accounting for all of the hunter's activities and potential outcomes of shots taken. One important finding was that some of the deer reportedly hit but not retrieved were actually killed and retrieved by other hunters. The net effect of this finding was that retrieval rates were higher. Future attempts to collect wounding data must carefully consider all hunter responses and potential outcomes of shots taken and the fate of deer reportedly hit.

Retrieval and loss rates

Retrieval rates of deer known to have been hit during the 4 hunts ranged from 83-92% with a mean of 87%. Corresponding loss rates (percentage of deer hit that were unretrieved) ranged from 8-17% with an average of 13% (Table 4). The loss rates

can be considered maximum estimates of unretrieved mortality for 2 reasons. First, loss rates do not account for the possibility that unretrieved deer may have been reported unretrieved by more than 1 hunter. Second, the loss rates included deer that were hit, but survived along with deer that were hit and died.

Our loss rates, representing maximum potential unretrieved mortality, closely compare with field searches by Herron (1984) and Lohfeld (1979) who found unretrieved deer mortality averaged 9% and 11%, respectively. During a controlled archery hunt in Connecticut, Kilpatrick and Walter (1999) reported that bowhunters retrieved 83% (19 of 23) of fatally hit radio-collared deer. In another telemetry study conducted in Missouri from 1989-1996, 15 of 18 (83%) deer that died as a result of archery hunting were retrieved by the hunter (L. Hanson, Missouri Department of Conservation, unpublished data).

If we had assumed each reported deer hit resulted in an unretrieved wounded deer, as past hunter survey studies have suggested, the mean estimated traditional "wounding" rate would have been 28%. However, our mean 13% loss rate incorporated detailed information from the hunters as well as from the retrieved deer. Use of prior hit data proved essential for calculating loss rates and providing a more accurate representation of a "wounding" rate. Without adjusting for retrieval by other hunters, the wounding rates reported in other studies imply that loss is greater than is actually the case. In our study, loss rate was less than half of the reported wounding rate.

Reported wounding rates would have been inflated if hunters had reported hits on deer that were actually misses, and if hits on deer that survived were included with hits on deer that died and were unretrieved. Further, a single deer with multiple hits that was harvested or that was unretrieved would have confounded the reported hit data. On the other hand, hits that were not reported, or hits that hunters thought were misses would result in underestimates of unretrieved deer.

Our estimates of reported deer hit were generated with the assumption that there was no bias associated with the hunters who were not interviewed. With our stratified 2-stage sampling design, for the sample to be biased, there would need to be a strong intra-correlation within vehicles. Hunters within vehicles would have to have a higher or lower propensity to wound deer. However, hunters who were not interviewed were not considered a source of bias since no criteria associated with their hunting behavior were used to discriminate between them and the hunters that

were selected for interviews. Also, estimates of prior hits were considered unbiased because an average of 99% of all retrieved deer from all hunts were examined. Therefore, we feel that the sampled population is representative of bowhunters at Camp Ripley.

It would be a logistical nightmare to collect wounding data in the field during regular bowhunting seasons which take place from sunrise to sunset and last many weeks to several months. The controlled Camp Ripley hunt provided a means to accurately collect wounding information. Higher hunter densities and the short season at Camp Ripley may have increased the pressure to kill a deer, which may have also increased the probability of longer or riskier shots and for more deer to be hit and unretrieved. Alternatively, the high hunter density conditions made it more likely that deer hit by 1 hunter may be hit or retrieved by another hunter. In typical archery hunting situations, the number of retrieved deer with prior hits would likely be less than the 10% found at Camp Ripley. These limitations should be considered when applying Camp Ripley results to other situations.

Management implications

Standard terminology is critical for interpreting and comparing wounding information. New terms introduced in this study were intended to help classify all of the information collected from hunters and the deer that they hit and killed.

Although the definitions may add to the complexity of the wounding issue, people must think carefully about the terms they use to describe the outcome of shots taken at deer.

