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MOVEMENTS AND DENNING HABITS OF A BADGER

Badgers (*Taxidea taxus*) are common throughout much of central and western North America, but surprisingly little is known of their ecology and behavior. For example, we found no documentation on aspects of the home range of this species in the literature. For this reason we initiated a study to determine the movements and denning habits of the badger in east-central Minnesota.

Field work was conducted in 1963 and 1964 on and adjacent to the 4500-acre Cedar Creek Natural History Area, which is approximately 30 miles north of Minneapolis (Fig. 1). The area is interspersed with deciduous woodlots, fields, swamps, marshes, occupied dwellings, roads, and contains a lake. The soil is sandy, and many of the fields were abandoned cropland that had grown to grasses and forbs.

Badgers were captured in steel traps with attached tranquilizer tabs (Balser, J. Wildlife Mgt., 29:438–442, 1965). A miniature radio transmitter, similar to that described by Cochran and Lord (J. Wildlife Mgt., 27:9–24, 1963) was attached to each badger by a leather or cloth shoulder harness. A completed harness with the radio attached weighed approximately 150 grams. After releasing the badgers, we usually located them several times each night and visited the dens they occupied during the day. Most radio-locations were obtained with portable receiving equipment. The Cedar Creek Automatic Radio Tracking System (Cochran, Warner, Tester, and Kuechle, BioScience, 15:98–100, 1965) was used when it became operational in January 1964.

Home range as used in this paper is the area bounded by outer lines connecting consecutive radio-locations. Dens refer only to underground burrows used for resting.

Four adult badgers were captured in 1963 and 1964 and equipped with radio transmitters. Radio contact with three of them was lost within 3 days after their release. The fourth badger, an 11.5-pound adult female (apparently without young), was trapped on 26 July and released near the capture site on 29 July 1963 (Fig. 1, location A). Her

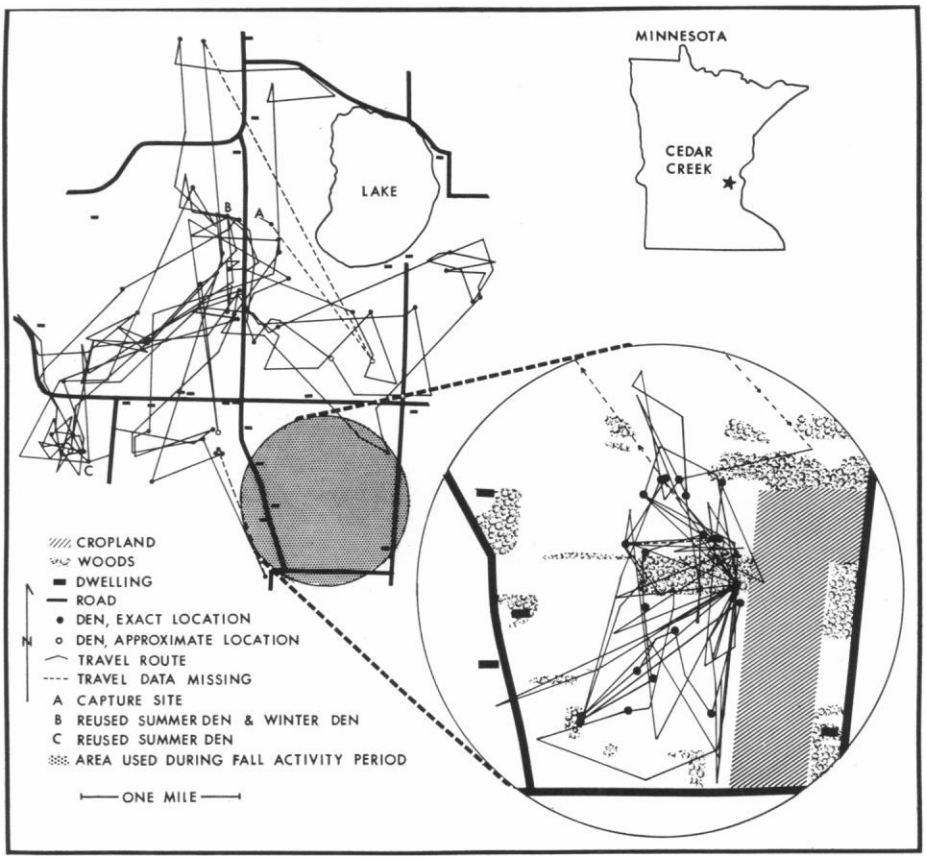

FIG. 1.—Diagram of travel routes and location of dens of a radio-equipped badger that was followed for 165 days on, and adjacent to, the Cedar Creek area.

