TELEMETRIC STUDY OF DEER MOVEMENT-ECOLOGY IN THE SOUTHEAST

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ABSTRACT

Twenty-eight deer were instrumented with radio transmitters in four Florida and Alabama habitats. Telemetric contact varied from a few hours to more than four months. Minimum home ranges of seven of these deer in their natural habitats ranged from 147 to 243 acres. This relative uniformity occurred despite considerable variation in habitat characteristics. Similarities among the habitats that might account for this uniformity were noted. Minimum home range major axes ranged from 0.76 to 2.23 miles in length with most being just less than one mile. Two semi-wild deer, when released in strange habitats, wandered over much larger areas (up to 10 times greater), but eventually established relatively small home ranges. Although major shifts in home range were not known to occur, in some instances the center of activity or "core area" changed in relation to seasonal food supply. Diel movement patterns often involved feeding out into open range or near food plots at night and returning to the wooded areas during the day. Distances between extreme diel locations averaged 0.71 miles. Minimum total distances moved during diel periods averaged 1.55 miles. Some examples of variation in the movement patterns could be related to the sexual cycle in both male and female. Data on the home range and movements of adult bucks (more than two years old) were inconclusive.

INTRODUCTION

There is currently much interest among biologists in the movement-ecology of wildlife both for basic scientific reasons and for its significance in practical management. In many instances this information is necessary for estimating wildlife population levels. Concerning southeastern deer, there is still a dearth of information on movements, and many game managers and researchers are too willing to draw on studies from other parts of the country. There is need for detailed study of many aspects of southern deer biology that may be unique to this part of the country. This is especially true of southern deer movement-ecology.

This paper reports the progress of a radio-telemetric study of the movement-ecology of deer in the Southeastern United States. The basic objectives of the study are to describe the normal diel[2] movement patterns and the size, shape and stability of the home range. Secondary objectives are to study the relationship between these behavioral patterns and individual differences of sex, age, and condition of the deer as well as environmental variables including habitat type, population density, and season. This study has been in progress for four years (1962-1966) during which time radios were placed on 20 does and eight bucks in four locations in Florida and Alabama. An attempt was made to select study areas in a wide variety of ecological situations.

[1] A joint contribution of the Alabama Cooperative Wildlife Research Unit, Auburn University, The Alabama Department of Conservation, The U. S. Fish and Wildlife Service and The Wildlife Management Institute, cooperating, and the Florida Game and Fresh Water Fish Commission, Pittman-Robertson Proj.

[2] Refers to an entire 24-hour period including a complete day and night.

STUDY AREAS

Citrus Tract

The first phase of the study was conducted on the 47,000-acre Citrus tract of the Withlacoochee State Forest, situated in Citrus and Hernando counties in west central peninsular Florida (Fig. 1). Physiographically Citrus is in the Sandhills Region of the Hilly Coastal Plain Province (Hodgkins, 1965). The topography is well-drained and rolling with elevation ranging from 20 to 150 feet above sea level. The vegetation occurring on the Citrus tract is principally the longleaf pine-turkey oak sandhill vegetation type described by Laessle (1942). The soil is mostly of low quality and valuable agriculturally only for citrus crops.

The population was estimated using the track-count method developed by Tyson (1952) at one deer per 17 acres. The Citrus deer are small in body measurements with legal bucks averaging under 100 pounds. Two deer were radio-monitored on the Citrus tract during the summer of 1963 (Marchinton, 1964).

Eglin Reservation

The second study area was a part of the Eglin Air Force Reservation referred to as Range 52 and located in Walton County in the northwestern Florida panhandle (Fig. 1). Physiographically, this area is in the same forest province and region as the Citrus tract. The terrain is only slightly rolling and varies from 60 to 110 feet above sea level. This area differed from the Citrus tract primarily in that much of it was composed of a clearing involving several square miles. Vegetation on the more recently cleared portions are predominantly herbaceous annuals and grasses, whereas the older sections also have considerable quantities of turkey-oak regeneration in the one-inch DBH class. The uncleared parts support basically the same sandhill vegetation association as the Citrus tract. Some portions of the area, however, appear to be more nearly an intergrade between this vegetation type and the sandpine-scrub oak association also described by Laessle (*op. cit.*).

The deer on the Eglin study area are similar in physical measurements to those of the Citrus tract. Hunting is ordinarily not allowed in the vicinity of Range 52 for military reasons, and as a result the deer population density at the beginning of the study was probably higher than that reported for the Citrus tract. A track-count estimate in 1964 showed a population density of one deer per 12 acres. The deer at this time were in poorer physical condition and had heavier loads of ectoparasites than in the other study areas. Shortly thereafter a reduction in numbers began to occur, and by the summer of 1966, the population was estimated at about one deer per 30 acres.

Telemetry was conducted on Eglin Field during the summer of 1964, summer and winter of 1965, and summer of 1966. During these periods, 19 deer were radio-monitored for various lengths of time. Four animals were monitored sufficiently to permit description of their home range and movement attributes. Part of the 1964 work has been given in a preliminary report by Jeter and Marchinton (1964).

Choccolocco Area

The Choccolocco Wildlife Management Area, part of the Talladega National Forest, is located in Cleburne County in northeastern Alabama (Fig. 1). It includes approximately 38,000 acres of Mountain Province habitat, with elevation averaging between 850 to 1,700 feet. The top soil is shallow and fertility is low. Agriculture was at one time attempted on a small scale in parts of the area, but has been abandoned for at least 25 years. Vegetation is composed of mixed pine-hardwood hillsides with small hardwood bottoms interspersed.

Physically the Choccolocco deer are only slightly larger than those on the Citrus and Eglin areas. Adams (1960) estimated the Choccolocco deer herd at approximately 3,500 animals. The population at the beginning of the present study was thought to be somewhat lower than this figure, possibly around 2,000 animals. This later estimate places

the population density at one deer per 20 acres and is comparable to that of the Citrus deer herd. It also approximates the Eglin herd during the summers of 1965 and 1966.

