Hunter Success and Selectivity of Archers Using Crossbows

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Abstract: Use of crossbow equipment to hunt white-tailed deer *(Odocoileus virginianus)* has increased in recent years. Concurrently, beliefs about efficiency of crossbows relative to upright bows has spawned concerns among many hunters that use of crossbows during standard archery seasons will lead to overharvest and herd degradation. To examine relative efficiency of crossbows as weapons for harvesting deer, we collected 5 years (1996–2000) of deer harvest data from special hunts in southeast Oklahoma where hunters were restricted to either crossbows or traditional (recurves or longbows) archery equipment. We found that success of crossbow hunters (22.8%) was greater than success of hunters using traditional archery equipment (6.9%). We found no difference in quality of deer harvested between crossbow and traditional archers as measured by body mass, antler characteristics, and age of male deer. In addition, there were no differences in proportion of males harvested by crossbow and traditional archers. These data suggest that while crossbow archers enjoy greater success than traditional archers, they do not harvest deer of greater quality.

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In recent years, issues surrounding ethics of archery hunting for white-tailed deer *(Odocoileus virginianus)* have come to the forefront of debate among natural resource managers, hunters, and animal rights organizations. Because of the increase in notoriety that archery has received, an effort has been put forth by natural resource managers, biologists, and scientists to gather and compile data that will help elucidate and clarify controversial issues relating to archery hunting. The result has been publications that have summarized scientific data relating to archery hunting and provided an overview of the importance of archery hunting to wildlife management (Kurzejeski et al. 1999, Warren 2002). Although our knowledge of archery issues and science has dramatically improved in recent years with these summary publica-

tions, they also have served to illustrate unexplored issues relating to archery hunting, such as variation in success rates and selectivity of hunters using different types of archery equipment.

To date, most scientific data concerning archery hunting have related to compound or traditional archery. However, technological advancements in weaponry and desire of hunters to experiment with variations on the archery theme have resulted in increased popularity and further development of the crossbow. This is a weapon designed to launch a modified arrow (bolt) without the physical demands of shooting a more typical archery weapon (e.g., compound bow, recurve bow, longbow). While not a common weapon at this point, it is gaining in popularity, especially among physically challenged hunters. Although most states ban the use of crossbow equipment during archery seasons (Tonkovich and Cartwright 2002), there are usually provisions for hunters who are physically challenged.

Concerns surrounding crossbows relate to efficiency (e.g., range and accuracy). Many groups feel that hunters who use crossbows have an advantage over hunters using more typical archery weapons in their ability to harvest deer. There are concerns that efficiency of the crossbow leads to success rates that are exceedingly high and increased selectivity of crossbow hunters for greater quality deer (e.g., large antlered bucks). It is theorized that crossbow archers have greater success rates and harvest deer of greater quality than other archers, and thus may jeopardize current management strategies designed to improve herd quality. However, data to address these issues have not yet been published.

With increasing popularity of the crossbow as a weapon for deer hunters and demands placed upon biologists and managers to accurately model white-tailed deer herd demographics, we felt information on success rates and selectivity of crossbow hunters was needed. To address these issues, we gathered 5 years of deer harvest data from hunts where crossbows were used to determine rates of hunter success. In addition, we compared these harvest data with data gathered from hunts where traditional archery weapons and compound bows were used to compare rates of selectivity. The deer herd at our study area was comprised of a large proportion (>50%) of mature males (>3.5 years old; Ditchkoff et al. 2000) and thus provided a unique opportunity to compare hunter selectivity. Because traditional weaponry is the most primitive of archery equipment and arguably has the lowest efficiency, we felt a comparison between traditional and crossbow archery equipment was a conservative test for differences in selectivity of archery hunters.

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Methods

The study was conducted at the McAlester Army Ammunition Plant (McAAP), which is an 18,212-ha ammunition production and storage facility operated by the U.S. Department of Defense, in Pittsburg County, Oklahoma. Vegetation of the area

has been described as tallgrass prairie (60%) interspersed with post oak *(Quercus stellata)*-blackjack oak *(Q. marilandica)* forest (40%) (Duck and Fletcher 1943). A more complete description of vegetation on the study area has been provided previously (Ditchkoff et al. 1996, 1997).

Hunting at McAAP was restricted to archery equipmetn during 6 weekends in autumn, followed by 2 shotgun antlerless hunts. Hunting permits (N=1,600) were allocated by lottery each year and individual hunters could hunt 1 weekend (2.5 days) and harvest 2 deer of either sex. A more complete description of the hunt scenario was provided by Ditchkoff et al. (1996, 1997). Prior to 1989, archers were allowed to hunt with compound bows and since 1989 have been restricted to traditional archery equipment (e.g., recurves and longbows). Since 1996, the second weekend (mid-October) of the hunting season has been limited to physically challenged hunters (N=100 annually). Prior to 2000, hunters had to legally apply for permits in Oklahoma to use crossbows in place of other archery equipment because of physical limitations. However, since 2000 hunters only need a signed statement from a medical doctor to hunt with a crossbow in Oklahoma.

