

## PRELIMINARY OBSERVATIONS OF SUBADULT BOBCAT MOVEMENT BEHAVIOR<sup>1</sup>

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*Abstract:* Two subadult male bobcats (*Lynx rufus*) were radio-tracked in the South Carolina Coastal Plain region during the winter and spring of 1979 and 1980. Subadults deserted their initial activity areas in early spring and began a nomadic pattern of movement characterized by establishment of temporary activity areas for varying periods of time (30-60 days). Minimum total straight line distances along the routes taken from initial capture sites to points of last radio location were about 25 km. One subadult exhibited a degree of temporal and spatial segregation from adult bobcats of both sexes monitored during the same time and at the same general location.

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Recent movement and social behavior studies have indicated that bobcat density may be limited by territorial restraints (Bailey 1974, Hall and Newsome 1976). Little natural mortality has been observed for adults (Bailey 1974) and it has been speculated that juvenile mortality and subadult dispersal are the primary mechanisms maintaining density (Bailey 1974, Crowe 1975). Almost no information is available on bobcats during the period from birth until they enter the reproductive portion of the population. With the exception of 2 juvenile bobcats radio-tracked for 63 and 41 days during the late spring and early summer by Marshall and Jenkins (1966) there are no published data on home range size and movement behavior of subadult bobcats. This paper provides preliminary information on activity area and movement behavior of 2 subadult bobcats radio-tracked in coastal South Carolina during the winter and spring of 1979 and 1980.

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### METHODS

One bobcat was trapped and monitored on the 81,000 ha Department of Energy's Savannah River Plant (SRP). The SRP is a nuclear production and research facility located in portions of Aiken, Barnwell, and Allendale counties, South Carolina and was closed to public access in 1952. The SRP forest is presently managed by the USDA—Forest Service for timber production. General habitat types included: upland pines

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(*Pinus* spp.), upland hardwoods (*Quercus* spp.), bottomland hardwoods, and scattered clearcuts. Langley and Marter (1973) gives a description of the geological, hydrological, meteorological and biological characteristics of the SRP site.

The second bobcat was trapped on and monitored on and adjacent to the James W. Webb Wildlife Center (WWC), a game management area administered by the South Carolina Wildlife and Marine Resources Department, located approximately 80 km south of the SRP near Garnett, South Carolina. WWC covers about 2,400 ha and is managed for wildlife, primarily whitetailed deer (*Odocoileus virginianus*) and bobwhite quail (*Colinus virginianus*), and limited timber and agricultural production. The area is interspersed with small agricultural fields, wildlife openings, clearcuts, and open pine uplands. The area has a limited mixture of bottomland hardwoods but contains an extensive bottomland hardwood and swamp system along the western boundary.

Bobcats were captured in Sullivan live traps and dirt-hole sets using No. 2 leghold traps placed along woods roads. The traps were baited and scented with deer (*Odocoileus virginianus*) heart and bobcat urine, respectively. After capture, bobcats were transferred to a wooden squeeze box, weighed, and anesthetized with an intramuscular injection of ketamine hydrochloride (22 mg/kg of body weight). Anesthetized bobcats were measured, ear tagged and classified as to adult or juvenile by tooth wear and body size. Bobcats were instrumented with collar-type radio transmitters weighing approximately 150 g and transmitting in the 164-165 mhz range. Instrumented animals were released at the capture site within 8 hours of capture and monitored by standard radiotelemetry techniques. Tracking regime consisted of recording daily locations and periodic diel tracking periods. Minimum total distance moved per day (MTD) was calculated for each diel period (Marchinton and Jeter 1966). In addition, the following values were calculated:

1. Interval Movement Rate (IMR)—the average distance moved per 2-hour interval per diel period.
2. Nocturnal Interval Movement Rate (NIMR)—the average distance moved per 2-hour interval during the nocturnal portion of a diel period. The distance between the 2 sequential locations that spanned the 2-hour interval during which daylight occurred was included as a nocturnal distance.
3. Diurnal Interval Movement Rate (DIMR)—the average distance moved per 2-hour interval during the diurnal portion of a diel period. The distance between the 2 sequential locations that spanned the 2-hour interval during which nightfall occurred was included as a diurnal distance.

Size of temporary activity areas were calculated by the minimum area method (Mohr 1947). An activity area is defined as that area within which an individual localizes his movement over a variable period of time (1 to several weeks). This area would contain resources needed to satisfy the individual's immediate needs.

