Effects of Raccoon Hunting on White-tailed Deer Movement and Harvest Potential

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Abstract: The impact of raccoon (*Procyon lotor*) hunting with trained hounds on movement, daily use area, and harvest potential of white-tailed deer (*Odocoileus virginianus*) was studied on Westvaco Corporation's North Whitener Tract in Jasper County, South Carolina, in winter 1993–94 and 1994–95. Two groups (treatment and control) of radio-instrumented deer were selected from a larger group of radio-collared deer. Minimum daily total distance moved (MTD), 4 subsets of MTD, and daily use area were calculated and/or plotted from radio-locations during the 24-hour period before and the 24-hour period during and after a raccoon hunt for each radio-instrumented deer. There were no differences ($P \geq 0.05$) between treatment and control areas in pre-hunt and post-hunt periods for any of the movement parameters. The percent overlap for each deer's pre-hunt daily use area and its corresponding post-hunt daily use area did not differ between treatment and control areas. Time-sequenced photographs were taken at 14 baited sites (7 control and 7 treatment) on the day prior to the raccoon hunt and the day following the raccoon hunt to provide an indicator of deer harvest potential. Total deer per frame at each camera location did not differ between treatment and control for either morning or evening. This study provided no evidence that raccoon hunting with trained hounds impacts the movement, daily use area, or harvest potential of white-tailed deer.

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Both raccoon and white-tailed deer hunting are favorite recreational pursuits for many people. However, there can be conflicts between deer and raccoon hunters because deer hunters perceive that hunting raccoons with hounds reduces their chances to harvest deer the following day. Possible disturbances to deer from raccoon hunting include the noises, scents, and activities of hunters and dogs. Many deer

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hunters believe these disturbances have a significant impact on deer feeding and movement behavior and thus, on deer hunting success. Therefore, many private landowners/managers and deer hunt clubs deny raccoon hunting until after the closure of the deer hunting season. Over one-half of the raccoon hunting season coincides with the deer hunting season in South Carolina. The perceived conflict is statewide and also occurs in other states, but most commonly in the southeast (S. Felder, field operations managers, United Kennel Club, pers. commun.).

Several authors have studied the effects of deer chases by dogs trained to chase deer (Sweeney et al. 1971, Corbett et al. 1972, Gipson and Sealander 1975, Spencer 1986) and of free-ranging dog chases on deer behavior (Perry and Giles 1971, Nichols and Whitehead 1978). However, almost no information exists about the effects of raccoon hounds and hunting on deer harvest potential. Corbett et al. (1972) reported no mortality of deer due to raccoon hunting with hounds, but they did not measure deer hunter harvest potential after raccoon hunts. Raccoon hunters, deer hunters, and state resource agencies want scientific data to determine the impact of raccoon hunting on deer harvest potential. Empirical data are needed by private land owners/managers to make informed decisions about raccoon/deer hunting conflicts. Our study objective was to determine the effect of raccoon hunting with trained hounds on white-tailed deer movements, behavior, and potential for harvest.

This is a technical contribution of the South Carolina Agricultural Experiment Station, Clemson University. The study was conducted through the South Carolina Aquaculture, Fisheries, and Wildlife Cooperative, a research and educational unit of Clemson University and the South Carolina Department of Natural Resources (SCDNR). Funding for this study was provided by SCDNR, Westvaco Corporation, South Carolina Coonhunters Association, and State Coonhunters Association Network. This study was a component of a comprehensive study on the North Whitener Tract studying the population dynamics and mortality of white-tailed deer. We thank K. Morgan and E. Turner for assistance with trapping and monitoring deer. J. Dozier, A. Adams, J. White, M. Cantrell, and M. Gibson assisted with data collection. We thank Deer Park Lodge Hunt Club and W. Roberts for their cooperation and raccoon hunters (S. Thomas, M. Thomas, S. Jones, and J. Blume) for their application of the treatments. V. Leech prepared the manuscript.

Methods

The study was conducted on Westvaco Corporation's North Whitener Tract, located southwest of Tillman, Jasper County, South Carolina. The North Whitener Tract is approximately 3,144 ha and lies in the Southern Floodplain Forest Region of the South Atlantic Plain (Newsom 1984). Lower elevations, as low as 3.5 m above sea level, are characterized by bottomland hardwood (*Quercus sp.*) and baldcypress (*Taxodium distichum*)/water tupelo (*Nyssa aquatica*) wetlands. High elevations, up to 11 m above sea level, are characterized by northwest/southeast sand ridges that are dominated by stands of loblolly pine (*Pinus taeda*) planted during and after 1978.

