USDA United States Department of Agriculture

Forest Service

Rocky Mountain Research Station

Research Paper
RMRS-RP-38

March 2003

Vegetative Characteristics of Swift Fox Denning and Foraging Sites

in Southwestern South Dakota

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Uresk, Daniel W.; Severson, Kieth E.; Javersak, Jody. 2003. **Vegetative characteristics of swift fox denning and foraging sites in southwestern South Dakota.** Research Paper RMRS-RP-38. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 4 p.

Abstract—Vegetative characteristics of swift fox (*Vulpes velox*) denning and foraging habitats were studied in southwestern South Dakota. We followed 14 radio-collared foxes over a two-year period and identified 17 den sites and 82 foraging sites. Height-density of vegetation (visual obstruction reading, VOR) was determined on each den and foraging site and on 81 randomly selected sites. Total vegetation VOR was higher (p=0.08) at den sites than on randomly selected sites (11.7±1.4 and 9.5±0.6cm (SE), respectively). Swift foxes used foraging areas with vegetation greater VOR (p=0.01) than that found on randomly selected sites (11.9±0.7 and 9.5±0.6 cm, respectively). Canopy cover for seven major plant species on foraging sites was different than on den sites (p=0.055) but random sites were not different from either foraging or den sites. While previous studies have described swift fox macrohabitats with little vegetative cover (e.g., plowed fields or heavily grazed areas), our study showed that height-density of vegetation is important to these foxes.

Keywords: Swift fox, *Vulpes velox*, foraging, dens, vegetation, habitat, South Dakota

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Acknowledgments

This study was done in cooperation with South Dakota State University, Department of Wildlife and Fisheries (28-C1-586). Partial funding was provided by the Nebraska National Forest and the Badlands Natural History Association, Interior, SD. Thanks are extended to Carmen Blumberg, Ryan Tompkins, Steve Denison, and Daryl Mergen for data collection. Rudy King, Station Biometrician, and Lakhdar Benkobi provided help with data analyses.

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Introduction

The swift fox (*Vulpes velox*) is currently considered endangered in the states of Nebraska and Kansas and is listed as a threatened species in South Dakota. This fox, once abundant, was distributed from southeastern Alberta southward into the Texas Panhandle and from the Rocky Mountains eastward to the western edge of the tallgrass prairie (Scott-Brown et al. 1987). Population declines began with the settlement of the Great Plains and by 1900 the species was rare. There were no reported sightings of swift fox from Nebraska between 1901 and 1953, from North Dakota between 1915 and 1970, or from South Dakota between 1914 and 1966. An increase in the number of sightings from South Dakota since 1966 suggested that a population was becoming reestablished (Hillman and Sharps 1978). However, more recent surveys show that swift fox populations are decreasing.

Great Plains habitats of the swift fox have been generally described as gently rolling prairies dominated by grasses, particularly wheatgrasses (*Agropyron* and *Pascopyrum* spp.), blue grama (*Bouteloua gracilis*), and buffalograss (*Buchloe dactyloides*) (Kilgore 1969, Boggis 1977, Hillman and Sharps 1978, Hines and Case 1991). Hines and Case (1991) have been the only authors to report home range selection. Investigation of swift fox use of the various habitat components within home range, except for den site selection, has been limited. Vegetation and physical characteristics of den sites have been described by Cutter (1958), Hines and Case (1991), and Uresk and Sharps (1986).

The objectives of this study were to examine selection of den and foraging sites based on vegetation characteristics including cover and vegetation height-density (visual obstruction reading, VOR). The null hypothesis tested was that there were no differences between available sites (randomly selected) and those used by swift fox for denning and foraging.

Study Area

The study area was on lands administered by the USDA Forest Service's Buffalo Gap National Grassland in southwestern South Dakota. It included 4,144 ha of a mixed-grass prairie habitat dominated by western wheatgrass (*Pascopyrum smithii*) and blue grama and encompassed several cattle allotments grazed in either season-long or rotation grazing systems. Topography was gently rolling upland straddling the divide between Mule and Horsehead Creeks. Small, first order drainages flowed northwest toward the former or southeast to the latter.

October 1 to September 30 precipitation was 50.5 and 41.2 cm during the two-year study. The 83-year average for annual precipitation is 45.0 cm. Mean monthly temperatures for both years averaged between 17° and 22° C during June-September.

Methods

Capturing and Monitoring Foxes

Swift foxes were trapped during June and July during 1991 and 1992. Tomahawk traps were set and baited with canned mackerel near known den sites and on 10 selected 1.6 km transects spaced 1.6–3.2 km apart along secondary roads used for management of the grasslands. Seven traps were placed surrounding each den site approximately 10 m from the den. Ten evenly spaced traps were placed on transects along the two track roads. Trapped foxes were fitted with a radio with an external antenna attached to a 2.5 cm wide collar. Radiocollared foxes were released at the capture site and were relocated at night with handheld antennas. We used vehicle-mounted or handheld spotlights to note behaviors (foraging, running, etc.) and marked locations on USGS 1:25,000 contour maps and on the ground with steel posts. Only den sites and locations where foraging behavior was noted were used in these analyses. Since swift foxes are primarily nocturnal, observations were conducted after sunset. Foxes were tracked a minimum of twice per week during the summer months (June-September). One observation on a given night per animal was used for a location but not all animals were located each night.