Four different deer were radio-monitored on the Choccolocco study

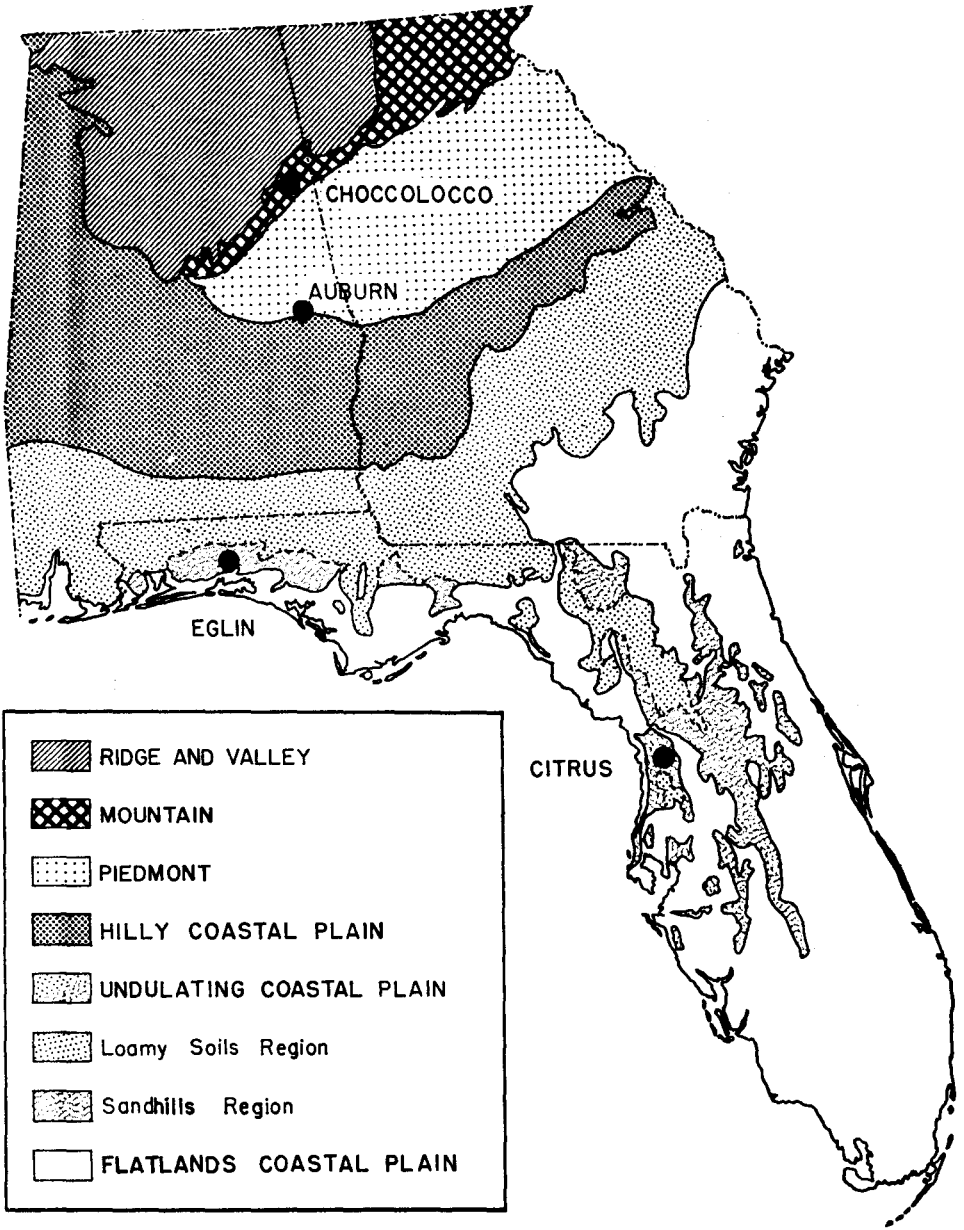

Fig. 1. Study area locations; Southeastern forest habitat regions according to Hodgkins (1965).

area during the winter, spring, and summer of 1966. The normal range attributes were computed for two of the animals, but considerable useful information was also obtained from the others.

North Auburn Area

The Auburn study area is in Lee County in east central Alabama (Fig. 1). It is in the Piedmont Habitat Province (Hodgkins, 1965). The area is primarily on Auburn University Agricultural Experiment Station land; because of the unrestrained wanderings of the animals, part of the tracking was done on private land. Forest type is dominantly pine-oak-hickory uplands with some mesic associations along creek bottoms and in beaver swamps. This area differs from the others studied in that primary land use is agricultural with an important part of the study area being in crop land or improved pasture. Even though much of the topsoil has disappeared, the soil fertility is kept at a relatively high level by liberal use of commercial fertilizer.

The Auburn deer herd is relatively new. The population density may be as low as one deer per 150 acres and is certainly much lower than in any of the other study areas. These deer are larger and in better physical condition than those in the other study areas, perhaps because of uncrowded conditions and high quality food supply. Two pen-reared deer were released on the study area. One was monitored during the fall of 1965 and winter of 1966 and the other in the spring and summer of 1966.

PROCEDURE

Instrumentation

Transmitters and receivers built by seven different manufacturers were used. The transmitters varied greatly in performance, design, and weight. Transmitter life varied from a few days to more than four months. Signal reception ranged up to 12 miles but averaged about one mile, depending on type of equipment and conditions. Weight was a problem with some of the early transmitters; the ones now in operation however, weigh only a few ounces and are attached by means of a leather collar. Excellent receivers are now available from commercial sources, also.

Tracking Technique

The capture and tracking technique is essentially the same as that described by Jeter and Marchinton in a preliminary report (1964). Locations were ordinarily taken every one to three hours throughout a 24-hour period. In most cases, individual deer were monitored for one or two complete 24-hour tracking periods each week. Additional locations were obtained as time permitted. In a few instances an animal was monitored every two hours for continuous periods greater than a week. In addition to locating the animal, the equipment now in use simultaneously telemeters information concerning the animal's activity.

Treatment of Data

Data analysis involved the development of certain movement and home range attributes for each individual during the period it was studied. These basic attributes include the following:

1. Minimum home range—the area included within a line connecting the outermost radio locations of the deer during the entire period of telemetric and visual contact. Since some of the ranges were irregularly shaped, an attempt was made to connect locations with lines that would result in the most nearly accurate home range acreage. The technique is similar to the modified minimum area method described by Harvey and Barbour (1965), but differs primarily in that a knowledge of the habitat rather than a mechanical procedure was used in determining the minimum home range boundaries.
2. Home range major axis—a line segment formed by connecting the two radio locations of the deer, obtained any time during

the study, that are the greatest distance apart. In instances where such a line would not lie entirely within the minimum home range, it was angled so that it would follow the approximate mid-line of the range and still connect these two radio locations.

3. Home range minor axis—A line segment perpendicular to the major axis and connecting the boundaries of the minimum home range at its widest point.
4. Distance between extreme diel locations (DBE)—the greatest distance between any two radio locations of the deer during a particular 24-hour tracking period.
5. Average distance between extreme diel locations (i.e., average DBE)—the arithmetic mean of all telemetrically obtained DBE's for an individual deer.
6. Minimum total distance moved in diel period (MTD)—the sum of the distances between sequential locations during a particular 24-hour period of tracking. The data upon which this value was based were subject to a certain amount of experimental error because of inconsistent frequency of obtaining radio locations.
7. Average minimum total distance moved in diel period (i.e., average MTD)—the arithmetic mean of all MTD's obtained throughout radio contact.

RESULTS

Useful telemetric data were obtained from most of the 28 deer that have been instrumented. At least nine were studied intensively enough to provide reasonably complete movement pattern information. Table 1 summarizes this information for deer instrumented in the wild. Similar data for two semi-wild deer released in a new habitat are presented in Table 2. The information pertaining to the other 19 deer is not specifically tabulated, but much of it will be considered in the discussion.

TABLE 2. Some individual and movement pattern information relating to two semi-wild deer released near Auburn in an agricultural and mixed-pine-hardwood habitat with estimated population of only 1 deer per 150 acres.

