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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 <sup>1</sup>

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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 Savannah 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

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area because it provided a good network of access roads and appeared to be relatively good bobcat habitat.

Dunbarton was typical of small rural towns in this area. During establishment of the S.R.P., all dwellings were either moved off of the plant area or demolished, leaving shrubbery, shade trees, guttered streets with paved sidewalks, and debris. The immediate surrounding area consisted of pastures, cultivated farm lands, and various forest types. Since 1952 old house sites have grown up in thick stands of plum (*Prunus* spp.) and honeysuckle (*Lonicera japonica*). Most of the abandoned land has proceeded through the broomsedge (*Andropogon* spp.) stage of succession, and has been planted in pines (*Pinus elliotti*, *P. palustris*). These fields are interspersed with dense stands of plum, honeysuckle, blackberry (*Rubus* spp.), and lespedeza (*Lespedeza cuneata*). The study area was about evenly divided into cultivated lands, sand hill regions (scrub oak-pine) and forest lands.

## MATERIALS AND METHODS

### *Capturing, Handling and Treatment*

The bobcats used in this study were captured in Sullivan live traps using dead cottontail rabbits (*Sylvilagus floridanus*) as bait. Traps were set along secondary and field roads throughout the study area where bobcat tracks and/or scats were noted in abundance. Captured bobcats were anesthetized in the trap by an intramuscular injection of sernylan.<sup>4</sup> Each animal was weighed, measured (standard body measurements) and ear tagged.

Two adult bobcats, a male (688) and female (699), captured April 17, 1965, were equipped with continuous signal transmitters. Two young bobcats, a male (755) and female (174) captured May 13, 1965 and May 26, 1965, were equipped with pulsed signal transmitters. All animals were released at the point of capture.

No method for determining the ages of bobcats has been described in the literature. Criteria such as tooth wear and color and body weight were used to identify young animals.

### *Radio-Tracking Equipment*

#### Transmitters

Continuous and pulsed wave transmitters were used in this study. They were purchased from Heat Transfer Laboratories, Inc., St. Paul, Minnesota. The collar type transmitters were similar in design to those used by Verts (1963) for tracking skunks, and Storm (1965) for tracking red foxes, except for antenna modifications. The transmitting antenna consisted of a copper strip 1" wide, .025" thick and 4" in diameter. The electronic components were encapsulated in epoxy cement. Both the antenna and components were glued to a polyethylene strip (1 1/8" wide, 1/10" thick) 4" in diameter. The entire unit was covered with a plastic material.

An adjustable collar fabricated from old army belts was taped inside the transmitting assembly to provide a custom fit for individual animals.

Two mercury cells provided the power source and the complete unit weighed about 200 grams. The transmitters operated on frequencies from 27.555 to 27.670 megacycles spaced 5 kc apart to facilitate identification.

A single wrap of reflector tape on both sides of each transmitter was useful in locating bobcats at night with a spotlight.

#### Receiver

The receiver was a custom built high frequency unit constructed by Sidney L. Markusen, Cloquet, Minnesota. This unit was designed to

<sup>4</sup> Sernylan<sup>®</sup> was kindly supplied by the Veterinary Research Division Parke, Davis and Co., Detroit, Michigan.

be used as a portable set. However, it was satisfactorily converted for use as a mobile unit by constructing and mounting a mobile antenna (described later) on a four-wheel drive pickup truck and preparing the proper connections for the receiver.

The receiver sensitivity was such that it gave bearings with a signal input of less than 1/10 microvolt. Specifically, it was a crystal-controlled double-conversion superheterodyne receiver. It had twelve channels which correspond to the frequencies of the transmitters, with fine tuning controls for each channel. The power supply consisted of 10 flashlight batteries (size C). Alkaline-manganese batteries were used because of the longer life. The receiver was equipped with 2,000 ohm headphones.

### Antennas

Three types of antennas were used: (1) a hand-held loop; (2) a roof-mounted mobile loop; and (3) a roof-mounted nine-foot whip:

The hand-held loop antenna, which was purchased with the receiver, was a 20-inch diameter single turn loop of number 9 aluminum wire. A 24" piece of  $\frac{1}{2}$ " aluminum pipe served as a handle.