movements and denning habits were followed until 9 January 1964 when radio contact was lost. Her location was determined at least once each day on all but 17 of the 165 days during the tracking period. All travel by the badger started after sunset and usually terminated before sunrise. A den was used each day. Diurnal surface activity could have been missed, but the badger was never located in more than one den on any day.

The overall home range of the badger encompassed 2100 acres (Fig. 1). She appeared to travel and den alone, and only one other badger, an adult male, was known to occur in her home range. Home range varied seasonally and was characterized by substantial differences in denning habits and in the size of the area occupied. Therefore, we divided her movements among summer, autumn, and winter activity periods.

Summer activity period.—During this period (29 July to 27 September), the badger occupied 1880 acres. This was the largest area used during a seasonal activity period. In spite of the large area, the badger revisited many peripheral parts of her range. A lapse of 40 days occurred between visits to the northernmost den area. From 12 September through 27 September, the badger traveled at least 17 miles in a circuit roughly outlining the entire area.

In the summer, the badger was never found in the same den on 2 consecutive days, and she reused only two of her 46 known dens. Each of the two reused dens (Fig. 1, locations B and C) were occupied twice, and both appeared to have had much previous animal use. Thirty-nine of 50 dens, including four for which only the approximate location was known, were in wooded areas and the remaining 11 were in fields.

Generally, the badger moved directly from the denning area used one day to the denning area to be used the next day. The average straight-line distance between consecutively used dens was 0.7 mile (range 0.1 to 1.8 mile). Because of this movement pattern and the large area occupied, reuse of specific areas was usually infrequent and brief. Yet, with the large number of scattered dens and the numerous other burrows that were dug apparently for feeding, sign of the badger was conspicuous throughout the area.

On 28 to 29 September the badger could not be located. On 30 September she was found in an adjacent area where she remained during the autumn.

Autumn activity period.—This period (30 September to 30 November) was characterized by intensive use of a 130-acre area (Fig. 1, enlarged circle) and by considerable reuse of dens. The comparatively small area used during this period consisted primarily of idle fields that had grown to grasses and forbs, and several small woodlots. On the basis of the relatively large number of mounds observed, this area appeared to have one of the densest populations of pocket gophers (*Geomys bursarius*) in the badger's total home range. The badger dug extensively into burrows of the pocket gophers, apparently in search of food.

Use of dens by the badger was documented for 57 days during which 23 different dens were occupied. The average straight-line distance between consecutively used dens was 0.1 mile (range 0.0 to 0.6 mile). Twenty of the dens were in fields, and three were in woodlots. The 20 dens in fields, seven of which were reused, were occupied for a combined total of 30 days (1.5 days per den). In contrast, the three dens in woodlots were all reused for a combined total of 27 days (9.0 days per den). On 21 days the badger was found in the same den that she had used the previous day, and on many occasions she apparently remained denned overnight. Travel by the badger decreased as the fall progressed and temperatures fell.

The onset of winter occurred during the period 25 November through 2 December when temperatures dropped below freezing each night. The temperature of the soil, 4 inches below the surface, dropped to 4° C on 25 November, and light snow fell on 29 November.

From 0730 on 30 November to 2330 on 1 December, the badger could not be located. On 2 December she was found in a den 1.7 miles from the last den she was known to have used during the autumn activity period. A light snowfall on 2 December enabled us to track the badger approximately 0.2 mile in a direct route to the den entered on 3 December.

