

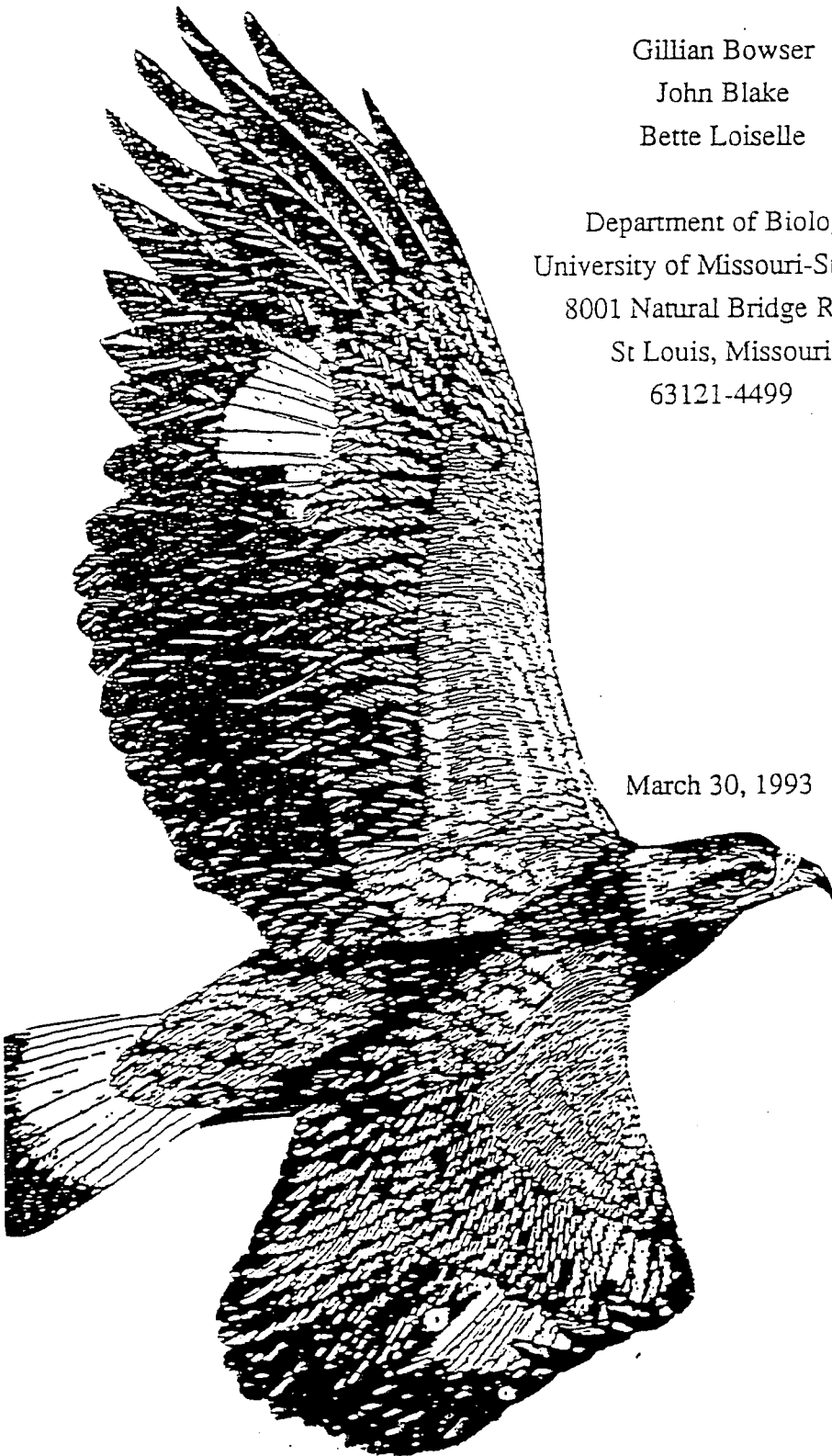
Predator Activity on Proposed Black-footed Ferret Reintroduction Sites in  
Badlands National Park, South Dakota.

Final Report  
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Gillian Bowser  
John Blake  
Bette Loiselle

Department of Biology  
University of Missouri-St Louis  
8001 Natural Bridge Road  
St Louis, Missouri  
63121-4499

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## Executive Summary

The black-footed ferret (*Mustela nigripes*), is North America's most endangered mammal (Biggins et al. 1987). Existing only in captive populations since February 1987, efforts are now underway to restore this rare predator to its native habitat. The Conata Basin of Badlands National Park, South Dakota, is home to one of the largest remaining populations of black-tailed prairie dogs (*Cynomys ludovicianus*), the principal prey species of the black-footed ferret. Three sites--Tyree Basin, Burn's Basin, and Kocher Flats--are being considered for restoration of black-footed ferrets because they each contain large prairie dog colonies. In this study, each of these three sites was surveyed for predators that might affect recovery efforts. Our surveys found trends for predator activity to vary over the season and among sites, but there was no clear pattern to predator activity (i.e., no consistent, statistically significant differences among sites). We do, however recommend that one site, with generally higher numbers of predators, not be used as a potential ferret reintroduction site.

## INTRODUCTION

The black-footed ferret (*Mustela nigripes*), one of the world's most endangered mammalian species, exists in four captive and one reintroduced populations in the United States. The ferret has been extinct in the wild (prior to a recent 1992 release) since 1987, and captive populations have been reared since then for the eventual reintroduction of the ferret to its native habitat. The ferret is an obligate predator on prairie dogs (*Cynomys* spp), as a consequence, recovery plans for the ferret must focus on prairie dog colonies and the associated inhabitants of those colonies--a wide variety of birds and mammals.

Prairie dogs are colonial, fossorial rodents that live within the mixed-grass prairie of the Great Plains. These colonies create a significantly different habitat than the surrounding grasslands; this habitat is widely used by other animals, including bison (*Bison bison*), antelope (*Antilocapra americana*), coyotes (*Canis latrans*), bighorn sheep (*Ovis canadensis*), mule deer (*Odocoileus hemionus*), and avian predators (*Buteo* and *Accipiter* spp.; Clark 1989). Some species that occur on prairie dog colonies also are potential predators of the black-footed ferret, posing a threat to ferret recovery efforts. Preliminary trial releases of the siberian ferret (*Mustela evermanni*) in the fall of 1990 indicated that other vertebrate predators are a concern for reintroduction efforts; all Siberian ferrets were killed by predators within five days of their release (Biggins et al. 1987). Forty-nine black-footed ferrets were released in Shirley Basin, Wyoming, during the fall of 1991; 6 were known to be killed by predators within two weeks of release; at least 12 survived 30 days; two females birthed 6 kits the following spring. The 1992 release of 90 ferrets had similar results: 7 ferrets were killed by coyotes, 5 by other predators (B. Bessken, pers. commun.).