The roof-mounted loop antenna (27" in diameter) was made of  $\frac{1}{2}$ " copper tubing welded to a 10" piece of  $\frac{1}{2}$ " galvanized pipe which served as a handle. It was erected on a specially made mount with the handle extending through the roof into the vehicle. Mounted on the inside roof of the vehicle was a 10" circular protractor. An indicator, mounted on the antenna handle, corresponded to the null or "minimum signal" and provided a bearing on the animal's position as the antenna was rotated.

The roof-mounted whip antenna was the type used with citizen band radios.

### *Radio-Tracking Procedure*

The general location of a radio-tagged animal was determined by connecting the receiver to the nine-foot whip antenna and driving until the signal of a radio-tagged bobcat was received. The whip antenna was then removed and the loop antenna mounted. The vehicle was driven to the nearest "fix point" (a point of known map location such as a road intersection, fence corner or other landmark) and a reading was taken. The animal's location was determined by rotating the loop antenna back and forth until the minimum audible signal or no signal was detected. The point or null occurs at right angles to the plane of the loop. This operation was repeated at a second station. Locations were then plotted on field maps prepared from aerial photographs scaled 8" to the mile by use of a protractor. Frequently, three or four readings were obtained as a means of checking location accuracy. On several occasions bobcats were observed after readings were taken and the radio-location was within 100 feet of the animal's actual location at distances up to 0.25 miles.

Generally, radio fixes were taken at two- to three-hour intervals beginning about 4:00 p.m. until about 10:00 a.m. the following morning. On many occasions bobcats were located at regular intervals over 24-hour periods. Sometimes individual animals were monitored for one- to two-hour periods. Midafternoon fixes were often taken to determine daytime resting sites.

Each radio location was recorded as to time of day, date, weather conditions and activity (whether an animal was walking, resting, etc.).

### *Data Analysis*

Home ranges of bobcats were determined by connecting the outermost peripheral radio-fixes with straight lines. This approximated the maximum home range. The area within these boundaries was determined with a planimeter. Three measurements were taken and averaged for each animal. The determination of movements was obtained by measuring the distances between consecutive radio-fixes taken over 24-hour periods. Interpretation of hunting habits was based pri-

marily on visual observations. Additional information was ascertained by monitoring radio-tagged bobcats while they were hunting.

## RESULTS

### *Effect of Transmitters*

Although bobcats were noticed scratching at transmitters on several occasions, no signs of skin chaffing were observed on the neck region of two recaptured animals wearing collar-type transmitters for 3.0 and 3.5 months, respectively. The transmitters did not appear to interfere with the ability of the bobcat to capture prey.

### *Movements*

During this study radio-tagged bobcats were usually most active beginning about 4:30 p.m., or three hours before sunset, until around midnight at which time activity was minimized. They were again active from about one hour before sunrise until about 9:30 a.m. or four hours after sunrise. No particular patterns of choosing daytime resting areas were noted.

TABLE I. MOVEMENTS OF BOBCATS AS DETERMINED BY RADIO-TRACKING FOR 24-HOUR PERIODS

Bobcat Number	Sex	No. Days Tracked	Ave. Distance Traveled		Ave. No. Fixes/Day	Min. Move. (Mi.)	Max. Move. (Mi.)
			(Yds.)	(Mi.)			
699	F	18	2919	1.65	7.9	0.50	2.78
688	M	3	5236	2.97	7.3	2.53	3.51
755*	M	22	2082	1.17	7.2	0.66	2.10
174*	F	13	2393	1.35	5.8	0.31	2.58

\* Young Bobcats

### *Home Ranges*

Sufficient data were obtained on three bobcats to disclose their approximate home range size during the period they were radio-tagged (Table II). The distribution of locations for these three animals is shown on maps number 1, 2 and 3.

TABLE II. SUMMARY OF BOBCAT HOME RANGE DATA OBTAINED BY RADIO-TRACKING, SAVANNAH RIVER PLANT — 1965

Bobcat Number	Tracking Periods		Approximate Home Range		Number of Locations
	Interval	Days	Acres	Sq. Mi.	
699	4/17-6/29	74	1143.10	1.79	256
755*	5/13-7/14	63	886.82	1.36	197
174*	5/26-7/14	41	610.23	0.95	119