We collected deer harvest data from 1996–2000 during crossbow hunts and hunts with traditional archery equipment that were held the weekend prior to and following crossbow hunts. We also collected harvest data during periods of compound (1983–1988) and traditional (1989–1995) archery hunts from the same weekend in mid-October as the crossbow archery hunts. All harvested deer were returned to a check station where sex and age were recorded. Deer ages were estimated from tooth replacement and wear (Severingaus 1949). All deer were weighed to the nearest 0.5 kg to obtain field-dressed carcass mass. On all males, we measured circumference of main beams 2.54 cm above the burr and length of both main beams and counted number of points on each antler.

We tested for differences in hunter success and proportion of fawns in the harvest using arcsine transformed data (Zar 1984) with an analysis of variance (ANOVA). We tested for differences in age, body mass, and antler characteristics of deer harvested by crossbow and traditional archers using ANOVA. We used multiple comparisons between means when main effects were significant ($P<0.05$) using Fisher's least squares differences (LSD) procedure (Hicks 1993).

Results

Hunter success during crossbow hunts (22.8 ± 2.4%; x ± SE) was more than 3 times greater ($F_{2,12}$=23.15, $P<0.001$) than during traditional archery hunts (6.9 ± 1.3%) during 1996 to 2000 (Fig. 1). There was no difference (P=0.464) in hunter success between the 2 traditional archery hunts. Success of crossbow hunters (23.2± 2.2%) from 1996 to 2000 was greater (P=0.004) than success of compound archers (13.6±1.5%) from 1983 to 1988 , and greater (P=0.001) than success of traditional archers (8.3%±1.4%) from 1989–1995 (Fig. 2). Success of compound archers was greater (P=0.002) than success of traditional archers.

We did not detect differences in selectivity of hunters with crossbow and tradi-

Figure 1. Mean success (±SE) of white-tailed deer hunters during crossbow archery hunts preceding and following traditional archery hunts each October from 1996–2000 at the McAlester Army Ammunition Plant n southeastern Oklahoma.

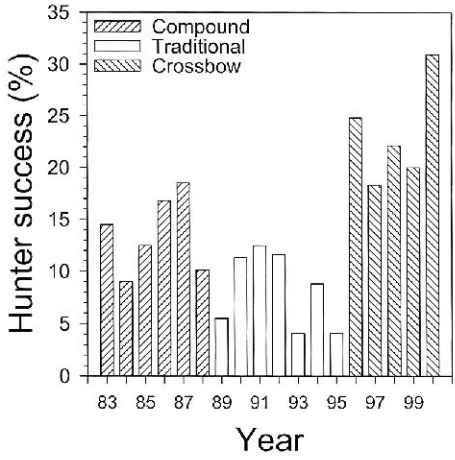

Figure 2. Success of white-tailed deer archers using compound (1983–1988), traditional (1989–1995), and crossbow (1996–2000) archery equipment during the second hunt held each year (early October) at the McAlester Army Ammunition Plant in southeastern Oklahoma. Data collected before 1996 were published by Ditchkoff et al. (1996).

tional archery equipment as measured by age ($F_{2, 101}$=0.08, P=0.920), body mass ($F_{2, 102}$=0.26, P=0.768), main beam length ($F_{2, 82}$=0.25, P=0.777), main beam circumference ($F_{2, 82}$=0.09, P=0.910), or number of antler points ($F_{2, 81}$=1.23, P=0.296) of harvested males (Table 1). There also were no differences in mass of harvested female deer ($F_{2,127}$=1.59, P=0.208), proportion of fawns in the harvest ($F_{2,12}$=1.52, P=0.259), sex ratio of the harvest ($F_{2,6}$=1.04, P=0.409), or sex ratio of harvested

Table 1. Age, antler, and morphometric characteristics of male deer harvested during 2 traditional archery hunts[a] and 1 crossbow archery hunt.

	Traditional 1			Crossbow			Traditional 2			
	N	*x*	SE	*N*	*x*	SE	*N*	*x*	SE	*P*
Age (years)	29	2.09	0.32	47	2.10	0.21	40	1.98	0.18	0.920
Body mass (kg)[b]	29	38.94	2.90	47	39.50	1.77	41	40.05	1.95	0.768
Beam circumference (cm)	22	7.16	0.51	40	7.14	0.33	35	7.24	0.38	0.910
Beam length (cm)	22	31.52	3.15	40	31.90	2.00	35	32.21	2.24	0.777
Antler points	22	5.95	0.62	39	6.02	0.51	35	6.60	0.55	0.296

a. Traditional archery hunts were held weekends preceding and following the crossbow hunt.

b. Field-dressed carcass mass.

Table 2. Age, and body mass of harvested female deer and demographic characteristics of the harvest during 2 traditional archery hunts[a] and 1 crossbow archery hunt.

