HOME RANGE AND DIET OF BOBCATS IN EASTERN TENNESSEE[1]

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Abstract.--Three adult and two juvenile bobcats (Lynx rufus rufus, Schreber) were trapped, radiocollared and released during the first four months of 1979 on the Department of Energy's Oak Ridge Reservation in eastern Tennessee. Home range, determined from six months of radiotracking, varied from an average of 11.5 km^2 for two adult females to 42.9 km^2 for an adult male. Two juveniles, one male and one female, which had presumably been born to one of the adults, settled into areas remote from their rearing grounds; territories were 5.8 km^2 and 26.0 km^2, respectively.

Daily measurements of distances moved were different, with the adult male averaging 4.5 km and the adult females 1.2 km. The two juvenile bobcats averaged approximately the same distance as the females.

Preliminary results of scat content analysis indicated that the frequency of cottontail rabbit remains in the scats was 67% and 70% in samples collected in spring-summer and fall-winter, respectively. Remains of pine voles, groundhogs and deer also occurred in a number of samples.

INTRODUCTION

Interest in the status of the bobcat (Lynx rufus rufus) on the Department of Energy's Oak Ridge Reservation has stemmed concomitantly from a desire to learn more of the habits of this animal and to monitor the effects of anthropogenic activities on these habits. We have begun a long-term program to acquire data on home ranges, population density, habitat usage, spatial distribution of individuals, movement patterns, predator-prey interaction and food habits.

Increasing demands for the fur of this animal since the early 1970s have pushed pelt prices ever higher. In Tennessee, the average price paid by fur buyers for a bobcat pelt has risen from $3.44 in 1970-71 to $96.50 during the 1978-79 trapping season.[3] Thus, knowledge of bobcat ecology is needed by federal and state wildlife professionals responsible for setting harvest quotas.

ACKNOWLEDGMENTS

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[3]Letter from the Tennessee Wildlife Resources Agency to the Endangered Species Scientific Authority responding to a request for information on bobcat trapping data for 1979-80 (1979).

DISCLAIMER

MATERIALS AND METHODS

Study Area

The Oak Ridge Reservation is located 24.1 km west of Knoxville, Tennessee. Its southern, western and eastern boundaries are formed by the Tennessee Valley Authority's (TVA) Melton Hill and Watts Bar Reservoirs on the Clinch River. The City of Oak Ridge forms the northern boundary. The area has been under government control for over thirty years and has been relatively undisturbed except for regulated site development, forest management and environmental research, highways and transmission lines.

The dominant oak-hickory association on the 15,000-ha Reservation contains elements of the mixed mesophytic association commonly found in the adjacent Cumberland Mountains. The oak-hickory association is typified by extensive stands of mixed yellow pine and hardwoods as well as oak and hickory. Yellow poplar often forms nearly pure stands on well-drained bottomlands and lower slopes, while willow, sycamore and boxelder border streams and are dominant on poorly drained floodplains. Species more commonly found in the mixed meosphytic association — such as beech, sugar maple, magnolia, buckeye and basswood — often occur in coves and sheltered slopes. In addition, approximately 2000 ha of the Reservation were planted in loblolly pine between 1947 and 1956 while smaller acreages have since been planted in loblolly pine, black walnut, river birch, sycamore and poplar (Kitchings and Mann 1976).

Radio Equipment

Transmitters used in this study were the pulsing, high frequency type in the 150-mHz range, purchased as prepared units from Wildlife Materials, Incorporated. Battery life for these units is listed by the manufacturer at 555 days ± 111 days.

A single receiver was used with a truck-mounted whip antenna and a hand-held four-element Yagi antenna. Range of reception varied and, while signals were received at distances up to 7.9 km on both the whip and Yagi antennas, most bearings were taken at distances of 1.6 km or less from the transmitters. All tracking was done from the ground, and there were a few days when we were unable to locate the bobcats. On the few occasions when we were able to obtain only one bearing for an animal, no attempt was made to estimate the distance to the transmitter along this one bearing; we found that signal strength varied tremendously depending on the cover afforded the bobcat by its immediate surroundings.

