Food Plots and Deer Home Range Movements in the Southern Coastal Plain

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Abstract: Radio-collared white-tailed deer (*Odocoileus virginianus*; 7 males, 13 females) were tracked from 1984 to 1989 on the Marion County Wildlife Management Area in southern Mississippi. Alternating halves of the study area were planted with 66 0.1-ha and 20 0.4-ha cool-season and 20 0.4-ha summer agronomic forage plots. Mean annual production and utilization (air-dry) of cool-season forages were 1,904 kg/ha (SE = 59) and 1,107 kg/ha (SE = 41), respectively. Summer forage production and utilization were 664 kg/ha (SE = 50) and 586 kg/ha (SE = 48), respectively. Annual 95% convex polygon home ranges averaged 691 ha for 6 adult ($\geq$ 3 years) bucks and 343 ha for 12 adult does. Significant ($P < 0.05$) seasonal differences in home range size were observed for does, but seasonal differences for bucks were not significant ($P = 0.12$). Significant movements both toward and away from the planted side of the study area were observed for some individual deer. Net movement of radio-collared deer, however, did not respond positively or negatively to the planting of food plots.

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Food plots in the Southeast have been commonly used in wildlife habitat management since 1935 (Halls and Stransky 1969, Larson 1969). While many researchers have demonstrated the high degree to which deer utilize agronomic food plots (Handly and Scharnagel 1961, Webb 1963, Johnson et al. 1987, Davis 1988), little research has been done to document their effects on deer movements. Brown and Mandery (1962) reported that fertilized agronomic forages would attract and hold elk from considerable distances. Byford (1970) related an account of a radio-tracked doe changing her center of activity 4 times in several months, presumably in response to changing food availability. Mott et al. (1985) reported that deer appeared to shift their geometric center of use toward soybean fields

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during the summer. The purpose of this study was to determine the effects of agronomic forage plantings on white-tailed deer movements in the Southern Coastal Plain.

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Methods

The 2,900-ha Marion County Wildlife Management Area (MCWMA) was established in 1952 and is located in the Coastal Plain region 9 km southeast of Colum- bia in Marion County, Mississippi. The primary soils are the Falkner-Benndale and Smithdale-Lucy associations with Bibb silt loams present in the many small drainage basins (Nichols et al. 1985). The soils of the MCWMA are generally well drained, loamy and siliceous, and strongly acidic (pH = 4.5 – 5.5), with slopes of 5% to 40%. Topography is moderately rolling to undulating. Climate is dominated by moist tropical air from the Gulf of Mexico.

The principal overstory species present on the area are longleaf pine (*Pinus palustris*), slash pine (*P. elliottii*), and loblolly pine (*P. taeda*) with various oak-hickory (*Quercus* spp. -*Carya* spp.) associations occurring in the bottomlands (Nichols et al. 1985). Principal understory species are yaupon holly (*Ilex vomitoria*), gallberry (*I. glabra*), flowering dogwood (*Cornus florida*), and wax myrtle (*Myrica cerifera*). The area is open to deer hunting from October through December (3,450 deer hunting visits annually), and mean annual harvest from 1985 to 1988 was 135 animals (Vanderhoof and Jacobson 1991).

Planting Design

From September 1984–May 1985, cool-season agronomic forages were planted in all of the 172 plots across the entire MCWMA; from May 1985–August 1985, summer forages were planted in the 40 0.4-ha plots only. Beginning September 1985 and extending through April 1986 we used a power line right-of-way which bisected the MCWMA into 2 areas of approximately equal size and with equal numbers of plots on each side. The northeast half of the area was planted in cool season agronomic crops, while the southwest half remained fallow (unplanted and uncultivated). From May 1986 to August 1986, the northeast half was planted with summer forages while the southwest half remained fallow. Beginning September 1986 treatments were reversed and the southwest half was planted while the northeast half remained fallowed. Treatments were reversed annually in this manner until August 1989. These cross over treatments were designed to "average out" area effects by each half receiving the same treatments (planted and fallow) for the same number of years.

