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AUTUMN AND WINTER DIET OF THE SWIFT FOX (*VULPES VELOX*) IN SOUTH-EASTERN WYOMING

PETER PECHACEK*, FREDERICK G. LINDZEY** AND STANLEY H. ANDERSON**

** *Wyoming Cooperative Fish and Wildlife Research Unit, Box 3166, University Station, Laramie, WY 82071, USA.*
* *Nationalparkverwaltung Berchtesgaden, Doktorberg 6, 83471 Berchtesgaden, Germany.*

ABSTRACT - We investigated the Swift fox *(Vulpes velox)* food habits during an autumn (October) and winter month (December and January) in a sagebrush-grassland habitat in south-eastem Wyoming in 1996 and 1997. The percentage of occurrence of various food items was determined from 63 scat samples of 6 radio-collared foxes (3 pairs). Mammals, especially rodents, and insects were the most common prey (24.5 % and 19.1 %, respectively). 49 scat contained plant material. Ungulate carrion was an important part of the Swift fox's diet. No significant difference between autumn and winter diet was detected.

Key ***words:*** *Vulpes* ***velox,*** scat analysis, autumn-winter diet, Wyoming.

INTRODUCTION

The Swift fox *(Vulpes velox)* inhabits the Great Plains prairies from Canada to Texas. Many aspects of their behavioural ecology are still unknown (Scott-Brown *et al.*, 1987). This became apparent in 1992, when the Swift fox was petitioned for listing as "endangered" under the Endangered Species Act. The U.S. Fish and Wildlife Service's 12-month administrative finding in 1995 concluded that listing was warranted but was precluded due to insufficient biological information (U.S. Fish and Wildlife Service, 1995).

Swift fox food habits were summarised by Zumbaugh *et al.* (1985). However, most biologists have investigated the Swift fox diet during the breeding season (Cutter, 1958; Kilgore, 1969; Hillman and Sharps, 1978; Uresk and Sharps, 1986). Hines (1980) and Hines and Case (1991) combined winter, spring and summer diet. Zumbaugh *et al.* (1985) analysed winter scat of the Swift fox. Cameron (1984) studied annual diet in Colorado. No data have been collected in Wyoming.

Our aims were to define the diet of Swift foxes in a sagebrush-grassland habitat of south-eastern Wyoming, and to compare it in autumn and winter.

MATERIAL AND METHODS

We conducted the research near Medicine Bow, Wyoming, (42°N, 106°W). The topography of the study area at 2070 m a.s.l. was flat to mildly undulating with a lot of dry lakebeds. The habitat was dominated by grasses, interspersed with individual and small patches of low-growing (<1 m) sagebrush *(Artemisia* spp.), and greasewood *(Sarcobatus vermiculatus)*. The average annual precipitation was less than 300 mm/year. There was little human development in the 280 km^2 study area which is primarily used for cattle grazing. The mean density of the Swift fox was estimated at 1.6 individuals/10 km^2 (Dieni *et al.*, 1996).

We sampled faeces at the den sites of radio-collared Swift foxes in October 1996 and from mid December 1996 to mid January 1997. All scat and animal remains were removed from the dens 1 week before the seasonal sampling started. Den sites were visited weekly and each time all new faeces were collected. We randomly selected one piece of scat from faeces found in a pile, and considered this scat along with scat found solitarily in a sample unit. Labelled scat samples were air-dried for at least 4 months, and measured (length, width) before dissection.

We softened scat by washing it over a 0.5 x 0.5 mm mesh sieve. Each sample was then spread out in a Petri dish underlayed with a 2 x 2 cm grid. We took subsamples with tweezers out of all grid intersections to determine a diet composition per scat in an unbiased manner. We used a dissecting microscope with 7x – 30x magnification to detect larger prey remains, such as bones, teeth, insects, feathers, etc., and a binocular compound microscope with 100X and 400X magnification to identify hair. A hair reference collection and dorsal guard hair key (Moore *et al.*, 1974) were used to identify mammalian prey remains to the lowest taxonomic level possible.