This study, initiated in the spring of 1991, addresses predator activity on three potential ferret release sites located within the Conata Basin of Badlands National Park and Buffalo Gap National Grassland, South Dakota. These sites contain prairie dog colonies deemed large enough to sustain ferrets (B. Bessken, pers. commun.). The objectives of the study are: (1) to survey prairie dog colonies for potential ferret predators; and (2) to determine which of three proposed release-sites has the lowest predator activity. Predator activity is loosely defined as observations of predators within the boundaries of a prairie dog town. We could not determine predator density or absolute numbers, because we were unable to distinguish individual animals during our surveys; the potential exists that individual animals were observed more than once.

The study was divided into two phases: pilot and actual. The pilot study was conducted during the summer of 1991, with two objectives: (1) to select and recommend an efficient survey technique for mammalian and avian predators; and (2) to design a

monitoring scheme for predators on potential ferret release-sites. Results from the pilot phase were summarized in an earlier report (Blake et al. 1992). The actual phase had two objectives: (1) to gather data on predator activity at the three Conata Basin sites using the two techniques identified as most efficient during the pilot phase (Blake et al. 1992); and (2) to recommend, based on the predator-activity patterns, which site had the lower potential of predation on ferrets. In this report, results from the actual phase are reported and site recommendations made.

## METHODS

Three study sites (Tyree Basin, Burn's Basin, Kocher Flats) within Badlands National Park, South Dakota, were selected as candidate areas for the black-footed ferret release in 1993 (Fig. 1). Each site had the following characteristics: (1) a large active prairie dog colony; (2) exemption from prairie dog reduction programs; and (3) relative isolation. Preliminary studies on prairie dog density and colony characteristics were conducted on each site by the park service or forest service in 1987-89 (B. Bessken, D. Uresk pers. commun.); prairie dog density was estimated from transect counts and aerial photographs (1:24,000 ft, black and white, 1990).

### *Study Sites*

All of the three study sites were located within the Badlands Wilderness Area of Badlands National Park (Tyree Basin and Kocher Flats). The wilderness area is a separate management unit within the park, with specific objectives; hence, prairie dog populations are not systematically reduced or controlled. The third site, Burns Basin, was within the park boundaries, but surrounded by areas in which prairie dog numbers are controlled (forest service lands to the south, and periodically controlled areas within the park to the east and north).

The study site at Tyree Basin was located 11 km west of the Conata Basin access road and 1 km west of the park boundary on a small bench above Sage Creek Pass (Fig. 2). This area was homesteaded until 1935 and still contains abandoned housing materials, fence posts, and a family grave site. The old road access to the Tyree homestead provided easy access to the site from the Huerther ranch at the foot of Sage Creek Pass. The prairie dog colony at Tyree Basin is 118 ha and consists of three separate towns with an average prairie dog density estimated at 46.5/ha (Bessken and Vaughan 1990; Bessken pers. commun.).

The Burns Basin site was located below the main badlands wall 1.5 km north of highway 240 (Fig. 3). The site is divided into three lobes by a series of dry stream-beds

draining from the badlands wall. The three lobes cover 232 ha, with an average prairie dog density of 51/ha (Bessken and Vaughan 1990, Bessken pers. commun.). The southern end of the site is adjacent to a private holding and experiences frequent intrusions by cattle; the southwestern end of the site is bordered by national grassland, where extensive hunting and shooting are permitted.

Kocher Flats is located 11 km east of county road 590, 1 km east of the park boundary in the Sage Creek Wilderness (Fig. 4). Access to this site is across 8 km of private land and is restricted by poor road conditions and weather. This site is the largest prairie dog colony in the Badlands Wilderness; there are three main towns covering over 327 ha with an average prairie dog density of 49.4/ha (Bessken and Vaughan 1990, Bessken pers. commun.).

### *Surveys*

Two survey techniques were evaluated during the pilot phase (1991): direct (visual identification) and indirect (analysis of signs and scats). We found that two types of direct surveys--spotlighting and dawn surveys--were the most effective (Blake et al. 1992); thus, these were the methods used for the actual phase.

Data from the actual phase were collected from June through August (1992) in the following manner: (1) dawn and spotlight surveys were conducted in tandem to complete one sample; (2) one rotation consisted of three consecutive samples; (3) each rotation was separated by three weeks to sample three different parts of the summer season (early, middle or late). If weather or other factors prevented us from completing three consecutive samples, then the rotation was rescheduled, if possible, or canceled. Surveys were only conducted when: (1) wind speeds were less than 25 mph; (2) there was no precipitation (due to the electrical equipment required for spotlighting); (3) there was good visibility (no fog or haze); and (4) there were no environmental hazards such as lightning or large bison herds.

Spotlight Surveys--Spotlight surveys were conducted along a 2000m transect that bisected each study site (within chosen prairie dog towns). These transects allowed us to systematically census a pre-determined route marked at 100 or 200 meter intervals with fluorescent reflective stakes--easily visible for 500 meters by spotlight. We used a Collins-Dynamics™ 1.5 million candlepower hand-held spotlight, powered by a 12 volt liquid-cell battery mounted on a backpack. Every 50 meters along the transect line (40 stops per transect line), we made two 360° sweeps with the spotlight held at breast height, recording all species, eyeshine, color and movement (Biggins 1984). In addition,

animal behavior and orientation with respect to the transect were recorded (movements away from the observer, etc.). Small hand-held flashlights were used to navigate between transect points both to reduce the impact of the spotlight on animal movement and to preserve the spotlight's battery. Each survey was started one hour after sunset and took 3 to 5 hours to complete.

Dawn Surveys--Dawn surveys were conducted for two hours from fixed survey points overlooking each study area. Dawn surveys started one hour before sunrise, so that observers were in place as visibility increased. During the survey, a 77 mm Kowa™ zoom-spotting scope and field binoculars were used to search the area for predators. Predators were recorded by species, identifying marks and characteristics, and behavior (hunting, walking, resting, etc.). Weather conditions were noted during all surveys, especially when wind speed and direction could have affected the activity of some predators (coyotes, etc., downwind of the observers).

