

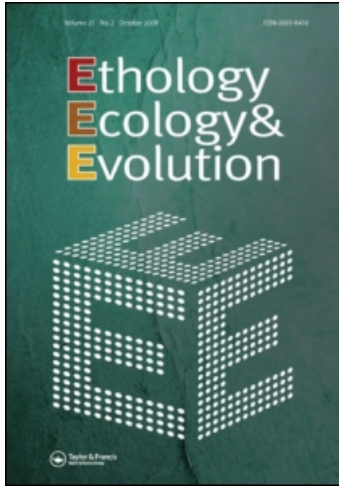
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Morning ambush attacks by black-footed ferrets on emerging prairie dogs

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Black-footed ferrets (*Mustela nigripes*) often hunt at night, attacking normally diurnal prairie dogs (*Cynomys* spp.) in underground burrow systems. While monitoring black-footed ferrets in South Dakota during morning daylight hours, we observed an adult female ferret ambush a black-tailed prairie dog (*C. ludovicianus*) emerging from a burrow. On a neighboring colony, we observed a second adult female ferret engaging in similar ambush behaviors on 12 occasions, although prey was not visible. We retrospectively assessed radio-telemetry data on white-tailed prairie dogs (*C. leucurus*) and a male and a female ferret to evaluate ferret activity in relation to timing of prairie dog emergence. Activity of radio-collared ferrets was high during the hourly period when prairie dogs first emerged and the following 2 hr, relative to later daylight hours. Such behavior is consistent with behaviors observed in South Dakota. Nighttime movements by ferrets might involve hunting but also reconnaissance of prey preparatory to morning ambush attacks.

KEY WORDS: ambush, predation, predator behavior, telemetry, *Mustela nigripes*, *Cynomys*.

INTRODUCTION

Black-footed ferrets (*Mustela nigripes*) are endangered, musteline carnivores, highly dependent on normally diurnal prairie dogs (PDs, *Cynomys* spp.) as prey (SHEETS et al. 1972; CAMPBELL et al. 1987). Ferrets often hunt PDs at night (HILLMAN 1968; BIGGINS et al. 1985; CLARK et al. 1986b; BIGGINS 2000) in PD burrow systems (CLARK et al. 1986b; VARGAS 1994; MILLER et al. 1996). However, during morning daylight hours, ferrets have occasionally been observed to wait motionless aboveground next to a burrow

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opening and attack an emerging PD (McNULTY 1970, image plates 10–11, CLARK et al. 1986b), exhibiting elements commonly used to define the term ambush (i.e. waiting in concealment and surprise attack). Frequency and circumstances of such morning ambush attacks by ferrets are currently unclear.

We investigated morning ambush hunting via focal observations of ferrets inhabiting black-tailed PD (BTPD, *C. ludovicianus*) colonies of the Conata Basin, South Dakota (post-reintroduction of *M. nigripes*), and indirectly via telemetry data on radio-collared white-tailed PDs (WTPD, *C. leucurus*) and ferrets near Meeteetse, Wyoming (pre-reintroduction). This research complements previous observations (CLARK et al. 1986b) and contributes to the understanding of morning attacks by ferrets.

MATERIALS AND METHODS

We monitored wild-born ferrets inhabiting BTPD colonies, herein referred to as East (202 ha) and West (452 ha) colonies, in the Conata Basin of southwestern South Dakota. The colonies, first inhabited by reintroduced ferrets in 1997, were on land administered by the U.S. Department of Agriculture (USDA) Forest Service (Buffalo Gap National Grassland); see LIVIERI (2006) for site characteristics. We retrospectively evaluated radio-telemetry data collected on WTPDs and ferrets in 1984 at Meeteetse, Wyoming (see CLARK et al. 1986a and FORREST et al. 1988 for site characteristics). Investigators are indicated via initials below.

Focal observations

Between ~ 06:00 and ~ 07:00 hr (MDT) in August and September 2007, we monitored 2 adult female ferrets (03-031, East colony; 02-001, West colony), identifiable by unique dye-marks, via focal observation (ALTMANN 1974). Areas of occupancy were known from spotlight surveys (CAMPBELL et al. 1985; BIGGINS et al. 2006); such knowledge aided in locating the females during early morning hours. On 2 August 2007, an observer (MF) watched and photographed 03-031 (FORSEBERG 2009: 85–89). During 9 August–29 September 2007, an observer (DAE) obtained 17 focal observations on female 02-001 at distances > 100 m with the aid of binoculars, recording details and timing durations of some behaviors via wrist watch.