Measuring Vegetation

Vegetation measurements were taken at den sites, foraging sites, and on randomly selected sites. Random sites were selected by computer-generated random numbers (Universal Transverse Mercator coordinates). Canopy cover of major plants by individual species and by total grasses, forbs, shrubs, and total two-dimensional cover was estimated on 30, 0.1 m^2 plots placed at 1-m intervals along a 30-m transect (Daubenmire 1959). Two 30-m transects were sampled at each den, foraging, and random site location. Those at den sites were perpendicular, crossing at the center of the main den entrance, while those at animal foraging and random sites were parallel, 30-m apart. Data

were collected on foraging and random sites within one week of locating. On each site, a modified Robel pole (Robel et al. 1970, Benkobi et al. 2000) with 2-cm alternating orange and white bands was placed at 5-m intervals for a total of 13 stations along each of two 60 meter transects. Four readings at each station were taken at 90° points around the pole. Visual obstruction readings were taken and recorded at the first ring above visual obstruction of the vegetation (height-density of vegetation).

Visual obstruction data and canopy cover data were reduced to one mean per site for den, foraging, and randomly selected sites. Mean visual obstruction of random sites was compared with den and foraging sites using the Mann-Whitney U test as an alternative to a t-test in this situation to address non-normally distributed data. Canopy cover for seven variables (western wheatgrass, blue grama, buffalograss, green needlegrass [*Nassella viridula*], sideoats grama [*Bouteloua curtipendula*], prairie Junegrass [*Koelaria macrantha*], and scarlet globemallow [*Sphaeralcea coccinea*]) for random, den, and foraging sites were compared with Multi-Response Permutation Procedures (Mielke, et al. 1976, Mielke et al. 1982, Zimmerman et al. 1985). A Bonferroni correction was applied to the probabilities. Significance levels were estimated using exact methods to address the small number of dens (SPSS 1998). Biological differences were considered at α=0.10.

Results and Discussion

A total of 14 swift foxes was captured: 6 in 1991 and an additional 8 in 1992. Twice-weekly tracking and surveying of the foxes resulted in the discovery of 3 dens in 1991 and 14 dens in 1992. Each den was used by an individual family unit. In 1991, 20 foraging areas were identified; an additional 62 foraging sites were located in 1992; and 81 random sites were sampled over the 2-year period. Years were examined separately between and among den, foraging, and random sites but data were too limited in 1991 to reflect differences. When years were combined, the results were consistent with 1992 data. Canopy cover data from 1991 and 1992 were combined for an overall analysis and differences were detected between foraging and den sites (p=0.055). No differences were found in comparisons of canopy cover between den and random sites or between foraging and random sites. The null hypothesis was accepted for plant canopy cover but was rejected for visual obstruction.

Vegetation

Percent canopy cover for seven major plant species was evaluated to determine differences among denning, foraging, and random sites for the swift fox (table 1). Major species in order of decreasing cover were: western wheatgrass, blue grama, buffalograss, green needlegrass, sideoats grama, junegrass, and scarlet globemallow. The three treatments differed overall (p=0.007), showing selectivity by the swift fox with respect to availability and differences between den and foraging sites. Characteristics of den sites were different from those of foraging sites (p=0.055). These sites were primarily lower in western wheatgrass canopy cover.

Den Sites

Previous papers describing swift fox habitats have documented a variety of conditions where dens have been found. These have included plowed fields, heavily grazed areas, fence rows, on or near hilltops, and short and mixed grass prairies (Cutter 1958, Kilgore 1969, and Uresk and Sharps 1986). Some of these macrohabitats may appear to lack cover (e.g., plowed fields or heavily grazed areas). Our study, however, focused on microhabitats (or at least a higher order of habitat definition [see Johnson 1980]) and showed that some vegetative attributes are important to these foxes. Overall, vegetation around den sites differed (p=0.055) from foraging sites (table 1). Den sites had less western wheatgrass canopy cover but were similar in cover for the six other plant species and for total cover, total forbs, and grass. However, there were no differences in plants overall between den and random sites (p=0.105). Visual obstruction of vegetation was greater (p=0.08) at den sites than on randomly selected sites (11.7$\pm$1.4 and 9.5$\pm$0.6 cm, respectively). Height-density of total vegetation, measured in terms of visual obstruction, does influence use of sites for both denning and foraging (figure 1). Our results, that vegetation surrounding the den is more dense, may relate to use of screening cover for burrow entrances or places where foxes could loiter outside the den with greater security. The magnitude of the differences (2.2 cm) in height-density is important and represents the difference that completely obstructs view; maximum vegetation height would be greater. Hiding cover would be significantly augmented by total vegetation height.

