

Naturally Occurring Encounters between Black-tailed Prairie Dogs (*Cynomys ludovicianus*) and Snakes

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ABSTRACT: Four naturally occurring encounters between black-tailed prairie dogs and snakes are described. The behaviors shown by the prairie dogs included investigatory approaches and alarm communicatory behaviors, as well as attacks upon and interment of the snakes. The behaviors observed during these interactions are compared to those reported by Owings and Owings (1979) during artificially staged encounters between prairie dogs and their snake predators. The possible evolutionary significance of cooperative antipredator behavior is briefly discussed.

INTRODUCTION

Opportunities to observe naturally occurring encounters between predators and their prey are relatively rare. Naturally occurring encounters between black-tailed prairie dogs (*Cynomys ludovicianus*) and predators have been reported only in the case of the black-footed ferret *Mustela nigripes* (Hillman and Linder, 1973) and the red-tailed hawk *Buteo jamaicensis* (Stromberg, 1974). Merriam (1901) and King (1955) briefly described encounters between prairie dogs and snakes, and Hoogland (1981) described the responses of prairie dogs to stuffed badgers *Taxidea taxus*, and a stuffed mink *M. vison*.

Snakes may be important predators of prairie dogs (Owings and Owings, 1979). Throughout the geographic range of the black-tailed prairie dog, bullsnakes (*Pituophys melanoleucus sayi*) and several species of rattlesnakes (*e.g.*, *Crotalus viridis* and *C. atrox*) are capable of preying on juvenile and small adult prairie dogs. Furthermore, large specimens of the eastern yellow-bellied racer (*Coluber constrictor flaviventris*), the great plains rat snake (*Elaphe guttata emoryi*) and the prairie kingsnake (*Lampropeltis calligaster*) may also be able to prey upon nursing prairie dog pups and small juveniles.

Owings and Owings (1979) described the responses of prairie dogs to rattlesnakes and bullsnakes during staged encounters. In their study, anesthetized and freely moving snakes were introduced to captive and field populations of prairie dogs. The responses of the prairie dogs were complex and included investigatory approaches, jump-yip vocalizations and foot-thumping. However, since these encounters were artificially staged, it was not clear if the same behaviors would occur during natural encounters between prairie dogs and their snake predators. This paper describes four naturally occurring encounters between prairie dogs and snakes, compares the snake-directed behaviors of prairie dogs to those of other sciurid species, and discusses the possible evolutionary significance of cooperative predator defense by *Cynomys ludovicianus*.

METHODS

The described encounters occurred at a 1.7-ha prairie dog town located at the Quivira National Wildlife Refuge in S-central Kansas. The prairie dogs at the town are feral, but have become habituated to our presence.

Among the potential snake predators of prairie dogs, the most frequently observed species on the refuge is the bullsnake, but prairie kingsnakes and eastern yellow-bellied racers are also present. The prairie rattlesnake (*Crotalus viridis*) is uncommon.

Research on this town was conducted from May through August, 1978 to 1981. All prairie dogs residing in the town were trapped, sexed and marked, thus allowing easy

identification. During the first two encounters, notes on the behaviors of the animals were recorded directly in a notebook. The same was done during encounters 3 and 4, but the different stages of the encounters were also timed with a stopwatch.

RESULTS

Encounter 1. 20 May, 1978.—At 1415 hrs, a lactating female prairie dog was seen interacting with a 109-cm prairie kingsnake approximately 3.0 m from the entrance to the female's burrow. The female repeatedly made short dashes out of her burrow and approached the head of the snake with an elongate, tense body posture until she almost made contact with the snout of the snake. These approaches were accompanied by head-bobbing movements during which the prairie dog repeatedly stretched and shortened its neck, while at the same time making rocking movements with its body towards and away from the snake. After almost touching the snake's snout, the prairie dog would leap back quickly and jump-yip (see Smith *et al.*, 1976, for a description). Both high and low amplitude jump-yips (Owings and Owings, 1979) were recorded. After each retreat the female usually performed between one and three jump-yips before reapproaching the snake. Jump-yipping bouts occurred at a rate of approximately once every 5 sec. Throughout this encounter, the snake remained immobile. No other prairie dogs were active in the immediate area, and only the one female was seen to interact with the snake. After approximately 10 min, my assistant and I approached the area to capture, identify and measure the snake. The female retreated to her burrow but continued to jump-yip and monitor our actions from the burrow. After the snake was released, the female continued, for approximately 30 min, to cautiously investigate (elongated approaches and sniffing of the ground) the area where the snake had been. During these investigations, she frequently jump-yipped, then retreated to her burrow or foraged nearby.