Selection and Establishment of Agronomic Forage Plots

Species selection was determined through a mail survey of wildlife biologists in the southeastern United States. Those surveyed were asked which agronomic species they thought were most beneficial to white-tailed deer (Jacobson et al. 1985). Thirteen species were chosen for cool-season plantings when the study began in 1984: oats, wheat, rye, ryegrass, yuchi clover, subterranean clover, crimson clover, berseem clover, ladino clover, alfalfa, fescue, turnips, and vetch. Three species were chosen for summer plantings: cowpeas, soybeans, and joint vetch. Corn was also planted during the summer, but because it does not mature until fall it was considered to be a cool season planting. Subsequent evaluation of first year data revealed that berseem clover, alfalfa, and turnips were not productive enough to be considered suitable crops for wildlife food plots in southern Mississippi. Meechi clover was then substituted for alfalfa, and ball clover was added in 1987.

The 172 food plot sites (40 0.4-ha and 132 0.1-ha plots) were evenly distributed throughout the entire MCWMA. Sites were chosen using aerial photos with ground verification to ensure the site's suitability (i.e., level topography, adequate drainage, and road accessibility). Plots were either located in existing openings or were cleared with a bulldozer (Lunceford 1986). Plots were randomly assigned an agricultural forage species each season. Seeding rates were the same as those recommended in the Mississippi Planting Guide (Davis 1988) or as modified by a Marion County Extension agent. Fertilizer and lime were applied as indicated by soil tests.

Production and Utilization of Agronomic Forage Species

Production and utilization of agronomic forage species were determined using 0.78 - m^2 wire cage enclosures at a density of 10/ha. Forage within each cage and from an equal area, randomly-selected, outside but near each cage were clipped monthly to within 2.5 cm above the ground. Initial monthly forage production was estimated using the weight of the forage clipped inside the cage. Subsequent estimates of monthly production were calculated by subtracting the weight of the forage clipped outside the cage the previous month from the weight of the forage clipped inside the cage during the current month. Monthly utilization estimates were calculated by subtracting the weight of the forage clipped outside the cage from the weight of the forage clipped inside the cage.

After each clipping, cages were moved within the plot to a random location. Locating the cage was done by throwing 1 of the stakes which secured the cages to the ground in the air with a spinning motion—direction determined by which direction the stake was pointing when it hit the ground. A random number generator was then used to determine the distance the cage was to be moved. Forage samples were then sealed in paper bags labeled, oven-dried at 35° C (Boyer 1959) and weighed to the nearest gram.

During the 1987–88 and 1988–89 cool seasons 20 fallow plots chosen at random were monitored for residual growth of agronomic forages from the previous year. One 0.78 - m^2 wire cage enclosure was placed in each plot and clipped monthly to determine forage production/utilization.

Determination of Deer Movements

Telemetry equipment included 5 fixed-station, null peak, radio-telemetry receiving stations consisting of 3-element horizontally mounted dual yagi antennas. Antennas were between 4 and 6 m above ground level and mounted 1 wavelength apart (2.02 m) on 4.5-cm x 3-cm steel masts connected to a Telonics[R] TR-2 receiver via differential coaxial cables and Telonics[R] TAC-5 180° phase shift, 2-port null combiners. Transmitters consisted of a 5.08-cm-wide, 250-g butyl-rubber collar fitted with a 255-g Telonics[R] 5A transmitter operating at a frequency of 148 MHz.

Deer were captured using drop nets (Ramsey 1968) during January and February. Captured deer were ear-tagged, tattooed, aged (Severinghaus 1949), and radio-collared.

Deer movements were monitored for 24 hours/month. Monitoring was divided into 4 6-hour sessions with a minimum of 12 hours between sessions to promote independence of observations. All time periods 0000–2400 hours were monitored equally. Radio-collared deer were located by 2 observers obtaining an azimuth simultaneously from 2 different receiving stations. Observer activities were coordinated via CB radio. Receiving station error arcs were determined with stationary radio-transmitters placed at known locations throughout the MCWMA (Burns 1988). Mean error arcs from each receiving station were used to calculate 90% error polygons for each telemetry location, and from these, mean error polygon size was calculated.

