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A Field Habitat Model for Black-Footed Ferrets

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Abstract.--We present a model to compare prairie dog complexes with known black-footed ferret habitat. The model assumes: 1) black-footed ferret populations require prairie dog colonies for survival, 2) prairie dog colonies can accommodate an additional black-footed ferret for each approximate 50 hectare increase in size, 3) a higher percentage of overall area covered by prairie dogs can accommodate more black-footed ferrets. We list four biological variables. They are: 1) total hectares in prairie dog colonies, 2) percent of total complex inhabited by prairie dogs, 3) intercolony distance, 4) an estimate of burrow density per hectare. In addition, two non-biological parameters are included. They are development potential and land ownership patterns. The model can provide an initial critique of a prairie dog complex for a black-footed ferret search or as a reintroduction site.

INTRODUCTION

Black-footed ferrets (Mustela nigripes) appear to depend on prairie dogs (Cynomys spp.) for food and shelter. Of 310 museum specimens listed by Anderson et al. (1986), only six were collected outside prairie dog range. Biggens et al. (1985) reported telemetered ferret location highly correlated with prairie dog towns.

In South Dakota, 91% of black-footed ferret diet was prairie dog (Sheets et al., 1969). In Meeteetse, a food habit study showed 87% of black-footed ferret scats contained prairie dog remains (Campbell et al., 1987). Powell et al. (1985) estimated a caloric intake of 110-130 Kcal per day, and speculated a ferret would kill one prairie dog a week during winter. A female raising a litter would have to increase her rate of predation. Observations by Paunovich and Forrest (pers. comm.) indicated a female with a litter of five may have been killing .6 prairie dogs per day. Therefore, any area containing prairie dogs can be considered black-footed ferret habitat.

In this paper we present a model which evaluates prairie dog complexes where black-footed ferrets were known to occur in Wyoming. A prairie dog complex is defined as a group of individual prairie dog colonies. The biological parameters follow the outline of the habitat suitability index (Houston et al., 1986). It differs from that model in four ways. Our model uses four biological variables instead of five, we use simple linear relationships, we have added two non-biological parameters, and our model can be calculated rapidly without the use of a pocket computer.

The model can serve two functions. First it is a relatively inexpensive method to search for undiscovered populations of black-footed ferrets. Second, our model provides a rapid method for initial identification of prairie dog complexes to be considered for more extensive study as reintroduction sites. A model that could then be applied to these screened sites is the black-footed ferret habitat suitability index of Houston et al. (1986).

The data upon which our model is based comes from two black-footed ferret populations, one in South Dakota on a black-tailed prairie dog (Cynomys ludovicianus) complex, and the

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other from the Meeteetse population located on a white-tailed prairie dog (Cynomys leucurus) complex. Because our model is based on data from both ferret populations, we believe that it can be useful throughout the original black-footed ferret range.

MODEL BACKGROUND

Ferrets are solitary. Females display smaller home ranges than males (Biggins et al., 1985; Richardson et al. in press) with one male home range typically overlapping the ranges of several females. Within a sex, however, there is little spatial or temporal overlap (D. Biggins, pers. comm.), a pattern typical of mustelids (Powell, 1979).

The Meeteetse prairie dog complex has prairie dog densities varying from 2 to 20 per hectare (Menkens unpubl. data). At maximum Black-footed ferret densities in Meeteetse, Forrest et al. (1985) estimated an adult ferret occupied about 50 hectares of prairie dog habitat. This relationship was constant whether calculated over individual colonies or over the entire complex. The 50 hectares of habitat per ferret therefore appears to be a linear relationship. The black-footed ferrets at the Meeteetse site existed on a complex of 18 colonies ranging from 12.5 hectares to 1302 hectares in size (Forrest et al., 1985). The total prairie dog acreage was 2790 with a mean intercolony distance of 0.9 km. (Forrest et al., 1985).

The black-footed ferret model therefore makes the following assumptions:

1) black-footed ferret populations require prairie dog colonies for survival
2) prairie dog colonies can accommodate an additional black-footed ferret for each approximate 50 hectare increase in size
3) a higher percentage of overall area covered by prairie dogs can accommodate more black-footed ferrets

MODEL DEVELOPMENT

We used four biological parameters for evaluation of prairie dog complexes. They are: 1) total hectares prairie dog colonies, 2) percent of complex area inhabited by prairie dogs, 3) intercolony distance within the complex, and 4) burrow density. These variables are sufficient to evaluate a prairie dog colony or complex for a black-footed ferret search effort. If the purpose of the evaluation is to investigate potential reintroduction sites, two non-biological variables are added: 1) development potential, and 2) land ownership patterns.

Total hectares occupied by prairie dog colonies can be calculated from accurate mapping of the prairie dog complex. This variable assumes the larger the prairie dog colonies in the complex, the greater the potential for a viable black-footed ferret population. On black-tailed prairie dog colonies in South Dakota, Hillman et al. (1979) recommended a 12 hectare minimum colony size for individual black-footed ferrets, and a 40 hectare minimum for females with a litter. In Meeteetse, the maximum black-footed ferret density was one black-footed ferret for every 50 hectares over 2800 hectare area (Forrest et al., 1985). The smallest prairie dog colony supporting an individual black-footed ferret was 12 hectares, and the smallest colony supporting a litter was 50 hectares (Forrest et al., 1985).