Radiotracking Procedure

The general location of a bobcat was determined using the truck-mounted whip antenna and driving until the signal from one of the bobcats was received. This antenna also enabled us to select sites of optimum signal strength before trying to determine the magnetic bearing to the transmitter. Once a site was selected, the direction of greatest signal strength was then determined using the Yagi antenna, and the magnetic bearing was read from a Silva Type 1 hand-held compass.

Magnetic bearings were plotted on a 1:24,000 scale map using a Jeppesen Navigation Plotter. While two such plots separated by a sufficiently wide angle (preferably 45°—135°) showed the approximate location of the bobcat, frequently a third bearing was taken to verify the accuracy of the first two. Practice sessions with the transmitters used in this study, and with other similar transmitters, demonstrated that radiolocations were 158 ± 30 m (N = 23) within actual location.

Trapping Procedures

Bobcats were captured in Sullivan box traps using cat lure and parts of road-killed white-tailed deer (Odocoileus virginianus) as bait. Two sizes of box traps were used, 122 × 41 × 51 cm and 183 × 66 × 66 cm.

Handling of the bobcats was accomplished after immobilizing them with ketamine hydrochloride (Ketaset, Veterinary Products, Bristol Laboratories, Division of Bristol-Myers Co.). A dosage of 22 mg/kg was generally satisfactory for immobilizing these animals. During captivity, each animal was supplied food and water after the effects of the anesthetic had worn off. We found that animals held in the lab would accept deer meat, whole cottontails and whole gray squirrels which had been road-killed.

Scat Collection

Ten bobcat scats were collected from Reservation roads from December 1978 through early March 1979 (fall-winter period); twenty-one were collected from March through

mid-August 1979 (spring-summer period). Scats were prepared according to Buttrey (1974); each sample was washed with detergent, the contents separated, freeze-dried, examined, identified and recorded.

Data Analysis

Home range areas were determined by the convex polygon method to facilitate comparisons of our data with those of other investigators. Jennrich and Turner (1969) pointed out that the convex polygon method normally is an underestimate of the home range, particularly when the sample size is low. Thus, our area estimates may be lower than will prove to be the case as more data are obtained. Areas were determined by utilizing a Fortran IV program which calculated home ranges from locations expressed as XY coordinates. To compare daily movements between the male and female, the linear distance between four or more consecutive daily locations was measured.

RESULTS AND DISCUSSION

Trapping Success

Since initiating the bobcat trapping program in February 1978, 5 individual bobcats (2 male and 3 female) have been captured a total of 15 times during 1,542 trap nights. The males were captured eleven times while the females were caught four times. The five animals consisted of one adult male, one juvenile male, two adult females and one juvenile female. The two juvenile cats are believed to be two of three offspring of one of the adult females. In addition to those animals captured during 1979, one young female was road-killed in June 1979. The age of this animal and location of the accident led us to believe that she might be the third offspring of the adult female.

The adult male bobcat (#209, 9.6 kg) was first captured in March 1978, and has subsequently been recaptured six times. Weights obtained at each capture indicated that maximum weight apparently occurred during the winter. This animal weighed 9.6 kg in April 1978 as well as in September 1979, but in January 1979 he weighed 10.2 kg before dropping to 9.7 kg in February and March and to a low of 9.4 kg in June. The two adult females (#'s 225, 6.8 kg, and 218, 6.9 kg) were trapped in March 1978 and 1979, respectively. The juvenile animals were captured in January 1979 (#211, 5.0 kg, male) and April 1979 (#221, 4.9 kg, female).

Home Range Movements

Areas used by each of the radio-tagged bobcats are shown in Fig. 1. The five bobcats were radio-located 473 times during the period January-August 1979. The home range