	Deer Number	
Item	Auburn No. 1	Auburn No. 2
Telemetric study period	9/25/65 to 1/15/66	5/30/66 to 8/6/66
Age when tracking began	14 months	11 months
Sex	female	male
Total range from time of release	2,800 acres	500 acres
Minimum home range after adjustment	900 acres	255 acres
Minimum home range major axis	1.79 miles	1.18 miles
Minimum home range minor axis	1.61 miles	0.74 miles
Range of DBE	0.25-1.38 miles	0.37-0.75 miles
Mean DBE	0.70 miles	0.53 miles

Table 1. A summary of movement pattern attributes of seven deer in their normal habitat in relation to some individual and ecological variables

Habitat	Estimated population (acres per deer)	Telemetric study period	Deer number	Sex	Age (years)	Movement Pattern Attributes*						
						Minimum home range (acres)	Major axis (miles)	Minor axis (miles)	Range of DBE (miles)	Mean DBE (miles)	Range of MTD (miles)	Mean MTD (miles)
Central Florida, longleaf pine-turkey oak sandhills	17	6-16-63 7- 1-63	Citrus No. 1	F	8+	230	0.97	0.59	0.25-0.70	**	0.33-2.00	**
Northwestern Florida, longleaf pine-turkey oak sandhills, and sand pine scrub	12	6-24-64 8-17-64	Eglin No. 2	F	2½	200	1.80	0.40	0.30-1.40	0.91	0.90-2.23	1.70
	12	1-22-65 3-14-65	Eglin No. 8	M	1½	147	0.76	0.38	0.25-0.76	0.53	0.44-1.95	1.15
	20	7-27-65 8-24-65	Eglin No. 11	F	2½	161	1.02	0.42	0.52-1.02	0.67	0.21-2.06	1.81
	30	7-17-66 8- 2-66	Eglin No. 17	F	2½	240	2.23	0.41	0.68-1.14	0.93	0.82-1.87	1.47
Northeastern Alabama, mixed-pine-hardwood, mountain province	20	2- 9-66 3-13-66	Choc. No. 1	F	3	215	0.93	0.68	0.47-0.93	0.61	1.16-2.13	1.64
	20	3-16-66 5- 7-66	Choc. No. 4	F	4	243	0.96	0.70	0.47-0.74	0.60	1.24-1.71	1.50

* See treatment of data for explanation of symbols

** Insufficient data to compute averages

DISCUSSION

Home Range Area and Shape

The areas included in the minimum home ranges of those deer studied in their usual habitat were small and surprisingly uniform (Table 1). This was true even though there were habitat differences in soil types, climatic conditions, plant associations, and especially topography. However, there were also certain fundamental similarities among the three non-agricultural study areas and these may be of greater importance than the differences in determination of deer movement patterns. Two of these similarities are:

1. There was a high degree of interspersion of oak-mast and other foods on the three areas. As a result the changing food

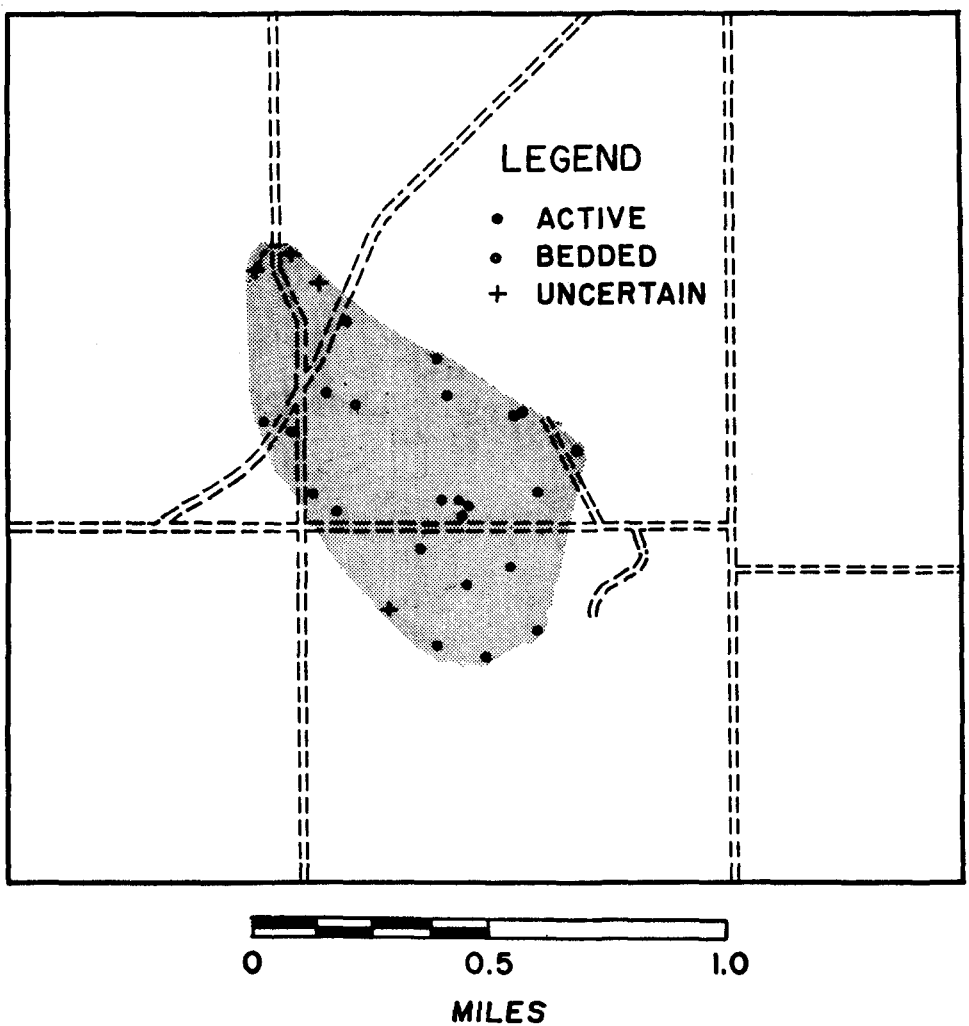

Fig. 2. The 230-acre minimum home range of an adult doe, Citrus No. 1, including bedded and active locations.

availability related to season causes little necessity for major shifts in movement patterns.

2. The deer population levels were comparable and ranged from moderately high to high on the three study areas. This could be extremely important since evidence is available that high population levels have a restricting effect on the home range of some mammals (Frank, 1957).

Until further study is conducted in other habitats, caution should be used in the interpretation of these results as generally applying to ecological conditions other than those studied.

Another factor that is probably important but was not fully evaluated in the present study is the difference between the home ranges