Radio-telemetry

During 12 August–26 September 1984 (i.e. the same months of focal observation in 2007), investigators (DEB and colleagues) radio-tracked one adult male (WY-male) and one adult female ferret (WY-female), and 13 young-of-year WTPDs (methods in BIGGINS et al. 1985, FAGERSTONE & BIGGINS 1986). We summarized ferret data by tabulating presence or absence of telemetry signals in six hourly time-intervals (05:00–05:59 hr, 06:00–06:59 hr, etc.), and calculated the proportion of days each ferret was active (aboveground) during each interval. Approximately 30 min commonly elapsed between sequential radio signal checks for individual WTPDs. We used the earliest telemetric signal of an individual WTPD on a given day as its day-specific estimate of first emergence.

RESULTS

Focal observations

At 06:15 hr on 2 August 2007, female 03-031 was located aboveground. Subsequent to movements between burrows, 03-031 stopped near a burrow opening and waited

motionless. She occasionally tilted an ear toward the burrow opening (e.g. Fig. 1A) or leaned slightly forward, perhaps to detect scent. After ~ 20 min, 03-031 assumed an arched, coiled posture (i.e. front legs nearly touching back legs, with arched back) and quickly dove into the burrow opening. Screams, growls, and dust emanated from the burrow opening (CLARK et al. 1986b: 119; see Fig. 1B). On numerous occasions during the event, the attacked BTPD (an adult) partially emerged with its front limbs braced on the burrow opening (Fig. 1B), but was restrained, presumably by 03-031 (see also EADS et al. 2010). After ~ 30 sec, 03-031 pulled the BTPD into the burrow system. A few minutes later, 03-031 emerged, mouth agape and panting, with blood on her face. Female 03-031 then moved aboveground and descended into another burrow opening ~ 30 m to the south. While the ferret was underground, the BTPD emerged; blood was visible on its throat and around its tail (Fig. 1C). The BTPD retreated (with apparent difficulty), and descended into a burrow opening ~ 15 m from the burrow then occupied by 03-031. After ~ 10 min, 03-031 emerged, returned to the attack site, and descended into the burrow. Female 03-031 then emerged and moved quickly among numerous burrow openings in her vicinity; 03-031 did not visit the burrow opening entered by the injured BTPD, but moved to another area.

Behavioral patterns of 02-001 were similar to those reported for 03-031. Female 02-001 waited nearly motionless at one or two burrow openings per focal observation and, in all instances, upon selecting a burrow opening positioned herself prostrate on the downwind side of the opening. While waiting, female 02-001 often tilted an ear toward the burrow opening, occasionally turning her head toward the opening, as if attempting to detect scent. Female 02-001 waited motionless for varying durations, after which she either assumed an arched, coiled posture (Fig. 1A) and quickly dove into the burrow (\bar{x} = 13 min of waiting, n = 12 suspected attacks), or began investigating surrounding burrow openings (\bar{x} = 4 min of waiting). We did not observe interactions between 02-001 and a PD. However, behavioral similarities with the observation of 03-031 suggest 02-001 was indeed hunting emerging BTPDs, rather than sunning (CLARK et al. 1986b) or interacting with other ferrets.

Radio-telemetry

Average first daylight emergence for Meeteetse WTPDs (\bar{x} = 07:23 hr, range 06:58–08:03 hr) was 1.6 hr after sunrise (\bar{x} = 05:46 hr). Aboveground ferret activity (Fig. 2) during this period (07:00–07:59 hr) was relatively high (20 and 24% of the days for WY-M and WY-F, respectively) and remained high for the following 2 hr compared to average frequencies of days with detections during later daylight hours. Ferret activity in the two earlier periods (05:00–05:59 and 06:00–06:59 hr) was even higher.

