

- Arizona. Trans. San Diego Soc. Nat. Hist., 20:247-276.
- MOHLHENRICH, J. S. 1961. Distribution and ecology of the hispid and least cotton rats in New Mexico. J. Mamm., 42:13-24.
- SELLERS, W. D., AND R. H. HILL. 1974. Arizona climate: 1931-1972. Revised Second ed. Univ. Arizona Press, Tucson, 616 pp.
- ZIMMERMAN, E. G. 1970. Karyology, systematics and chromosomal evolution in the rodent genus, *Sigmodon*. Publ. Mus. Michigan State Univ., Biol. Series, 4:385-454.

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SCENT-MARKING BEHAVIOR BY WOODCHUCKS (*MARMOTA MONAX*)

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Active scent marking with glands located in the oral angle has been reported for terrestrial sciurids (Halpin, 1984). The anatomy and histology of these glands in woodchucks (*Marmota monax*) have been described by Walro et al. (1983). Although active marking behavior in woodchucks has been studied in captivity (Hébert, 1985; Hébert and Prescott, 1983), no study has yet analyzed active scent-marking behavior of woodchucks in the wild. As a result, functions of scent-marking behavior in this species are not yet understood. In an attempt to gain insight into the functions of this behavior, we conducted a contextual analysis of scent marking in natural conditions.

As part of a study on social and spatial organization of woodchucks in eastern Quebec, 204.2 h of focal-animal sampling (Altmann, 1974) were recorded, during 413 observation bouts, on radio-collared animals during the postbreeding season in 1984. Animals were visible to the observer during an average of 29.7 min (for 204.2 h) of the 37.8 min (for 260.0 h) that they were active above ground during observation bouts. Behavior could not be determined during the remainder of the time when animals were partly or completely hidden by vegetation or by objects, such as fences and rocks. Behavioral observations were interrupted during haying in the 1st week of July. Six adult males were observed for 91.3 h (13.4-19.8 h per individual) and five adult females were observed for 88.9 h (12.1-23.4 h per individual) between 7 May and 5 August. Data on adults were recorded for an average of 30.0 h (range 20.2-43.4 h) per 2-week period. Young emerged during the 1st week of June and began to disperse during the 1st week of July. Two young females were observed for 24.0 h (11.6 and 12.4 h per individual) between 4 June and 5 August for an average of 6.0 h (range 4.4-8.0 h) per 2-week period. As woodchucks are diurnal, observations were conducted only during daylight hours (0500-1000 h, 32.4%; 1001-1500 h, 31.2%; 1501-2000 h, 36.0%). Animals were located with a receiver equipped with a three-element folding yagi antenna. After being located, subject animals were observed with binoculars. Each behavior pattern was recorded with the exact time of its occurrence. The distance of the animal relative to its burrow was established with markers placed before sampling at 6, 12, and 18 m from each burrow. We recorded all movements between burrows. We also noted if the focal animal interacted visually or physically with another woodchuck. Observations were dictated into a tape recorder and later transcribed for computer analysis. All instances ($n = 189$) of active scent-marking behavior by muzzle rubbing recorded during these observation bouts were analyzed.

Muzzle rubbing is achieved by twisting the head to one side then dragging the side of the face across an object or on soil. One side or both sides of the face alternatively (considered as a single muzzle-rubbing act in our data) contact the substrate. The different substrates used for muzzle rubbing were fences, woodpiles, shrubs, rocks, burrow mounds, and unidentified substrates (Ouellet, 1986). Inability to classify a substrate was because of the presence of several structures close together that made it impossible to determine where the scent mark was deposited. The exact location of scent marks on each structure was not recorded. However, we observed in two instances that animals visiting a vacant burrow occupied by another woodchuck the previous day scent marked over a mark we had seen made by the former resident, even though other suitable