Encounter 2. 13 March, 1981.—At 1100 hr, I noticed two female prairie dogs repeatedly jump-yipping and behaving in a manner similar to that described above. As I approached, a snake, tentatively identified as a small bullsnake, disappeared into the tall grass at the edge of the town. The two prairie dogs returned to their burrows approximately 7 m away, and were not seen to reinvestigate the area.

Encounter 3. 5 August, 1981.—At 1105 hrs, my assistant and I noticed a group of prairie dogs congregated around the entrance to a burrow, performing elongated approaches, jump-yipping behaviors, and head-bobs of the kind described above. The group consisted of a breeding male and female and six of their 5-month-old male and female young. When I approached, most of the animals walked away and began foraging nearby. The adult female and one male juvenile, however, stayed at the burrow and continued to jump-yip and approach the entrance. Suddenly, the female began rapid head-bobbing and performed repeated sharp, high-pitched vocalizations. Although these vocalizations were different from the bark and the jump-yip vocalization, they somewhat resembled the first syllable of a jump-yip. While still vocalizing continuously, the female repeatedly kicked dirt into the burrow with her hind legs. Occasionally she turned, pushed the dirt into the burrow with her front legs, and tamped it down with her nose. This behavior continued until the entrance to the burrow was completely covered (approximately 12 min), at which point the female jump-yipped four times and walked away. Thirty min later, I dug out a 177.5-cm bullsnake which was alive and showed no signs of injury. Further digging revealed that the burrow had only one entrance. The prairie dogs did not show increased interest in the area. Instead, shortly after the snake was buried, two juveniles began digging a new burrow entrance at the same mound, approximately 135° from the entrance to the original burrow. By the following day, the new burrow appeared to be completed and was used by all the animals in the group.

Encounter 4.—At 1620 hr, a juvenile prairie dog was noticed jump-yipping repeatedly at an immobile, 150-cm bullsnake located almost in the center of the group

territory and approximately 4 m from the nearest burrow. Within seconds, apparently attracted by the behavior of the juvenile, one adult female and six other juveniles gathered in a semicircle around the head of the snake. The behaviors of the prairie dogs were the same as those seen during encounter 1 above. After approximately 5 min, however, all the prairie dogs walked away from the snake and foraged about 3 m away. For the next 8 min all of the animals returned individually about once per minute to inspect the snake, often almost making nose-to-snout contact with it. Although in a few cases several animals approached at roughly the same time, it did not appear that these animals were coordinating their approaches or behaving in unison. However, 13 min after the encounter had started, the snake, which had remained completely immobile, suddenly began moving. Immediately and in unison, all eight prairie dogs ran to the snake and began jumping on it, biting and scratching it, and leaping back. These attacks were directed at the entire body of the snake and were not confined to the head region. At one point, the adult female attempted to shake the snake by the back of the head, while one of the juveniles bit and pulled on the tail of the snake. During the attack, the snake writhed, coiled back upon itself, and attempted to strike at the prairie dogs, but eventually escaped down a burrow. Although the animals involved in this interaction were the same as those in encounter 3, no attempt was made to bury the snake. Instead, for over 1 hr, the animals approached and investigated the burrow where the snake had disappeared. During this time, several animals entered the burrow, then reappeared jump-yipping repeatedly. Elongate approaches and leaps away from the burrow were also common, but became less intense as time passed. By sunset, the snake had not reappeared and the prairie dogs were involved in their normal foraging activities. By the following morning, all the animals were using the burrow and there was no evidence of snake-related behaviors.

One last incident deserves mention. On 27 March, 1979 a 98-cm eastern yellow-bellied racer, covered with bites apparently inflicted by prairie dogs, was found dead at the entrance to a prairie dog burrow. Since it had been a cold day and there had been a sharp drop in temperature during the day, it is possible that the snake had become sluggish and had then been killed by the prairie dogs.

DISCUSSION

The similarities between the encounters reported here and those described by Owings and Owings (1979) are striking. However, two differences did occur: (1) Foot-thumping, one of the most common behaviors in their study, was never observed by me. The reasons for this discrepancy are not known. (2) The sharp, high-pitched vocalizations which occurred during encounter 3 were not reported in the earlier study. It is possible that these vocalizations occur only during interments and Owings and Owings (1979) did not observe interments.