#### *Data Analysis*

There were three questions addressed by the data analysis: (1) do sites differ in predator activity; (2) do predator observations differ between day and night; and (3) is there a seasonal component to predator activity of the study sites? The first question addresses differences in predator activity among sites. We used mean number of predators observed because total numbers observed was thought to be sensitive to survey duration--a factor that varied among sites and with weather conditions.

The second question compares diurnal vs nocturnal predator activity during the times when ferrets are most active (daybreak and evening). However, raptors were not well sampled during spotlight surveys (very few owls were heard and thus are not included in these analyses) and only mammalian predators (predominately coyotes) were considered in this analysis. We used paired t-tests to compare diurnal and nocturnal survey results at each site.

The third question, seasonality, examines potential changes in predator numbers over time (June through August). We can only address trends within a single season; however, because our surveys were conducted only during summer, was divided into early, middle and late summer--roughly corresponding to the three rotations. Data from both survey techniques were combined to determine if predator numbers differed across the season. To finer smaller scale trends, data were split by survey technique and predator type. Seasonal variation was analyzed using a Kruskal Wallis test.

## RESULTS

We observed 292 individuals from 18 species (14 avian, 3 canid, and 1 mustelid). Most of the predator species occurred at all three sites with the following exceptions: (1) foxes (*Vulpes* spp.) only at Tyree Basin; (2) badgers (*Mustela*) at Burns Basin; and (3) great horned owls (*Bubo virginianus*) and short-eared owls (*Asio flammeus*) at Burns and Tyree Basins. The predominate mammalian predator at all sites was the coyote, representing approximately 90% of the observations. Ferruginous hawks (*B. jamaicensis*) were the dominant avian predator (65%), followed by red-tailed hawks (*B. regalis*, 20%), Swainson's hawks (*B. swainsoni*, 15%) and the occasional golden eagle (*Aquila chrysaetos*, <1%).

The survey design called for both survey techniques--dawn and spotlight--to be conducted 3 times per rotation for a total of 9 samples at each site. There were, however, several exceptions to this design. First, Kocher Flats had 3.5 surveys during the last rotation; two dawn surveys at Tyree and at Burns Basin were cut short by 30 minutes hour due to weather problems. Third, two spotlight surveys were cancelled completely at Tyree because of lightening. Partial surveys are included in Table 1, but dropped for all the statistical analysis.

The two surveys differed in duration and the number of observations per hour. Dawn surveys took an average of 1.6 hours to complete for an average of 8.6 observations per hour (sd=4.37). In contrast, spotlight surveys were 3.4 hours long on average with 3.6 observations per hour (sd=1.96). There were 166 and 113 predator observations during completed dawn and spotlight surveys respectively (Table 1).

Table 1. Total and mean predator activity (mammalian and avian) on three sites in Badlands National Park, South Dakota. N= number of surveys; sum= total number of predators observed. See text for further explanations.

| Location         | N  | Sum | Mean | SD   |
|------------------|----|-----|------|------|
| <b>Total</b>     |    |     |      |      |
| Burns Basin      | 18 | 85  | 4.7  | 2.95 |
| Tyree Basin      | 17 | 58  | 3.4  | 3.46 |
| Kocher Flats     | 20 | 149 | 7.4  | 6.05 |
| <b>Dawn</b>      |    |     |      |      |
| Burns Basin      | 7  | 44  | 6.3  | 3.35 |
| Tyree Basin      | 7  | 37  | 5.3  | 4.19 |
| Kocher Flats     | 9  | 85  | 9.4  | 6.82 |
| <b>Spotlight</b> |    |     |      |      |
| Burns Basin      | 9  | 35  | 3.9  | 2.52 |
| Tyree Basin      | 7  | 20  | 2.9  | 2.27 |
| Kocher Flats     | 9  | 58  | 6.4  | 5.36 |

Note: Total numbers reflect all attempted surveys. These numbers will differ from Dawn and Spotlight totals since all partial surveys were dropped from the analysis.

### *Predator activity by sites*

The three sites did not differ in predator activity during 1992 (Fig. 5). Total predator activity did not differ among sites for either survey type (Table 2). When predator type (avian and mammalian) were examined separately, coyote activity did vary at night (KW=6.00;  $p<0.04$ ). There was a tendency for coyote activity to be higher at Kocher than the other two sites (Figs. 6, 7); however, given the large sample variances, the ability of the Kruskal Wallis test to determine significance was reduced.

Table 2. Predator activity among sites at Badlands National Park. Each site was treated separately in the analysis. See text for explanation and table 1 for means

| Site               | N  | Kruskal-Wallis | p value |
|--------------------|----|----------------|---------|
| Total <sup>1</sup> |    |                |         |
| dawn               | 46 | 5.22           | 0.07    |
| night              | 25 | 1.46           | 0.50    |
| Avian              |    |                |         |
| dawn               | 23 | 0.29           | 0.87    |
| Coyote             |    |                |         |
| dawn               | 23 | 2.94           | 0.24    |
| night              | 25 | 6.00           | 0.04    |

<sup>1</sup>= both avian and mammalian predators combined

### *Predator activity at dawn and night.*

The sites did not differ in predator activity day or night. To compare day and night differences in predator activity, each survey was adjusted by the average number of hours the survey took to complete and these adjusted averages were analyzed using a paired t-test. Overall there appeared to be more predators active during the dawn hours--a result confounded by the unequal representation of raptors between dawn and night. When coyotes alone were compared, there was no significant difference between dawn and night activity ( $t=1.26$ ;  $p<0.26$ ), except again a slight trend for Kocher Flats to have more coyote activity during dawn than at night. This result is also potentially biased by the late-season observations of a substantial number of coyote pups active near their dens. These animals would probably not be active at night, or would be less visible because their activity is localized to the den area.

### *Predator activity by rotation (season)*

Predator activity varied somewhat across the summer (KW=5.56;  $p<0.06$ ). Variation was most pronounced at Kocher Flats, there was a tendency for predator activity to increase towards the later part of the season (Fig. 7-10), due in part to the activity of newly fledged/emerged young. Coyote activity varied over the season for dawn surveys (KW= 6.05;  $p<0.05$ ). A substantial number of young animals observed at

Kocher Flats during the second rotation probably contributed to the significant results (Fig. 8). Conversely coyote activity did not vary significantly during spotlight surveys (Fig. 9), although the same trend for an increase in coyote activity during the middle part of the season was also apparent. Raptor activity increased sharply from the first rotation to the second. Unlike coyotes, where activity declined from the middle to late summer, the raptor activity remained high during the late summer (although this trend was not significant; Fig. 10).

