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Efficiency of Archery Hunting for White-tailed Deer on Medway Plantation.

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We conducted this study to determine efficiency of archery equipment in conjunction with tracking dogs for harvesting white-tailed deer (Odocoileus virginianus) on Medway Plantation in the Coastal Plain of South Carolina. Twenty-two experienced archers hunting from elevated stands over corn feeders shot 61 deer. A tracking dog was used whenever deer did not fall within sight of the hunter (41 of the 61 deer shot). Immediately following each hunt, the hunter completed a questionnaire to determine equipment used, shot conditions and deer reaction. We recovered 60 of the 61 deer shot (98%) within 24 hours of being hit. Comparison of shot situation variables (draw weight, deer activity, alertness, reaction, position, number of deer present, arrow penetration and number of broadhead blades) with shot placement and distance traveled after the shot revealed few significant associations. Position of the deer when shot ($P = 0.04$) and shot placement

(P = 0.06) were associated with distance traveled after the shot. Careful shot selection, shooting skill and using tracking dogs may be the main factors contributing to our high recovery rate. Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl. Agencies 49:000-000.

Archery hunting is being attacked by anti-hunting and animal rights organizations as primitive and inhumane (Nettles et al. 1976). This was illustrated by a well-publicized court case in California in 1990, when the black bear archery season was closed (Mayer and Samuel 1992). Under a suit filed by the Fund for Animals, the courts ruled that the California Fish and Game Commission had inadequately reviewed wounding literature, had not complied with the California Environmental Quality Act and had not considered the welfare of individual animals in establishing hunting seasons. A key point in the decision was the high wounding rates (as high as 100%) reported by Benke (1989). Thus, considerable debate continues about archery wounding rates and the proportion of wounded animals that recover from their wounds.

The few existing studies of wounding loss for white-tailed deer are based on small sample sizes and hunter surveys (Mayer and Samuel 1992). Reliability of such studies is questionable because (1) considerable time elapses between the hunt and the survey, (2) surveys provide no details about seriousness of the wound and (3) small sample sizes can result in proportionately high wounding rates with only a few deer wounded. For example, Stormer et al. (1979) compared numbers of deer wounded by archery and firearms hunting and found there were

actually more deer wounded proportionally through firearms hunting. Modern archery equipment is much more technically advanced, provides greater cast and is less difficult to shoot accurately than traditional recurve or long bows, allowing for a higher hunter success rate (Gladfelter et al. 1983).

With increasing focus on wildlife uses such as bowhunting by special interest groups and the general public, it is necessary to examine the humaneness and efficiency of these uses. Archery hunting is a viable management tool especially in urban or residential areas where deer are a nuisance and safety hazards exist (McDowell et al. 1993, McAninch 1993). Significance of animals lost from hunting wounds should be debated from both ethical and biological perspectives. The objective of this study was to examine efficiency of modern archery equipment for harvesting white-tailed deer in the Lower Coastal Plain of South Carolina, and the effectiveness of using dogs to retrieve "lost" deer.

STUDY AREA

The study was conducted on the 2,429-ha Medway Plantation near Goose Creek in Berkeley County, SC. The deer population is managed by an archery hunting club of 20-25 members who harvest approximately 150-200 deer between August 15 and November 25. There is no limit on antlerless deer taken after October 1 under the Doe Quota Program of the South Carolina Department of Natural Resources. Major forest types include natural stands of longleaf (Pinus palustris) and loblolly (P. taeda) pines, mixed pine-hardwoods and bottomland hardwoods. The plantation contains an

extensive network of openings and foodplots. Deer density estimated by spotlight surveys is approximately 35 deer/km^2 (225 deer/mi^2) (Personal Comm., William Mahann, SC Department of Natural Resources).

METHODS

Data on shot situation and deer reaction variables were collected by all members of the Medway Archery Club (n=22) during the 1993 hunting season. Archers were proficient and experienced averaging 89 deer killed by bow and 13 years experience in archery hunting. All hunting occurred from elevated tree stands near corn feeders. Trained trailing dogs were used for recovery when deer did not fall within sight of the hunter. Dogs were not allowed to track wounded deer until 1 hour after the deer was shot.

