

## **Cognition and Communication in Prairie Dogs**

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My central research question concerns the relationship between the complex communication system of Gunnison's prairie dogs and their cognitive abilities. Gunnison's prairie dogs (*Cynomys gunnisoni*) are social, colonial animals that are found in the American Southwest, within the states of Arizona, New Mexico, Utah, and Colorado. There are four other species of prairie dogs: the Black-tailed prairie dog (*Cynomys ludovicianus*), found in the midwestern United States; the Utah prairie dog (*Cynomys parvidens*), found in the state of Utah; the White-tailed prairie dog (*Cynomys leucurus*), found in the states of Montana and Wyoming; and the Mexican prairie dog (*Cynomys mexicanus*), found in the state of Chihuahua in Mexico.

Gunnison's prairie dogs typically spend the winter in a state of torpor inside extensive underground burrow systems, then emerge in the spring to set up territories (Slobodchikoff 1984; Rayer 1988). Each territory is defended by the group living on it, and the social structure can vary considerably within the same colony. Some territories are occupied by a single male or female, others are occupied by a single male and a single female, still others are occupied by a single male and several females, and some are occupied by several adult males and several adult females (Slobodchikoff 1984; Travis and Slobodchikoff 1993). The structure of the social system within a territory seems to be correlated with the distribution of food resources: uniformly distributed food resources correlate with single male-single female territories, while patchily distributed food resources correlate with single male-multiple female and multiple male-multiple female territories (Slobodchikoff 1984; Travis and Slobodchikoff 1993). The colonies are spatially fixed, and the extensive burrow systems can persist for perhaps hundreds of years.

The spatial concentration of prairie dogs into colonies means that a number of predators can encounter a dependable food source throughout much of the year. Prairie dogs are preyed upon by coyotes, foxes, badgers, golden eagles, red-tailed hawks, ferruginous hawks, harriers, black-footed ferrets, domestic dogs, domestic cats, rattlesnakes, and gopher snakes. Also, prairie dogs are hunted extensively by humans for target practice and sport. Prior to the introduction of rifles, prairie dogs were hunted as a source of meat by Native American peoples for at least 800 years (Slobodchikoff et al. 1991).

Such predation pressure was probably important for the evolution of anti-predator defenses. Prairie dogs have dichromatic color vision (Jacobs and Pulliam 1973) and can detect the presence of a predator from long distances. They also have an alarm call system that allows them to advertise the approach of a potential predator. The alarm calls are very loud and can carry for distances of more than a kilometer (Hoogland 1996). The burrows provide an escape route from most terrestrial and aerial predators. The burrow architecture within a territory has several openings to the surface connected to a series of underground tunnels that can run a horizontal distance of more than 10 meters below the ground surface (Fitzgerald and Lechleitner 1973).

The alarm call system has proven to be a Rosetta stone for deciphering the information encoded in the prairie dog vocalizations. When a prairie dog detects a predator, he or she emits a call that alerts other prairie dogs to the presence of danger. The call can be given as a single bark, or as a series of barks that comprise a calling bout. The external referent, the predator, can be seen and videotaped by field observers, as can the escape behaviors of the prairie dogs in response to the predator. The alarm calls can be recorded on audiotape and brought back to the laboratory for analysis. The calls can be analyzed through Fast-Fourier transform to assess the acoustic structure of the vocalizations. Different parts of the waveforms of the calls can be measured, and statistical analyses or fuzzy-logic neural net analyses can be performed to determine whether calls elicited by different predators are similar to one another or different from each other (Slobodchikoff et al. 1991; Placer and Slobodchikoff 2000). The calls recorded for each predator can be played back to the prairie dogs when no predator is present and when no prairie dog is calling. The escape behaviors of the prairie dogs can be recorded on