Each food item in a scat was counted only once regardless of its distribution in subsamples of that scat. We measured the frequency with which a food item occurred in our scat sample relative to the other items detected calculating percentage of occurrence (% occurrence) of items in scat [(number of times a food item occurred (frequency)/total number of occurrences of all items) * 100] (Kelly, 1991). We also calculated the percentage of occurrence for food groups considering 8 categories: rodents, lagomorphs, ungulates, other mammals (shrews, carnivores), birds, insects, vegetation and miscellaneous (reptiles, undetermined remains such as soil, rock parts, or grit). The bulk of diet (volume) was visually estimated for these categories only. We compared scat size (ONEWAY) and diet composition (Chi-square test) among fox pairs, to detect whether or not there was any justification in combining scat samples for further analysis. We applied the independent t-test for comparison of scat size in autumn and winter. We used the Chi-square contingency table to test for differences in dietary composition between seasons.

RESULTS

We examined 63 faeces samples evenly distributed from 6 radio-collared Swift foxes (3 pairs) at 17 den sites. Scat size averaged 3.0 x 0.9 ± 0.1 x 0.1 cm (x ± SE) with no significant difference among fox pairs. Scat size did not significantly differ between autumn and winter.

The overall diet composition among fox pairs did not differ significantly, and therefore, the scat was combined for fox pairs. We found 17 food items in 31 scat collected in autumn and 17 food items in 32 scat in winter. In total, 18 prey items were detected throughout the study period (Table 1). The overall diet based on the percentage of occurrence of the food groups was characterised by rodents (24.5 %), vegetation (20.3 %), and insects (19.1 %). Other food groups were less common: lagomorphs (9.5 %), ungulates (9.1 %), miscellaneous (6.6 %), other mammals (5.4 %), and birds (5.4 %). Mammals, especially rodents and particularly Cricetidae, occurred in almost every scat and made up the largest percentage by bulk (<50 %). We found that 45 faeces samples contained insect remains and 49 contained plant material consisting of mostly grass and seeds.

Rodents were ground squirrels (*Spermophilus* spp.), white-tailed prairie dogs (*Cynomys leucurus*), pocket mice (*Perognathus* spp.), deer mice (*Peromyscus maniculatus*), and voles (*Microtus* spp.). Reptiles

Table 1 - Dietary composition of 6 Swift foxes (3 pairs) based on 63 scat collected in autumn and winter at Medicine Bow, Wyoming, 1996/97. Frq, frequency; %occ, percentage of occurrence.

	autumn n=32		winter n=31		overall n=63	
	frq	%occ	frq	%occ	frq	%occ
Soricidae	6	3.6	3	2.1	9	2.9
Leporidae	9	5.4	14	9.9	23	*1.5*
Rodentia (undet.)	1	0.6			1	0.3
Sciuridae	15	9.0	15	10.6	30	9.7
Geomydae	3	1.8	3	2.1	6	1.9
Heteromyidae	*5*	3.0	2	1.4	7	2.3
Cricetidae	24	14.4	28	19.9	52	16.9
Canidae	3	1.8	1	0.7	4	1.3
Antilocapridae	3	1.8	4	2.8	7	2.3
Cervidae			1	0.7	1	0.3
Bovidae	8	4.8	7	5.0	15	4.9
birds	4	2.4	9	6.4	13	4.2
reptiles	3	1.8	2	1.4	*5*	1.6
insects (undet.)	23	13.8	14	9.9	37	12.0
Coleoptera	18	10.8	8	5.7	26	8.4
Orthoptera	7	4.2	3	2.1	10	3.2
unidentified	10	6.0	3	2.1	13	4.2
vegetation	25	15.0	24	17.0	49	15.9

included lizards. Bird remains were most likely from small-size passerines. Identifiable insects were primarily from two orders: Coleoptera (8.4 %) and Orthoptera **(3.2** %). Carrion likely comprised a part of the diet, as indicated by the body size of some prey items such as cattle, pronghorn (*Antilocapra americana)* and deer *(Odocoileus* sp.). We found Swift fox hair in some scat, probably from their ingestion during grooming or eating combined with licking. Little amounts of small rocks and soil were generally found in faeces, only ***2*** scat samples in autumn contained more than 95 % of it. We did not find a significant difference in diet composition between autumn and winter.