Percentage of the total complex area in prairie dog colonies assumes the greater the percent area occupied by prairie dogs, the better the black-footed ferret habitat. Percent area occupied by prairie dog colonies can be calculated by drawing a polygon around the colonies comprising the complex, and calculating the area inside the polygon. Total area of prairie dog colonies (variable 1) is divided by the area of the polygon to calculate this variable. The Meeteetse prairie dog complex has about 22% of the total area occupied by prairie dogs (Houston et al., 1986), and the South Dakota site has about 1.7% of its area inhabited by prairie dogs (Hillman et al., 1979).

The third variable is average intercolony distance. We assume that smaller intercolony distances lead to higher quality black-footed ferret habitat. Large intercolony distances may make intercolony travel and dispersal more difficult (MacArthur and Wilson, 1967). Intercolony distance is about .9 km. at the Meeteetse site (Forest et al., 1985), and about 2.4 km. at the Mettetse County site in South Dakota (Hillman et al., 1979). Intercolony distance can be calculated by measuring the shortest boundary distance between colonies on a map.

The fourth variable is burrows per hectare. Black-footed ferret habitat quality is affected by the density of both prairie dogs and their burrows. There is no rapid technique to estimate prairie dog density since populations fluctuate (Menkens, 1987). Our model therefore accepts the presence of prairie dogs as sufficient. We can, however, count the prairie dog holes. Burrow densities are not a reliable indicator of prairie dog density (Menkens et al. in press; King, 1955), but burrow density is an important part of the prairie dog ecosystem for the black-footed ferret. They provide the ferret with shelter, and allow escape from predators. Selected plots can be sampled, and the burrow numbers averaged. The prairie dog complex can be classed into one of six categories of burrow density per hectare.

If a site is being evaluated for a search effort, these four biological variables are sufficient. If it is being considered for reintroduction of captive raised black-footed

ferrets, two subjective non-biological variables are added.

The first is development potential. The sequence from worse to best case includes: 1) heavy development (such as a strip mine) that will obliterate most of the habitat; 2) moderate development with the potential to expand to heavy development; 3) moderate development, but well planned to mitigate effects to wildlife; 4) light development, but with potential expansion; 5) light development that is well planned; and 6) no development pending.

The second variable is land ownership patterns. The sequence from worst to best case is: 1) hostile or uncooperative; 2) a complex situation with multiple owners that presents potential cooperation problems; 3) private ownership which is cooperative, but unstable economically; 4) private ownership which is stable, but owners have mixed feelings about ferrets and the activities associated with reintroduction; 5) an even mix of stable private ownership, and federal land; and, 6) all or most of the land in federal ownership with the remainder friendly and stable. It is important to recognize that development potential and land ownership patterns can sometimes change.

MODEL USE

Each variable in the model has 6 categories. We have assigned a value to each of these categories. If the purpose of the evaluation is to prioritize prairie dog complexes for a black-footed ferret search effort, only the first 4 variables are used. To produce a total, add the appropriate value for each variable and divide by four. There will then be a comparative score representing the particular prairie dog complex. If the purpose of the evaluation is to choose potential black-footed ferret reintroduction sites that are worthy of further analysis, use all 6 variables. Again, add the appropriate value for each variable. Then, divide this total by 6 to assign the prairie dog complex a comparative score. In table 1 and 2 we present the variables in the model with the relative value assigned to each of their categories. In table 3 , we offer a comparative score of the Meeteetse site and another complex.

Table 1. Biological variables of the habitat model

Variable 1. Total hectares in prairie dog colonies.

Value	Hectares
1	0000-1500
2	1500-3000
3	3000-4500
4	4500-6000
5	6000-7500
6	7500

Variable 2. % hectares of the prairie dog complex in prairie dog colonies.

Value	%
1	0-10%
2	10-15%
3	15-20%
4	20-25%
5	25-30%
6	30%

Variable 3. intercolony distance

Value	Distance
1	1.5
2	1.5-1.2
3	1.2-0.9
4	0.9-0.6
5	0.6-0.3
6	0.3-0.0

Variable 4. burrows per hectare

Value	Burrows
1	0-15
2	15-30
3	30-45
4	45-60
5	60-75
6	75

Table 2. Non-biological variables of the habitat model

Variable 5. development potential	
Value	
1	heavy development
2	moderate development with potential expansion
3	moderate development well planned for wildlife
4	light development with potential expansion
5	light development well planned for wildlife
6	no development pending

Variable 6. land ownership patterns	
Value	
1	hostile
2	complex ownership situation with potential problems
3	private ownership is cooperative, but unstable economically
4	stable private ownership, but owners reluctant or unsure
5	mix of stable private ownership and federal land
6	most or all federally owned

Table 3. Application of the model to the Meeteetse site, and a prairie dog complex in southwestern Wyoming on which a black-footed ferret skull was located.

Meeteetse would score:

Variable	Value
1	2
2	4
3	4
4	4
5	5
6	5

The score for the first 4 variables would be 3.5. The score for all 6 variables would be 4.0.

The complex in southwestern Wyoming would score as follows:

Variable	Value
1	1
2	5
3	4
4	2
5	2
6	2

The comparative score for the first 4 variable would be 3. The comparative score using all 6 variables would be 2.7.

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