\* Young Bobcats

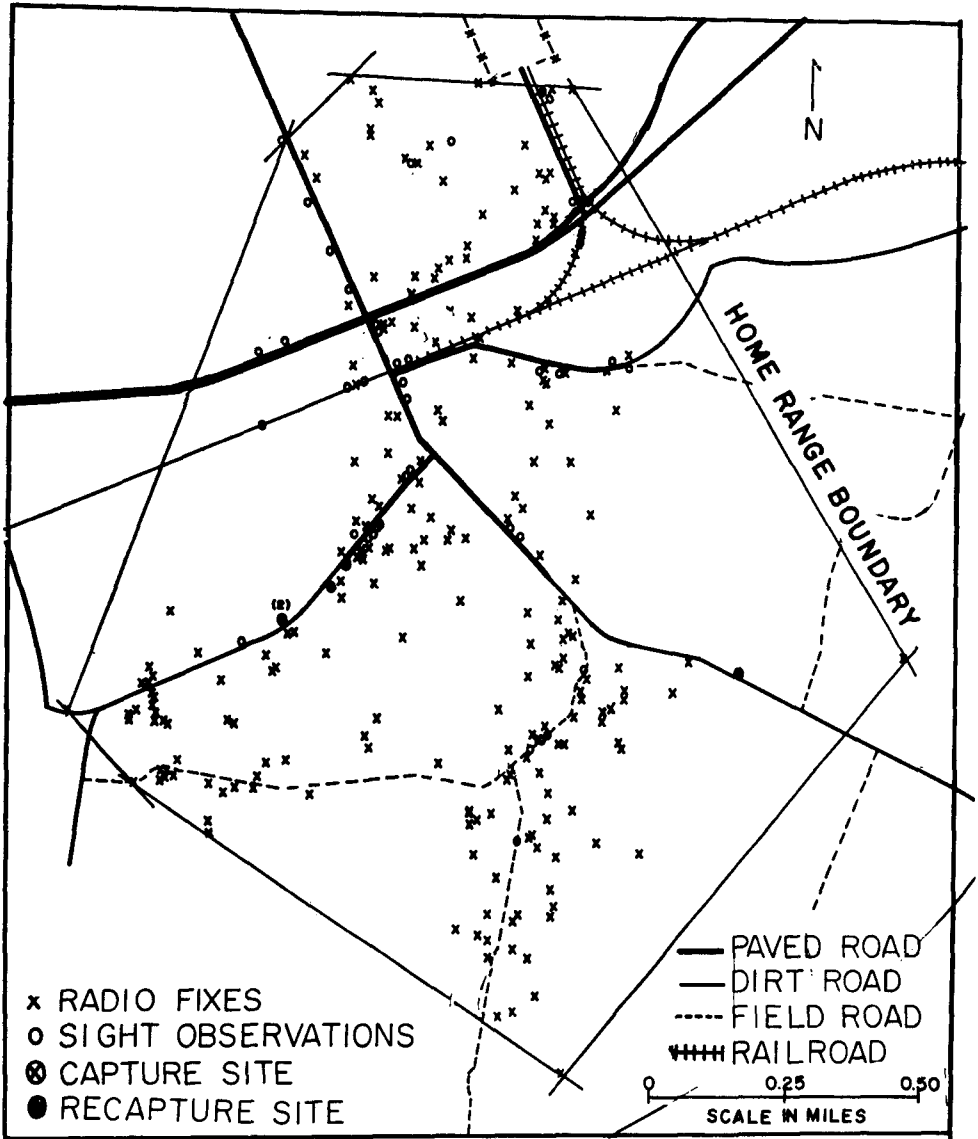
## DISCUSSION

### *Movements and Home Ranges*

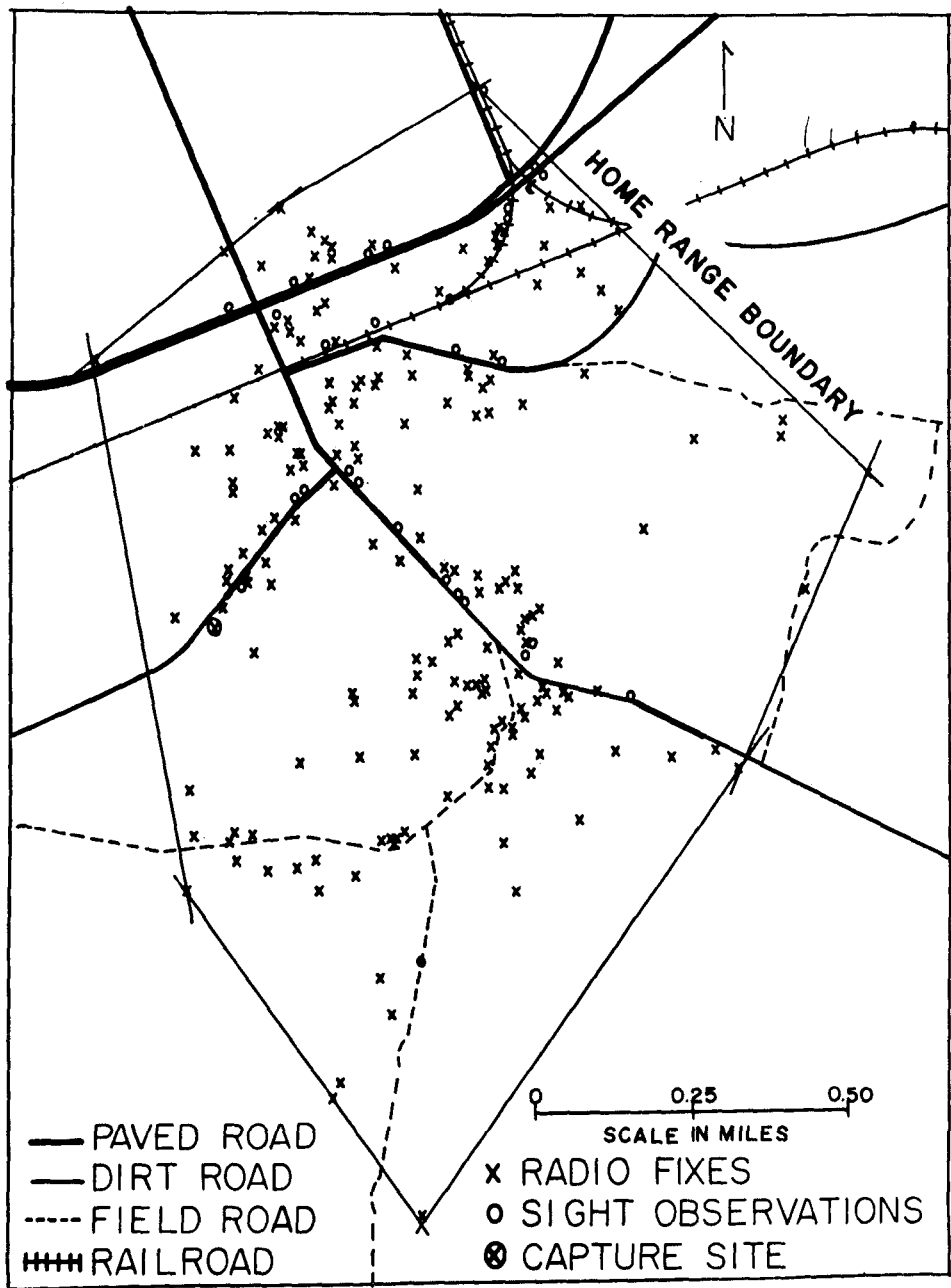
The radio-system described here was adequate for obtaining information on movements, home ranges and hunting habits of the bobcat. Robinson and Grand (1958) tried to obtain this information by trapping and tagging bobcats in Montana. They tagged 81 bobcats from 1954 to 1957 and recaptured 48. Of these, only seven were recaptured a second time.

Several accounts of bobcats' movements and home ranges are given in the literature. Seton (1929), basing his opinion upon probability, estimated the home range of a bobcat to be no more than 1,000 acres in regions where food is plentiful, but more on "starved" lands.