DISCUSSION

In general, Swift foxes in our study area appeared to feed on a variety of prey including carrion. The high overall occurrence of small nocturnal mammals together with insects was similar to that found by several authors (Cutter, 1958; Kilgore, 1969; Hillman and *Sharps,* 1978; Hines, 1980; Cameron, 1984; Uresk and Sharps, 1986; Hines and Case, 1991). It was not clear how important insects were in the Swift fox diet, due to possible underestimation of this easily digestible prey (Scott-Brown *et al.,* 1987). Although we observed that insects were commonly consumed by foxes, they accounted for less than 10 % of the total volume of the faecal sample. However, we found one scat sample in autumn with 30-40 % of beetles and grasshoppers. Kilgore (1969) observed large numbers of insects but did not feel they were significant in terms of biomass. Cutter (1958) found that insect remains comprised of 55 % of bulk. Similarly, plant material previously was known to be consumed by Swift foxes, but its importance in fox diet was unclear (Scott-Brown *et al.,* 1987). Vegetation may be ingested accidentally with food, but some fox species are known to use plant material as a food resource (Morrell, 1972; Fritzell, 1987). Cutter (1958), Hines (1980), Cameron (1984), Uresk and Sharps (1986) and Hines and Case (1991) agreed that vegetation was eaten intently by Swift foxes. Kilgore (1969) reported that plant material comprised the bulk of some scat samples. Our findings showed the highest known frequency of plant items in the Swift fox diet compared to the authors mentioned above. However, the plant material never comprised more than 5 % of the total scat volume.

Birds and lagomorphs were consistently reported in food habit studies, and especially leporids frequently represented the largest proportion of Swift fox diet (Cutter, 1958; Kilgore, 1969; Hines, 1980; Cameron, 1984; Hines and Case, 1991; Zumbaugh *et al.*, 1985). Our findings suggested that birds and lagomorphs were not commonly eaten, as observed by Uresk and Sharps (1986).

Food resources such as ground squirrels and insects probably were not available during winter because of migration, hibernation or overwintering under the ground. However, we detected these prey items in both, autumn and winter. Our data coincided with observations by Hines (1980), Cameron (1984), Zumbaugh *et al.* (1985) and Hines and Case (1991) from similar geographical regions. The following explanations were discussed to explore the origin of the seasonally unavailable prey in the Swift fox diet: food caching (1) was reported by Scott-Brown *et al.* (1987). Stephenson (1970) discovered that Arctic foxes *(Alopex lagopus)* may use food caches during winter, when prey supplies are limited. Cameron (1984) suggested that ground squirrels could be captured when they became active during a warm period (2) or that Swift foxes could excavate ground squirrels and insects from burrows (3).

We believe that, the presence of insects and hibernating animals in the Swift fox diet seemed to be explained by excavation of prey rather than by any other alternative discussed above. We observed a Swift fox digging a hole into frozen and snow covered ground on a January night close to a known ground squirrel burrow. Moreover, in autumn diurnal prey (Sciuridae) in the nocturnal Swift fox was detected providing evidence for the Swift fox's habit to excavate some prey at night, which may continue throughout the winter, and thus explaining presence of prey overwintering under the ground. There may be another explanation for diurnal prey in the Swift fox diet, such as fox scavenging (Egoscue, 1979), which indeed was recorded (cattle, ungulates), or fox ability to hunt diurnally as reported elsewhere in its geographic range (Cutter, 1958, Kilgore, 1969). However, we never observed the Swift fox hunting during the day (Pechacek *et al.*, unpubl. data) and Egoscue (1975) concluded that the closely related Kit fox *(Vulpes macrotis)* was unable to alter its nocturnal hunting habits and take advantage of the abundant diurnal prey, even when food was in short supply.