Data Analysis

Telemetry data were recorded on standardized field forms and entered into a microcomputer using dBASE IV ™ database software (Prague and Hammitt 1989). X and Y coordinates were calculated from azimuth data using PC SAS (SAS Inst. Inc. 1988) and a modified program by White and Garrott (1990). Calculation of the 95% convex polygon (Mohr 1947) home ranges were estimated using Program Home Range (Ackerman et al. 1990). Home ranges were calculated for 2 separate periods throughout the year. "Summer" home ranges included locations from 1 June through 30 November while "winter" home ranges were calculated from locations beginning 1 December through 31 May.

Mean home range size comparisons were done using ANOVA and Duncan's multiple-range test (SAS Inst. Inc. 1988). Home range movements between years were evaluated by 2 methods. The first employed a Fishers exact test (Everitt 1977) of a 2x2 contingency table of individual location estimates by area (northeast side or southwest side) and year-pair (1986 or 1987, 1987 or 1988, 1988 or 1989). Home range movements toward or away from the planted side of the study area were determined through inspection of the 2x2 table. A Chi-square goodness-of-fit-test (Daniel 1978) was used to determine if the total number of significant ($P = 0.05$) home range movements toward the planted side of the area from 1986 to 1989 exceeded the number expected by chance.

The second method used the Mann-Whitney *U*-test of median X and Y coordinates of the calculated 95% convex polygon home range estimate (Mohr 1947, Daniel 1978). Directionality of between-year comparisons of the X and Y coordinates with at least 1 significant movement in the X or Y direction were then classified as toward or away from the planted side of the area. As with the first method, a Chi-square goodness-of-fit-test (Daniel 1978) was used to determine if the number significant home range movements toward the planted side of the study area exceeded the number expected by chance.

Results

Agronomic plantings comprised 15.18 ha (1.0% of the range) on the planted side of the MCWMA each year during the winter months and 6.47 ha (0.45% of the range) during the summer months. Mean annual production and utilization (air-dry) of cool-season agronomic forages from 1985 to 1989 were 1,904 kg/ha (SE = 59) and 1,107 kg/ha (SE = 41), respectively. Mean annual production and utilization of summer agronomic forages were 664 kg/ha (SE = 50) and 586 kg/ha (SE = 48), respectively. While wild turkeys (*Meleagris gallopavo*), northern bobwhite (*Colinus virginianus*), eastern cottontail rabbits (*Syvilagus floridanus*), and swamp rabbits (*S. aquaticus*) were commonly seen at or near the agronomic plantings, evidence of measurable forage utilization by these species was not observed.

During 1987–89, cool season fallow plots produced little forage, only 65 kg/ha (SE = 11), compared to planted plots. Utilization of palatable deer forage within the fallow plots for the 1987–88 and 1988–89 cool seasons was 39 kg/ha (SE = 8), respectively. No residual production of summer forages was observed on the MCWMA.

Home Range Size

A total of 20 deer (7 males, 13 females) were tracked between 1984 and 1989 on the MCWMA. The number of locations defining each home range averaged 167. No significant relationship ($R^2 = 0.063$, $N = 99$) was found between number of locations in the sample and the resulting size of the 95% convex polygon home range. Error polygons for all deer locations from 1984–1989 on the MCWMA averaged 36.47 ha.

Significant ($P < 0.05$) season and sex home range differences were apparent for deer on the MCWMA throughout 1984–89. Adult male (>2 years) winter 95% convex polygon home range size averaged 666 ha and was significantly larger than the mean adult female winter home range size of 317 ha (Fig. 1). Mean adult female home range size was significantly smaller during the summer months than during the winter (Fig. 1). The same trend was evident for adult males as well, but was not significant ($P = 0.121$).