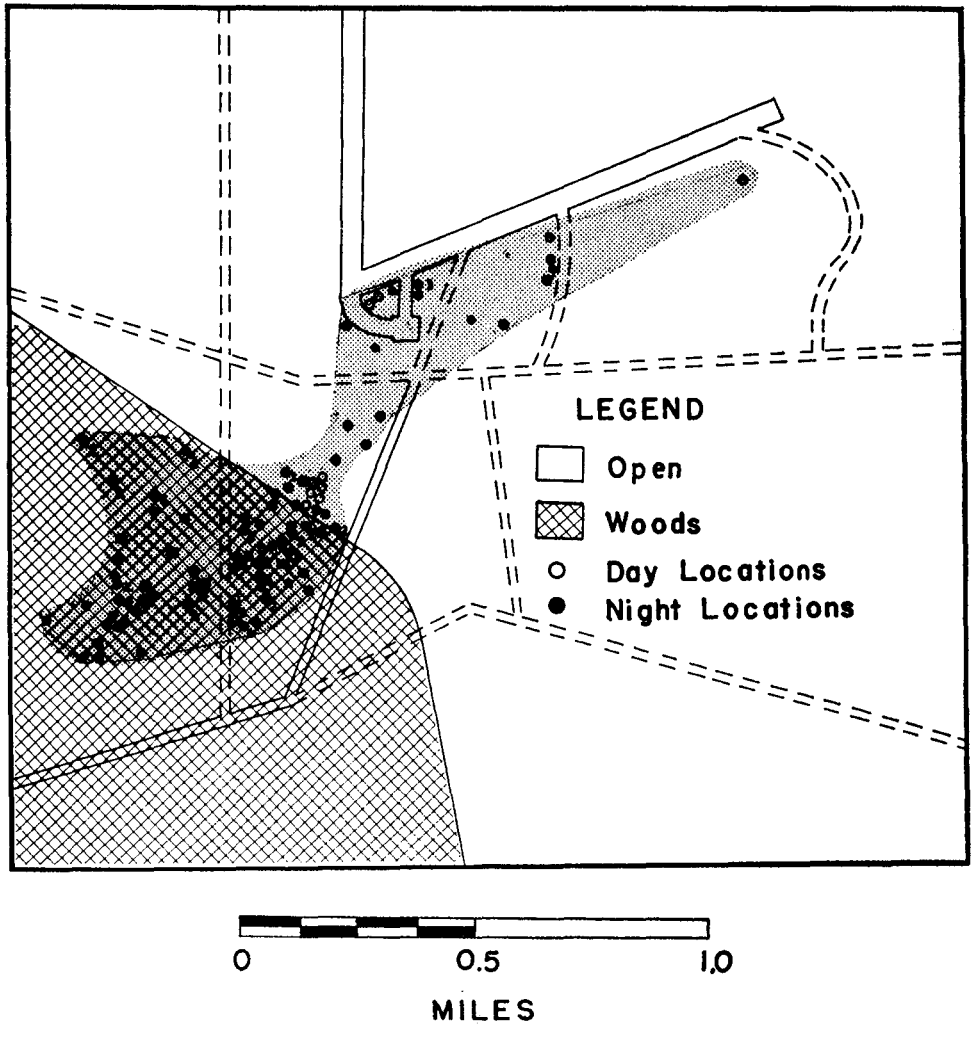

Fig. 3. The 200-acre minimum home range of an adult doe, Eglin No. 2, with day and night locations indicated.

of adult bucks and does. Previous studies of deer movement have almost invariably indicated greater movement by bucks. In the present study, although several adult bucks (more than two years old) have been radio equipped, the information obtained has been inconclusive because of radio failures. The yearling bucks studied had ranges similar to or smaller than the does. A 1½-year-old buck (Eglin No. 8) for which movement attributes have been described had a range of 147 acres. This is smaller than that of any of the does tracked. Auburn No. 2, a semi-wild yearling buck released on the Auburn study area, established a home range of 255 acres after a period of adjustment. Although this was slightly larger than the range of the animals in their natural habitat, it was much smaller than that of the released doe (Auburn No. 1).

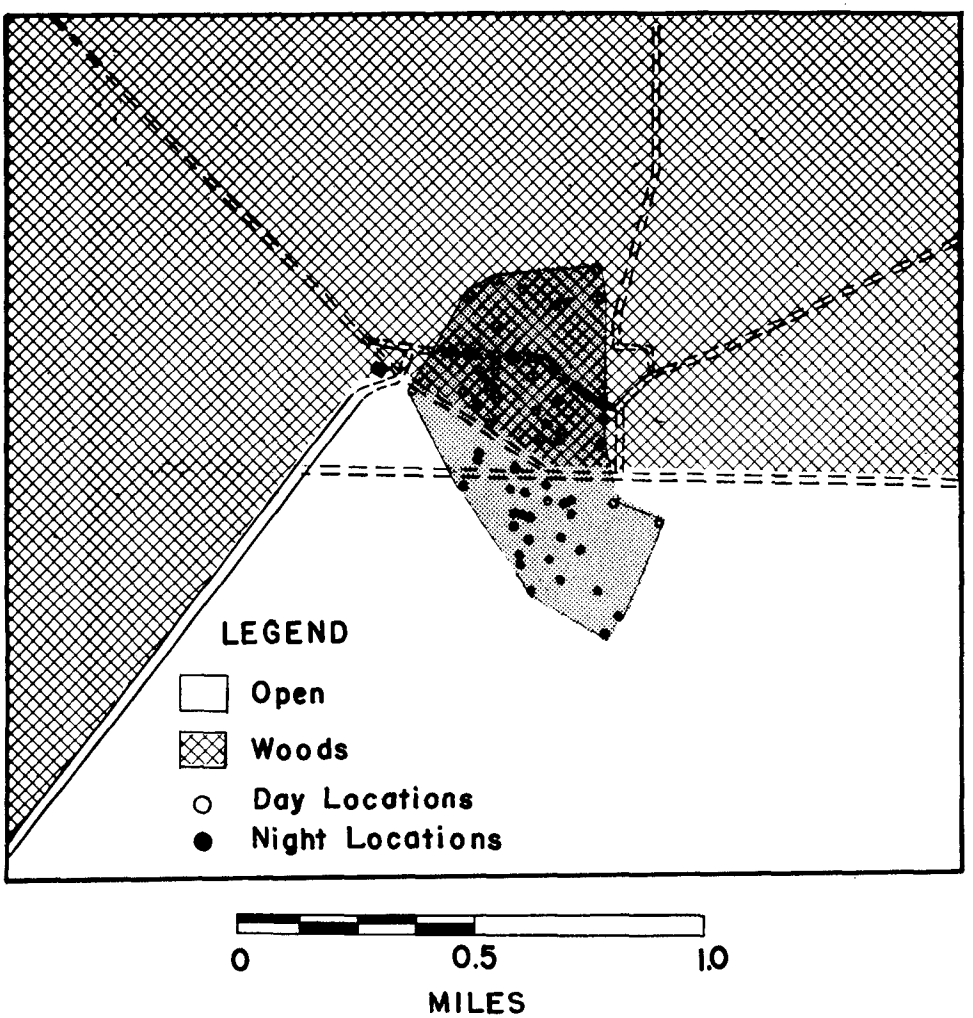

Fig. 4. The 147-acre minimum home range of a yearling buck, Eglin No. 8, with day and night locations indicated.

It is anticipated that greater insight into the relationships of these variables to home range size will be obtained as deer in other habitats are telemetrically studied. The investigators consider it quite probable that the dictates of some habitat situations result in larger home ranges than the study has indicated at this stage. However, it also seems possible that further study of these situations may allow establishment of an ecological constant. This constant when used in conjunction with certain population density and habitat variables could be useful in predicting average home range sizes for specific deer populations.

