**NOTES ON BLACK-FOOTED FERRET DETECTABILITY AND BEHAVIOR** -- Despite over two decades of recovery efforts, the black-footed ferret (*Mustela nigripes*) remains one of the least understood and most critically endangered mammals in North America. Once extinct in the wild, over 2,400 captive-born individuals of black-footed ferret (hereafter referred to as ferret) have been released at 13 reintroduction sites ranging from northern Montana to Chihuahua, Mexico, since 1991. However, ferret populations currently are considered to be self-sustaining at only two sites in South Dakota and a single site in Wyoming (United States Fish and Wildlife Service 2006).

To understand why ferret recovery is not succeeding at a majority of reintroduction sites, a better understanding of ferret behavior in the wild, particularly the behavior of reproductive females is needed. Ferrets are solitary carnivores that are adapted highly to live on prairie dog (*Cynomys* sp.) colonies. Prairie dogs compose a majority of their diet (Sheets et al. 1972, Campbell et al. 1987) and ferrets spend most of their lives underground in prairie dog burrow systems, with their above-ground activity typically occurring during the night (Clark et al. 1986, Richardson et al. 1987). The objectives of my study were to use multiple techniques to monitor above-ground activity of female ferrets to gain insight into their behavior in the wild, and to determine the efficiency of spotlight surveys at locating ferrets and effects of spotlighting on ferret behavior during the critical litter-rearing period.

From June through October 2006, I conducted 958 hr of spotlight surveys to monitor behavior of female ferrets and their litters at the Conata Basin, a portion of the Buffalo Gap National Grassland in southwestern South Dakota. Using a mobile, time-lapse video system, I also recorded greater than 1,040 hr of video to evaluate ferret behavior during litter rearing, and periodicity of above-ground activity.

The video system that I constructed was based on a system developed for monitoring the fate of bird nests (Thompson et al. 1999). Main system components were a Sony night vision infra-red camera (model number CM20WNV), a Sony 12V, 960-hr, time-lapse video cassette recorder (model number VCR960-12) and a 12V, deep-cycle marine battery (Fig. 1). I placed this system in a medium-sized igloo-style dog house to protect it from inclement weather, domestic cattle (*Bos taurus*), and the black-tailed prairie dog (*Cynomys ludovicianus*, hereafter referred to as prairie dog); the system cost was US$595.

Using systematic spotlight survey techniques (Biggins et al. 2006), I monitored above-ground activities of four adult female ferrets (and associated litters) on nearly consecutive nights throughout the field season. I conducted spotlight surveys between 2300 (MST) until dawn (0500-0700) to include peak activity periods (Biggins et al. 1986, Clark et al. 1986). Ferrets always were observed at or near prairie dog burrow entrances. I recorded GPS coordinates, burrow entrance type (Jachowski 2007), and identities of ferrets as revealed by

**Figure 1.** The video system used for monitoring above-ground ferret activity in southwestern South Dakota, June through October 2006. The system included, from left to right, carrying case with cables and viewer, video cassette recorder, video camera, igloo-style dog house, and 12V battery.

implanted passive integrated transponders (Fagerstone and Jones 1987) for each individual observed. I placed the video system approximately 3 to 5 m away from the burrow and collected continuous video footage when a female was located at her den burrow (location where she kept her kits). I reviewed the video recording every 24 hr, and moved the video system to a new den location when females were observed through video to have changed den sites or were observed through spotlighting elsewhere. The critical assumption of this technique is that the selected ferret will only use the single monitored burrow entrance. Prairie dog burrow systems occupied by ferrets frequently contain multiple above-ground entrances (Sheets 1970); however, due to my experience over the past 8 years with a high success rate for capturing ferrets by placing traps at single burrow entrances, I was confident in assuming that ferrets almost exclusively used a single burrow entrance. This assumption was further supported by video footage, which showed that for each den site monitored, the movement of kits to new den sites always occurred through the monitored burrow entrance.

Using continuous video-monitoring and intensive spotlight surveys throughout the litter-rearing period, I determined periods of above-ground activity of ferrets. Video-monitoring revealed peak activity between 2300 and 0400 hr, which accounted for 81% of all instances when female ferrets were recorded above

ground. Similarly, spotlight surveys showed peak activity between 0100 and 0600 hr, which accounted for 86% of all observations of ferrets.

