

A Comparative Study on the Effectiveness of Fixed Blade and Mechanical Broadheads

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Abstract: Bowhunting is often considered as an option for the harvest management of white-tailed deer (*Odocoileus virginianus*) in suburbs, parks, and similar restrictive environments. Higher deer recovery rates by bowhunters would promote better utilization of the resource and could lessen some of the objections to bowhunting. Bowhunters have a variety of equipment choices, yet little is known of the impact of these choices on bowhunter efficacy. The objective of this study was to evaluate the deer recovery metrics of bowhunters who used compound bows or crossbows with either fixed blade broadheads (having no moving parts) or mechanical broadheads (having moving parts). Our retrospective study relied on the daily reports of bowhunters who participated in a managed hunting program at the Naval Support Facility Indian Head, at Indian Head, Maryland. All bowhunters were required to pass the International Bowhunter Education Program and an annual pre-season shooting proficiency test. Bowhunters recovered 1083 of the 1296 deer (83.6%, SE=1.0) they hit over the 1989 - 2012 hunting seasons. The choice of compound bow or crossbow did not affect deer recovery rates ($P=0.108$). However, the choice of fixed blade broadheads or mechanical broadheads did affect deer recovery rates ($P=0.001$). We found that the use of mechanical broadheads improved the deer recovery rates for both compound bow users ($P=0.046$) and crossbow users ($P=0.021$) over their counterparts who used fixed blade broadheads. We recommend deer managers concerned about wounding rates in otherwise restrictive environments consider the implications of this research.

Key words: bowhunting, broadhead, crossbow, wounding, white-tailed deer.

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White-tail deer populations that expand past biological and/or cultural carrying capacity in suburbs and parks can create problems to the general welfare of these communities (DeNicola et al. 2000). Bowhunting is often proposed as a deer harvest management option because of its inherent safety, but there may be concerns expressed with deer wounding. While bowhunters have a variety of equipment choices, little is known of the impact of these choices on hunter efficacy. It is important that bowhunters make informed decisions on equipment choices that promote deer recovery in these public environments. Effectual deer recovery would reduce waste of this resource and could lessen objections to the expanded use of bowhunting as a management tool.

The number of states that allow bowhunters to use crossbows during their regular archery season has increased since 2000. For example, in 2010 the Maryland Department of Natural Resources (DNR) approved the use of crossbows during the regular archery season (mid-September to the end of January). There is a need to better understand crossbow performance and how this may impact deer harvest management (Tonkovich and Cartwright 2002).

Bowhunters have other equipment options for hunting white-tailed deer, and will seek to improve their choice of broadheads to achieve better shooting performance (Durkin 2002).

The choice of broadhead can be controversial due to its possible influence on whether a hit deer is recoverable. Broadheads can be generally typed as either fixed blade (having no moving parts) or mechanical (having moving parts, and sometimes referred to as expandable). More recent studies on deer wounding rates by archers (Ditchkoff et al. 1998, Kilpatrick and Walter 1999, Krueger et al. 2002, Morton et al. 1995, Pedersen et al. 2008, and Suchy et al. 2002) either did not differentiate the influence of broadhead type on deer wounding rates or the studies were restricted to the use of fixed blade broadheads. There are no published data on how mechanical broadheads impact bowhunters' deer recovery rates.

The Natural Resources Office (NRO) of the Naval Support Facility Indian Head (NSFIH) at Indian Head, Maryland, established a bowhunting program in 1989 to manage the deer population. The NRO allowed bowhunters to use mechanical broadheads beginning with the 2007 hunting season. The objective of our study

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was to determine the deer recovery metrics for bowhunters who used compound or crossbows with either fixed blade or mechanical broadheads over the 1989–2012 hunting seasons.