## DISCUSSION

Predator activity on potential ferret reintroduction sites showed no statistically significant trends among our study sites in Badlands National Park. There was no 'pattern' for predator activity to be higher or lower on a given site, nor was there any clear decline or increase in predators observed over the sample season. Our sample period (June through August) was much too short to assess changes in predator activity throughout the year, or to statistically distinguish among our sample sites. There could be an increasing trend for predator activity during late summer as immatures emerge--or fledge--indicating that fall would be a less desirable period for ferret release (especially in areas with active denning or nesting sites).

The three sites did not differ in predator activity during the dawn or evening (spotlight surveys), suggesting that overall predator activity may be fairly uniform. There were some indications, however, that one site had more predator activity than the other two at different times of the day. Kocher Flats tended to have more raptor and coyote activity than either Burns Basin or Tyree Basin during dawn surveys; therefore, the potential for dawn predation on ferrets is the highest, in our estimation, at Kocher Flats. In contrast, there was no significant difference among sites for night predator activity--the time when ferrets are more likely to be active.

### *1991 field season*

Results from the 1991 pilot and 1992 actual phases of this project were quite different. Coyote numbers were not significantly different for spotlight surveys between Kocher Flats (Larson's ranch in the 1992 report), and Burns Basin (Mann Whitney  $U=15$ ;  $p<0.50$ ) based on spotlight surveys, numbers at Tyree basin, however, were significantly lower ( $f=4.62$ ;  $p<0.018$ ). Our initial recommendations, based on these results were to reverse the direction of the spotlight surveys, so that prevailing winds across the basin would not broadcast our presence downwind (Blake et al. 1992). However, we were

unable to completely reverse the transect, instead we rotated it 90° to a new position, which seemed to eliminate any previous bias.

Predator activity during dawn surveys showed two different patterns between 1991 and 1992. There were fewer coyotes at Burns Basin than either Kocher or Tyree (KW=4.63,  $p<0.02$ ). Burns Basin did have fewer coyotes in 1992 as well, but the difference among sites was not significant. As with the spotlight surveys, 1991 dawn surveys were conducted later in the season than in 1992, which may have contributed to the different trends observed between the two sample years.

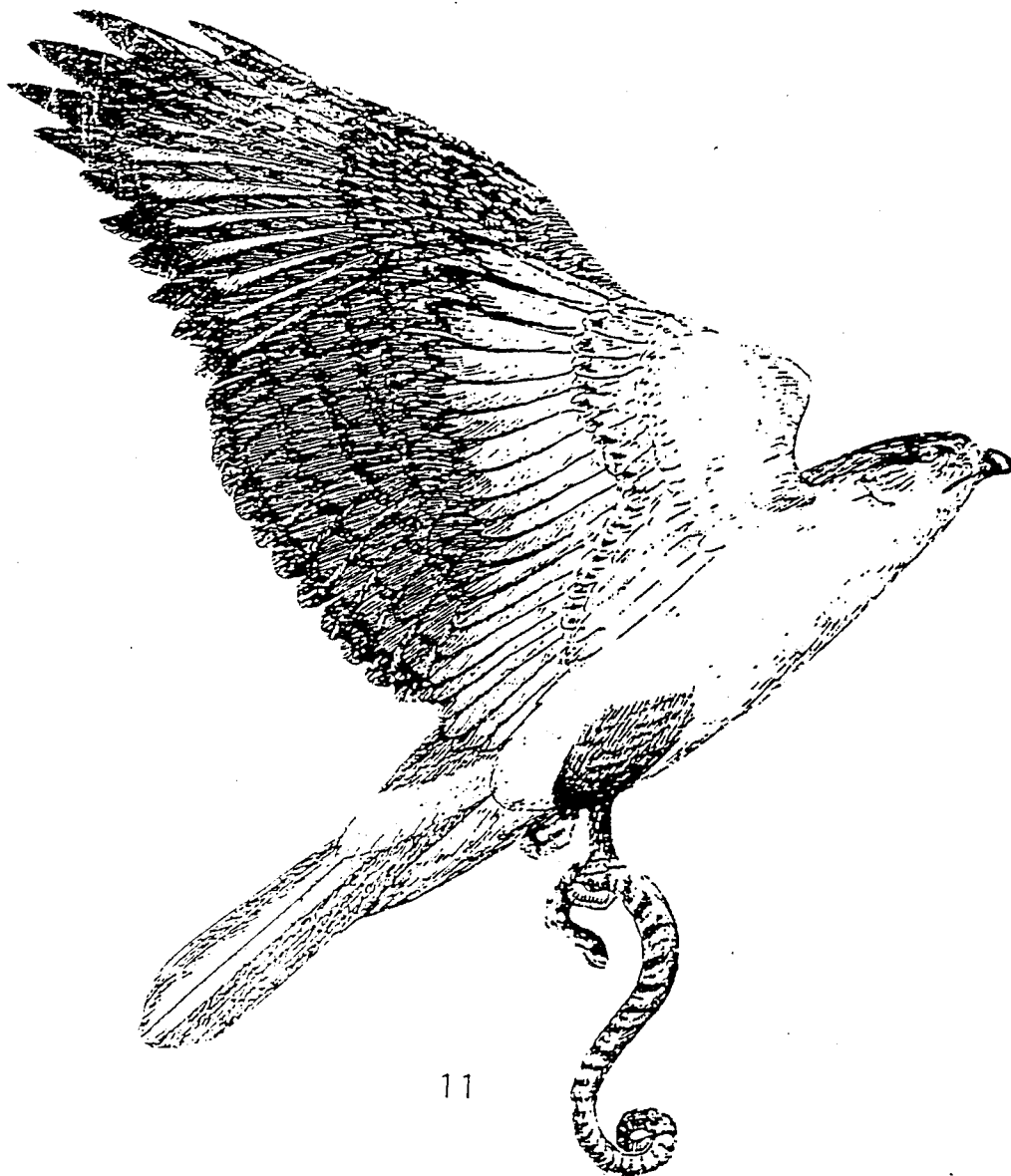
In general, the 1991 pilot phase of the study demonstrated several trends in predator activity that were not repeated in 1992. To resolve these differences, more extensive studies, covering a longer period of time would be necessary, and are beyond the scope of this study.