DISCUSSION

Although killing behaviors are probably developmentally fixed in black-footed ferrets (VARGAS 1994), it is conceivable that, like aspects of antipredator behavior (GRIFFIN et al. 2000), some aspects of hunting strategies are learned and culturally transmitted, and therefore could be lost or modified during generations of captivity. However, when considered collectively, our observations and those provided by others suggest that ambush hunting is a predatory behavior exhibited by female and male ferrets before and after the near extinction and captive propagation of *M. nigripes*. Before captive propagation, McNULTY (1970) presented images depicting a morning ambush attack by an

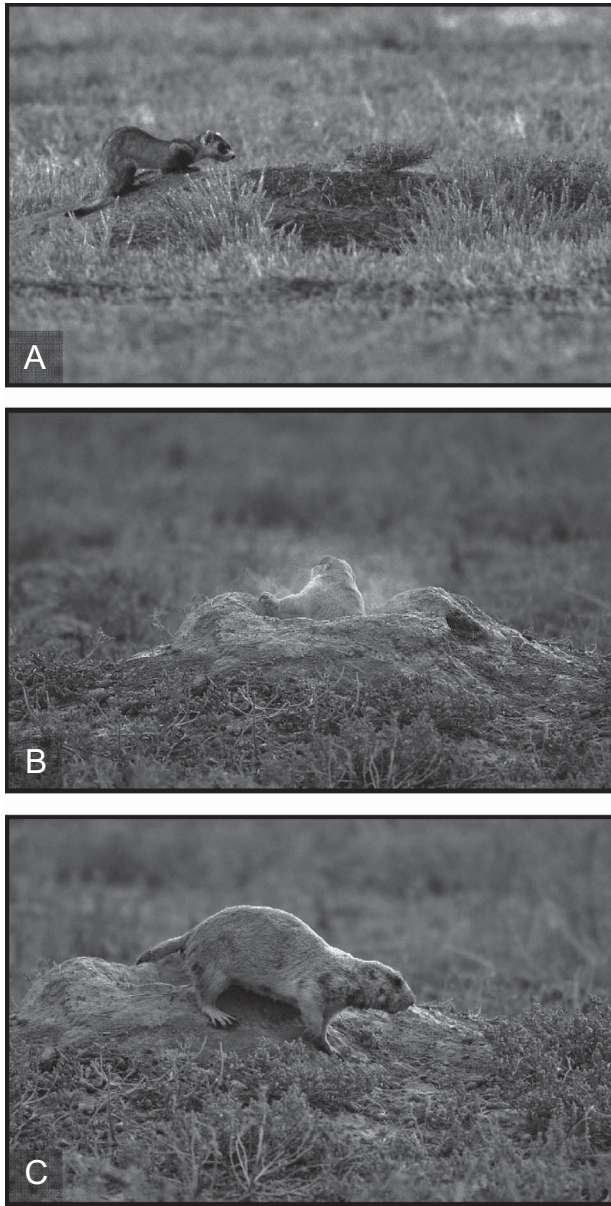


Fig. 1. — Sequence of behaviors exhibited during morning ambush attacks by black-footed ferrets (*Mustela nigripes*) on emerging black-tailed prairie dogs (*Cynomys ludovicianus*) in the Conata Basin, South Dakota, 2007. Ferrets waited motionless, in an arched, coiled posture at a burrow entrance (image A, female 02-001), and then descended into the burrow. During an attack observed on 2 August 2007, female ferret 03-031 descended, and prairie dog “screams”, ferret “growls”, and dust emanated from the burrow entrance (see CLARK et al. 1986b). The prairie dog then attempted to escape (on numerous occasions) the grasp of the ferret, which was pulling on the prairie dog’s hindquarters (image B). The prairie dog later emerged bloody with wounds on the throat and hindquarters (image C), and retreated. Photographs © M. Forsberg, all rights reserved.