The presence of screening cover around den sites has not been discussed in previous studies but may have been present since even heavily grazed pastures may

Table 1. Means and standard errors of percent canopy cover (Daubenmire 1959) for key plant species on swift fox study area sites.

	Denning[a]	Foraging[b]	Random[c]
Western wheatgrass	27.0±2.7	38.8±0.7	35.8±1.8
Sideoats grama	3.4±1.6	2.6±0.7	5.1±1.2
Blue grama	19.0±3.1	15.2±1.3	14.9±1.5
Buffalograss	16.4±3.5	17.0±1.6	11.2±1.4
Junegrass	2.9±0.9	3.5±0.6	2.5±0.4
Scarlet globemallow	0.7±0.2	1.5±0.1	0.9±0.1
Green needlegrass	3.4±1.0	5.3+0.7	4.2±0.5
Total cover[d]	79.0±2.6	80.5±1.3	77.5±1.6
Total forbs[d]	4.6±0.6	5.6±0.4	5.7±0.7
Total grass[d]	73.7±3.9	77.0±1.4	73.8±1.6

[a] n=17
[b] n=82
[c] n=81
[d] Two-dimensional percent cover

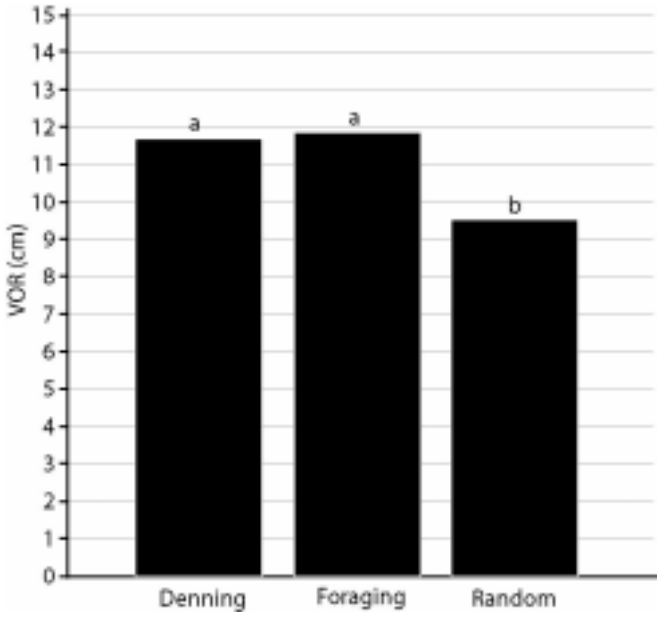

Figure 1. Mean visual obstruction readings of denning, foraging, and random sites. Different letters represent significant differences between means (p=0.10).

contain patches of ungrazed or lightly grazed, less palatable species. The exception would be dens found in plowed fields (Cutter 1958, Kilgore 1969). Kilgore considered dens in plowed fields a function of the percentage of land under cultivation in his study area. He noted that the dens were more shallow and less extensive than other dens and only rarely reopened when covered by plowing or discing. He concluded that these dens were temporary.

Foraging Sites

Multiresponse permutation procedures detected no differences in canopy cover of the seven plant species between foraging and random sites (p=0.114, table 1). Generally, canopy cover of the individual plant species and for the major categories was also similar between foraging and random sites. Swift fox did use foraging areas with more dense vegetation than was present on random sites; VOR=11.9±0.7 cm and 9.5±0.6 cm, respectively (p=0.01).

Uresk and Sharps (1986) studied swift fox food habits in other areas of western South Dakota and found that black-tailed prairie dogs (*Cynomys ludovicianus*), which are characteristic of early seral stages, and insects, primarily grasshoppers and beetles, were the most common food items eaten. Prairie dogs did not occur on our study area and voles (*Microtus* spp.) and northern pocket gophers (*Thomomys*) are found in areas of more dense vegetation in the mixed-grass prairie. Insects were abundant in the diets of the swift fox in our study (unpublished data). Cottontail (*Sylvilagus* spp.), pocket mice (*Perognathus* spp.), and thirteen-lined ground squirrel (*Spermophilus tridecemlineatus*) were also common in the swift fox diets. These species are generally found in less dense vegetation.

Swift fox are adapted to a wide range of habitat conditions. Feeding habits are cosmopolitan and focus on those animal and plant species that are available (Kilgore 1969, Boggis 1977, Hines and Case 1991, Uresk and Sharps 1986). Foraging relationships and site characteristics such as height-density of vegetation (VOR) and plant species canopy cover may reflect local availability of potential prey items during a particular season. Longer-term studies throughout the range of the swift fox are needed to determine the effects of variation in yearly and seasonal precipitation and temperature and prey base on microhabitat selection or use. Information on the intensity and duration of livestock grazing as related to vegetation structure and plant composition, and impacts to selectivity of den and foraging sites of swift fox, are also needed.

Management Implications

Management for swift fox in this area will require vegetation with greater visual obstruction than that which occurs randomly throughout the summer months. We recommend visual obstruction readings of 11–12 cm for den sites and foraging sites. Maintaining visual obstruction readings of 11–12 cm may require lighter grazing use by livestock.

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