Although the home acreage remained relatively constant, the shapes varied greatly. Some ranges had major axes three times longer than others. These long ranges were much narrower, however, and the areas included were about the same as in the short ranges. A recent paper

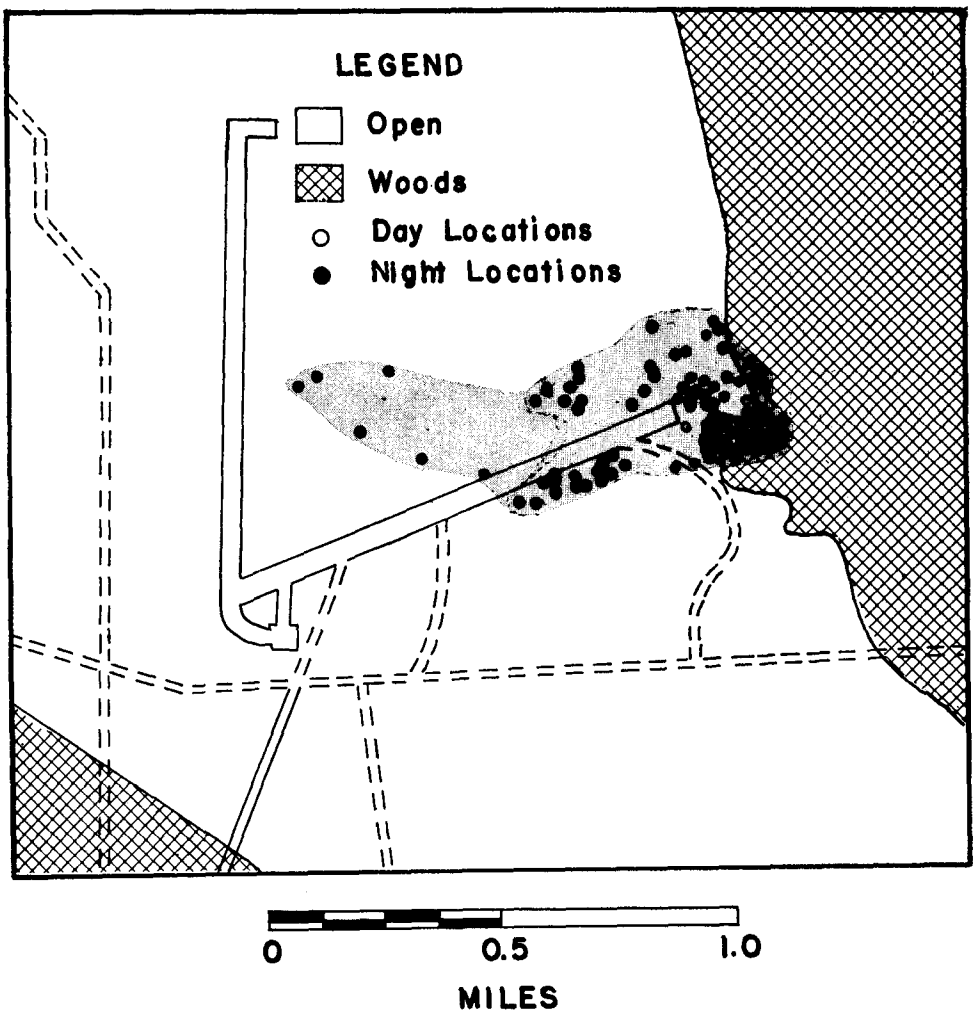

Fig. 5. The 161-acre minimum home range of an adult doe, Eglin No. 11, with day and night locations indicated.

(Stumpf and Mohr, 1962) reported that the home ranges of birds and mammals in general tend to be linear in shape. This was true for most of the deer studied, but the range of some could probably be better described as irregularly shaped. The most elongated ranges occurred on the open portions of the Eglin study area.

As the data in Table 1 indicate, five of the deer in their natural habitat had minimum home ranges between 0.74 and 1.03 miles long. The two others (Eglin No. 2 and Eglin No. 17) were much longer, with ranges 1.80 and 2.23 miles in length. These latter deer occupied spatially concurrent ranges for the most part but were radio tracked two years apart. Except for the unused air strip bordering the northern portion of the area, there was no obvious environmental gradient that would have resulted in the range elongation. Although Eglin No. 2 died in 1964, it is possible that Eglin No. 17, studied in 1966, was

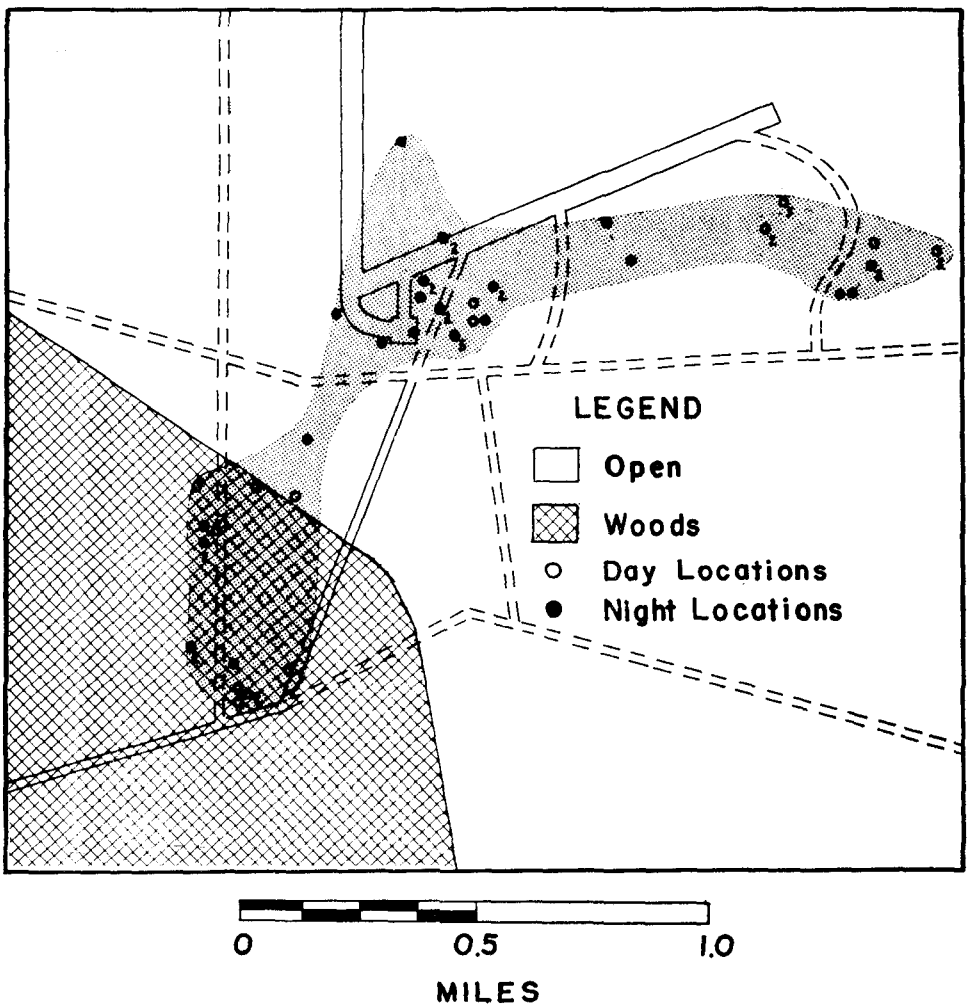

Fig. 6. The 240-acre minimum home range of an adult doe, Eglin No. 17, with day and night locations indicated.

associated with the same social group as Eglin No. 2, or with offspring from members of the group. This might account for the similarity in home ranges, since movement pattern tendencies may be a form of learned behavior passed on from one generation to the next. Further studies of the possible influence of this kind of learning on deer movement-ecology should provide some interesting results.

