Effects of Controlled Dog Hunting on Movements of Female White-tailed Deer

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Abstract: Understanding the responses of white-tailed deer *(Odocoileus virginianus)* to controlled dog hunting can aid in the effective implementation of canine-assisted population management strategies. We examined the 24-h diel movements of 13 radio-collared female deer exposed to dog hunting on the Savannah River Site (SRS) near Aiken, South Carolina, where regulated dog hunting has occurred since 1965. We compared diel home range size, rate of travel, and distance between extreme diel locations before, during, and after hunts from 14 September–14 December 2002. Diel home range size ($F_{2,91} = 7.71$, $P < 0.001$) and distance between extreme diel locations ($F_{2,91} = 6.78$, $P = 0.002$) on hunt day were greater than 10-day pre- and post-hunt periods. There was no difference between pre-and post-hunt diel home range size ($F_{2,91} = 7.71$, $P = 0.999$) and distance between extreme diel locations ($F_{2,91} = 6.78$, $P = 0.704$). Rate of travel ($F_{2,91} = 2.74$, $P = 0.070$) did not differ among the pre-, hunt day, and post-hunt periods. In 8 of 15 monitoring periods of individual deer during hunts, deer moved outside the periphery of their fall home range. The mean distance deer moved outside of their fall home range boundary was 0.8 km ($SE = 0.2$ km) and all returned within 13 hours. Our data suggest short-term, controlled dog hunting has little long-term effect on adult, female white-tailed deer movement on the SRS. Because deer did not leave the hunt area, the effectiveness of such hunts may be increased by extending their duration.

Key words: dog hunting, home range, movements, *Odocoileus virginianus*, South Carolina

Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl.Agencies 57:317–325

The intensity and duration of hunting pressure may have variable effects on white-tailed deer *(Odocoileus virginianus)* movements (Marshall and Whittington 1969, Sweeney et al. 1971, Root et al. 1988, VerCauteren and Hygnstrom 1998, Kilpatrick and Lima 1999). Because deer alter their movement patterns in response to hunting pressure, hunting-related activities may influence deer vulnerability to harvest and other sources of mortality (Root et al. 1988). Understanding responses of white-tailed deer to controlled hunting may help managers better meet harvest goals.

Many studies have suggested that deer exhibit a high fidelity to home ranges when disturbed, but may make temporary excursions outside of their home range to avoid hunting pressure (Sweeney et al. 1971, Downing and McGinnes 1976, Pilcher and Wampler 1982, VerCauteren and Hygnstrom 1998). Managed hunts often are designed to control deer density to alleviate localized deer-human conflicts. However, few studies have assessed whether normal ranges of deer disturbed by short-term hunting activity are reflected in kill locations (Downing and McGinnes 1976, VerCauteren and Hygnstrom 1998).

In previous reports of deer chased by hunting dogs, deer readily left their home ranges while being pursued; however, most returned within one day (Sweeney et al. 1971, Downing and McGinnes 1976). Sweeney et al. (1971) released 1–7 dogs in close proximity to radio-collared deer and observed individual deer movements. No studies have examined deer response to intensive, organized dog hunts involving hundreds of dogs and hunters in a concentrated area.

Our objectives were to assess the effects of controlled dog hunting on movements of white-tailed deer on Savannah River Site (SRS) and to use this information to refine deer population control methods on SRS. Additionally, this information will be helpful to researchers and managers interested in whether harvested deer lived in the area in which they were harvested.

Study Area

Our study was conducted on the 80,267-ha SRS in Aiken, Barnwell, and Allendale counties, South Carolina. SRS is a U.S. Department of Energy National Environmental Research Park located in the Upper Coastal Plain physiographic province (Imm and McLeod in Press). The topography is gently rolling to flat with elevations ranging from 20–130 m. SRS is 97% forested, with pines being dominant (68%) in the overstory canopy including longleaf pine *(Pinus palustris)* and loblolly pine *(P. taeda)*. Other major vegetation types are swamps and riparian bottomlands (22%) and upland hardwoods (7%) (Imm and McLeod in Press).