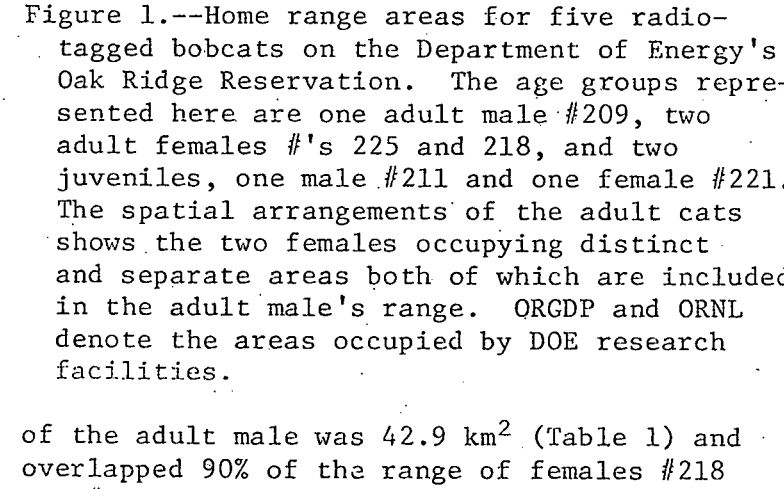

Figure 1.--Home range areas for five radio-tagged bobcats on the Department of Energy's Oak Ridge Reservation. The age groups represented here are one adult male #209, two adult females #'s 225 and 218, and two juveniles, one male #211 and one female #221. The spatial arrangements of the adult cats shows the two females occupying distinct and separate areas both of which are included in the adult male's range. ORGDP and ORNL denote the areas occupied by DOE research facilities.

of the adult male was 42.9 km^2 (Table 1) and overlapped 90% of the range of females #218 and #225. The area used by this animal is comparable to those reported for bobcat studies in the western United States (Bailey 1979). Reported values for home ranges of male bobcats in the southeast have generally been much smaller (Marshall and Jenkins 1966; Miller,[4] personal communication, 1979). In those studies, the study sites were composed of larger old-field type vegetation, areas where prey species would be abundant, thus limiting the necessity for extensive excursions for

[4]Doug Miller, Auburn University, Auburn, Alabama, 1979.

food. The large range of the bobcats located on the DOE Reservation probably reflects the lower food base available in the area.

The juvenile male actually occupied two distinct and separate areas during the tracking period. From January to April, this male used 10.5 km^2, seldom leaving the range established by female #225 (Fig. 2). During the first two weeks of April we were unable to locate this animal. Then he was found approximately 7.3 km north of the previously established area. From April to June, 62 locations indicated that he ranged over 5.6 km^2. The difference in home ranges could be attributable to a difference in habitat. The area occupied between January and April is primarily upland hardwoods with very little habitat where prey density would be low. The second site (April-June), on the other hand, is within a floodplain surrounded by large blocks of land which were harvested for timber, cleared and replanted, making ideal areas for prey species.

Figure 2.--Area utilized by bobcat #211 (juvenile male) during 1979. The area marked January 13-April 3 overlaps that of female #225. It is thought that #211 is an offspring of #225 and this area represents movements of the young with the parent. The area marked April 17-June 26 was occupied by #211 after he left #225's territory.

The two adult females' home ranges were 9.9 km^2 (#218) and 13.1 km^2 (#225) as shown in Table 1. These values were based on 56 and 88 radiolocations, respectively. The juvenile female utilized an area of 26.0 km^2 based on 97 radiolocations. No range overlap was noted between the two adult females, but the juvenile's range slightly overlapped the range of female #218. Buie[5] has determined that female bobcats at the Savannah River Plant utilize 10-12 km^2 which is similar to what we have estimated as the home range for our cats.

The juvenile female was captured and released in early April, just about the same time that the juvenile male was moving from one area to another. The large area (46.1 km^2 traveled by the young female during the two weeks following her capture would indicate that she was actually trying to establish a territory of her own. Average day-to-day movements during this period were 2.1 km, while subsequently she moved only 1.4 km (Table 1). The area occupied during the next four months (26.0 km^2) seems to be the range upon which she settled. During her movements

[5]David Buie, U.S. Forest Service, Savannah River Plant, Aiken, South Carolina, 1979.

in early April she crossed the Clinch River twice at points where the river is approximately 180 m wide.

All female bobcats appeared to use distinct localities within the total home range for varying periods of time (Fig. 3). The males, particularly the adult, appeared to move at random throughout their range but did return to previously used resting areas.

Figure 3.--It has been observed that the females appear to utilize distinct localities within the total home range for varying periods of time. This figure shows the use of certain portions of the home range by bobcat #221 during periods of time from April through August.

Measurements of daily distance moved (Table 1) were different with the adult male averaging 4.5 km and the adult females 1.2 km. The two juveniles moved approximately the same distance as the females. The adult male was found to have moved 11.2 km between radiolocations on consecutive days.