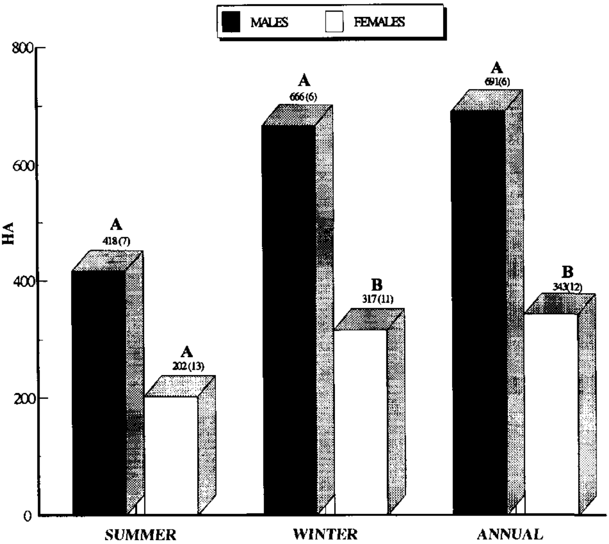

Figure 1. Comparison of 95% convex polygon home range size among adult deer (>2 years) on the Marion County Wildlife Management Area, Mississippi, 1985–89. Unique letters indicate differences significant to the P < 0.05 level between sexes within season and between seasons within sex.

Home Range Movements In Relation to Agronomic Plantings

Eleven deer (3 males and 8 females) were tracked for more than 1 year between 1986 and 1989 on the MCWMA. One buck was not included in the movement analysis because <50% of its home range was located within the study area. All 10 deer used in the movement analyses had home ranges that occurred in both the planted and unplanted sides of the MCWMA for at least 1 season between 1986 and 1989. The Mann-Whitney *U*-Test of median X and Y coordinates and the Fisher's exact text of independence of locations between years showed numerous significant annual home range movements (Table 1) during the crossover phase of this study (1986–1989). While some of these movements were statistically significant, they were not apparent upon visual inspection of the home range plots. Moreover, a Chi-square goodness-of-fit test of significant home range movements showed that the number of movements toward or away from the planted side of the study area did not differ significantly ($P = 0.05$) from that expected by chance alone for either the Mann-Whitney *U*-Test or the Fisher's exact test methods. During the course of this study, no deer was ever observed (through visual inspection of the home range plot) to noticeably alter its home range toward or away from the side of the MCWMA planted in agronomic forages.

Discussion

Home range of adult white-tailed deer in the Southeast rarely exceeds 300 ha (Marchinton and Jeter 1967, Byford 1970, Tucker 1981, Wood and Davis 1986). Mott et al. (1985), however, reported a mean 100% convex polygon home range

Table 1. Annual movements of adult deer toward or away from agronomic forage plots on the Marion County Wildlife Management Area, Mississippi (1986–89).

Winter range				Summer range			
Deer	Years	Fisher's exact test[a]	Mann-Whitney *U*-test[a]	Deer	Years	Fisher's exact test[a]	Mann-Whitney *U*-test[a]
575	86–87	+	+	575	86–87	+	+
	87–88	0	0		87–88	0	0
	88–89	0	–		88–89	0	+
700	86–87	–	–	700	86–87	0	–
	87–88	–	–		87–88	0	–
	88–89	–	0		88–89	0	–
726	86–87	0	–	726	86–87	0	–
	87–88	0	–	775	86–87	0	0
775	86–87	0	+	791	86–87	0	0
791	86–87	+	0		87–88	–	–
	87–88	+	+		88–89	0	–
	88–89	0	+	802	86–87	–	+
802	86–87	+	+		87–88	–	+
	87–88	+	+		88–89	+	+
	88–89	+	+	850	86–87	0	+
850	87–88	0	0		87–88	0	–
	88–89	+	+		88–89	+	–
862	87–88	0	0	862	86–87	+	+
	88–89	–	0		87–88	–	+
901	87–88	+	+		88–89	0	–
	88–89	+	+	901	86–87	+	+
938	87–88	–	–		87–88	0	0
	88–89	–	+		88–89	0	+
				938	86–87	0	–
					87–88	0	–
					88–89	–	+