In 1950, SRS was estimated to contain <24 deer (Johns and Kilgo in Press). By 1965 the population rebounded and controlled dog hunting was instituted to reduce the incidence of deer-vehicle collisions. Controlled dog hunting has provided a safe, efficient means of maximizing hunter effort within areas targeted for deer population control (Novak et al. 1999). The U.S. Forest Service sets annual population reduction goals to maintain a sitewide population of 4,000 deer with an even sex ratio. In 2002,

the pre-hunt population on SRS was estimated at 5,500 deer. During the hunt that year, 1,318 deer were harvested by hunters and 88 deer were killed by vehicles on SRS. Each hunt unit (3,458–5,273 ha) was hunted only 1–2 days from 28 September–4 December 2002 for a duration of 3–4 h either in the morning or afternoon. Hunts involved 91–200 stationary standers placed along roadways at >275 m intervals and 67–70 dog packs (3–6 dogs and 1 mobile handler each). Stationary stander and dog pack release sites were pre-determined and geo-referenced. Hunters used shotguns loaded with buckshot and were instructed to shoot all deer that presented safe shots, regardless of age or sex.

Methods

We captured deer in rocket nets and by tranquilization with a dart gun (Dan-inject, Borkop, Denmark; Palmer Cap-chur Equipment, Douglasville, Georgia) from January 2001 to July 2002. We targeted adult females during our capture efforts because male white-tailed deer movements during the breeding season are more variable and could have confounded our results (Marchinton and Hirth 1984, Beir and McCullough 1990, Sargent 1992). Rocket nets were placed on established food plots planted in seasonally desirable forage crops and baited with whole kernel corn and trace mineral salts. Deer captured in rocket nets were immobilized with xylazine hydrochloride administered intramuscularly at 1 mg drug/kg estimated body weight. We loaded transmitter darts (Pneu Dart, Williamsport, Pennsylvania) with a 3-cc mixture of Telazol (500 mg in solution) and xylazine hydrochloride (180 mg). Deer were fitted with radio-collars (Advanced Telemetry Systems, Isanti, Minnesota), eartagged, and assigned an approximate age by tooth wear and replacement criteria (Severinghaus 1949). We reversed immobilization drugs with yohimbine hydrochloride (0.06 mg/kg intramuscularly). Animal handling procedures were approved by the University of Georgia Institutional Animal Care and Use Committee (#A3437-01).

We used radio receivers (Advanced Telemetry Systems, Isanti, Minnesota; Communication Specialists, Orange, California) and 3-element folding Yagi antennas to take bearings from geo-referenced telemetry stations. We located deer at 1-h intervals by triangulation during two–five 24-h diel periods for 10 days pre- and post-hunt. Bearings for triangulation were obtained sequentially, taking <20 min to collect the 3–7 bearings used to estimate the location of an individual deer (Nams and Boutin 1991). On the day of the hunt, we located deer at 20-min intervals just before and during the hunt by biangulation using simultaneous bearings or triangulation. Immediately after hunters left the woods at the conclusion of the hunt, we continued to locate deer by triangulation at 1-h intervals for the remainder of the 24-h diel period encompassing the hunt. The mean angular telemetry error was 8.3° ($SE = 0.80$) as determined by estimating bearings ($N = 50$) to 10 test transmitters placed at known locations in the study area. We used LOCATE2 (Nams 1990) to estimate deer locations.

We entered geo-referenced deer locations into a spreadsheet and imported them

Table 1. Mean measures (SE) of diel home range size (ha), diel rate of travel (m/h), and distance between extreme diel radio locations (m) for 13 female white-tailed deer during pre-hunt, day of hunt, and post-hunt, Savannah River Site, South Carolina, 14 September–14 December 2002. Mean values in columns followed by the same capital letter did not differ ($P > 0.05$) according to Tukey's HSD comparisons.