North Whitener hunters harvest deer by still-hunting only, primarily from permanent stands baited with corn. Hunting deer with hounds has not taken place on North Whitener since 1981 (W. Roberts, district manager, Westvaco, pers. commun.). From 1988 to 1994, the mean annual harvest was 71 ± 7.9 does and 43 ± 3.5 bucks. Hunting raccoons with dogs on North Whitener occurred an average of 6 nights per year during the years preceding this study (W. Roberts, district manager, Westvaco, pers. commun.). The same 4 raccoon hunters who hunted the study area in previous years and their guests hunted for this study. Only raccoon hunting conducted for the purposes of this study was permitted on North Whitener during the 1993–94 and 1994–95 winter season.

Pretreatment Data

Individual deer (0.5- and 1.5-year-old) were selected for use in this study from a larger group of radio-instrumented deer used in a concurrent deer mortality and emigration study. Deer were located with a portable receiver and a handheld, 3-element yagi antenna as described by Swayngham (1988). Locations were analyzed as if they were taken on the prescribed hour and any locations not taken within the designated hour period along with all locations for that animal during that diel period were omitted. During the first year, diel tracking periods (1 location for each deer every even hour for 24 hours [13 locations]) were scheduled each week for 8 weeks (104 locations per deer) before the first raccoon hunt. The second year involved tracking each deer approximately 4 times for each hour period (96 total locations) before the first raccoon hunt. The order in which deer were located between diel continuous tracking periods was constant, except for deer that were difficult to locate. These deer were located last in the designated hour.

Telemetry data gathered before the initiation of the first raccoon hunting trials were used to draw boundaries of convex polygon home ranges (Mohr 1947) using a SAS program developed by Hill and Fendley (1982) and modified by Boyle (1986). Only those deer with adequate data to exhibit a stabilized home range estimate (Odum and Kuenzler 1955) and with a home range within the boundary of either treatment area (east side or west side) were included in the study. Individuals with home range centers removed from the greatest concentration of home range centers in each treatment area were omitted to insure that all deer could be located by 1 telemetry operator in each of the 2 areas within 1 hour. The center points of all the home ranges in both treatment areas were >3 km apart, and the center points of the home ranges of the 2 closest deer between the 2 treatment areas were >2 km apart.

Experimental Design

The treatment (raccoon hunt) alternated between the east and west areas each hunt (week). Odd-numbered hunts were conducted on the west side and even-numbered hunts were conducted on the east side treatment area. This alternating design was used to limit the confounding effect involved with applying the treatment to the same area for every observational period. The additive effect of applying the treatment to the same deer once every 2 or more weeks was not measured.

A raccoon hunt was scheduled weekly from 14 December 1993 to 1 March

1994 and 20 December 1994 to 18 February 1995. Hunts were rescheduled for either Monday or Wednesday night when rain was forecast for Tuesday. During hunts, hunters recorded the number of times raccoons were treed by the hounds. Hunters were also responsible for recording starting and ending times, the path of their dogs, and the locations of treed raccoons. Before hunts, the number of hounds and number of hunters were recorded.

The hunt started where collared deer were located during the 1800-hour time period just before the hunt. After the hounds were released, hunters were free to hunt any location except for the control area. Hunting time was restricted to 4 hours to approximate normal hunting conditions.

Each deer in the study was located every even hour for 48 hours starting with the 1800-hour time period 1 day before the scheduled raccoon hunt. The raccoon hunt could not begin until all deer were located for the 1800-hour time period the day of the hunt. Locations for 24 hours before the hunt were categorized as "pre" and all locations for 24 hours after the initiation of the hunt were categorized as "post."

Movement and Range Parameters

We estimated 5 movement parameters for each deer: minimum daily total distance moved (MTD) (Marchinton and Jeter 1966) and 4 6-hour modified MTDs. A 6-hour modified MTD was the sum of the distances between 4 consecutive locations for the time periods of (1) 1800–2400 hours (MTD 1); (2) 2401–0600 hours (MTD 2); (3) 0601–1200 hours (MTD 3); and (4) 1201–1800 hours (MTD 4). A modified MTD represented the smallest time interval that would contain the raccoon hunt (treatment), which was often 4 hours in duration. MTD 1 was the time during the raccoon hunt, and MTD 3 and MTD 4 included the times of legal deer harvest.