Five general habitat types were delineated from USDA Forest Service timber compartment maps within the temporary activity areas of 1 cat. Chi-square was used to determine random and non-random utilization of habitat types based on percent utilization and percent areal availability. An index to habitat utilization was calculated as: percent of total observations falling in that habitat type. Index values of  $< 1$ ,  $\approx 1$  or  $> 1$  imply less than expected, expected, or greater than expected use of a specific habitat type, respectively, and illustrates relative selection. Specific information on habitat types were not available for the other bobcat because the large privately owned land tracts within the WWC subadult use area had not been systematically inventoried.

## RESULTS

### SRP 43

A subadult male bobcat weighing 7.8 kg was captured at the SRP on 29 January 1979 inside the home range boundaries of a monitored adult male bobcat. This subadult was located 147 times during 153 days of tracking. He exhibited unpredictable movement patterns during this period and established 3 temporary activity areas before tracking was discontinued on 30 June 1979 (Fig. 1). The first recognized activity area encompassed a 1,300 ha area which partially overlapped the home range of an adult male. This area was utilized over a 38-day period after which contact was lost. This cat was recaptured 37 days later 14.4 km southeast of the initial activity area. Upon release, a second activity area of 1,052 ha was delineated around the recapture site and adjacent to the home ranges of 2 radio transmitter equipped adult bobcats (1 male, 1 female). The female's home range was entirely within the adult male's home range, and the subadult was never located within this area. This temporary activity area was maintained until a shift occurred 32 days later establishing temporary activity area III, 2.9 km from the center of and partially overlapping a portion of activity area II (Fig. 1). Activity area III encompassed 1,445 ha and was

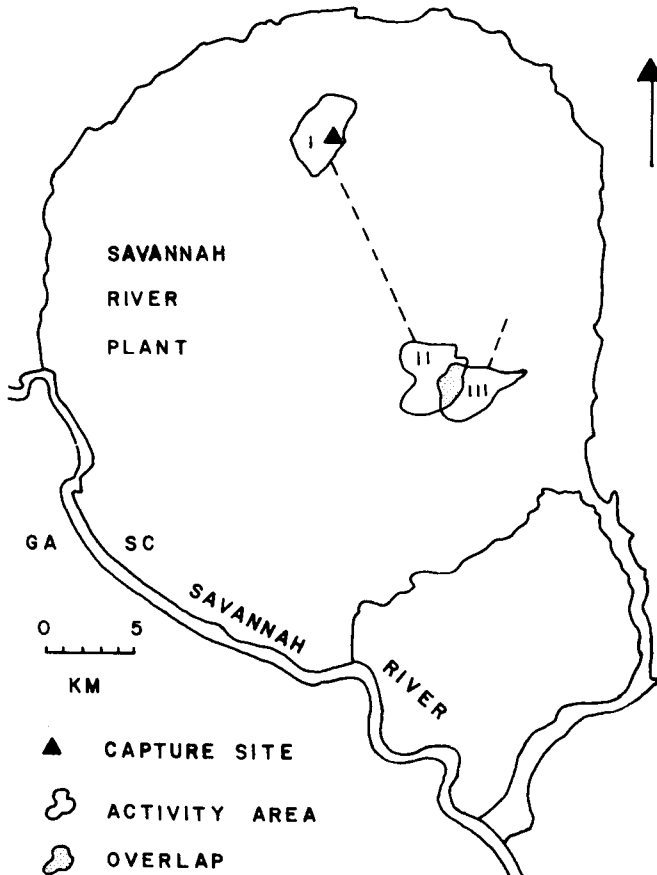


Fig. 1. Location of temporary activity areas and long term movement pattern of a subadult male bobcat (SRP 43) radio-tracked during the winter and spring of 1979 on the Savannah River Plant, South Carolina.

maintained for 38 days. The last location for this individual was recorded 6.0 km northeast of the center of home range III on 30 June 1979. The average activity area maintained by this subadult during the 5 months of tracking was 1,266 ha, and the minimum total straight line distance along the probable route taken from the initial capture site to the last radio-location was 24 km.