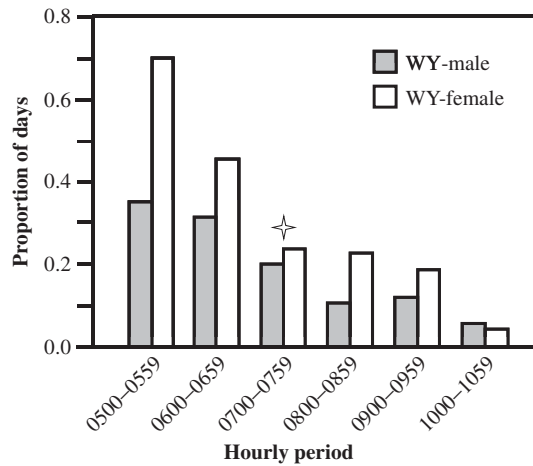


Fig. 2. — Proportion of days with activity during six hourly periods of the morning for a male and a female black-footed ferret (*Mustela nigripes*) on white-tailed prairie dog (*Cynomys leucurus*) habitat (Meeteetse, Wyoming) between 12 August and 26 September, 1984. Average first emergence of white tailed prairie dogs was 07:23 hr (star). Median sunrise was 05:46 hr.

adult female ferret on a BTPD in Mellette County, South Dakota. CLARK et al. (1986b) collected 208 hr of observations of Meeteetse ferrets ($n = \geq 237$) during a ~ 3 year period, reporting two instances of attacks by ferrets on emerging WTPDs. At Meeteetse in November 1981, a radio-collared adult male ferret was observed lying on the ground with its head near a burrow opening, cocking its head from side to side as if listening. After a few minutes, it dove into the burrow. Later (time not recorded) it re-surfaced with blood on its face (L.R. HANEBURY pers. comm.). Another Meeteetse ferret was seen on a WTPD colony moving burrow to burrow at 05:25 hr on 13 August 1985 (sunrise = 05:17 hr), cocking its head at the burrows as if listening (B.J. MILLER pers. comm.). We observed similar ambush hunting behaviors by wild-born, Conata Basin ferrets of captive-ancestry.

At burrow openings, ferrets appeared to behave in ways to increase ambush success. Ferrets occasionally tilted their ears or noses toward burrow openings, perhaps attempting to detect auditory and olfactory cues emanating from PDs within burrow systems. Ferrets might increase the likelihood of an encounter with an emerging PD by selecting burrow openings “broadcasting” PD cues, similar to rattlesnakes (*Crotalus* spp.) selecting ambush sites at locations where the chemical cues of prey are abundant (THEODORATUS & CHISZAR 2000; CLARK 2004). As suggested by our observations of 02-001 and those of Clark et al. (1986b), ferrets probably restrict cues available to prey by remaining relatively motionless on the downwind side of burrow openings, attacking as prey emerges.

Ambush attacks could be advantageous for ferrets. Prairie dogs often emerge head-first from burrow systems. Ferrets dove into burrow systems in pursuit of emerging PDs; perhaps the frontal encounter allows ferrets to establish a throat bite, the kill method most frequently observed in captivity (VARGAS 1994). In the burrow, ferrets can use burrow walls for leverage when battling PDs (VARGAS & ANDERSON 1998). Also, when ambushing, a ferret can target an isolated PD, rather than risking group counterattack by PDs underground (if such antipredator behavior is exhibited).

Ferrets are often most active at night. Thus, although potentially effective, morning ambush behavior is somewhat curious. A previous assessment of aboveground activity by radio-collared ferrets demonstrated avoidance of activity during daylight (BIGGINS 2000). However, within this broad period, ferrets were relatively less active before sunset, in the dusk-period (BIGGINS 2000). The ratio of movements per bout of activity was much higher at dawn. Dawn activity might involve ambush hunting, as we observed.

Before dawn, the large amount of movement by *M. nigripes* might include non-hunting initiatives that complement morning ambush attacks. Selection of nighttime hours by ferrets for aboveground movement (BIGGINS et al. 1986) has probably been shaped by selective pressure from their predators (namely diurnal predators and the crepuscularity of coyotes, *Canis latrans*; BIGGINS 2000). However, nighttime movements could enable ferrets to find suitable opportunities for ambush through reconnaissance of prey. Such behavior might help explain the high degree of selection by ferrets for movements during the post-midnight period (HILLMAN 1968; BIGGINS et al. 1986; CLARK et al. 1986b; PAUNOVICH & FORREST 1987). Indeed, if ambush opportunities can be assessed by ferrets during darkness, the most favorable period for conducting these searches should be when coyote activity is relatively low. Elevated risk from higher levels of predator activity in the post-dawn period (BIGGINS 2000) could be ameliorated by the proximity of escape cover; ferrets wait in ambush at a burrow opening that can provide immediate refuge. An implication that rewards of ambush hunting justify increased risk of daylight activity comes from an assessment of seasonal changes in timing of ferret activity. Post-dawn activity by radio-collared ferrets became less prominent during November on WTPD habitat (BIGGINS et al. 1986), as aboveground PD activity diminished due to hibernation. Perhaps morning daylight activity by ferrets declined with the presumably declining profitability of ambush hunting.