Winter activity period.—During this period (2 December to 9 January), the badger used a single den and traveled infrequently in a 5-acre area. This winter den was the last den used by the badger in the summer activity period (Fig. 1, location B). The den and all movements by the badger were in a woodlot of dense oak (*Quercus* sp.) and hazel (*Corylus americana*). A 6-inch snowfall on 8 December allowed us to track the badger on subsequent trips from the den. The temperature of the soil, 4 inches below the surface, dropped to 0° C on 23 December.

The badger left her winter den on 13, 16, 19, and 31 December when the minimum nightly temperatures were –18, –29, –27, and –29° C, respectively. The most extensive trip was on 16 December when tracks showed that she traveled about 300 yards west of the den and returned. During this trip several holes were dug through the snow into the unfrozen soil. On the last trip the badger traveled approximately 40 yards to a hole dug on 16 December and then returned to the den. Radio contact with the badger was lost on 9 January while she was in the winter den.

Dens.—Most dens had a single entrance with a large mound of freshly dug soil in front and, when occupied, the den entrance was generally partially plugged with loose soil. These dens were similar to those described by Balph (J. Mamm., 42:423–424, 1961) who sug-

gested that badgers may wait in them to "ambush" Unita ground squirrels (*Speromophilus armatus*) that ran into the dens. Although thirteen-lined ground squirrels (*Speromophilus tridecemlineatus*) were common on the Cedar Creek area, we have no reason to suspect that badgers used their dens as ambush sites.

There was no evidence of nest preparation in any den. Most of the dens that were used only once for resting appeared similar to many other burrows that were dug by the badger apparently for feeding. Many of the reused dens, particularly those in woodlots, appeared to have had much previous use. The two dens that were reused during the summer activity period were later used as rearing dens by red foxes (*Vulpes vulpes*), one each during 1964 and 1965.

Food habits.—During the study we found evidence of only one kill, presumably a pocket gopher. Only six old scats were found. All were exposed by the weathering of mounds that had been made by badgers digging into burrows of pocket gophers. All six scats contained remains of pocket gophers, one with skull fragments from three individuals. One scat also contained a trace of insect material. These observations agree with those of Snead and Hendrickson (J. Mamm., 23:380–391, 1942), who reported that badgers are secretive in their defecation habits and frequently deposit scats at the bottom of shallow excavations or bury them in the mounds of earth at the entrances to burrows.

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OBSERVATIONS ON THE INDUCTION OF OVULATION IN *MICROTUS MONTANUS*

It has been suggested that all species of the genus *Microtus* are induced ovulators (Breed, Nature, 214:826, 1967; Richmond and Conaway, J. Reprod. Fert., suppl. 6:357–376, 1969), and it has been demonstrated that *M. agrestis* (Breed and Clarke, J. Reprod. Fert., 22: 173–175, 1970) and *M. ochrogaster* (Richmond and Conaway, J. Reprod. Fert., *op. cit.*) ovulate approximately 10 hours after mating. *Microtus agrestis* also can be induced to ovulate after an injection of pregnancy urine gonadotrophin (Austin, J. Endocrinol., 15:iv, 1957), thus behaving similarly to the well-known induced ovulator, the rabbit.

In *Microtus*, however, certain aspects of preovulatory follicle development may be unique. Up to 20 hours after mating in *M. agrestis*, Breed and Clarke (*op. cit.*, 173–175) observed relatively small antral follicles obviously affected by the mating stimulus, but unable to complete the ovulation process. It was suggested that the small size of these "minimally stimulated" follicles might account for their failure to ovulate. Breed and Clarke also found that large dosages of luteinizing hormone (LH) eliminated the "minimally stimulated" follicles.

The present investigation examines follicle development and ovulation following both mating and human chorionic gonadotrophin (HCG) injection in *M. montanus*.

Microtus montanus, obtained from a laboratory colony, were weaned at 3 weeks of age and pooled in stock cages according to sex. Artificial fluorescent illumination was maintained 18 hours per day. Mature (open vagina) virgin females, from 25 to 30 grams, were used in all experiments. In mating experiments females were caged individually for 1 day prior