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REFERENCES

Cameron, M.W., 1984. The Swift fox *(Vulpes velox)* on the Pawnee National Grassland: Its food habits, population dynamics and ecology. M.S. Thesis, Univ. of Northern Colorado, Greeley (unpubl.). 117 pp.

Cutter, W.L., 1958. Food habits of the Swift fox in Northern Texas. Journal of Mammalogy, 39(4): 527-532.

Dieni, J.S., Lindzey, F.G., Woolley, T.P., Anderson, S.H., Rothwell, R. and Luce, B., 1996. Swift fox density estimation and survey technique evaluation in southeastern Wyoming. In: B., Luce and F., Lindzey (eds.), 1996. Annual report of the swift fox conservation team, Wyoming Game and Fish Department, Cheyenne (in press), 110 pp.

Egoscue, H.J., 1979. *Vulpes velox.* Mammalian Species, 122: 1-5.

Fritzell, E.K., 1987. Gray fox and island gray fox. In: M., Novak, J.A., Baker, M.E., Obbard and B., Malloch (eds.), Wild Furbearer Management and Conservation in North America. Ministry of Natural Resources, Toronto, Ontario, pp.: 409-420.

Hillman, C.N. and Sharps, J.C., 1978. Return of Swift fox to northern Great Plains. Proceedings of South Dakota Academy of Sciences, 57: 154-162.

Hines, T.D., 1980. An ecological study of *Vulpes velox* in Nebraska. M.S. Thesis, Univ. of Nebraska, Lincoln, 103 pp.

Hines, T.D. and Case, R.M., 1991. Diet, home range, movements, and activity periods of Swift fox in Nebraska. Prairie Naturalist, 23(3): 131-138.

Kelly, B.T., 1991. Carnivore scat analysis: An evaluation of existing techniques and the development of predictive models of prey consumed. M.S. Thesis, Univ. of Idaho, Moscow, 200 pp.

Kilgore, D.L., 1969. An ecological study of the Swift fox *(Vulpes velox)* in the Oklahoma Panhandle. The American Midland Naturalist, 81(2): 512-534.

Morrell, S.H., 1972. Life history of the San Joaquin kit fox. California Fish and Game, 58(3): 162-174.

Moore, T.D., Spencer, L.E., Dugnolle, C.E. and Hepworth, W.G., 1974. Identification of the dorsal guard hairs of some mammals in Wyoming. Wyoming Game and Fish Department, Cheyenne, 14: 177 pp.

Scott-Brown, J.M., Herrero, S. and Reynolds, J., 1987. Swift fox. In: M., Novak, J.A., Baker, M.E., Obbard and B., Malloch (eds.), Wild Furbearer Management and Conservation in North America. Ministry of Natural Resources, Toronto, Ontario, pp.: 433-441.

Stephenson, R.O., 1970. A study of the summer food habits of the Arctic fox on St. Lawrence Island, Alaska. M.S. Thesis, Univ. of Alaska, Fairbanks, 76 pp.

Uresk, D.W. and Sharps, J.C., 1986. Denning habitat and diet of Swift fox in western South Dakota. Great Basin Naturalist, 46(2): 249-253.

U.S. Fish and Wildlife Service, 1995. Endangered and threatened wildlife and plants: 12-month finding for a petition to list the swift fox as endangered. Federal Register, 60: 31663-31666.

Zumbaugh, D.M., Choate, J.R. and Fox, L.B., 1985. Winter food habits of the Swift fox on the Central High Plains. Prairie Naturalist, 17(1): 41-47.