The dependent variable used in analyses was computed by subtracting the natural log (ln) of the movement pre-hunt (first diel) from the ln (movement) post-hunt (second diel) and dividing by the ln (movement pre-hunt). The ln (proportional difference in movement) was used as an indicator of each deer's change in movement resulting from raccoon hunting, was normally distributed, and exhibited homogeneous variance.

The ln difference was then used as the dependent variable in ANOVA, which tested the null hypothesis that movement of deer changed at the same rate from pre-hunt to post-hunt between deer in the treatment area and deer in the control area. Main effects and all 2-, 3-, and 4-way interactions with hunt (1–18), age (0.5 or 1.5 years old), and sex (male or female) were included in the model. Type III sum of squares were used for evaluation and significance level was set at alpha = 0.05.

A minimum convex polygon was drawn based on the 13 locations of each individual's minimum total movement for the 24-hour tracking period pre-hunt, and this was overlaid with the corresponding convex polygon created from the 13 post-hunt locations. The area of overlap was divided by the pre-hunt area and multiplied by 100, resulting in a percent overlap of daily use area. The data on percent daily overlap were normally distributed. Percent overlap of daily use area was used as the dependent variable in ANOVA, which tested the null hypothesis: daily use overlap area was equal between treatment deer and control deer. As before, main effects and all 2-, 3-, and 4-way interactions with hunt (1–18), age (0.5 or 1.5 years old), and sex (male or female) were included in the model.

Bait Visitation Parameter

An index of harvest potential (i.e., deer visibility) was obtained by taking photographs at 7 locations in each study area. Camera locations were baited with corn in open fields or wooded areas. When open fields were used, the camera was placed 10–15 m from bait sites to maximize field of view. In wooded areas, corn was scattered in the middle of view, 5–10 m from the camera. These sites represented continuously baited, permanent hunt stands for each season.

Each camera was mounted to a tree or a wooden post and wired to an intervalometer (Trailmaster, Lenexa, KS. Cameras were loaded with 36-exposure, 400-speed, black and white film and placed on their mounts in the afternoon before telemetry started for each raccoon hunt. Intervalometers were programmed to take a photograph every 15 minutes for the first 2 hours of daylight (starting at official sunrise) and the last 2 hours of daylight (ending at official sunset). Photographs were taken in the morning and evening of the days before and after the raccoon hunt. Cameras and intervalometers were taken down after dark the day after the raccoon hunt and the film was removed for development. Unclear photographs were not used in the analysis. Number of deer and number of clear frames (9 possible) were recorded for each time (a.m. and p.m.), day (before and after), area (treatment or control), camera location (1–14), and hunt (1–18).

Total deer per frame for each time event (a.m. and p.m.) and hunt were determined. For each time event, we determined the difference in mean number of deer/frame for pre-hunt and post-hunt periods. Differences in deer visitation were not normally distributed and no transformation would normalize this statistic. Therefore, a nonparametric ranking system was used by ranking the difference by camera (1–14 for each hunt). Each rank was coded with its respective treatment or control indicator as well as the time period and hunt number. Ranks were the dependent variable in the ANOVA, which tested the null hypothesis that differences in deer visitation to baited camera sites before and after the hunt were not different between treatment and control sites by time event, hunt, treatment, and all interactions.

Results

Nine raccoon hunts occurred each field season for a total of 18. Hunts averaged (±SE) 4.4 ± 0.3 hunters, 3.4 ± 0.2 hounds, 3.4 ± 0.2 hours, and 4.9 ± 0.6 raccoons treed. Hounds treed raccoons 88 times during the 18 hunts, and at least 8 deer were seen by hunters on 5 different occasions while going to baying dogs. On one of the 5 occasions, deer were estimated to be within 50 m of the hunters. Deer were either bedded or standing when first observed and continued to stay bedded or slowly walk off as the hunters walked to baying dogs. Area boundaries based on 56 recorded treeings on the west side encompassed all geometric center points of deer home ranges as well as the camera locations for both years. The east side treatment boundary based on 32 total treeings included all of the deer home range geometric center points and

Table 1. Frequency of radio-instrumented deer by year, treatment area, sex, and age used in the raccoon/deer study on Westvaco's North Whitener Tract, Jasper County, South Carolina, 1993–1995.