WWC 51

A subadult male bobcat weighing 6.8 kg was captured on WWC on 31 January 1980. This bobcat was located 157 times over a 151-day tracking period. At the time of release, he rapidly moved 1 km to activity area I and remained there for 5 days (Fig. 2). The next day he was located in a new area (activity area II) 8 km northeast of the center of activity

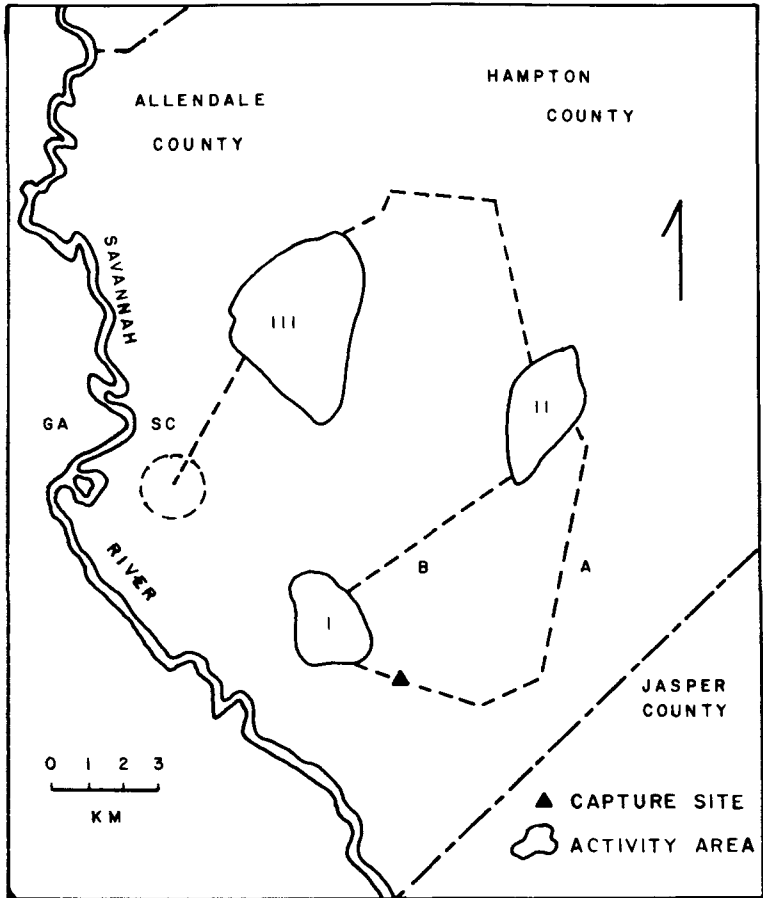


Fig. 2. Location of temporary activity areas and long term movement pattern of a subadult male bobcat (WWC 51) radio-tracked during the winter and spring of 1980 on the James W. Webb Wildlife Center, Garnett, South Carolina. Area enclosed by circle represents new use area of unknown size.

area I. He remained in activity area II for 6 days before returning to activity area I along route A (Fig. 2), a trip that required 1.5 days. He remained in activity area I for 5 days before returning to activity area II along route B (Fig. 2). This trip required only 0.5 days. The subadult returned to activity area I once more on 2 March, but remained there for only 1 day before returning to activity area II. He was never again located in activity area I. Activity areas I and II encompassed 230 ha (88% of the locations fell within 44 ha) and 326 ha, respectively, and were separated by a straight line distance of 8 km. On 9 April WWC 51 left activity area II and began moving in an erratic, wandering fashion until he reached activity area III 8 days later (Fig. 2). The straight line distance along the probable route taken during the 8 day trip was 11 km. Activity area III encompassed 1,050 ha and he occupied this area for 59 consecutive days before leaving. On 15 June WWC 51 was located 7 km southwest of activity area III, perhaps seeking a new, temporary activity area. The average activity area maintained by this subadult male during the 5 month tracking period was 535 ha and the minimum total straight line distance along the probable route taken from activity area I to the furthest location to date beyond activity area III was 27 km. The route taken by WWC 51 during his wandering movement almost forms a complete circle (Fig. 2).

#### Movements

Both bobcats exhibited similar MTD's, moving between 6-7 km/day (Table 1); however, differences were evident in the distance moved between sequential locations during diurnal and nocturnal periods (Table 1). WWC 51 exhibited greater movement during

Table 1. Movement values calculated from diel data for 2 subadult male bobcats radio-tracked in the South Carolina Coastal Plain region during the winter and spring of 1979 and 1980.