Scat Analyses

Analysis of scat samples has indicated nearly equal frequency of occurrence of cottontail rabbits for both the spring-summer and fall-winter sampling period, 67% and 70%, respectively (Table 2). This species has been the most commonly reported prey of the bobcat throughout its range (Progulske 1955 and Buttrey 1974).

Pine voles and groundhogs occurred with equal frequency, 28%, in our spring-summer samples, while during the fall-winter period the groundhog disappeared as a food item, and the pine vole occurred in 40% of the scats. In our area groundhogs are underground throughout a good portion of late fall and winter. Buttrey (1974) also found voles ranking second to the cottontail as a prey species, but he found little difference in frequency of occurrence between spring-summer and fall-winter samples (25% and 22.2%, respectively).

Many investigators have identified white-tailed deer as a food item of bobcats (Buttrey 1974; Marston 1942; Young 1958; Fritts and Sealander 1978; Rollings 1945; Pollack 1951; Jones and Smith 1979), and in Buttrey's Catoosa study (1974) deer was found to be the third most common bobcat food, occurring primarily in the fall-winter period (18.7% spring-summer, 38.9% fall-winter). We found deer in 19% of our spring-summer samples (all fawn) and in 20% of our fall-winter samples, placing deer fourth in importance as a food item for both times of year in this area.

During a period of intensive tracking, the young female #221 was noted to have spent one whole night and part of the following day in the vicinity of a badly decomposing deer carcass. The deer (54 kg doe) had apparently been killed by a vehicle and had gone unnoticed for some time. Thirty-six hours prior to the visit by the female, the carcass was examined and found to be badly bloated and producing an odor detectable at a distance greater than 400 m. An examination of the carcass late in the day after the cat had departed revealed that it had been reduced to bones.

Cotton rats occurred in only 10% of the spring-summer samples and in none of our fall-winter samples. Gray squirrel was found in 30% of the fall-winter samples but in none of the spring-summer scats. Buttrey (1974) observed that in his study, gray squirrels were taken almost entirely in the fall-winter period when the squirrels were on the ground more and may have been easier prey for the bobcats.

Small birds occurred in 14% of our spring-summer samples, but no bird remains were found in the fall-winter samples. Other species found in our spring-summer samples included the eastern chipmunk 5%, whitefooted mouse 5%, striped skunk 5%, opossum 5%, small, non-poisonous snake 5%, and insects 5%. Ticks were found in 52% of the spring-summer samples and none of the fall-winter samples. Insects were found in 10% of the fall-winter samples, and one sample contained the bones of an unidentified mouse. Grass was found in many scats but was not recorded as a food item.

CONCLUSIONS

The information presented here is a status report of an ongoing, long-term research effort at Oak Ridge National Laboratory. Therefore, much of the data concerning behavioral characteristics of the bobcats in our study is preliminary and many more questions have arisen than have answers. However, some general patterns of behavior can be drawn for the cats we have observed:

a) Bobcats living in habitats similar to those found on the Oak Ridge Reservation tend to need large territories, with adult males using 4 to 5 times the areas needed by adult females.

b) Female bobcats tend to utilize only a portion of their overall home range at any given time whereas the males appear to travel at random over their whole home range.

c) Juvenile bobcats tend to disperse to areas not already settled by their parents.

d) Food preference of the Oak Ridge bobcats is similar to those described for cats in other studies, with cottontail rabbits the most frequently occurring food item.