Immediately following each deer being shot, questionnaires were completed at the club house to determine archery hunting experience, equipment used, shot conditions and animal reaction. Questionnaires were monitored and collected by the plantation manager. Chi-square tests were used to detect associations of shot placement (vital and non-vital) with bow draw weight, deer activity or alertness when shot and reaction after being shot (Sokal and Rohlf 1973). Chi-square tests were also used to detect associations of distance traveled after being shot ($\leq$ 91 m and $>$ 91 m) with number of deer in group, position and alertness of the deer at the time of the shot, arrow penetration, number of broadhead blades, sign left by wounded deer, and shot placement. Chi-square tests were also used to detect associations of arrow

penetration (pass through or remain in deer) with position of deer when shot and sign left by wounded deer. Mean distances traveled by deer shot with 3-bladed and 4-bladed broadheads were compared with Student's "t" test. Statistical significance was accepted at $P \leq 0.10$.

RESULTS

The 22 archers shot 61 deer (29 does, 29 bucks and 3 fawns) and recovered 60 for a recovery rate of 98%. The single deer that was lost was a mature buck reportedly hit in a non-vital area. All archers used compound bows [average draw weight 28 kg (62 lb), average let off 52%] with 7 deer (11.5%) shot by archers using bows with overdraws. Most (80%) of the bows had draw weights of 23 to 32 kg (51-70 lb). Most deer were shot by archers using sights (97%), mechanical release aids (74%), aluminum (88.5%) or graphite (11.5%) arrows with feather fletching (85%) and 3-bladed (50%) or 4-bladed (50%) broadheads. Average broadhead weight was 8.3 gm (128 grains). Average height of tree stands was 8.2 m (27 yd) with most (73%) being 6 m (20 ft) or higher.

Most deer (80%) were shot in the afternoon or evening. Average distance of shots was less than 18 m (20 yd) with 90% of shots between 10-18 m (11-20 yd). Fifty-four percent of the deer were alert when shot and 46% were not alert. Fifty-nine percent of the deer were feeding when shot, 33% standing still and 8% walking. Approximately half (55%) of the deer were in the broadside position when shot, 15% quartering towards, 20% quartering away, 7% facing directly towards, 1% facing directly

away and 1% straight down. Most deer reacted to being shot by bolting with the tail down (72%) and left a blood trail (68%), blood spots (23%), rumen material (5%), bone fragments (2%), meat (1%) and hair (1%) after being shot. Comparisons of shot variables with shot placement detected no association between bow draw weight (χ^2 = 0.383, 1 d.f., P = 0.54), deer activity (χ^2 = 0.36, 1 d.f., P = 0.55) or alertness (χ^2 = 0.21, 1 d.f., P = 0.65) when shot, and reaction of deer once shot (χ^2 = 2.076, 1 d.f., P = 0.15) (Table 1).

Average distance traveled by shot deer was 100 m (109 yd) with 75% traveling less than 91 m (100 yd). Most deer were not spooked (96%) during the search. Most deer were dead when found (95%) and few were alive but dazed (3%) and alive but alert (2%). It took an average of 30 minutes after the dog was released on the trail to recover deer with 95% of deer recovered within the first 4 hours. Distance traveled by deer after being shot was associated with position of the deer when shot and shot placement (Table 2). Deer in the broadside position were less likely (χ^2 = 4.047, 1 d.f., P = 0.04) to travel more than 91 m (100 yd) than those shot in other positions. Similarly, deer shot in a vital area were less likely (χ^2 = 3.497, 1 d.f., P = 0.06) to travel more than 91 m (100 yd) than those shot in a non-vital area. Deer shot with 3-bladed broadheads traveled an average of 102 m (112 yd) and those shot with 4-bladed broadhead traveling 99 m (108 yd) (t = 1.24, d.f. = 58, P = 0.23). Deer with complete arrow penetration (72%) traveled an average of 104 m (114 yd) and those without penetration (28%) traveled only 90 m (98 yd) (t = 0.62 with 58 d.f., P = 0.54).

Seventy-one percent of the arrows passed completely through the deer and 29% remained in the deer. Most (83%) of 3-bladed broadheads penetrated completely through the deer compared to 59% of 4-bladed broadheads. Arrows tipped with 3-bladed broadheads were more likely to completely penetrate deer than those tipped with 4-bladed broadheads (χ_2 = 4.39, 1 d.f., P = 0.04). Position of the deer when shot (broadside versus quartering, facing, straight away or straight down) was not associated with penetration (χ^2 = 1.320, 1 d.f., P = 0.25). Signs left by wounded deer (blood trail versus blood spots, rumen material, bone fragments, meat or hair) was not associated with penetration (χ^2 = 0.003, 1 d.f., P = 0.95) or number of broadhead blades (χ^2 = 0.036, 1 d.f., P = 0.85).