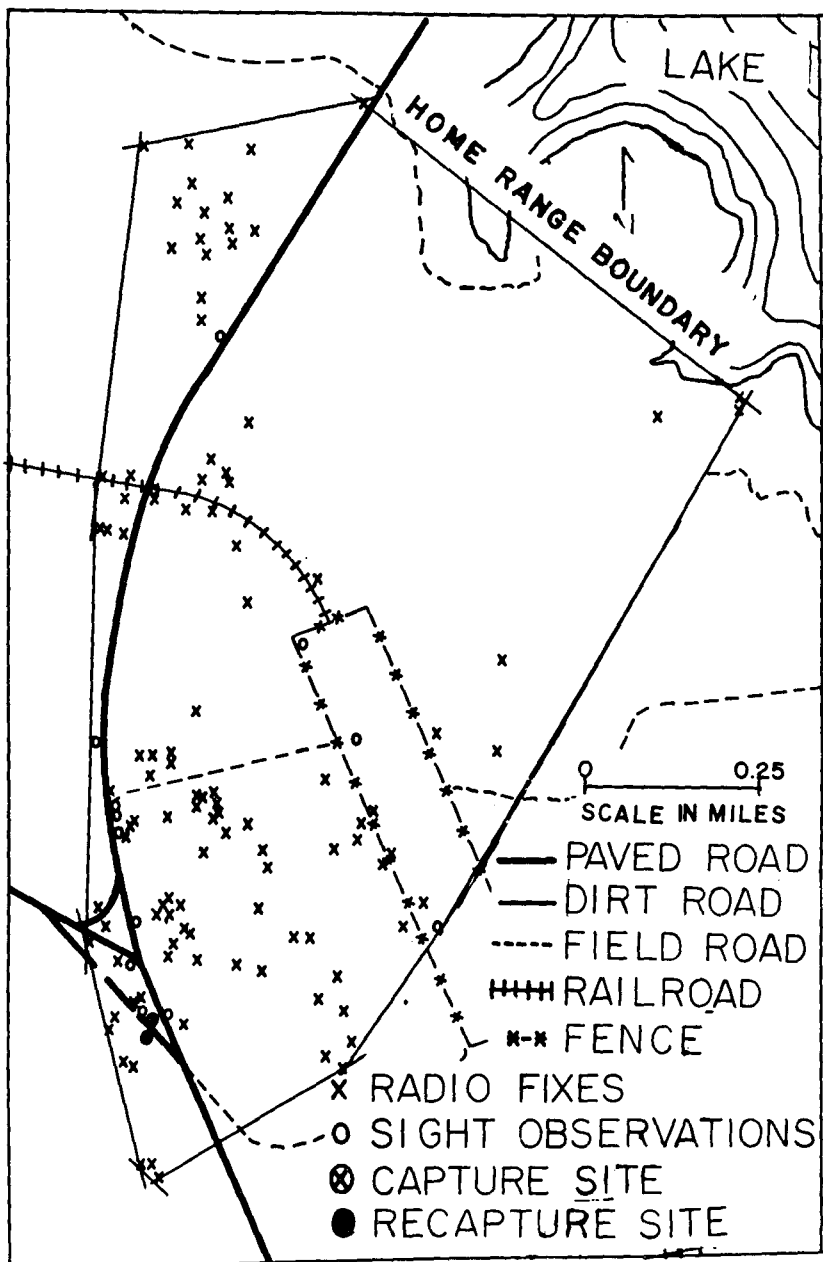
Marston (1942) states that a bobcat in Maine was located at three different points (within a month) forming a triangle of which the sides would total 18 miles. The circumference of the smallest circle to include the three points was nearly 23 miles. He also stated that if this bobcat traveled in circles as some people believe, it would have a territory of more than 40 square miles. Pollack (1949, 1951) estimates the home range of bobcats in the northeastern United States to be between 1.5 and 5.5 square miles. He further stated that fourteen bobcat trails followed in snow suggest the bobcat traveled two to five miles each night in their hunting forays. Rollings (1945), found that bobcats



MAP NO. 1 HOME RANGE OF ADULT FEMALE BOBCAT (699) FROM APRIL 14 TO JUNE 29, 1965



MAP NO. 2 HOME RANGE OF YOUNG MALE BOBCAT (755) FROM MAY 13 TO JULY 14, 1965.



MAP NO. 3 HOME RANGE OF YOUNG FEMALE BOBCAT (174) FROM MAY 26 TO JULY 14, 1965.

in Minnesota travel from three to seven miles, averaging  $5\frac{1}{2}$ , from evening until morning during the winter. He further stated that bobcats probably remain within an area of 10 to 15 square miles even under a severe food shortage. Kight (1962) conducted an ecological study of the S.R.P. bobcats and estimated the home range to be between 0.25 and 1.0 square miles, based on limited trapping and radio-tracking data. His estimate of bobcat home range size is near that obtained in this study.