		Age (years)				
		0.5		1.5		
Year	Area	Male	Female	Male	Female	Total
1993–94	East	5	5	2	1	13
	West	6	3	1	3	13
1994–95	East	3	0	2	2	7
	West	0	0	2	4	6
Total		14	8	7	10	39

all camera locations, except for 1 camera location each year. Boundaries drawn from locations of treed raccoons may have been smaller than the actual area covered by the hounds. Therefore, total treatment boundaries may have extended beyond the boundary of treeings.

Twenty-six deer were used for movement analysis during the first year (1993–94) and 13 during the second year (1994–95) (Table 1). Twelve of the 26 outfitted deer used the first year were also used in the second year. There were 309 sets (pre-hunt and post-hunt) of MTDs, modified MTDs, and daily use areas gathered from radio-collared deer monitored in this study.

There was no difference (Table 2) between pre-hunt and post-hunt daily MTD by deer between treatment (mean ± SE = 3908 ± 84 m) and control (mean ± SE = 3620 ± 70m) areas during all 18 raccoon hunts. Thus, deer moved in the same proportions before and after the hunt for both the treatment and control areas. None of the interactions tested among age, sex, hunt, and treatment were significant (Table 2). There was no significant difference (Table 2) between treatment (mean ± SE: MTD1 =

Table 2. Results of analysis of variance testing daily minimum total distance moved (MTD) and modified MTDs by white-tailed deer for differences between treatment (raccoon hunting) and control areas and interactions with hunt, sex, and age on Westvaco's North Whitener Tract, Jasper County, South Carolina, 1993–1995.

		MTD		Modified MTD 1–4	
Source	DF	*F*-Value	*P*	*F*-Value[a]	*P*[b]
Treatment	1	0.19	0.6661	0.63	0.4277
Treatment × sex	1	1.36	0.2451	2.23	0.1372
Treatment × hunt	17	1.01	0.4440	1.52	0.0910
Treatment × age	1	0.50	0.4808	1.32	0.2519
Treatment × sex × hunt	16	0.56	0.9093	1.05	0.4055
Treatment × sex × age	1	0.04	0.8403	3.04	0.0829
Treatment × hunt × age	8	0.41	0.9112	1.79	0.0804
Treatment × hunt × sex × age	8	0.75	0.7046	1.71	0.1484

[a]Largest value of the 4 Modified MTDs.
[b]Smallest value of the 4 Modified MTDs.

930 ± 31 m, MTD2 = 906 ± 29 m, MTD3 = 1058 ± 35 m, MTD4 = 1015 ± 33 m) and control (mean ± SE: MTD1 = 885 ± 25 m, MTD2 = 845 ± 22 m, MTD3 = 982 ± 29 m, MTD4 = 908 ± 30 m) areas in the difference of before and after in each of the 4 modified (6-hour) MTDs. No interactions among age, sex, and hunt and treatment were significant for any of the modified MTDs (Table 2).

There was no difference (Table 3) between the percent overlap of deer daily use areas for the treatment (mean ± SE = 43.9 ± 1.8%) and control (mean ± SE = 46.8 ± 1.6%) areas. Interactions among age, sex, and hunt and treatment were not significant for percent overlap in daily use area (Table 3).

A radio-collared, 1.5-year-old male deer was believed to have been chased by a hound during a hunt on 1 occasion. He moved long distances (up to 965 m in 2 hours) during the hunt, but by 0336 hours the following morning, it had returned to its original position. The day following the hunt, this animal moved as little as 41 m between the 1400 and 1600 hour telemetry locations. All movements of this animal during and after the hunt were within its original home range. No other deer were believed to be chased by the hounds during the treatment periods. Observations of radio-telemetry data indicate that no other radio-collared deer left its home range or general use area due to a raccoon hunt.

Out of a possible 9,072 photographic frames, 7,607 (84%) could be seen clearly. Low light, camera failure, rain, and fog contributed to unclear frames. A total of 2,530 deer was observed, with 1,262 deer in 3,800 frames in the treatment area and 1,268 deer in 3,807 frames in the control area. Most of the deer were recorded in the afternoon (2,341 deer in 3,832 frames), as opposed to the morning (189 deer in 3,775 frames). There was no difference between treatment and control ranks of differences in deer visitation between treatment and control or no significant interactions (Table 4).