Tradeoffs exist between foraging behaviors and predator avoidance (LIMA & DILL 1990). Movement might increase predation risk. As reported here for *M. nigripes*, for small carnivores that exhibit both active (search) and ambush (sit-and-wait) hunting, active hunting would be expected when risk of predation is relatively low, while sit-and-wait hunting would be expected when risk of predation is high. If the predator's prey exhibit predictable behaviors when predation risk for the predator is high, such as emergence by PDs in morning daylight, ambush hunting could be particularly advantageous (HUEY & PIANKA 1981). Predation risk is reduced by reduced movement, while a predatory opportunity is awaited. The benefits of such ambush hunting would be even greater if the predator uses refuge used by prey. Such is the case with *M. nigripes*. Similar cases might exist in other predator-prey systems.

Our observations provide additional insight into ambush hunting by ferrets, but limited information on success rates of ambush attacks. We cannot be certain that ferret 02-001 killed ambushed PDs. Indeed, ferret 03-031 did not kill the adult PD during the observed attack. Similarly, little is known about success rates of nighttime underground attacks by ferrets. In addition to morning ambush attacks at burrow openings and nighttime attacks within burrows, ferrets have been observed to attack Uinta ground squirrels (*Spermophilus armatus*; CLARK et al. 1986b) and PDs (HILLMAN 1968) aboveground in daylight, and murid rodents such as *Peromyscus* spp. (D.A. EADS & S. RAMAKRISHNAN pers. obs.) and voles (*Microtus* spp.) aboveground at night (M.R. MATCHETT pers. comm.). Snow tracking also suggests that ferrets attack murid rodents and lagomorphs (*Sylvilagus* spp.) outside burrow systems (CLARK et al. 1986b). Future innovative research might reveal additional predatory methods of this endangered carnivore, and provide insight into the potential use of nighttime reconnaissance preparatory for morning ambush attacks on emerging PDs.