Period	Diel home range (ha)	Diel rate of travel (m/h)	Distance between extreme diel locations (m)
Pre-hunt	43.0 (4.7)A	188.9 (9.5)A	691.5 (57.7)A
Hunt day	85.7 (17.2)B	225.8 (22.1)A	1301.8 (209.4)B
Post-hunt	43.0 (5.0)A	184.2 (8.1)A	758.0 (89.7)A

into ArcView 3.2 (Environmental Systems Research Institute, Redlands, California) as point themes. We calculated minimum convex polygons (Mohr 1947) with the Animal Movements extension (Hooge and Eichenlaub 1997) in ArcView to estimate fall home range and diel home range. For all 24-h monitoring periods, we calculated diel home range using only one location/1-h interval. We used 50 to 145 locations/deer from 18 April 2001 to 11 April 2003 to define annual home ranges. We derived fall home ranges for each deer from a distribution of 21–27 randomly-selected locations/deer from 14 September to 23 December 2002, not including hunt days. We quantified diel home range (ha) as the area used in a 24-h period. We also used point locations to calculate diel rate of travel and distance between extreme diel locations. Diel rate of travel (m/h) was the sum of successive distances traveled between sequential radio locations divided by the number of hours a deer was monitored. Distance between extreme diel locations (m) was the greatest distance between any two radio locations obtained for a deer during a diel monitoring period (Labisky and Fritzen 1998). We performed statistical analyses with Statistical Analysis System software. We used analysis of variance (PROC ANOVA) (SAS 2001) to detect differences among diel home range size, diel rate of travel, and distance between extreme diel locations for the pre-, post-, and hunt day periods. We used Tukey's HSD to make pairwise comparisons of significant results ($P < 0.05$).

Results

From 14 September to 14 December 2002, we located 13 female deer 1,938 times during 94 24-h diel monitoring periods (pre-hunt = 35, hunt day = 15, post-hunt = 44). We monitored female deer movements relative to four individual hunts on 28 September, 30 October, 2 November, and 4 December 2002. Mean measures of diel home range size ($F_{2,91} = 7.71$, $P < 0.001$) and distance between extreme diel locations ($F_{2,91} = 6.78$, $P = 0.002$) during hunt days were greater than pre- and post-hunt monitoring periods (Table 1). We detected no differences among pre- and post-hunt periods for diel home range size ($F_{2,91} = 7.71$, $P = 0.999$) or diel rate of