Seasonal Shifts in Home Range

Seasonal movement is apparently pronounced in parts of the United States where marked seasonal variations occur in the environmental conditions. This is true in the northern portions of the white-tail range because of effects from extreme contrasts in weather. In these areas seasonal shifts in home range varying from a few miles to as many as

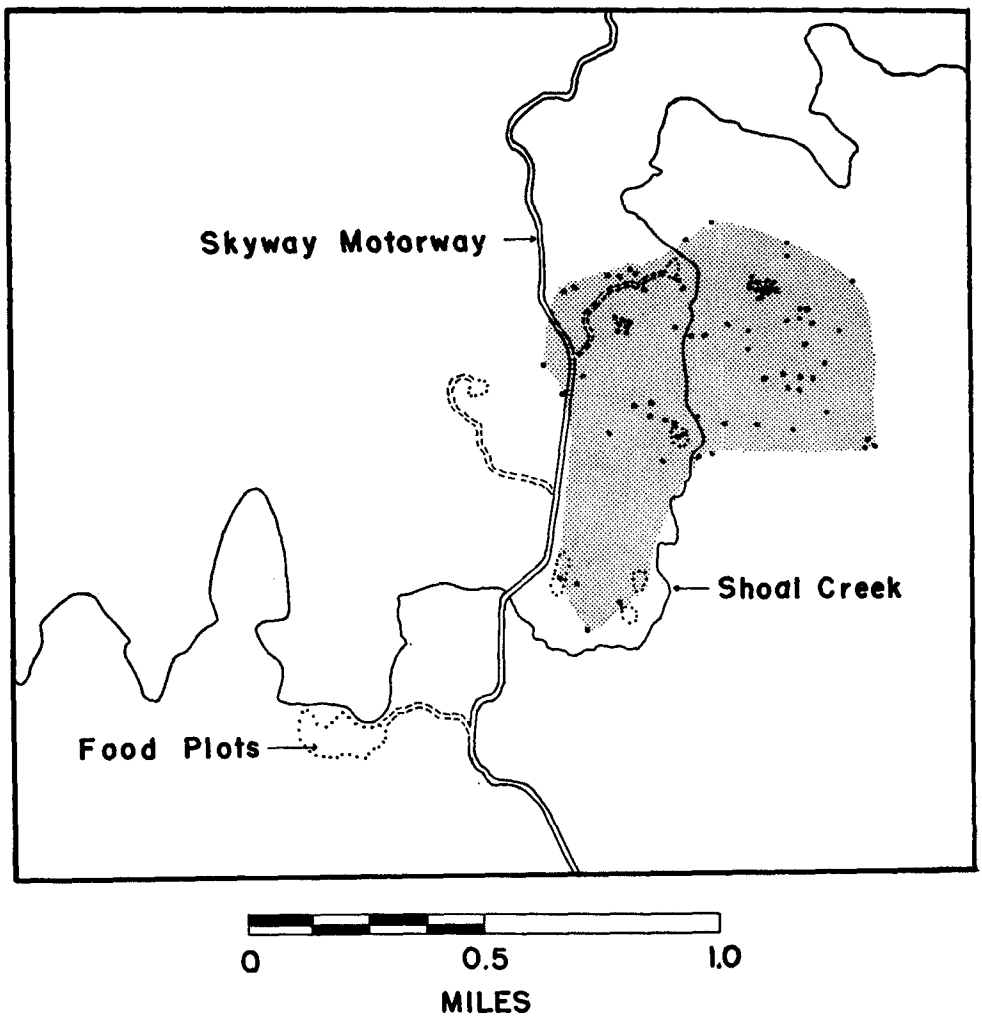

Fig. 7. The 215-acre minimum home range of an adult doe, Choccolocco No. 1.

75 miles have been recorded in a number of studies (Bartlett, 1950; Olson, 1938; and others). Southern ecosystems, however, are more complex and weather changes are less pronounced. Studies in the South have indicated little shifting of the range related to seasonal changes (Siglin, 1965).

Detection of seasonal shifts in the home range is one of the objectives in the present study. The ability to accomplish this is restricted, of course, because of the limits of transmitter life. Nevertheless, of the 28 deer thus far equipped with radios, some have been monitored during every month of the year. If major shifts typically occur on the study areas, it is probable that some of the animals tracked would have exhibited this behavior. But in no case did movement occur that might be construed as a home range shift. Repeated observations of animals wearing the inoperative transmitters for long periods after radio

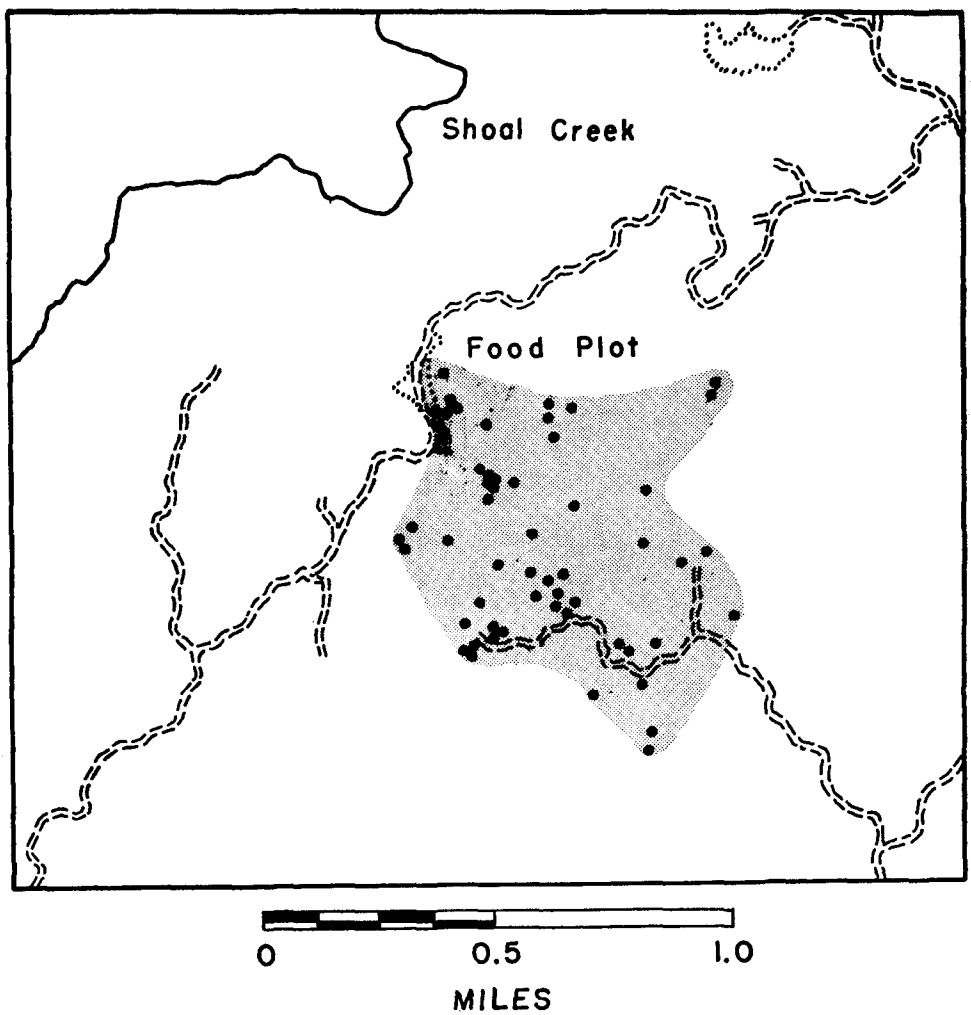

Fig. 8. The 243-acre minimum home range of an adult doe, Choccolocco No. 4.

contact ceased have all been within the individual animal's telemetrically established home range. Two animals were found dead, apparently from natural causes, and both were within the previously established core area of the home range. It is probable, therefore, that large seasonal shifts in home range are not the typical behavior pattern at least of deer on the Citrus, Eglin, or Choccolocco study areas.