### *Conclusion*

Overall, predator activity at the three sites varied substantially, but not consistently, among sites and throughout the season. Tyree Basin tended to support fewer predators than Burns Basin or Kocher Flats; Kocher tended to support more diurnal and nocturnal predators. Such variability makes recommendations for ferret reintroduction difficult when based on these data alone. Other factors, such as prairie dog density, land-activity patterns, and sociological constraints also influence the final recommendations for a ferret release site and could be more important for the long-term survival of the ferret than predation risk alone. Based solely on predator activity--as an indication of predation potential--we suggest that the chance of a ferret release succeeding at Kocher Flats is lower than at Burns Basin or Tyree Basin, because the dawn and night-time coyote activity are higher at the former site. Furthermore, higher raptor numbers, the presence of a golden eagle nest, and an active coyote den--all at Kocher--indicate that the risk of predation on released ferrets is high at this site.

In conclusion, three potential black-footed ferret release sites within Badlands National Park, South Dakota, did not differ significantly in the level of predator activity, as determined by direct survey techniques (dawn and spotlight surveys); however, one site tended to have higher predator activity than the other two and therefore is not recommended as a release site. Reintroduction efforts should examine predator activity as one factor in the overall consideration of potential release sites. The continuous presence at all sites of a number of raptors and coyotes--both potential predators of the black-footed ferret--suggests that the reintroduction of ferrets at these sites may be less likely to succeed. Furthermore, the apparent trends of increasing predator activity over

the season suggests that to adequately address predator activity of prairie dog towns, a year-round study would be required. Such a study could address the potential impacts of juvenile predators as they emerge from their dens/nests, and could look at changing patterns of activity over the year.



## LITERATURE CITED

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Figure 1. Three proposed black-footed ferrer reintroduction sites in Badlands National Park, South Dakota.

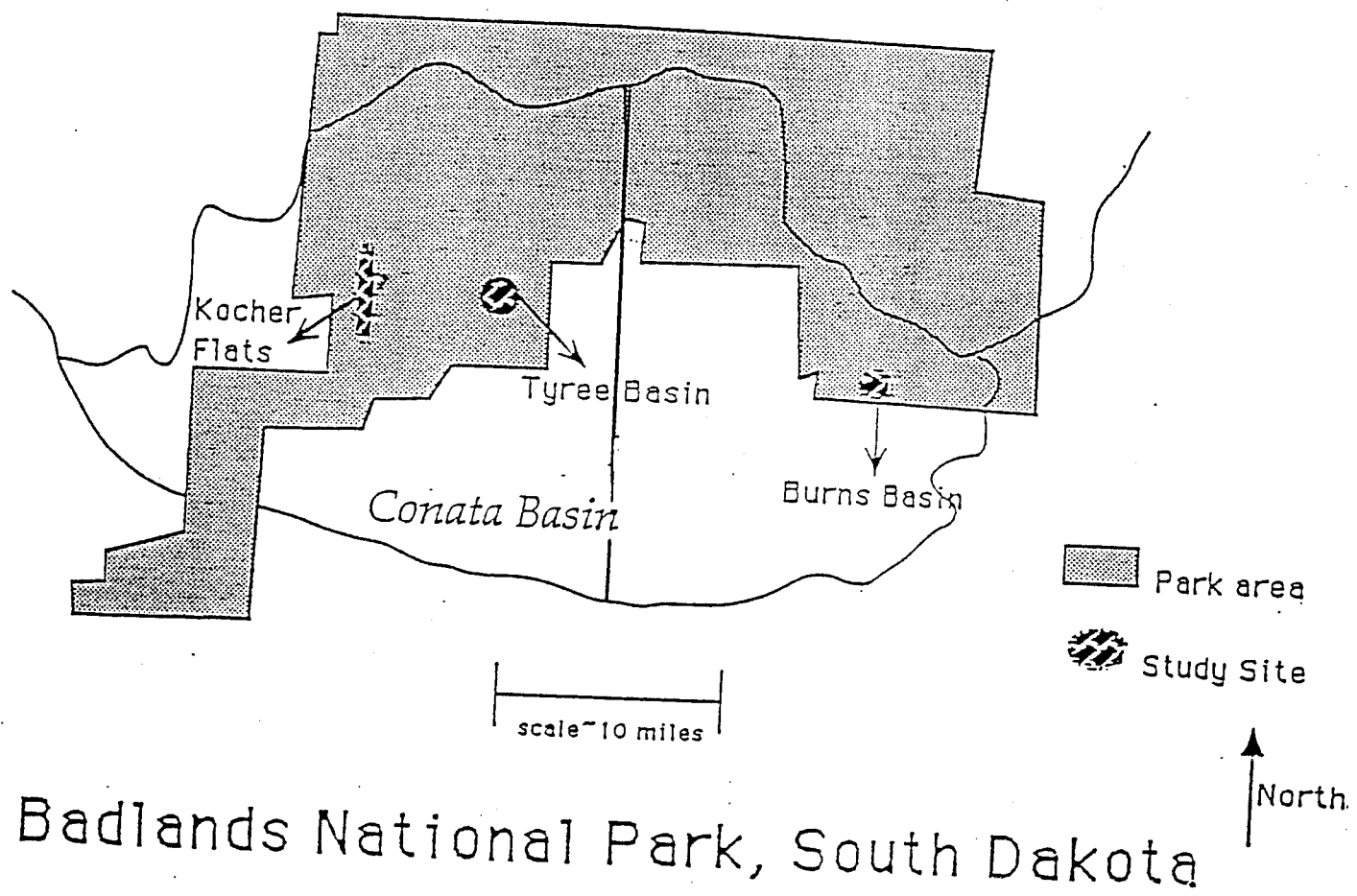


Figure 2. Tyree Basin study site. Towns within the site are indicated by hatched lines.  
 Star connected by lines indicate position of transects for spotlight surveys in 1992.  
 Scale: one block=one mile