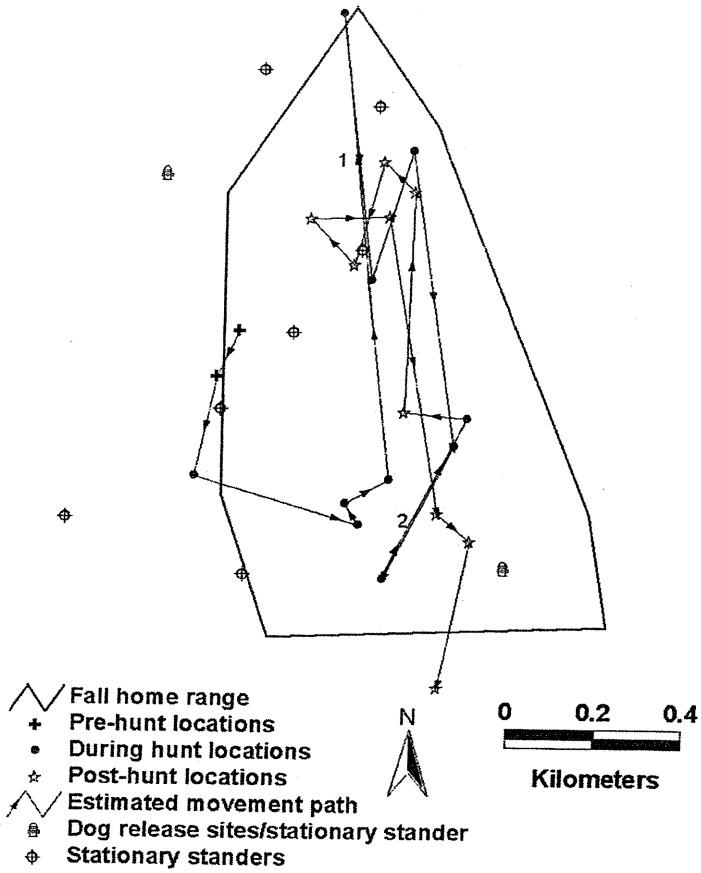

Figure 1. Estimated movements of 1 female white-tailed deer on Savannah River Site, South Carolina, during a 24-h period, which included a controlled dog hunt on 28 September 2002. The numbers "1" and "2" indicate distinct backtracking patterns.

travel ($F_{2,91} = 2.74$, $P = 0.704$) (Table 1). Diel rate of travel ($F_{2,91} = 2.74$, $P = 0.070$) did not differ among periods although it was more than 15% greater on the hunt day (Table 1).

All radio-collared deer remained within hunt area boundaries during the 15 24-h hunt day monitoring periods. Two radio-collared deer were harvested during hunts and data on their movements were excluded from analyses. Hunters did not report seeing other marked deer. Estimated movement paths of deer during hunts suggested that deer avoided dogs and hunters by backtracking, running long distances, and remaining inactive for extended periods (Fig. 1). Our telemetry data, along with the

fact that few of our research animals were observed by hunters, suggest that deer made use of thick escape habitats such as stream corridors and young pine plantations. In 8 of 15 monitoring periods during hunts, deer were observed outside the periphery of their fall home range. The mean distance deer moved outside of their fall home range boundary during a hunt was 0.8 km ($SE = 0.2$ km). One doe traveled 2.3 km from her fall home range boundary and did not return to her home range until about 13 h later after the hunt ended (Fig. 2). This deer remained outside of her home range longer than any other. In 6 of 15 monitoring sessions during hunts, deer were observed outside of their annual home range. The mean distance deer moved from the periphery of their annual home range was 0.8 km ($SE = 0.3$ km).

Discussion

Despite the release of ≥200 dogs/hunt, controlled dog hunting had no apparent long-term effect on female deer movements. During the hunts, does displayed a high fidelity to seasonal and annual home ranges. Those deer that did leave their fall or annual home ranges during the hunts generally returned before the hunt was over or soon after disturbance subsided. Deer resumed normal movements within seasonal and annual home ranges during the post-hunt monitoring period.

Our findings are consistent with most previous reports of deer chased by hunting dogs (Schoonmaker 1938, Sweeney et al. 1971, Downing and McGinnes 1976) and deer exposed to human hunting pressure for a more extended period (Pilcher and Wampler 1982, VerCauteren and Hygnstrom 1998, Kilpatrick and Lima 1999). Sweeney et al. (1971) found that deer left their home ranges when pursued in 78% of experimental chases with dogs and 98% of those deer returned to their home ranges within one day. Downing and McGinnes (1976) introduced dogs to an enclosure on 6 weekends during a 2-month period to drive deer from a 245-ha watershed, and although virtually all deer were driven from the area, most returned to their home ranges the following day. VerCauteren and Hygnstrom (1998) reported deer that flushed from their home ranges during a 3-day muzzleloader hunt returned to pre-hunt home ranges within 6 days post-hunt. Conversely, Kilpatrick and Lima (1999) found that most deer responded to disturbance by shifting diurnal core use areas within their home range to avoid hunters during a 9-week urban archery hunt.