DISCUSSION AND CONCLUSIONS

The recovery rate of deer shot by archers (98%) in this study is much higher than rates reported in other studies. Downing (1971), Lohfeld (1979), McPhillips et al. (1985), Boydston and Gore (1987), and Langenau (1986) reported that approximately 50% of deer shot by archers were not recovered. These studies were based primarily on hunter surveys and only Downing (1971) used field searches to verify that wounding resulted in mortality. Small sample size (4 of 8 deer wounded) detracts from the value of Downing's data. During a 3-year study using hunter questionnaires and ground searches, Herron (1984) reported that 31-39% of deer shot by archers were not recovered. Unretrieved kills by archers were 5-12% of deer wounded. These results suggest that many deer shot by archers may recover from

their wounds. Causey et al. (1978) reported that 74 of 88 (84%) of deer shot with broadhead arrows fitted with a device containing crystalline succinylcholine chloride were killed and recovered after the deer traveled an average distance of 100 m.

The high recovery rate of deer shot by archers on Medway Plantation may be attributed to the degree of control over shot situation, the experience/skill level of hunters and the use of trailing dogs to search for wounded deer. The use of corn feeders allows archers to locate elevated stands for unobstructed shots, accurately estimate distance and take shots at standing or feeding deer exposing a vital target. Changes in archery equipment over the last 2 decades such as the use of compound bows, sights, release aids and pre-sharpened broadheads may have contributed to the difference in recovery rates between this study and earlier studies (Gladfelter et al. 1983). Langenau (1986) reported that the likelihood of recovering wounded deer increased with experience of the archer.

Although we detected few significant associations between shot situation variables and shot placement or distance traveled by wounded deer, these variables likely affect the efficiency of archery hunting in situations such as those encountered on many public areas. Due to the unusual degree of control over these variables, our results may not reflect efficiency of archery hunting for white-tailed deer in these situations. However, our results do confirm that archery hunting can be a highly efficient means of harvesting white-tailed deer when shot selection and shooting skills are emphasized and using trailing dogs is required as part of an organized management approach. With

expanding deer populations in urban and residential areas where firearms hunting is precluded, controlled hunting by proficient archers offers a viable and feasible management approach. Harvest of deer by archers is critical to the achievement of management goals in some states (McDowell et al. 1993, McAninch 1993).

Archery hunting provides a humane means of harvesting white-tailed deer on Medway Plantation. Virtually all deer shot were recovered within a short period of time (average 30 minutes). Most (75%) wounded deer traveled less than 91 m. Thus, with careful control of shot situation variables, use of trailing dogs and demonstrated proficiency of archers, white-tailed deer can be efficiently harvested in a humane manner that should be acceptable to a large segment of society.

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Table 1. Comparisons of archery shot situation variables with shot placement on white-tailed deer on Medway Plantation in the Lower Coastal Plain of South Carolina (1993).

	Shot placement		
Shot situation variable	Vital	Non-vital	P value
Draw weight (kg/lbs)			
≤ 27/60	20	9	
> 27/60	23	9	0.536
Deer activity			
Feeding	27	9	
Standing or walking	17	8	0.549
Alertness			
Yes	23	21	
No	10	7	0.645
Reaction			
Bolt, tail down	34	10	
Bolt, tail up	10	7	0.150

Table 2. Comparisons of distance traveled with archery shot situation variables for white-tailed deer on Medway Plantation in the Lower Coastal Plain of South Carolina (1993).

	Distance traveled (m/yds)		
Shot situation variable	<91/<100	>91/>100	P value
Number of deer			
Deer alone	15	5	
≥ 2 deer	34	6	0.466
Position			
Broadside	28	5	
Quartering or other	17	8	0.044*
Alertness			
Yes	22	9	
No	23	7	0.597
Penetration			
Yes	35	8	
No	23	7	0.54
Number of broadhead blades			
3	24	6	
4	22	8	0.23

Table 2 (cont'd).

	Distance traveled (m/yds)		
Shot situation variable	≤91/≤100	>91/>100	P value
Sign of hit			
Blood spots	15	6	
Blood trail	28	12	0.959
Shot placement			
Vital	36	7	
Non-vital	10	7	0.061*

* Significant P ≤ 0.10.