Effects of Moonlight on Cover Usage and Spatial Learning of Black-footed Ferrets

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Conservation biology and animal behavior are two fields of science that can complement one another. Animal behavior research is important for understanding the complex needs of a species to be managed or restored to its native range and can be a critical part of the foundation for preservation of a species. Black-footed ferrets (*Mustela nigripes*) are endangered, nocturnal carnivores native to the North American prairie ecosystem. Siberian polecats (*M. eversmannii*) are their closest living relative and inhabit the steppe grasslands of Asia and Eastern Europe. Polecats were used as a surrogate species for behavioral studies in the initial stages of restoration attempts for the black-footed ferret. In previous studies, ferrets and polecats were highly susceptible to predation (Biggins, 2000). In this study, we hypothesized that ferrets and polecats would react to moonlight similarly to small nocturnal mammalian prey species that decrease activity and increase use of cover with increasing moonlight to avoid predation (Kavanau, 1969; Clarke, 1983; Falkenberg and Clarke, 1998; Zollner and Lima, 1999). We investigated the effects of moonlight on nocturnal cover usage and spatial learning abilities of black-footed ferrets. Multivariate general linear models with a repeated measures design were used to analyze data with $P = 0.05$ chosen as the significance level.

We tested cover usage by black-footed ferrets ($n = 8$) in an indoor chamber (7 m^2) under simulated new (0.05 lux), half (0.35 lux), and full (2.2 lux) moonlight levels. We measured use of cover (edge, burrows) and open areas. We detected no effect of moonlight level on use of cover versus open space for black-footed ferrets. Free-ranging ferrets and polecats studied previously increased their aboveground activity and movements with increasing moonlight levels, and black-footed ferret activity was low during primary activity periods of their principal predators, regardless of moonlight levels (Biggins, 2000). Energetic demands of ferrets may not allow moonlight to be a principal determinant of activity even if they prefer certain light levels. Also, light may be beneficial for spatial learning of home ranges, finding burrows, and locating prey or mates.

Spatial learning refers to the ability to remember the location of key features in one's environment (Gaulin and Fitzgerald, 1989; Lavenex and Schenk, 1998). Ferrets may use moonlight to examine their surroundings. We tested black-footed ferret spatial learning abilities (as indexed by distance traveled before the subject found a goal in a faux burrow) in a hexagonal indoor chamber (9 m^2) in new, half, and full moonlight levels. The ferrets typically stayed close to the walls of the arena during trials, a behavior known as thigmotaxy. Black-footed ferrets seemed to learn, but moonlight levels appeared to have no effect on that process. Polecats tested in another study that used similar methods (Sheffer, 2001) exhibited spatial learning abilities that appeared to be enhanced in half moonlight. Black-footed ferrets may be more nocturnally adapted than polecats (Biggins, 2000; Sheffer, 2001). Both species traveled less with successive spatial learning trials, suggesting that they either learned the goal location or the ritual for the test (fig. 1). Black-footed ferrets did not decrease the distance traveled to locate the goal in full moonlight; there was no evidence for a positive correlation between spatial learning and light level. Overall, black-footed ferrets traveled shorter distances than did polecats (fig. 1). Learning abilities of both species should be examined further to determine how cage rearing might affect spatial learning skills (e.g., Biggins and others, 1998). If these skills can be lost or fail

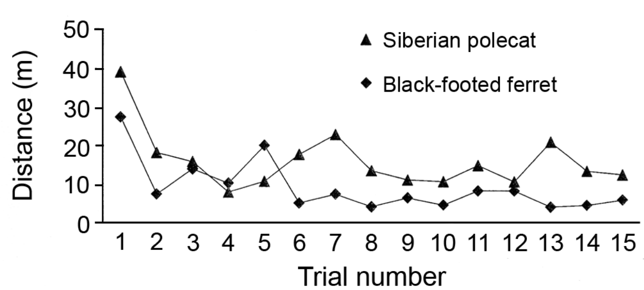

Figure 1. Mean distance traveled (m) by black-footed ferrets (*Mustela nigripes*) and Siberian polecats (*M. eversmannii*) during 15 consecutive trials.

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to develop without appropriate stimuli, then modifications in captive breeding facilities may be necessary. Understanding these aspects of ferret behavior may be critical to conservation efforts for the species, particularly the success of captive breeding programs and species restoration. For example, better understanding of ferret behaviors under varying light levels may lead to increased efficiency in searching for ferrets (Biggins, Godbey, Matchett, and others, this volume) and improved interpretations of both energetic relationships (Harrington and others, this volume) and interactions with other predators (Breck and others, this volume).

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