Sweeney et al. (1971) observed deer harassed by hunting dogs to exhibit characteristic behaviors to escape pursuit including holding, circuitous movements, and distance running. Similarly, we found as the hunt progressed, deer made presumably deliberate attempts to elude dogs and humans as displayed by periods of inactivity integrated with occasional extensive movements. We also observed deer using backtracking movement patterns. Deer backtracked only during hunts and generally toward the interior of their home range. Deer returning to their home ranges after the hunt used direct routes rather than backtracking.

Downing and McGinnes (1976) found that kill locations of tagged deer during managed dog hunts did not represent the normal ranges of those deer, though they did not quantify differences. Sweeney et al. (1971) found that >90% of marked deer re-

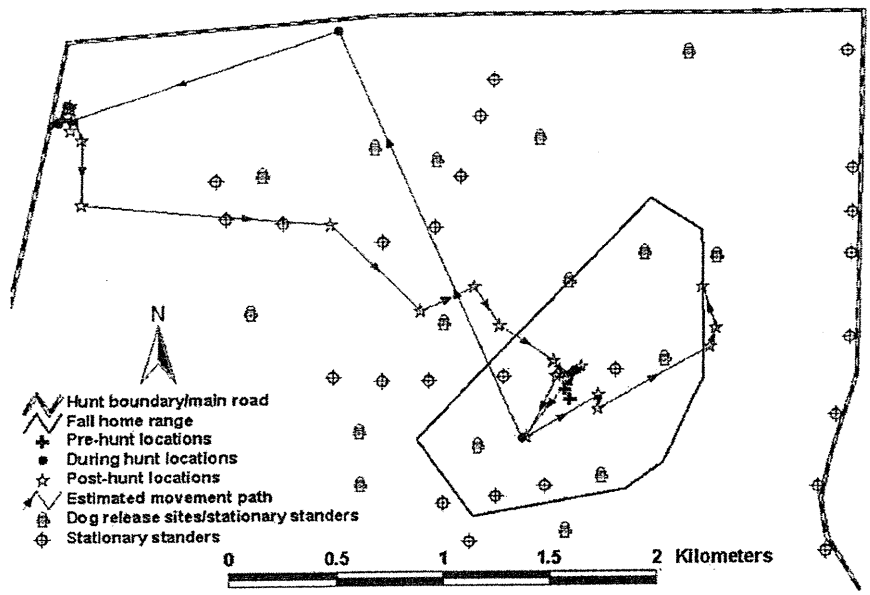

Figure 2. Estimated movements of 1 female white-tailed deer on the Savannah River Site during a 24-h period, which included a controlled dog hunt on 2 November 2002.

mained within 1 km of their home ranges. Our results also indicated that does exposed to short-term, intensive, dog-hunts remained in close proximity to their established fall and annual home ranges. All radio-collared deer were available for harvest in the hunt areas during the 3–4 h hunts, but only 2 of 13 were sighted. Increasing the duration of hunts in individual units may facilitate a more effective harvest by forcing deer to continue moving and in turn present hunters with more shot opportunities. Also, because of the limited range of buckshot, further concentrating dog packs and increasing the number of standers may increase hunt efficiency. Future research quantifying the habitat characteristics of escape cover may prove beneficial to hunt planners.

Ackowledgments

We thank D. Copney, J. Falzone, A. Foley , P. Johnston, K. Middlebrooks, M. Olsen, C. Roever, K. Settlage, V. Swaminathan, and W. Ulrey for field assistance. We gratefully acknowledge the support of W. Jarvis, P. Johns, D. Napier, D. Wilson, and Wackenhut Services, Inc. This project was funded by the U.S. Department of Energy-Savannah River Operations Office through the U.S. Forest Service-Savannah River under Interagency Agreement DE-IA09-00SR22188, and the Daniel B. Warnell

School of Forest Resources-University of Georgia. Additional funding was provided by Antler King Trophy Products and Moultrie Game Feeders. Finally, we thank S. Castleberry and J. Carroll for reviewing the manuscript.

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