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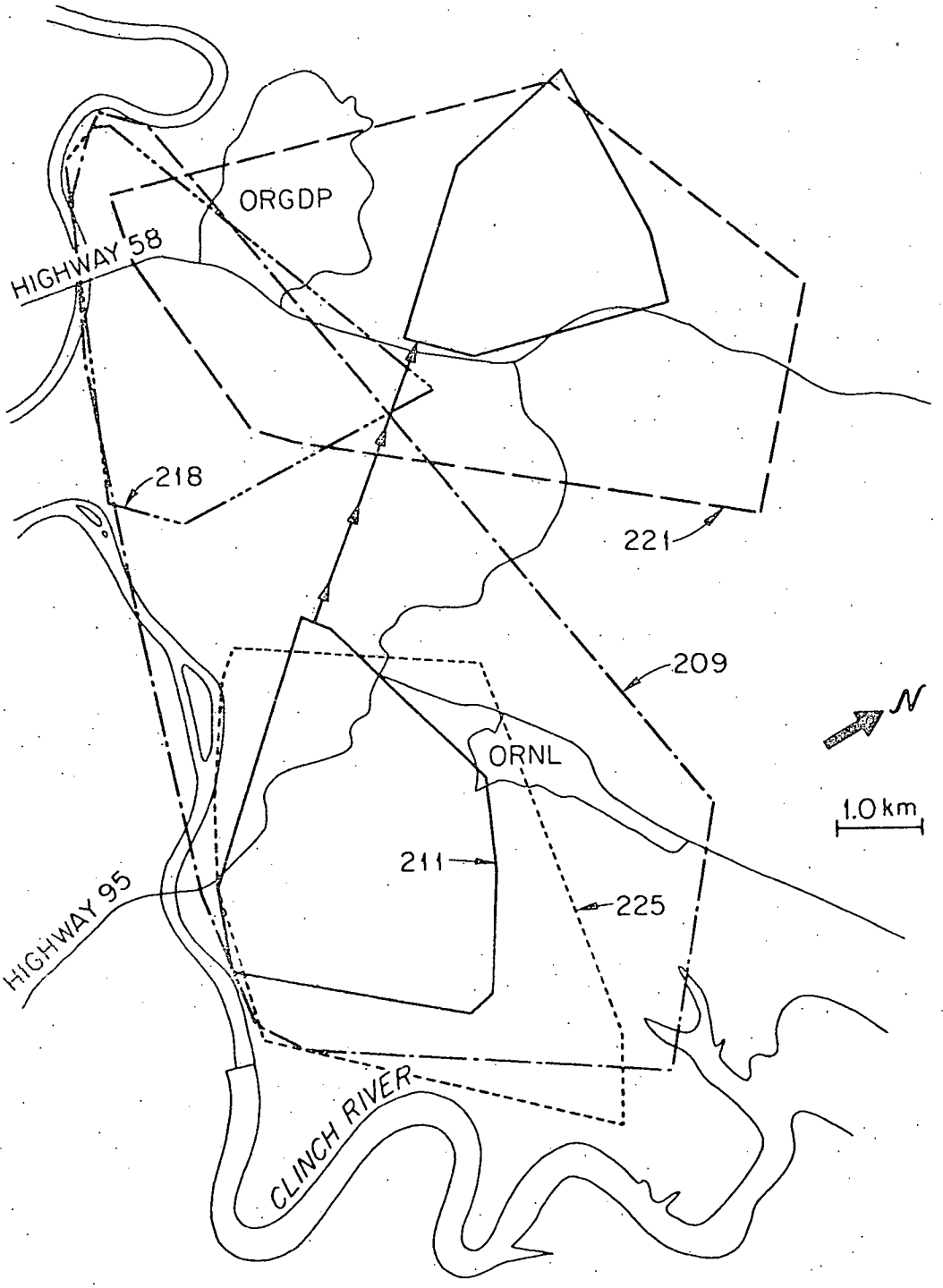