	Traditional 1			Crossbow			Traditional 2			
	N	*x*	SE	*N*	*x*	SE	*N*	*x*	SE	*P*
Age (years)	40	2.80	0.33	53	3.58	0.31	49	2.83	0.33	0.207
Body mass (kg)[b]	40	30.46	1.03	53	33.32	0.92	41	31.63	1.06	0.465
M:F harvest	5	0.88	0.24	5	0.95	0.19	5	0.94	0.13	0.409
Proportion of fawns (%)	5	20.6	3.5	5	12.3	4.7	5	19.7	4.8	0.259
M:F harvested fawns	4	1.19	0.94	3	0.44	0.29	4	0.50	0.20	0.762

a. Traditional archery hunts were held weekends preceding and following the crossbow hunt.

b. Field-dressed carcass mass.

fawns ($F_{2,7}$=0.28, P=0.762) among hunts with traditional and crossbow archery equipment (Table 2).

Discussion

As expected, success of crossbow hunters was greater than traditional archery hunters, likely due to greater efficiency of crossbow weaponry relative to traditional archery equipment. Crossbows have technological advantages over traditional bows that increase their efficiency. Advantages include sighting aids, a mechanical release, and a pre-drawn arrow that is mechanically held. In addition, crossbows are usually more powerful than traditional bows, resulting in greater arrow speed and range. These advantages potentially could result in improved accuracy and precision of arrow placement, greater range, and less body movement by the hunter that may scare deer, and could account for greater success of crossbow archers relative to traditional archers.

Success of crossbow hunters (22.8%) in our study was greater than success rates of crossbow hunters reported by Tonkovich and Cartwright (2002). They reported hunter success rates of 13.6% and 12.3% for Ohio and Arkansas, respectively. How-

ever, it is difficult to compare hunter success rates across studies because of differences in herd composition, time spent hunting, and habitat characteristics. Although Tonkovich and Cartwright (2002) indicated that crossbow hunters in their study spent an average of approximately 13 days hunting (crossbow archers at McAAP could only hunt for 2.5 days), there may have been substantial differences in herd demographics and hunting pressure as herd densities at McAAP are approximately 13 deer/km^2 (Ditchkoff et al. 1997). Success rates of crossbow hunters reported by Tonkovich and Cartwright (2002) were greater than success rates of traditional hunters during selected hunts in our study, but were similar to an 8-year mean of success rates (10.7%) of traditional archers reported by Ditchkoff et al. (1996). The success rate we calculated for crossbow hunters also was greater than success of compound archers (17.8%) from 1983–1988 at the same study site (Ditchkoff et al. 1996). Given the advancements of compound archery technology and resulting increases in range and accuracy since compound archery equipment was restricted at McAAP in 1989, we speculate that compound archers would have greater success today than during 1983–1988 and would have success rates similar to those reported for crossbow archers in our study.

We originally speculated that crossbow hunters would harvest male deer of greater quality (e.g., size, age, and antler characteristics) than traditional archers because of increased weapon efficiency. Mature male deer are not as susceptible to human-induced mortality as young males (Roseberry and Klimstra 1974, Ditchkoff et al. 2001) and thus are not harvested in proportion to their availability in the herd (Roseberry and Woolf 1988, Ditchkoff et al. 2000). Increased range of crossbows relative to traditional bows would theoretically improve chances of harvesting a mature deer if probability of acquiring a shot at an animal increases with distance (e.g., lower probability of hunter being detected by deer). However, there were no differences in age, size, or antler characteristics of deer harvested by traditional and crossbow archers.

We predicted that we would detect differences in sex ratio of harvested deer, proportion of fawns in the harvest, and sex ratio of harvested fawns because of selectivity differences between crossbow and traditional archery hunters. However, we detected no differences. It is possible that if our data were collected later during the progression of the rut (mid-November), we may have detected differences in selectivity because of greater vulnerability of mature male deer. Evidence suggests that more mature deer are harvested during rut as opposed to pre-rut at McAAP (S. S. Ditchkoff, unpub. data). Additionally, it is possible that crossbow archers at McAAP did not display greater selectivity, because like traditional archers they were limited to 2.5 days of hunting and attempted to harvest any deer they had the opportunity to shoot.

Our data suggest that the impact that crossbow archers have on herd demographics is similar to that of traditional archers because they do not harvest greater quality deer. Furthermore, we can assume that crossbow archers are not more selective than compound archers although we did not compare selectivity of crossbow and compound archers. The only difference in harvest characteristics between crossbow

and traditional archery hunts was hunter success. Increased success of crossbow archers could potentially cause short-term impacts on deer management strategies if hunter success of crossbow hunters is not accounted for when employing harvest regulations. We agree with Tonkovich and Cartwright (2002) that crossbow hunting does not result in overharvest or herd decimation, and we do not believe that it would threaten management strategies such as quality deer management.

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