[a] Significant ($P < 0.05$) movements toward (+) or away (-) from the planted side of the study area; zero indicates no significant movement.

for 3 adult females and an adult male to be 947 ha and 758 ha respectively, in bottomland hardwood habitat in Mississippi. Scanlon and Vaughan (1985) reported 100% convex polygon home range estimates in Virginia of 444 ha for 3 adult does captured along a mowed-grass road corridor and 879 ha for 4 deer captured in oak-hardwood forest. Home range estimates for bucks in these same habitats were 2–4 times larger than for the does. Our data show that deer inhabiting the Coastal Plain of Mississippi exhibit larger home ranges than generally reported in the Southeast, but averaged less than the values reported by Mott et al. (1985) and Scanlon and Vaughan (1985). Our data also support the findings of Progulske and Baskett (1958), Wood and Davis (1986), Mott et al. (1985), and Scanlon and Vaughan (1985) that adult male home ranges of bucks tend to be twice that of adult does.

Seasonal home range data in our study showed no significant differences between mean annual and winter home range sizes for deer of either sex (Fig. 1).

This indicates that summer home ranges are, for the most part, subsets of the winter range in the Southern Coastal Plain of Mississippi. Deer on the MCWMA appear to simply expand their home range during the winter months rather than shifting it in any specific direction. For bucks this phenomenon is probably a result of increased activity during the rut (Downing et al. 1969, Kammermeyer and Marchinton 1977) which occurs during the first week in January on the MCWMA (Casscles 1992). For does, restriction of range during the summer months after parturition has been previously reported (Bartush and Lewis 1978, Ozoga et al. 1982).

While variations in activity patterns resulting from changing food supplies have been documented (Michael 1965, Marchington and Jeter 1967, Byford 1970, Mott et al. 1985), reports of large-scale home range shifts by white-tailed deer in response to changing food supplies have not been reported. Mott et al. (1985) reported that even though their telemetry data showed that soybean fields were used significantly less than expected by deer, evidence of forage utilization was high and deer appeared to shift the geometric center of their home range toward soybean fields during the summer. They hypothesized that because of the low foraging time involved deer could spend comparatively little time at the fields and still have soybeans constitute a major portion of their diet.

Our data show that of all the agronomic forage produced on the MCWMA between 1985–1989, <3% was produced residually on the fallow food plots, and no residual forage growth was observed on the summer fallow plots. Moreover, utilization data (58% of cool season and 88% of summer plantings) show that agronomic plantings were highly palatable to white-tailed deer. Despite this high utilization, deer did not consistently or noticeably shift their seasonal home ranges in response to the presence or absence of agronomic food plantings. In addition, the data used in determining directionality of seasonal movements in response to agronomic plantings on the MCWMA (Table 1) came from deer whose home ranges occurred over both planted and fallow portions of the area. Therefore, awareness by deer of the presence of the agronomic plantings in this study could be assumed to be high. We should point out, however, that the deer in our study were subjected to annual changes in the location of agronomic forage. Constant shifting of forage plantings from 1 side of the area to the other could potentially confuse an animal's ability to locate and utilize agronomic forages effectively. The cumulative effect of agronomic forages on deer movements over several years has not been investigated.

Conclusions

Our data reinforce the concept of high home range fidelity previously reported for white-tailed deer (Sweeney et al. 1971, Corbett et al 1972, Gavitt et al. 1975, Gipson and Sealander 1977) and do not support the assertion of Mott et al. (1985) that deer shift their home ranges to exploit agronomic crops. They do show, however, that agronomic plantings are highly attractive to deer, and that deer will utilize them heavily if they occur within their established home range. Managers should be aware that in areas where acute crop depredation is a problem and fencing is not practical, deer removal efforts concentrated in the immediate vicinity of the damage site will produce the most effective results. Conversely, when establishing food plots for deer, plantings should be evenly distributed to ensure maximum availability. Because seasonal home ranges of southern deer can be smaller than 100 ha, we recommend a minimum of 1 planting per km^2 to ensure adequate availability to all the deer within the target area.

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