Wounding information is difficult to obtain. Field studies are labor intensive and information from hunters relies on their ability to observe and recall events that happened while in the field. Hunter exit surveys can be cost-effective and will reduce recall and prestige bias as well as non-response rates. Regardless of survey type, sufficient detail must be collected during hunter surveys. Simple, direct questions such as, "Did you wound a deer?" are inadequate for accurate interpretation of the fate of shots taken.

Several features of hunting programs can be managed to minimize the potential for deer to be lost. The season length may have an important role in determining hunter behavior. The type of land where the hunt occurs, whether public or private, may also influence the behavior of a hunter. Hunters on private land may have minimal competition from other hunters and therefore they may be more selective and patient in their shot selection.

Special hunts that place restrictions on hunters (i.e., no scouting allowed at Camp Ripley) may also alter common hunting patterns. Since Camp Ripley is a renowned trophy buck area, a higher proportion of trophy hunters may be participating who exhibit behavioral characteristics

Table 3. Proportion of total deer hit, reported deer hit, and substantiated deer hit estimated during the 4 Camp Ripley, Minnesota bowhunts from 1992-93.

| Estimates | Date of hunt | | | | | |
| | 1992 | | 1993 | | | |
	31 Oct-1 Nov	21-22 Nov	21-22 Oct	30-31 Oct	Mean	SE
Total deer hit (N)	331	219	266	139	238.8	40.4
Retrieved deer[a]	75%	72%	71%	70%	72%	1.1
Reported deer hit[a]	25%	28%	29%	30%	28%	1.1
Reported deer hit (N)	83	61	76	42	65.5	7.8
Presumed deer hit[b]	7%	0%	8%	0%	4%	2.2
Claimed deer hit[b]	42%	20%	21%	24%	28%	5.2
Substantiated deer hit[b]	51%	80%	71%	76%	68%	6.4
Substantiated deer hit (N)	42	49	54	32	44.3	6.3
Prior hits[c]	50%	35%	50%	44%	45%	3.5
Lost deer[c]	50%	65%	50%	56%	55%	3.5

[a]Percentage of total deer hit.
[b]Percentage of reported deer hit.
[c]Percentage of substantiated deer hit.

Table 4. Estimated retrieval and loss rates during the 4 Camp Ripley, Minnesota bowhunts from 1992-93.

| | Date of hunt | | | | |
| | 1992 | | 1993 | | |
Variable	31 Oct-1 Nov	21-22 Nov	21-22 Nov	30-31 Oct	Mean
Retrieval rate (%)[a]	92.2	83.2	87.6	84.3	86.8
(95% C.L.)	(86.2, 98.2)	(76.5, 89.9)	(83.3, 91.9)	(80.0, 88.7)	
Loss rate (%)[b]	7.8	16.8	12.4	15.7	13.2
(95% C.L.)	(1.8, 13.8)	(10.1, 23.5)	(8.1, 16.7)	(11.3, 20.0)	

[a] (Retrieved deer/(Retrieved Deer + Lost Deer)) x 100
[b] 100-Retrieval Rate

that are different than a typical hunter (i.e., pass up more shots, take riskier shots at large bucks). Further study is needed to determine what differences, if any, there are between Camp Ripley hunters and the general bowhunting population.

Although Camp Ripley represents 1 bowhunting situation, the Camp Ripley hunts share similarities with the sites of previous wounding studies. Typically, studies have been conducted on small sites with a relatively small sample of hunters. In addition, these hunts are highly controlled and of short duration, thus creating a high-intensity situation. The discussions that have been made of wounding and bowhunting have been based on studies of this nature.

The high retrieval rates at Camp Ripley demonstrate that bowhunting is an efficient deer hunting technique and should be considered a viable option for controlling deer populations. In an ideal world, no deer would be wounded and left unretrieved, and hunter education efforts should strive to achieve that goal. However, unretrieved deer will inevitably be a part of hunting and there is no number of unretrieved deer that anti-hunters will find acceptable. Hunt coordinators must be prepared to address anti-hunting concerns as well as concerns for providing recreational opportunity and management of the wildlife resource.

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