Methods

Study Area

The NSFIIH is located about 50 km south of Washington, D.C., in Charles County, Maryland. It encompasses approximately 1416 ha with 26 km of shoreline on three separated peninsulas on or near the Potomac River. The land includes mowed and early successional fields, wildlife plots, tidal and non-tidal wetlands, and broken tracts of woods. The NSFIIH allowed its civilian employees, contractors, military personnel, and retirees to bow hunt. The NRO established deer management goals and exempted bowhunters from state limits through an annual memorandum of understanding with the Maryland DNR. Bowhunters passed the International Bowhunter Education Program and an annual pre-season shooting proficiency test. All bowhunters were required to notify a hunt captain, an agent of the NRO, if they hit a deer. Experienced volunteers were generally available to provide tracking assistance to any bowhunter who requested help with deer recovery.

Hunter Data

All bowhunters signed in/out for each hunting event. The NRO required every hunter to submit a data sheet within 24 hours of each hunt. The data sheet documented the hunter’s name, hours hunted, type of bow, and whether the hunter hit or recovered a deer. In 2007, the data sheet was modified to include the type of broadhead. We analyzed data sheet summaries from the 1989 - 2012 hunting seasons to determine each bowhunter’s effectiveness at recovering a hit deer with respect to their choice of equipment. Several hunters used different bow types and/or broadhead types during the study period, and they are treated as separate participants within each respective equipment group.

Analyses

We defined the hunter success rate as the percentage of bowhunters who harvested at least one deer ([number of bowhunters who harvested at least one deer] × 100/[number of hunters who participated]). We defined the recovery rate as the percentage of hit deer that were recovered within 24 hours ([number of deer recovered within 24 h] × 100/[number of deer hit]). Deer not recovered within 24 hours were categorized as wounded, even though some archery-hit deer were known to have survived wounding. Accordingly, the wounding rate was defined as (100 - recovery rate). We used chi-squared tests for all statistical comparisons, with Yates’ correction for continuity applied for 2x2 tables. Statis-

tical tests were performed using R version 3.01 software (R Core Team 2013) with a significance level of $P < 0.05$.

Results

Bowhunters ($n=209$) who participated over the 1989–2012 seasons hunted a total of 35,011 hours over 1849 days. Bowhunters ($n=135$, 64.6% of the participants) hit 1296 and recovered 1083 deer for a recovery rate of 83.6% (SE = 1.0). Accordingly, bowhunters averaged 32.3 hours of hunting effort per recovered deer.

The hunter success rate for individuals who used a compound bow was 63.1% (130 of the 207 users). The hunter success rate for individuals who used a crossbow was 58.3% (14 of the 24 users). The choice of bow type had no effect on hunter success rate ($\chi^2_1 = .055$; $P=0.815$). Bowhunters used crossbows to harvest 11.0% of the deer over the study period. Since 2010 (when the Maryland DNR liberalized the use of crossbows), bowhunters using crossbows have accounted for 25.6% of the deer harvest.

Bowhunters who used a compound bow recovered 83.0% of the deer they hit and bowhunters who used a crossbow recovered 88.8% of the deer that they hit. The choice of bow type did not affect deer recovery rates; ($\chi^2_1 = 2.579$; $P=0.108$; Table 1). Bowhunters who used fixed blade broadheads recovered 82% of the deer that they hit, and bowhunters who used mechanical broadheads recovered 90.9% of the deer they hit. The choice of broadhead type did affect deer recovery rates; ($\chi^2_1 = 10.227$; $P=0.001$; Table 2). Bowhunters who used a compound bow had a higher deer recovery rate with mechanical broadheads (88.8%) than with fixed blade broadheads (82.0%); ($\chi^2_1 = 4.071$; $P=0.043$; Table 3). Bowhunters who used a crossbow had a higher deer recovery rate with mechanical broadheads (95.7%) than with fixed blade broadheads (81.5%); ($\chi^2_1 = 5.362$; $P=0.021$; Table 4).

Table 1. Bowhunters’ recovery rates by choice of bow type at the Naval Support Facility Indian Head, at Indian Head, Maryland

Bow type	<i>n</i> deer recovered	<i>n</i> deer not recovered	Recovery rate (%) (95% CI)
Compound bow (<i>n</i> = 132 hunters)	964	198	83.0 (80.7–85.1)
Crossbow (<i>n</i> = 14 hunters)	119	15	88.8 (82.4–93.1)

Table 2. Bowhunters’ recovery rates by choice of broadhead type at the Naval Support Facility Indian Head, at Indian Head, Maryland.