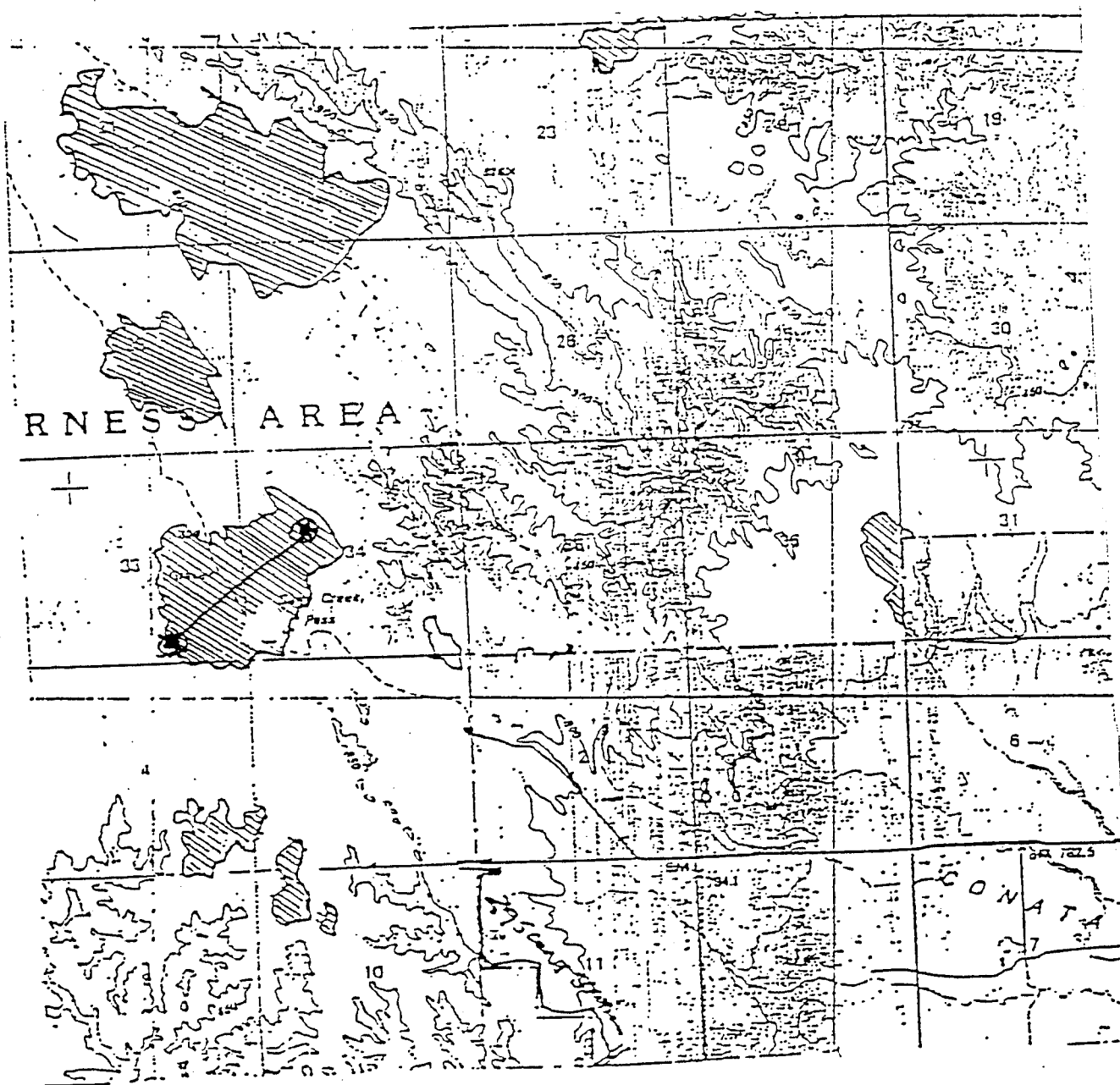


Figure 3. Burns Basin study site. Towns within the site are indicate by hatched lines. All three towns were surveyed in 1992. Spotlight transect is marked by line connecting two stars. Scale: one block=one mile.

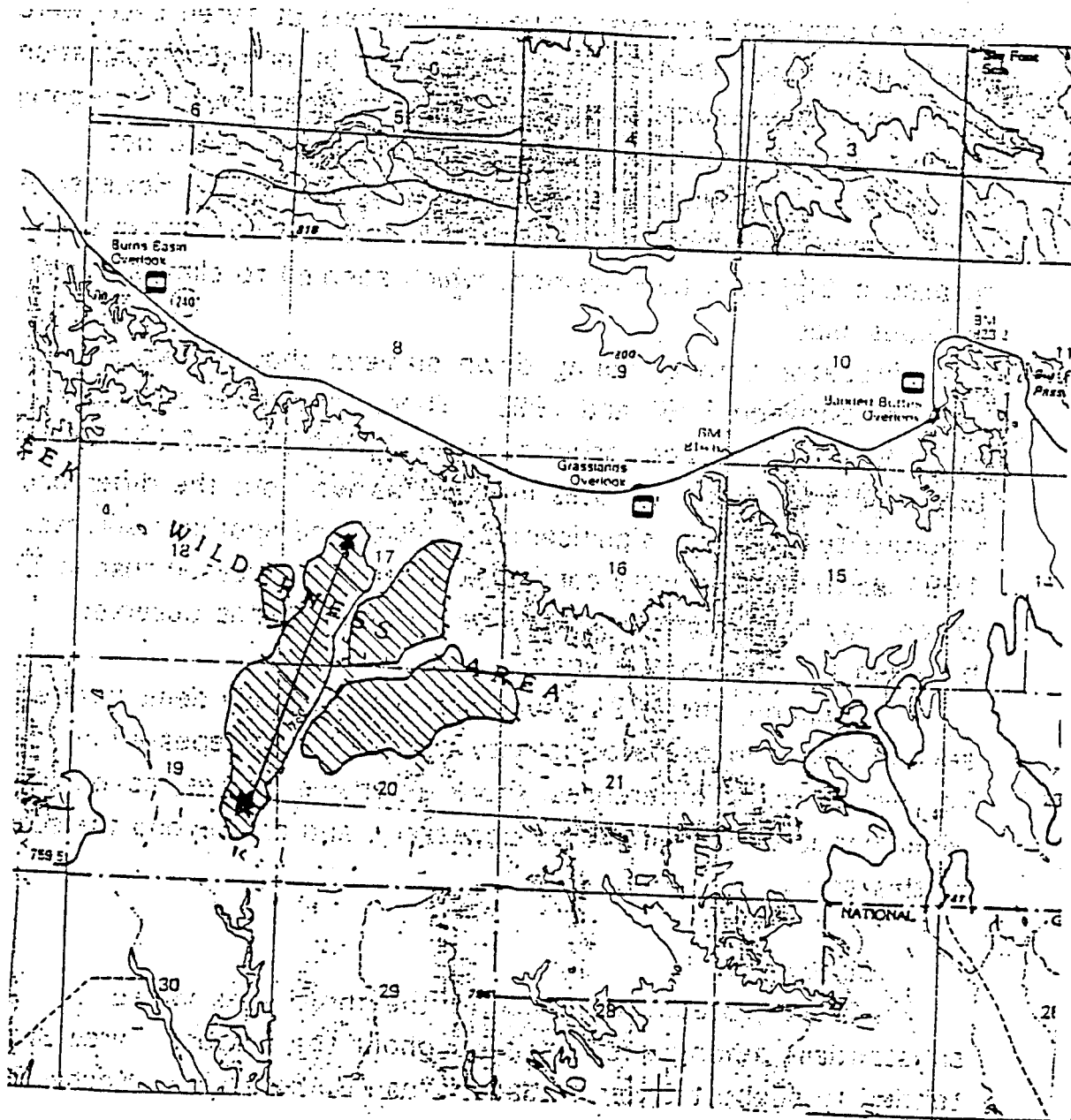


Figure 4. Kocher Flats study site. Towns within the site are indicated with hatched lines. Spotlight transect is marked by line connecting two stars. Scale:

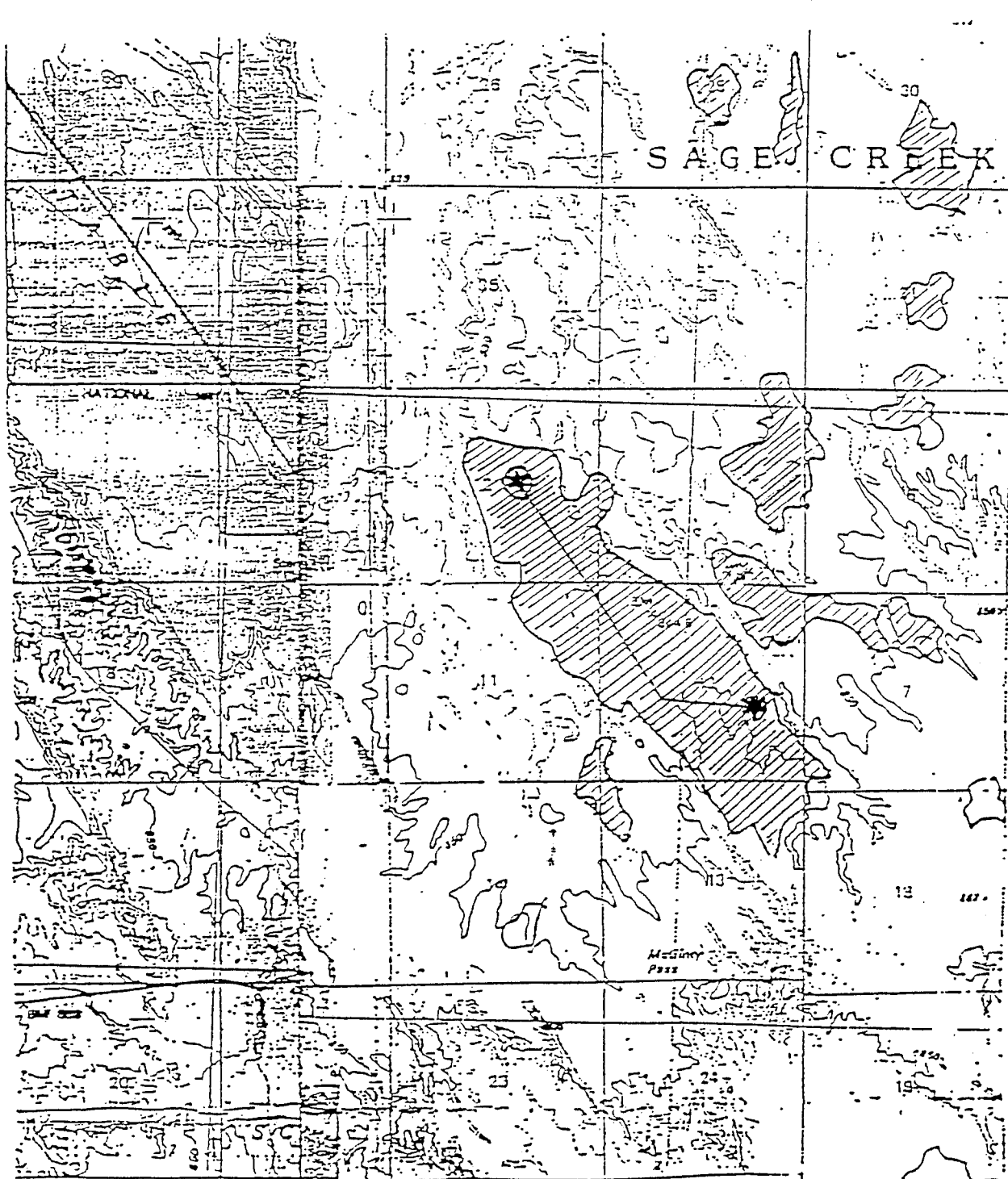


Figure 5. Predator activity at three sites in Badlands National Park, South Dakota.

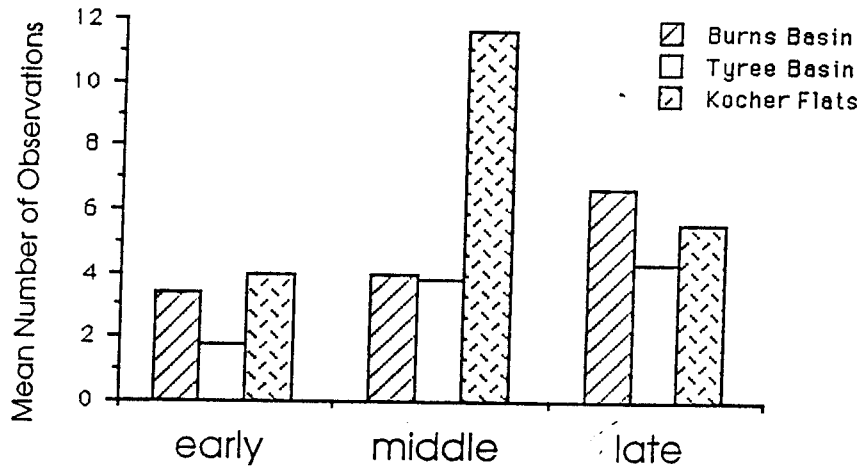


Figure 6. Total number of coyotes recorded during spotlight surveys at Badlands National Park, South Dakota.