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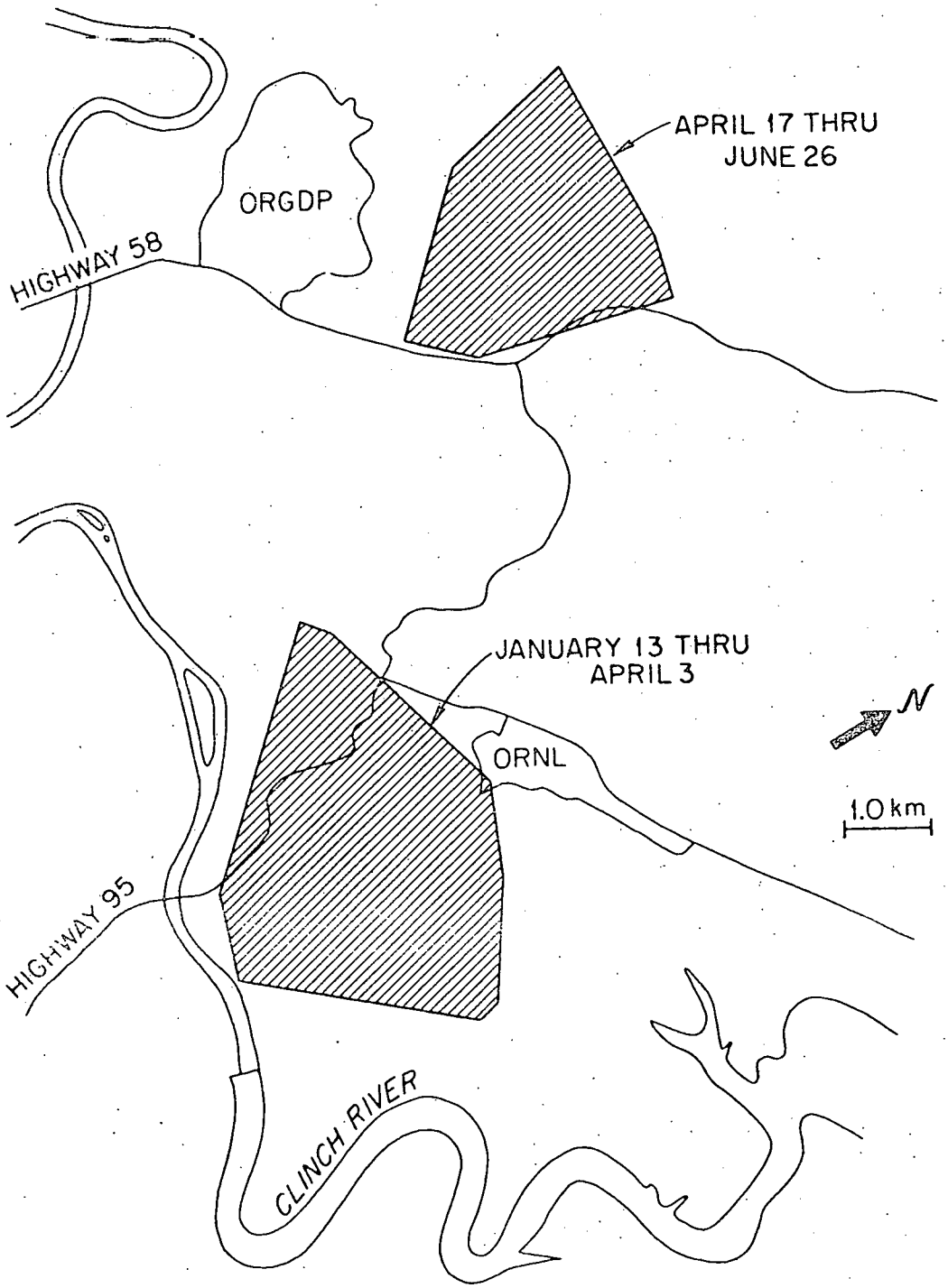