Again it is important to point out that the results thus far obtained probably do not apply to all situations even in the South. Certain areas experience season-related environmental fluctuations which almost certainly force animals into different ranges. Such situations might include river bottoms and swamps that are periodically flooded.

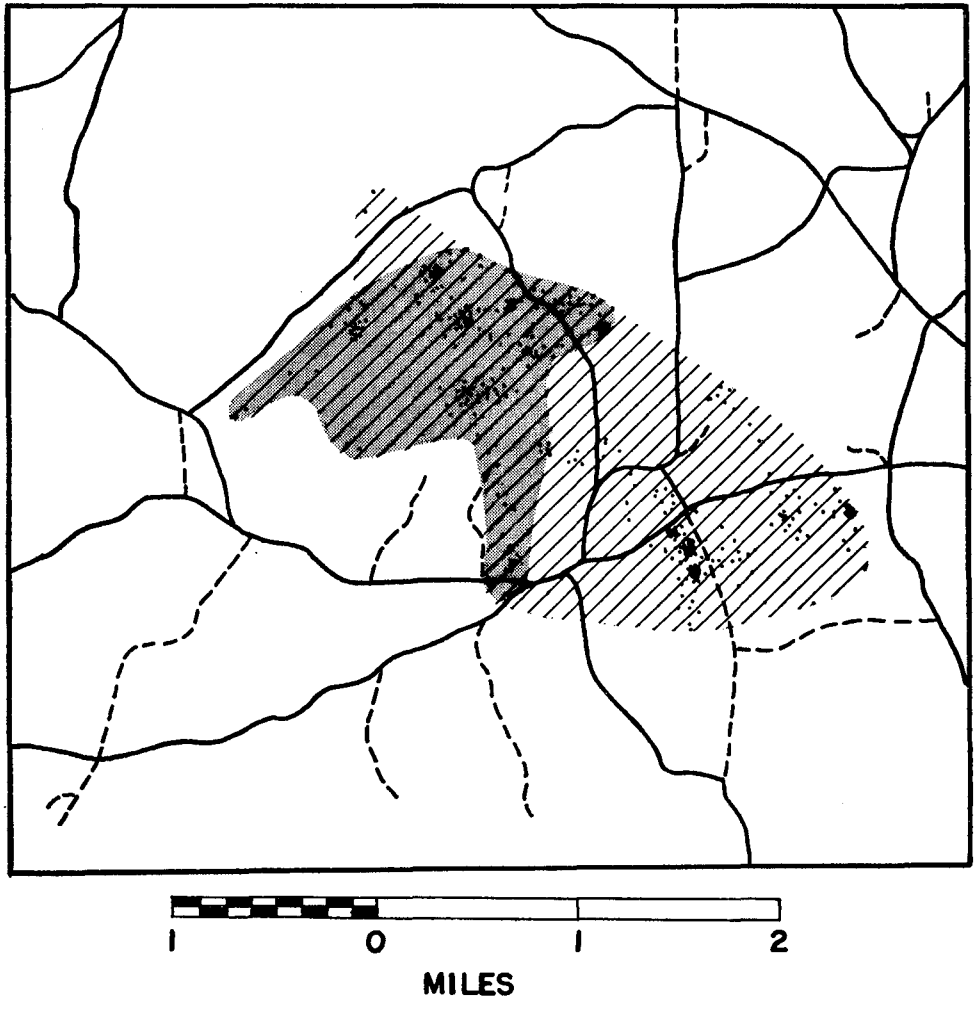

Fig. 9. Total area covered and the minimum home range established after a period of wandering by a yearling doe, Auburn No. 1, released in a new habitat. Total area indicated by cross hatch. Minimum home range indicated by shading.

It is also possible that food supply or hunting pressure may result in home range shifts under certain conditions. Further study that should facilitate better understanding of the effect of these factors is being planned.

Diel Movements

Although the daily movements of individual deer showed considerable variation, the average values did not differ greatly between deer (Tables 1 and 2). Mean distances moved during diel periods varied from 1.15 to 1.81 miles. There were tendancies in most deer for night locations to be distributed differently from day locations (Figs. 2-6).

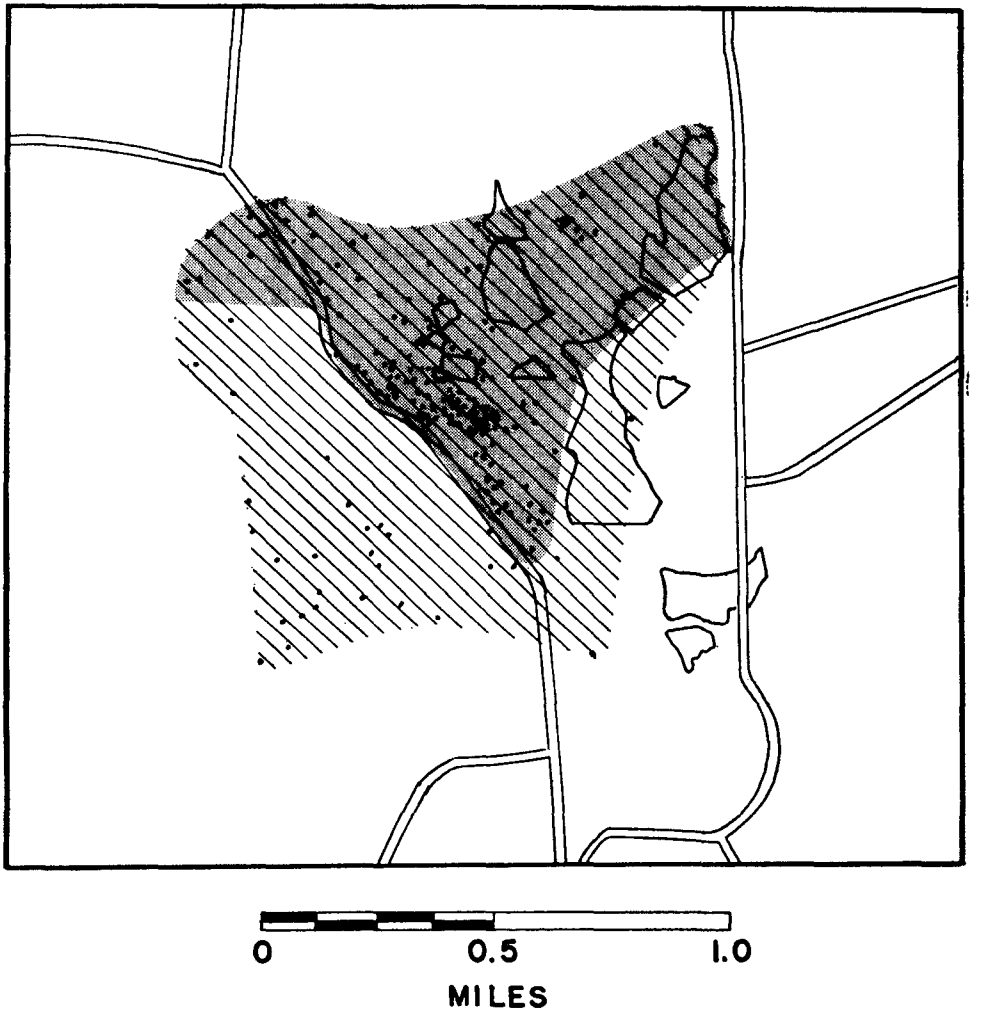

Fig. 10. Total area covered and the minimum home range established after a period of wandering by a yearling buck, Auburn No. 2, released in a new habitat. Total area indicated by cross hatch. Minimum home range indicated by shading.