The snake-directed behaviors of prairie dogs and California ground squirrels (*Spermophilus beecheyi*) also have many elements in common (Coss and Owings, 1978; Owings and Coss, 1981). In both species, burrows, which may be used as refuges by snakes, are often approached and investigated after a snake has been in the area. Snake-related behaviors, including repeated investigation of burrows, are most likely to continue if the snake escapes down a burrow or disappears from the area. If the snake is interred, however, the animals are more likely to discontinue snake-related behaviors and return to their normal activities. This may be particularly true if a snake is interred in a burrow with only one entrance. In addition, both ground squirrels and prairie dogs will briefly break away from snake encounters and engage in other activities while apparently still continuing to monitor the behavior of the snake.

D. H. Owings (pers. comm.) has found that California ground squirrels seem to focus so much of their attention on snakes that, during an encounter, other potential predators may be able to approach much closer than would normally be the case. Although we never observed other predators approaching during our snake en-

counters, the prairie dogs did allow us to approach to within 2 m or less when snakes were present. The intense focusing of attention on the snake was also obvious when, during encounter 3, one juvenile approached a plastic cable lying on the ground and leaped back as if it were a snake. During encounter 4, a juvenile approached the adult female, leaped back, then performed an elongated approach before engaging in an amicable greeting with the female. Also, during the attack on the snake in encounter 4, two juveniles leaped back away from the snake, collided with each other, engaged in a brief fight, then, after appearing to recognize each other, rejoined the attack on the snake.

The behavior of the prairie dogs in the encounters reported here showed much variation. Several factors, including the size and previous behavior of the snake, and the potential danger posed by the snake may have been important. D. H. Owings (pers. comm.), for example, has evidence of differences in the behaviors of prairie dogs, depending on the size of the snake and on the potential risk of envenomation.

The observations reported here also raise interesting questions regarding the evolutionary significance of cooperative antipredator behavior (mobbing) in the black-tailed prairie dog. Hoogland (1981) stated: "I have not considered the possible importance of mobbing in the evolution of prairie dog coloniality simply because White-tails and Black-tails do not mob their predators. . . ." In the case of snakes, however, it is clear from both the present report and from the observations of Owings and Owings (1979), that mobbing is an important component of the black-tailed prairie dog's antipredator behavior. Cooperative defense against snakes is evident both in the interment of snakes and in the coordinated attacks directed towards moving snakes aboveground. In addition, reports of encounters between black-tailed prairie dogs and some of their other predators also suggest that cooperative antipredator attacks may be important. Stromberg (1974), for example, reports that after a red-tailed hawk had captured and killed a prairie dog, other prairie dogs attacked the hawk by rushing at it and hitting it with their bodies, ultimately forcing the hawk to leave the town without the dead prairie dog. Prairie dogs have also been reported to inter, harass and even follow and chase black-footed ferrets (reviewed in Hillman and Linder, 1973). Although these behaviors are only mildly effective against the ferrets, they may discourage and intimidate younger, less experienced animals. Thus, in view of these observations, it may be necessary to reconsider the importance of mobbing behavior as a factor in the evolution of black-tailed prairie dog coloniality.

In regard to this, there would appear to be little doubt that coordinated attacks on a predator can minimize the chances of a successful hunt by discouraging the predator. In addition, a coordinated attack may confuse the predator or result in its injury. The observations reported here suggest that prairie dogs may, on occasion, be able to injure and perhaps even kill snakes. Hillman and Linder (1973) report that prairie dogs may sometimes injure black-footed ferrets, and in special cases (such as when a ferret is incapacitated by a trap) may even kill them. Although there is little empirical evidence on the risks incurred by prairie dogs during cooperative attacks on predators, it is likely that the risks are relatively low. In the case of encounter 4, for example, the snake appeared completely unable to defend itself against the prairie dogs except by escaping down a burrow; repeated attempts to strike at the prairie dogs were completely unsuccessful, apparently because as the snake prepared to strike, another animal would attack from a different direction, causing the snake to arrest and redirect its movements. Since mobbing has generally been considered to represent an altruistic behavior, additional information on the risks incurred by prairie dogs during cooperative antipredator attacks would be extremely useful.

Certain limits on the cooperative antipredator behaviors of prairie dogs are apparent. Only prairie dogs in whose territory the snakes were found engaged in anti-snake behaviors. Cooperation among prairie dogs from different social groups did not occur. Adult females appeared to be most active in snake defense, but this may only

reflect the smaller number of adult males present within the town. Juveniles were also very active in defense against snakes, and there were no obvious differences between the snake-related behaviors of male and female juvenile prairie dogs and those of the adults.

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