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REFERENCES

- ALTMANN J. 1974. Observational study of behavior: sampling methods. *Behaviour* 49: 227–267.
- BIGGINS D.E. 2000. Predation on black-footed ferrets (*Mustela nigripes*) and Siberian polecats (*M. eversmanni*): conservation and evolutionary implications. *Ph.D. Dissertation, Colorado State University*.
- BIGGINS D.E., GODBEY J.L., MATCHETT M.R., HANEbury L.R., LIVIERI T.M. & MARINARI P.E. 2006. Monitoring black-footed ferrets during reestablishment of free-ranging populations: discussion of alternative methods and recommended minimum standards, pp. 155–174. In: Roelle J.E. et al., Eds. Recovery of the black-footed ferret: progress and continuing challenges. *U.S. Geological Survey Scientific Investigations Report 2005–5293*.
- BIGGINS D.E., SCHROEDER M., FORREST S. & RICHARDSON L. 1985. Movements and habitat relationships of radio-tagged black-footed ferrets, pp. 11.1–11.17. In: Anderson S.H. & Inkley D.B., Eds. Black-Footed Ferret Workshop Proceedings, 18–19 September 1984. *Cheyenne, WY: Wyoming Game and Fish Department*.
- BIGGINS D.E., SCHROEDER M.H., FORREST S.C. & RICHARDSON L. 1986. Activity of radio-tagged black-footed ferrets. *Great Basin Naturalist Memoirs* 8: 135–140.
- CAMPBELL T.M. III, BIGGINS D., FORREST S. & CLARK T.W. 1985. Spotlighting as a method to locate and study black-footed ferrets, pp. 24.1–24.7. In: Anderson S.H. & Inkley D.B., Eds. Black-Footed Ferret Workshop Proceedings. *Cheyenne, WY: Wyoming Game and Fish Department*.
- CAMPBELL T.M. III, CLARK T.W., RICHARDSON L., FORREST S.C. & HOUSTON B.R. 1987. Food habits of Wyoming black-footed ferrets. *The American Midland Naturalist* 117: 208–210.
- CLARK R.W. 2004. Timber rattlesnakes (*Crotalus horridus*) use chemical cues to select ambush sites. *Journal of Chemical Ecology* 30: 607–617.
- CLARK T.W., FORREST S.C., RICHARDSON L., CASEY D.E. & CAMPBELL T.M. 1986a. Description and history of the Meeteetse black-footed ferret environment. *Great Basin Naturalist Memoirs* 8: 72–84.
- CLARK T.W., RICHARDSON L., FORREST S.C., CASEY D.E. & CAMPBELL T.M. 1986b. Descriptive ethology and activity patterns of black-footed ferrets. *Great Basin Naturalist Memoirs* 8: 115–134.
- EADS D.A., CHIPAULT J.G., BIGGINS D.E., LIVIERI T.M. & MILLSPAUGH J.J. 2010. Nighttime above-ground movements by prairie dogs on colonies inhabited by black-footed ferrets. *Western North American Naturalist* 70: 261–265.
- FAGERSTONE K.A. & BIGGINS D.E. 1986. Summary of black-footed ferret and related research conducted by the Denver Wildlife Research Center. *U.S. Fish and Wildlife Service*.
- FORREST S.C., BIGGINS D.E., RICHARDSON L., CLARK T.W., CAMPBELL T.M., FAGERSTONE K.A. & THORNE E.T. 1988. Population attributes for the black-footed ferret (*Mustela nigripes*) at Meeteetse, Wyoming, 1981–1985. *Journal of Mammalogy* 69: 261–273.
- FORSBERG M. 2009. Great plains: America's lingering wild. *Chicago, IL: University of Chicago Press*.
- GRIFFIN A.S., BLUMSTEIN D.T. & EVANS C.S. 2000. Training captive-bred or translocated animals to avoid predators. *Conservation Biology* 14: 1317–1326.

- HILLMAN C.N. 1968. Life history and ecology of the black-footed ferret in the wild. *MS Thesis, South Dakota State University*.
- HUEY R.B. & PIANKA E.R. 1981. Ecological consequences of foraging mode. *Ecology* 62: 991–999.
- LIMA S.L. & DILL L.M. 1990. Behavioral decisions made under the risk of predation: a review and prospectus. *Canadian Journal of Zoology* 68: 619–640.
- LIVIERI T.M. 2006. Ten-year history of the Conata Basin black-footed ferret population: 1996–2005. *Wall, SD: Prairie Wildlife Research*.
- MCNULTY F. 1970. Must they die? The strange case of the prairie dog and the black-footed ferret. *Garden City, NY: Doubleday and Company*.
- MILLER B., READING R.P. & FORREST S. 1996. Prairie night: Black-footed ferrets and the recovery of endangered species. *Washington DC: Smithsonian Institution Press*.
- PAUNOVICH R. & FORREST S.C. 1987. Activity of a wild black-footed ferret litter. *Prairie Naturalist* 19: 159–162.
- SHEETS R.G., LINDER R.L. & DALHGREN R.B. 1972. Food habits of two litters of black-footed ferrets in South Dakota. *The American Midland Naturalist* 87: 249–251.
- THEODORATUS D.H. & CHISZAR D. 2000. Habitat selection and prey odor in the foraging behavior of western rattlesnakes (*Crotalus viridis*). *Behaviour* 137: 119–135.
- VARGAS A. 1994. Ontogeny of the endangered black-footed ferret (*Mustela nigripes*) and effects of captive upbringing on predatory behavior and post-release survival. *Ph.D. Dissertation, University of Wyoming*.
- VARGAS A. & ANDERSON S.H. 1998. Ontogeny of black-footed ferret predatory behavior toward prairie dogs. *Canadian Journal of Zoology* 76: 1696–1704.