Broadhead type	<i>n</i> deer recovered	<i>n</i> deer not recovered	Recovery rate (%) (95% CI)
Fixed blade (<i>n</i> = 132 hunters)	874	192	82.0 (79.6–84.2)
Mechanical (<i>n</i> = 27 hunters)	209	21	90.9 (86.5–94.0)

Table 3. Bowhunters' compound bow recovery rates by choice of broadhead type at the Naval Support Facility Indian Head, at Indian Head, Maryland.

Broadhead type	n deer recovered	n deer not recovered	Recovery rate (%) (95% CI)
Fixed blade (n = 119 hunters)	821	180	82.0 (79.5–84.3)
Mechanical (n = 26 hunters)	143	18	88.8 (83.0–92.8)

Table 4. Bowhunters' crossbow recovery rates by choice of broadhead type at the Naval Support Facility Indian Head, at Indian Head, Maryland.

Broadhead type	n deer recovered	n deer not recovered	Recovery rate (%) (95% CI)
Fixed blade (n = 9 hunters)	53	12	81.5 (70.5–89.1)
Mechanical (n = 9 hunters)	66	3	95.7 (88.0–98.5)

Discussion

We found in our study that the choice of bow type did not affect hunter success rates. Ditchkoff et al. (2001) found that bowhunters with crossbows were more successful than bowhunters with compound bows in the limited weekend-only hunts at McAlester Army Ammunition Plant, Oklahoma. Perhaps equipment plays less a part in hunter success over the longer term. We noted that crossbows are becoming more popular at NSFIH, and crossbows will likely account for an increasing percentage of the future archery harvest.

Our study showed that the choice of broadhead type did affect the ability of bowhunters to recover deer. The data clearly showed that bowhunters who used mechanical broadheads had achieved higher deer recovery rates over their counterparts who used fixed blade broadheads. Another consideration of the recovery data is that the used of mechanical broadheads reduced the wounding rate by half over that realized with fixed blade broadheads (9.1% vs. 18%). The larger cutting width of mechanical broadheads (typically 5 cm vs. 2.5 - 3 cm for fixed blade broadheads) apparently overcame any supposed issues with penetration or reliability. Mechanical broadheads could facilitate a more humane harvest of deer by causing a quicker death and making hit deer easier to find.

The combination of crossbow and mechanical broadhead realized the highest average deer recovery rate over the study period. We speculate that this may be indicative of the higher kinetic energy (and so better penetration) typically available with modern crossbows. Bowhunters who used fixed blade broadheads with compound bows or crossbows achieved nearly identical deer recovery rates, suggesting that the arrow energy (or ability to penetrate) was not a factor for this type of broadhead.

We were able to establish a relative performance for fixed blade and mechanical broadheads by gathering reliable data from a number of bowhunters who used either or both types over many hunting seasons. We recommend deer managers concerned about wounding rates in otherwise restrictive environments consider the implications of this research. Increasing deer recovery rates would reduce waste of the resource, and may reduce objections to using bowhunting as a management tool in non-traditional hunting environments.

The bowhunting program at NSFIH facilitates the comparison of equipment choices as several variables affecting bowhunter performance assessment are controlled. Notably, all hunters undergo minimum training and annual pre-season qualification testing. Bowhunters pursue the same population of deer in the same environment. And importantly, the same unbiased level of effort to recover deer is available to any hunter who hits a deer. Accordingly, NSFIH provides an ideal environment to gather comprehensive, long-term bowhunter performance metrics, and the NRO will continue to do so as a matter of course in managing the deer herd. As the popularity of crossbows continues to increase at NSFIH, we will be better able to distinguish performance metrics such as hunting effort, shot distances, and deer recovery rates between compound bow and crossbow users in future analyses.

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