Cat #	# diel periods	MTD (km ±SE)	DIMR <sup>1</sup> (M ±SE)	NIMR <sup>2</sup> (M ±SE)	Movement ratio DIMR/NIMR
SRP 43	8	6.2±0.8	656±75	554±80	1.2
WWC 51	4	6.9±1.1	455±77	672±113	0.7

<sup>1</sup>The average distance moved per 2-hour interval during the nocturnal portion of a diel period.

<sup>2</sup>The average distance moved per 2-hour interval during a diurnal portion of a diel period.

nocturnal periods; whereas, SRP 43 moved slightly more during diurnal periods. Even though both bobcats exhibited a bimodal daily activity pattern and both were active about the same time during the late afternoon and early evening, peak activity during morning was about 4 hours earlier for WWC 51 than for SRP 43 (Fig. 3)

#### Habitat Use

SRP 43 exhibited non-random utilization of habitat types ( $X^2$  test,  $P < 0.05$ ). He used bottomland and hardwood areas slightly more than expected and old field/1-4-yr-old pine plantations much more than would be expected based on areal availability (Table 2). Conclusions concerning utilization of upland hardwood and 5-14-yr-old pine plantations are uncertain because of the low percent of the total area in those habitat types and the low percent of total observations falling in those habitat types. It appears that 15-yr-old and older pine stands were used slightly less than expected based on areal availability.

Only general statements can be made concerning habitat use by WWC 51. Activity area I was composed of a mixture of bottomland hardwoods and Cypress-tupelo (*Taxodium distichum-Nyssa aquatica*) swamp and a limited amount of upland pine. Movement within

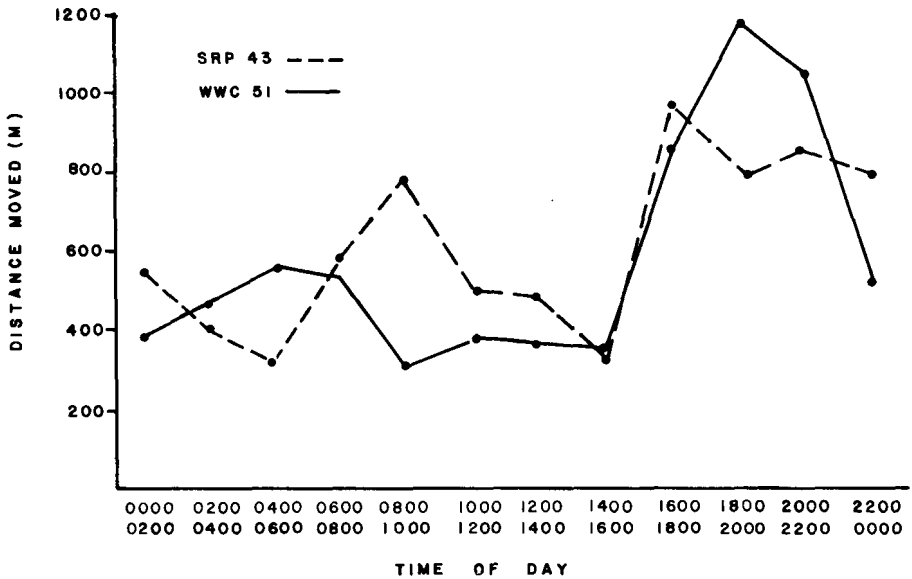


Fig. 3. Diel activity patterns for 2 subadult male bobcats radio-tracked during the winter and spring of 1979 and 1980 in the South Carolina Coastal Plain region.

this activity area was generally limited to an area encompassing 44 ha. Activity area II was primarily composed of a 3-yr-old pine plantation and adjacent bottomland hardwood and sparse to dense 15-yr-old and older pine plantations. Activity area II contained the 2 habitat types selectively used by SRP 43—bottomland hardwoods and old field/1-4-yr-old pine plantations. Similar to SRP 43, WWC 51 used the 3-yr-old pine plantation more than bottomland hardwoods or older pine plantations. Activity area III was composed of bottomland hardwood drainages interspersed with large agricultural fields and dense 15-yr-old and older pine plantations.

## DISCUSSION

Recent studies of movement behavior strongly indicate that adult bobcats exhibit intrasexual territoriality (Bailey 1974, Hall and Newsome 1976). Bailey (1974) reported no subadult movement data, but speculated that the land tenure system of adult bobcats prevented juveniles from settling in occupied areas, implying a nomadic search for unoccupied, resource adequate home range sites. Although our data are limited they do support Bailey's (1974) contention of long distance dispersal by subadults.