According to Young (1958), the two most important factors that determine the home range of the bobcat is the available prey and the extent to which the bobcat is hunted. The S.R.P. area is closed to the public and has not been hunted prior to this investigation since it was established in 1950. Population data on prey species of the bobcat on the study area was not obtained; however, visual observations indicated an abundance of rodents and cottontail rabbits. Kight (1962) determined the food habits of S.R.P. bobcats and found that cotton rats (*Sigmodon hispidus*), cottontail rabbits, grass and small birds constituted 88.4 percent by occurrence of the yearly food intake. Golley *et al.* (1965) disclosed that broomsedge-vine and lespedeza type habitats support the greatest number of cotton rats and other small mammals on the S.R.P. This type of habitat was interspersed throughout the study area. Gentry (1961) stated that cotton rats were so numerous as to be pests in some areas of the S.R.P. area in 1960.

The abundance of prey species and absence of hunting pressure may account for the relatively small home range of the animals studied here when compared with other areas.

#### *Hunting Habits*

Considerable time was spent observing radio-tagged (and non-tagged) bobcats in the wild. Most of the observations were made from the radio-tracking vehicle with the aid of binoculars along roads or in relatively open areas.

A total of three kills was witnessed. The first observation was made at 10:20 p.m., May 20. Number 755 was sitting on the side of a road in old Dunbarton peering attentively into a plum thicket. He suddenly crouched and leaped out of sight into the brush. He returned to the road with what appeared to be a cotton rat. The entire rodent was consumed and 755 moved out of sight. The place where the rodent was eaten was inspected and no hair or blood was observed.

The second observation was made on June 10, at 6:00 p.m. Female No. 699 was seen intently watching something in a lespedeza patch on a road bank. It began raining, and the bobcat remained stationary. The rain became very heavy and 699 retreated out of sight over the road bank. The radio signal indicated she moved only a few feet. The rain ceased in about five minutes and 699 returned to the original point of observation. She crept slowly for about one yard at which time she trapped something with her forefeet and consumed it. (It took the animal 13 minutes to move the one yard.) The area was inspected and the remains of a cotton rat nest were found.

The third observation was made as the senior author attempted to take some pictures of animal number 755 on June 20, at 6:15 p.m. The young male was located in a pine stand with sparse understory. Number 755 was first observed partially hidden behind a small bush at a distance of about 25 yards. The bobcat looked at the author momentarily, then cautiously walked slowly to the left about six feet. A young cottontail rabbit was then observed about 10 yards from the bobcat. The young male watched both the author and the rabbit for a few minutes, then cautiously advanced toward the rabbit in a semi-crouched position utilizing all of the available cover between him and his prey until he was within 6-8 feet of the rabbit. Number 755 caught the apparently unsuspecting rabbit in a few short leaps.

Bobcats frequently hunt from roads and railroads. They spend a great deal of time sitting, watching and listening. On May 31, a large bobcat (not radio-tagged) was observed about  $\frac{1}{2}$  mile south of Dun-



barton for 20 minutes. The bobcat would walk 15-20 feet down the road and sit. Then it would scan the shoulder of the road. It would then walk to the opposite side of the road and repeat the same action (two or three minutes per sitting). Anything attracting its attention was immediately investigated.

Seton (1929) and others, state that the bobcat depends mainly on its eyesight to detect prey. Pollack (1951) suggests that the bobcat has a keen sense of smell. The authors believe the bobcat also has a very keen sense of hearing which it also utilizes to detect prey. On several occasions these animals were observed watching something and suddenly turning their heads to the opposite direction when something apparently attracted their attention. Number 699 was observed on one occasion to leap about eight feet from a road into a very dense grass. It would have been virtually impossible for her to see her target.

#### SUMMARY

Home ranges determined for three bobcats were as follows: (1) an adult female located 256 times had an approximate range of 1,142 acres. (2) A young male located 197 times had an approximate range of 886 acres. (3) A young female located 119 times had an approximate range of 610 acres. Movement data obtained by measuring consecutive radio-location of bobcats for 24-hour periods shows that an adult male traveled the greatest average, maximum and minimum, distance of the animals studied. An adult female traveled the next greatest average distance followed by a young female and then a young male. No signs of skin chaffing were observed on two recaptured bobcats wearing transmitters for 3.0 and 3.5 months. Knowing the exact location of bobcats offered the opportunity for numerous sight observations of this elusive, secretive predator.

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