Spotlighting results showed a dramatic change in ferret detection from June and July to August, September, and October. Mean number of ferret observations per night increased from 1.41 (SE = 0.25) in June and 1.82 (SE = 0.42) in July, to 8.36 (SE = 0.96) in August. I performed a one-way ANOVA and found that the mean number of observations in September and October ($\bar{x}$ = 7.93, SE = 0.63) was similar ($F = 0.92$, $df = 11$, $p = 0.55$) to August ($\bar{x}$ = 8.36, SE = 0.96). Similarly, time spent spotlighting per ferret observation decreased from a mean of 270 (SE = 33) min in June to 76 (SE = 9) min in August. I found that mean time-to-observation rates were slightly longer in September and October ($\bar{x}$ = 98 min, SE = 30) than August, possibly due to dispersal of kits from the study area. Video recordings revealed similar trends in ferret above-ground activity. The ratio of minutes ferrets were above ground to the length of time the system was deployed (i.e., above-ground time:video focal duration) changed from 1:24 in June to 1:44 in July, and 1:33 in August.

Combinations of video-monitoring and spotlighting allowed me to evaluate effectiveness of spotlighting as a technique to detect ferrets and impacts of spotlighting activities on ferrets. When ferrets were observed above ground through video, spotlight surveys detected individuals on 3 of 10 occasions. On 3 other occasions, the video showed ferrets above ground even though observers failed to detect individuals while spotlighting. Failure to detect ferrets while spotlighting was most likely due to long distances of ferrets from the vehicle or because ferrets were looking away from spotlight beams. On each of the 10 occasions when video footage showed a ferret above ground, individuals did not appear to alter their behavior when the spotlight vehicle approached or when ferrets were illuminated by spotlight beams.

I observed female ferrets changing den sites at intervals ranging from 2 to 5 days, depending on the age of the litter. During June, female ferrets were rarely active above ground, with one recorded sustained den occupation lasting 91 hr. In contrast, by late August it became difficult to deploy the video system effectively because ferrets changed den sites every 1 to 3 days and kits began to disperse and inhabit separate proximate burrows. In each of the seven documented den site changes, adult females left den sites and returned within a few minutes to 24 hr later, to relocate kits to a new site. On two occasions while spotlighting, I observed female ferrets carrying freshly killed prairie dogs above ground; however, I failed to video record females bringing prey directly back to their kits. Rather, probably kits accompany their mothers to kill sites or to intermediate “cache” burrows (Hillman 1968, Paunovich and Forrest 1987) rather than to occupied den sites.

Monitoring of females during the entire litter-rearing period provided unique insight into burrow use patterns by female ferrets. Over 90% of observations (n = 762) occurred at or near “dome” shaped burrow entrances, as opposed to “flat” or “rim-crater” entrances as defined by Hoogland (1995). Once females vacated

burrows used as den sites, individuals were not observed reusing those burrows as den sites during the remainder of the litter-rearing period. This pattern of burrow use could be explained by range of factors including prey selection, territorial behavior, and antagonistic behavioral responses of prairie dogs to the presence of ferrets.

I observed two forms of antagonistic behavioral responses of prairie dogs towards ferrets. First, on one occasion in September during daylight at 1000 hr, a young-of-the-year ferret was above ground and chased by prairie dogs as it ran between burrows. When the ferret left a burrow, a large male prairie dog wrestled briefly with the ferret, forcing it to retreat and run out of the coterie (family territory) in a direction opposite to that from which it entered. I verified male prairie dog status through visual identification of testes and overall body size during time of observations and through review of high definition video footage. When the ferret ran into the adjacent coterie, another adult male prairie dog approached and chased the ferret until it ran out of my view.

A second form of prairie dog behavioral response to ferrets is to plug burrow entrances with soil following occupancy by ferrets (Andelt and Beck 1998). I observed only one instance of burrow plugging in video footage, when an adult female prairie dog spent 13 min in the morning and 7 min in the evening of the same day plugging a burrow recently vacated by a female ferret. The adult female ferret had vacated the burrow during the night, which suggested that the prairie dog identified her presence from the scent she deposited or by cues (scent, sound, etc.) initiated by her litter, which remained in the burrow. When continuous video footage revealed that the female ferret returned to the plugged burrow the following evening, she spent 1 min 33 sec excavating the burrow plug by using a well-documented ferret trenching behavior (Miller et al. 1996).

Video data revealed that while not always effective in detecting ferrets above ground, spotlighting detection rates provided a reliable index to actual above-ground activity by ferrets. Additionally, while other reports suggest that intensive spotlighting disturbed ferrets (Campbell et al. 1985), my video data suggested that spotlighting, when conducted following established protocol (Biggins et al. 2006), rarely disturbed ferret behavior. Detection rates for ferrets increased as the litter-rearing season progressed. Female ferrets changed den sites with increasing frequency as their litters matured, likely in response to energetic demands. Female ferrets preferentially selected dome-style burrow entrances for den sites, which is likely due to their greater underground burrow complexity and the availability of nesting chambers (Hoogland 1995). Prairie dogs actively responded to the presence of a ferret through hazing and burrow plugging, which indicated that prairie dogs have a suite of specialized behavioral responses to this typically nocturnal predator in addition to the well-documented alarm call responses to diurnal predators (Hoogland 1995).

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