Common movement patterns involved feeding out into open areas or toward a food plot at night and returning to denser wooded areas at about dawn. There were frequent variations from this pattern, however.

There were definite effects on the diel movement patterns related to seasonal changes. Some of these were correlated with external environmental factors related to changing food supply and with internal factors related to the reproductive cycle in both male and female. Concerning the former, it was stated previously that major shifts in the home ranges were not known to occur in any of the deer studied. On the other hand, shifts in the center of activity or home range "core area" did occur, at least in the case of the Auburn deer. For example, Auburn No. 2 was known to change his center of activity on several occasions, and these deviations were apparently related to changes in food supply resulting from agricultural operations. Auburn No. 1 and the group of deer with which she was associated also moved their center of activity on a number of occasions, but the causes were less apparent. This type behavior occurred less frequently in the other areas studied. This is to be expected since these latter areas are relatively homogeneous forest or range habitats, while the Auburn area is broken into pasture, forest, and agricultural crops of various kinds.

Some variation in diel movement patterns was detected that could be related to rutting and fawning behavior. For example, on February 21, 1965, a considerable increase in the movement activity of the yearling buck (Eglin No. 8) was noted. Bedding became less frequent and occurred only for brief periods. He constantly moved from one part of the home range to another but was not known to leave the area that had already been telemetrically established as his range. This change in behavior occurred about the time rutting behavior became evident in other bucks observed on the area. It was felt that the beginning of the breeding season was at least partly responsible for the increase in movement. The direct causes of the increased movement were not established, but it is possible that he was attempting to mate since he was observed in company with several different does during the next few weeks. On the other hand, because of his immaturity and the fact that there were some large adult bucks occupying the same area, it is conceivable that his movements were an avoidance response to prevent conflict with larger males.

Mating behavior by Auburn No. 1 was observed on December 30, 1965, four months after she was released into the wild. A fight between two large bucks was followed by the winner pursuing Auburn No. 1 for the better part of the night. The movement pattern during the "chase" was telemetrically recorded. Although the doe appeared to be in frantic flight, the area covered was less than 50 acres. It is assumed that mating probably occurred, but the actual time of mating was not recorded.

Concerning the effect on movements of pregnancy, parturition and care of fawn, some of the information thus far obtained may not reflect normal patterns because of the circumstances. For example, Eglin No. 2 had a notable decline in movement prior to parturition, but her condition during late pregnancy may not have been normal as she died while giving birth. The other does studied during late pregnancy have not shown any movement pattern that could be related to their condition. Auburn No. 1, however, exhibited a very different diel movement pattern while attending her fawn. Her daytime movement involved periodically leaving the fawn and traveling to a feeding area usually within one-half mile and returning to the fawn about two hours later. At night she stayed relatively close to the fawn and exhibited little movement. Since Auburn No. 1 was semi-wild and had just been introduced into the area, her behavior could hardly be accepted as typical without further substantiation.

In addition to the above factors affecting movement, there was evidence that injury and heavy parasitism have a restricting influence on diel movements.

Movements of Released Deer

Prior to release these animals had been confined for a part of their lives in the Auburn Wildlife Research Unit deer pen, a 1.6-acre enclosure. It is, of course, realized that because of the complexity of the home range phenomenon and the learned behavior associated with it, the movements of these animals did not reflect patterns typical of the wild deer in the area at least during the period of time required for their adaptation to the new environment. It was considered desirable, however, to study the movements of released deer and their behavioral adjustment to the wild environment. Furthermore, study of their movements after they became associated with groups of wild deer is considered to be indirect evidence as to the movement patterns of the latter.

Auburn No. 1 —On September 25, 1965 a semi-wild, 14-month-old doe, was released in the North Auburn Study Area with her three-week-old fawn. The total range covered during more than four months of radio contact was approximately 2,800 acres (Fig. 9). This is more than 10 times the area covered by deer tracked for a similar period of time in their natural habitat. Most of this difference in range size can probably be attributed to a tendency for animals, when placed in an unfamiliar environment, to wander or search for familiar surroundings. Eventually a stable range was established. This area included about 900 acres and may correspond to the home range of a group of wild deer with which she became closely associated. Since all visual observation for the last two months of tracking indicated that she was traveling as a part of the group, this is probably a reasonable assumption. When her diel movement was separated according to three stages of behavioral adjustment, considerable variation was evident. First, during the period when the fawn was attended, mean DBE was only slightly greater than 0.4 miles. Second, after losing the fawn during the third week following release, the doe went through another period of exploration in which the DBE average increased to 1.5 miles per day. Third, she began traveling with the group of wild deer previously mentioned, and the average daily movement after that time was approximately 0.7 miles. This is of considerable interest since information is difficult to obtain concerning movements of deer in farmland habitat or at low deer population levels.

Auburn No. 2—This animal was a buck captured and brought to the deer pens as a spotted fawn. He was reared in the 1.6-acre pen, but no effort was made to tame him. On May 30, 1966, at the age of almost one year, he was released in the center of Auburn No. 1's home range on the North Auburn Study Area. Radio transmission continued until August 6, 1966. During this period of more than two months, he had a total range of approximately 500 acres. After the first three weeks, he settled into a more restricted area and established a consistent pattern involving a 255-acre minimum home range. The diel movement attributes after this adjustment corresponded closely to those recorded for Eglin No. 8, a wild buck of about the same age.

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MOVEMENTS AND HOME RANGES OF BOBCATS AS DETERMINED BY RADIO-TRACKING IN THE UPPER COASTAL PLAIN OF WEST-CENTRAL SOUTH CAROLINA [1]

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INTRODUCTION

Relatively little is known concerning the life history of the bobcat (*Lynx rufus*) and our knowledge of this animal in the southeastern United States, particularly, is incomplete. This probably is due to the shy, secretive nature, and relative scarcity of this species in many regions. The literature reveals only four studies dealing with southeastern bobcats (Progulske 1952, 1955, Davis 1955, Kight 1962). In April, 1965, a study of the bobcat was initiated in west-central South Carolina. The objectives were to obtain information concerning movements, home range and hunting habits of this predator in its natural habitat as part of an overall project designed to determine the effects of low level radiation on the efficiency of a large predator and the development of a census technique involving the use of isotopes.

Location and Description of Study Area

The study was conducted on the United States Atomic Energy Commission Savananh River Plant (S.R.P.). The area is composed of approximately 325 square miles and is located in portions of Aiken, Barnwell and Allendale counties.

The area selected for the radio-tracking study is located in Barnwell County near the southeastern boundary of the S.R.P. Elevation varies from 190 to 310 feet above sea level and is situated on portions of both the Brandywine Coastal Terrace and the Aiken Plateau. The abandoned town of Dunbarton was chosen as the center of the study

[1] This investigation was conducted under Contract AT(38-1)-310 Task 2 between the U. S. Atomic Energy Commission and The University of Georgia. Certain equipment and supplies were made available from McIntire-Stennis Project No. 12. Journal paper No. 525 College Experiment Station, The University of Georgia College of Agriculture Experiment Stations, Athens, in cooperation with the Georgia Forest Research Council.

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