The specific time of year when self-sufficiency develops or subadult dispersal behavior is initiated may depend upon the age of the individual subadult, the development of breeding aggression in adults or the development of intolerance in the adult female related to parturition. We have no evidence that the initial bobcat capture sites or activity areas

Table 2. Index to habitat utilization by a subadult male bobcat (SRP 43) radio-tracked on the SRP during the winter and spring of 1979 and 1980.

	Bottomland hardwood	Old field/ 1-4 yr pine	Upland hardwood	5-14 yr pine	15+ yr pine
Percent of total locations	23.0	7.0	3.0	5.0	63.0
Percent of total land area	19.0	3.0	4.0	4.0	70.0
Index to utilization <sup>1</sup>	1.2	2.3	0.8	1.3	0.9

<sup>1</sup>Percent of total locations falling in a habitat type divided by percent of total land area in that habitat type. Index values of <1, =1, or >1 imply less than expected, expected, or greater than expected utilization, respectively.

were, in fact, their natal areas. Each subadult deserted his initial activity area during the late winter/early spring and embarked on a long, nomadic journey. The time of departure from the initial activity area corresponds favorably with the general peak breeding period reported for bobcats nationwide (Young 1958, Gashwiler et al. 1961, Nelson 1971, Crowe 1975) suggesting that aggression associated with breeding activities may be the most important factor in sub-adult dispersal behavior.

In a study of Idaho bobcats Bailey (1974) reported that no tagged kittens from the previous year were captured within their mother's home range after she had her next litter. WWC 51 may have partially abandoned his natal area prior to initial capture in late January, since he simultaneously utilized two areas apparently connected by narrow travel lanes that may have fallen between adult territories as evidenced by depositories and other signs of bobcats. During visits to activity area I, his movements were always restricted. The regular use of 2 areas connected by a narrow travel land has been reported for a 2-yr-old male bobcat by Hall and Newsome (1976).

The average activity area for SRP 43 of 1,266 ha closely paralleled the average home range size (1,035 ha) observed for 3 adult females at the SRP during the same time (Buie 1980). This similarity may reflect the close maternal ties that subadult male bobcats maintain from birth to dispersal. The average activity area of WWC 51 was somewhat smaller (535 ha) than that found for SRP 43, but no adult home ranges have been documented in his vicinity. Marshall and Jenkins (1966) reported on the movement behavior of 2 subadults (1 male and 1 female monitored for 63 and 41 days, respectively) during late spring and early summer. Their subadults exhibited somewhat smaller home ranges than an adult female monitored at the same time and location. Examination of home range maps presented by Marshall and Jenkins (1966) reveals an almost complete overlap of the subadult male and adult female home ranges. However, their subadults did not exhibit the apparent dispersal movements found in the present study. Their subadult bobcats may have already established permanent use areas or their tracking period may have fallen between shifts in activity areas. The animals in our study used temporary activity areas from 30-60 days before moving to new sites.

Average MTD's for both subadults were similar to the average value found for 3 adult female bobcats (6.2 km) monitored during the same period and in the same general area as SRP 43 (Buie 1980) and may also reflect maternal influence from parturition to dispersal. SRP 43 exhibited peak activity periods (Fig. 3) about 2 hours later than adult males monitored at the same time (Buie 1980), possibly reflecting a behavioral mechanism reducing interaction with intrasexual adults. In addition, SRP 43 selectively used (Table 1) the 2 habitat types selectively used by adult bobcats on the SRP (Buie 1980). However, of the two habitat types, SRP 43 exhibited a lesser affinity for the habitat type selectively used most by adults (bottomland hardwood) and a greater affinity for the habitat type selectively used the least by adults (old field/1-4-yr-old pine plantation) (Buie 1980). Within activity area II, WWC 51 also seemed to selectively use a 3-yr-old pine plantation. As with activity periods, such habitat segregation would appear to reduce the probability of encountering territorial adults.

Our data are limited and answer few questions. They support Bailey's (1974) speculation of long distance, nomadic wandering by subadults and suggest the possibility of temporal and spatial segregation of subadult and adult bobcats during the subadult dispersal period. Simultaneous studies of subadults and adult bobcat movement behavior, and habitat selection have been initiated at the SRP to verify these possibilities.

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