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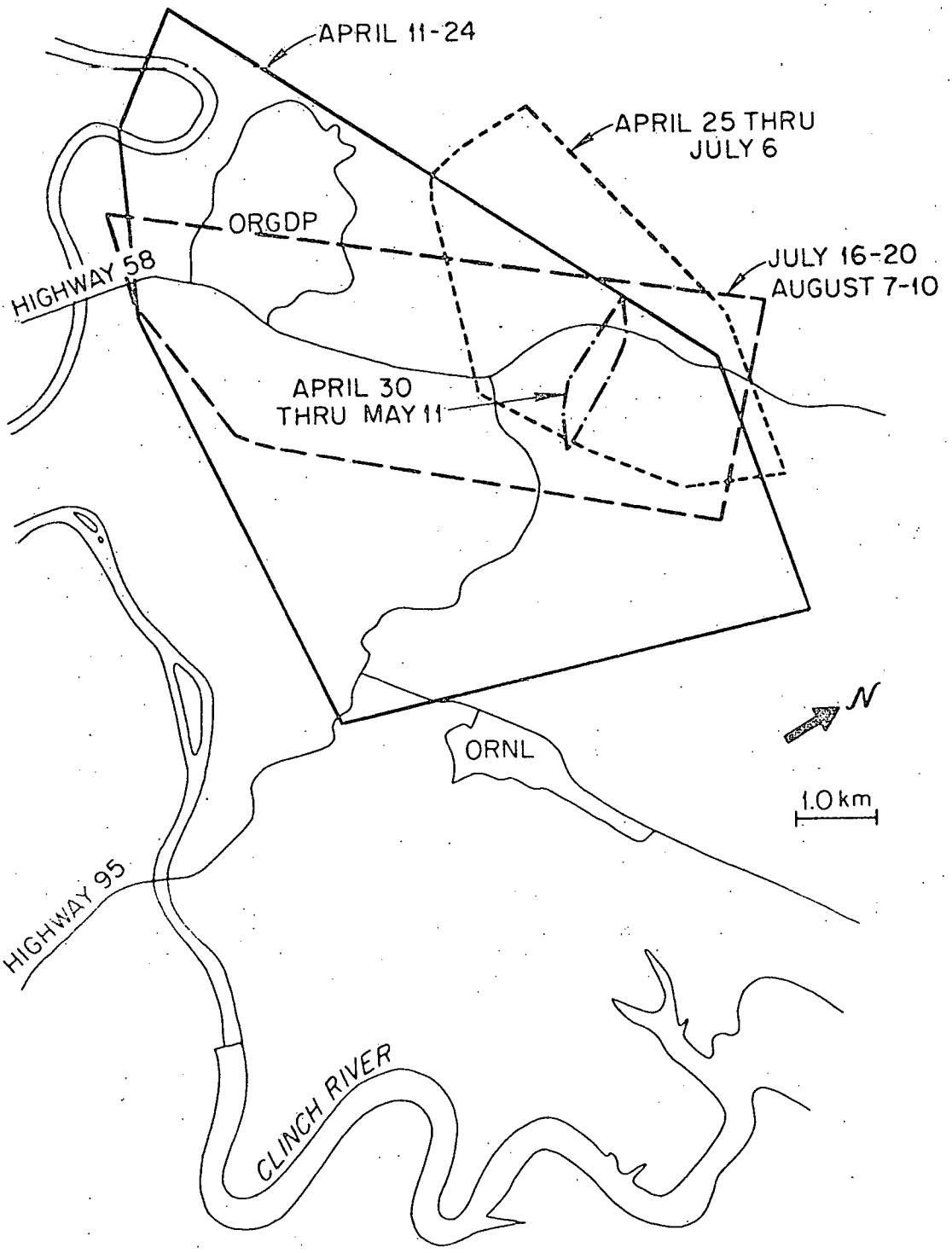

Table 1. Home range movemenets of five radiotagged bobcats (2 male and 3 female) on the Department of Energy's Oak Ridge Reservation

Animal Number	Sex	Age	Number of Tracking Days	Number of Radiolocations	Home Range (km^2)	Average Day to Day Movements (km)
209	Male	Adult	60	96	42.9	4.48 ± 0.50 (29)[a]
211	Male	Juvenile	80	136	10.5 Jan-Apr 5.6 Apr-Jun	0.94 ± 0.12 (52)
225	Female	Adult	66	88	13.1	1.49 ± 0.22 (24)
218	Female	Adult	40	56	9.9	0.94 ± 0.15 (24)
221	Female	Juvenile	56	97	26.0	1.38 ± 0.25 (31)

[a]Values are mean ± 1 S.E. (sample number).

Table 2. Summary of Frequency of Occurrence of Prey Species Found in Bobcat Scats

Prey Species	Percent Frequency Spring-Summer (n=21) [Mar. 15-Sept. 15]	Fall-Winter (n=10) [Sept. 15-Mar. 15]
Cottontail rabbit *Sylvilagus floridanus*	67	70
Pine vole *Microtus pinetorum*	28	40
White-tailed deer *Odocoileus virginianus*	19 (all fawn)	20
Groundhog *Marmota monax*	28	0
Small bird Unidentified birds	14	0
Gray squirrel *Sciurus carolinensis*	0	30
Chipmunk *Tamias striatus*	5	0
Whitefooted mouse *Peromyscus leucopus*	5	0
Cotton rat *Sigmodon hispidus*	10	0
Insects (Unidentified)	5	10
Snake (non-poisonous) Unidentified	5	0
Striped skunk *Mephitis mephitis*	5	0
Opossum *Didelphis marsupialis*	5	0
Unidentified mouse	0	10