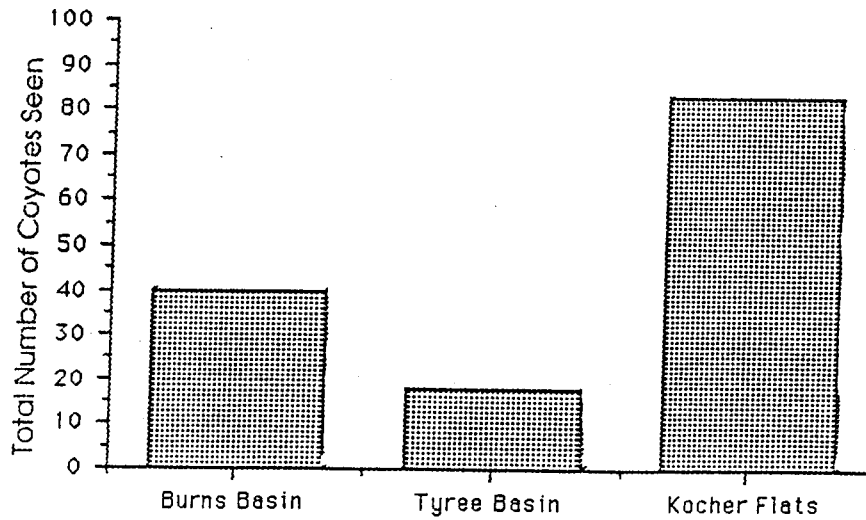


Figure 7. Predator activity recorded during dawn surveys at three sites in Badlands National Park, South Dakota.

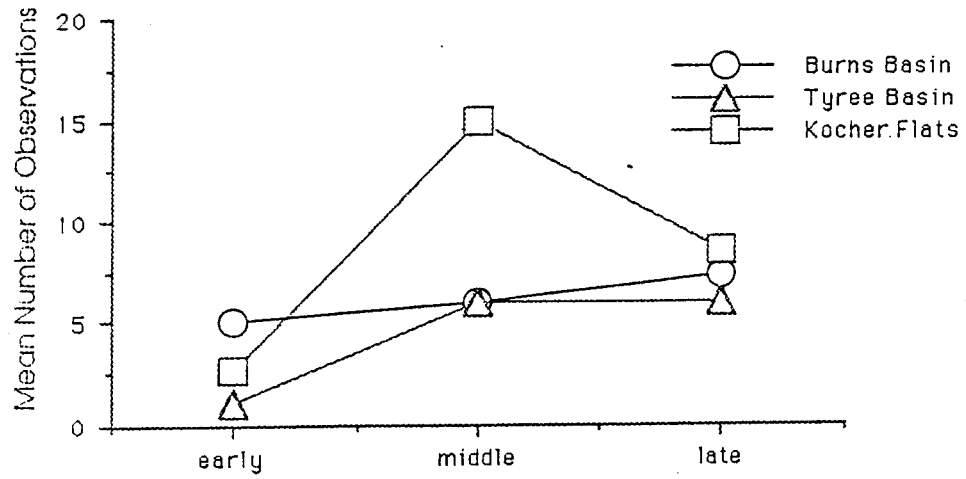


Figure 8. Coyote numbers during dawn surveys at three sites in Badlands National Park, South Dakota.

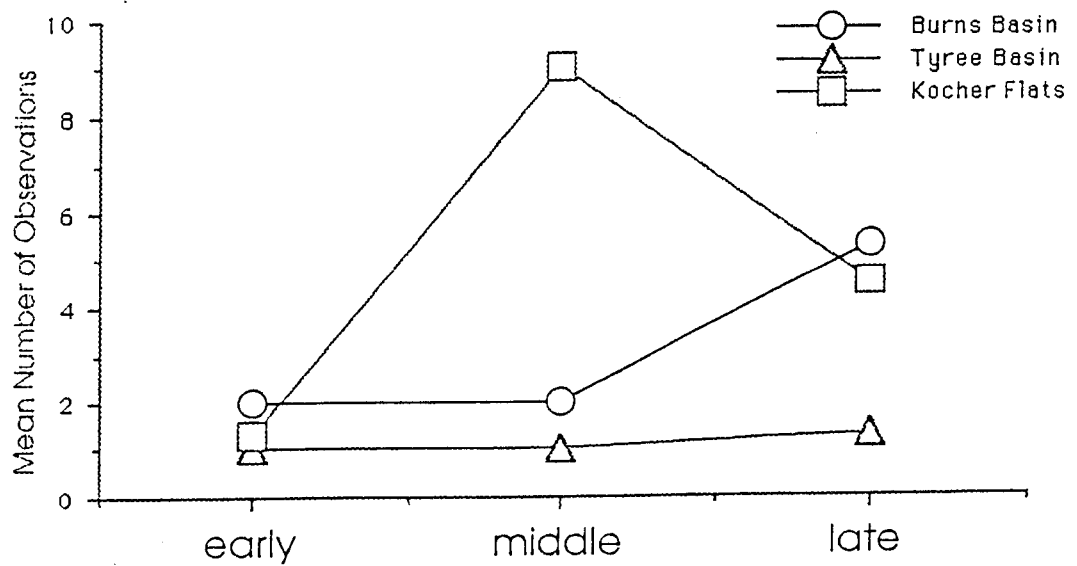


Figure 9. Coyote activity recorded during spotlight surveys at three sites in Badlands National Park, South Dakota.

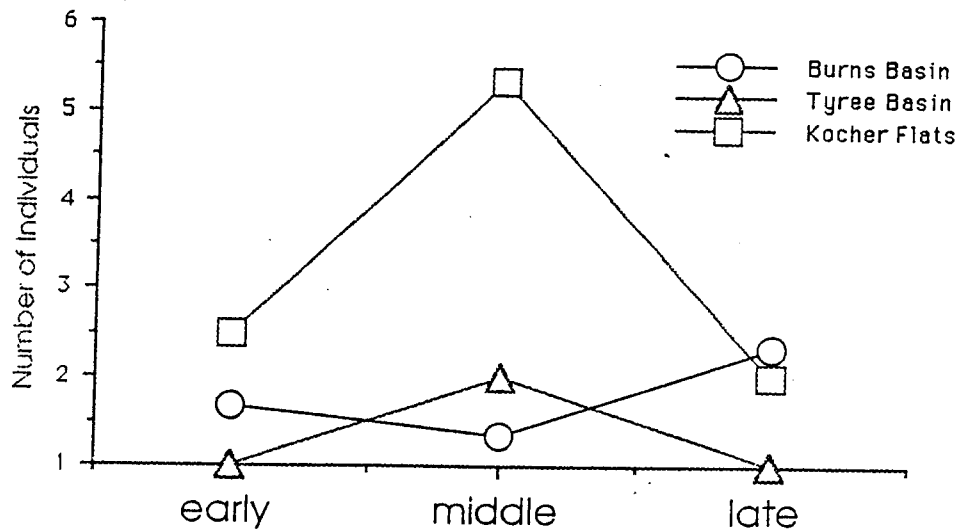


Figure 10. Raptor activity recorded during dawn surveys at three sites in Badlands National Park.