Discussion

Raccoon hunting conditions and the simulated deer harvest conditions were as typical as possible, although only a few of the raccoon hunts were actually conducted during the deer hunting season. The alternating treatment design and the use of a

Table 3. Results of analysis of variance testing percent overlap in deer daily use areas for differences between treatment (raccoon hunting) and control areas and interactions with hunt, sex, and age on Westvaco's North Whitener Tract, Jasper County, South Carolina, 1993–1995.

Source	DF	*F*-Value	*P*
Treatment	1	0.60	0.4403
Treatment × sex	1	2.23	0.1372
Treatment × hunt	17	0.93	0.5377
Treatment × age	1	0.28	0.5971
Treatment × sex × hunt	16	0.52	0.9329
Treatment × sex × age	1	0.46	0.5006
Treatment × hunt × age	8	0.11	0.1170
Treatment × hunt × sex × age	8	0.24	0.9754

Table 4. Results of analysis of variance of photographic ranks of all deer for differences between treatment (raccoon hunting) and control areas and interaction with time and hunt on Westvaco's North Whitener Tract, Jasper County, South Carolina, 1993–1995.

Source	DF	*F*-Value	*P*
Treatment	1	0.09	0.7681
Treatment × time	1	0.36	0.9919
Treatment × hunt	17	0.55	0.9284
Treatment × time × hunt	17	0.24	0.9994

control group of deer activity were essential to eliminate the confounding effects of other factors that change deer activity. Also, testing the differences in each movement parameter between pre-hunt and post-hunt for each deer reduced the variance associated with differing movement rates of individual deer. Observations were limited to fawns and 1.5-year-old deer. It is possible that older deer may react differently to the disturbances associated with hunting raccoons with hounds. There was no evidence that raccoon hunting affected ages (fawns and 1.5 year old) and sexes (males and females) differently based on pre- and post-hunt differences in MTD. However, the female fawn response to raccoon hunting disturbances probably reflected the response of their mothers.

Raccoon hunting did not change deer movements as measured by MTD characteristics. The average MTD in this study exceeded distances reported in other studies on white-tailed deer movement (Marchinton and Jeter 1966, Bridges 1968, Swayngham 1988, Boller 1992). From a deer hunter's perspective, MTD 3 and MTD 4 were more meaningful than the daily MTD, because they include the primary times that a deer hunter would be attempting to harvest a deer. We concluded that movement of deer during legal hunting hours is not affected by raccoon hunting in the area the night before.

Deer that raccoon hunters saw while going to treeing hounds were apparently not affected by hunters and hounds. It is unknown, however, if deer were near the treeing hounds and ran off before hunters could see them. In studies that used hounds to directly chase deer (Sweeney et al. 1971, Corbett et al. 1972, Gipson and Sealander 1975, Nichols and Whitehead 1978), most deer that left their home ranges when chased by hounds returned within 24 hours, and all returned within 72 hours. Deer also could have been close to treeing hounds, but not noticed by hunters. When in dense cover, deer often will elect to remain bedded when approached by hounds (Dasmann and Taber 1956, Sweeney et al. 1971, Corbett et al. 1972, Gipson and Sealander 1975). This behavior can result in deer remaining undetected. In our study, deer not chased were not affected by the presence of hunters and raccoon hunting dogs in the area.

Data on percent overlap of daily use areas and bait station visitation indicated that hunter opportunities to harvest deer were not affected by raccoon hunting. Photographs suggested that raccoon hunting did not cause deer to avoid baited areas, and the technique produced economical and unbiased results. Camera/intervalometer failure was equally distributed between treatment and control, but did impact the sample size of photographs. Low light availability restricted photographic sessions to after official sunrise and before official sunset, however. Deer hunters legally can harvest deer for approximately 30 minutes before official sunrise and after official sunset. An alternative technique for making observations of deer at bait stations during these times would have been valuable.

We conclude that raccoon hunting (as conducted in this study) has no effect on the ability of hunters to observe and potentially harvest deer in the same general area during the following diurnal period. We recommend that raccoon hunters, using trained raccoon hounds, be allowed access to properties concurrently being hunted for deer in coastal South Carolina.

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