SWIFT FOX STATUS ON NATIONAL PARK SERVICE LANDS, 2001

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Badlands National Park in southwest South Dakota has made a commitment to reintroduce swift fox to the park. The closest known extant population is about 60 miles to the southwest on the Fall River Ranger District of the Buffalo Gap National Grasslands. The proposed reintroduction effort will collaborate with the Turner Endangered Species Fund/Bad River Ranch (owned by R. E. Turner) swift fox reintroduction, located about 60 miles to the northeast. Other potential collaborators on the park's reintroduction include the adjoining Wall Ranger District of the Buffalo Gap National Grasslands, the State of South Dakota, South Dakota State University, and the USGS-Biological Resources Division. The proposed reintroduction is contingent on funding. The park has submitted a proposal for funding, the success of which should be known in late summer of 2002.

No other projects specifically related to swift fox are occurring in National Parks. At this time swift fox are not known to be resident on any National Park Service lands.

Nebraska Swift Fox Scent Station Survey, 2001

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Abstract

During April and May 2001 the Nebraska Game and Parks Commission conducted a scent station survey targeted at swift fox (*Vulpes velox*) in selected counties in the Nebraska Panhandle. Out of 18 transects, 7 yielded swift fox sign.

Introduction

Swift Fox (*Vulpes velox*) is a small fox species native to western Nebraska's short grass prairies. The species is listed as endangered in Nebraska. Recent information about swift fox in Nebraska is based mainly on observation and mortality reports tracked by the Heritage Program.
In an effort to begin an annual monitoring program, a preliminary scent station survey was conducted between April 17 and May 1, 2001 in the Nebraska Panhandle. The objective was the evaluation of this technique for future and more widespread use during periodic monitoring sessions.

Methods

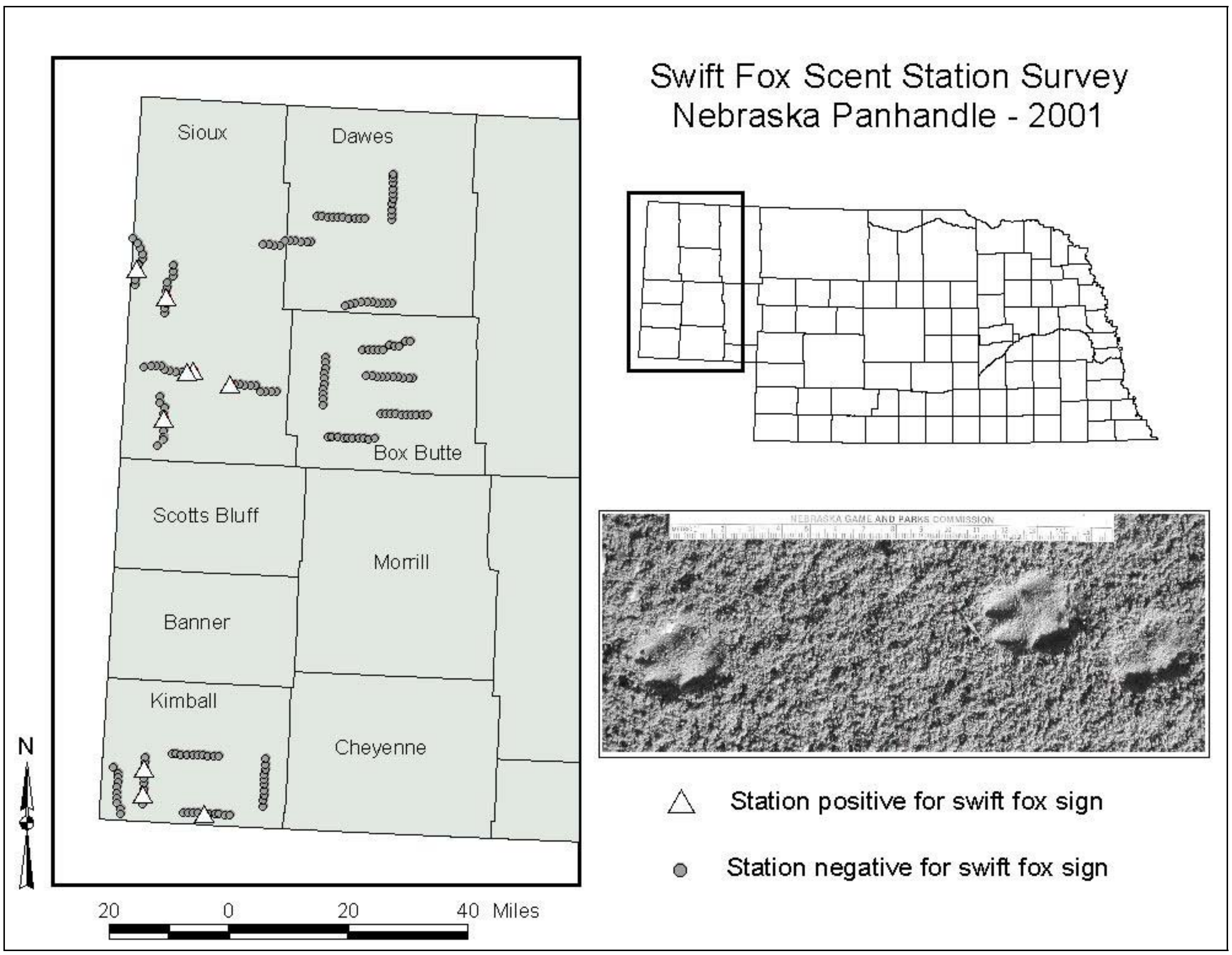
The method used had been tested and implemented by Robert Harrison in New Mexico (personal communication). Twenty-one transects were placed in Sioux, Dawes, Box Butte, and Kimball Counties. Each transect consisted of 10 stations, 1 mile apart, in the right-of-way along county roads (gravel or dirt). Transects were at least 6 miles apart. Stations were created by clearing vegetation and sifting fine sand mixed with glycerin (to create a good tracking medium). A plaster tablet soaked in a cod-liver/salmon oil mix was placed in the center of the station (attached to the ground with a nail and covered with a thin layer of sand).
Ideally, stations on a transect were inspected and re-set for three consecutive days or until at least one station showed signs of swift fox visitation (tracks, feces). If after three days no station on the transect had been visited by swift fox, the transect was counted as negative for swift fox presence. Swift fox signs were easily identified and the signs of other species visiting the stations were recorded as well. Several stations were only operated for one or two nights, due to adverse weather conditions.

Results

Out of 18 transects set, seven were positive for swift fox sign (5 in Sioux County and 2 in Kimball County). All stations visited by swift fox (9) were either within or in close vicinity to short grass prairie habitats. Due to frequent rains, we were unable to run some transects for the required three days. Two transects were abandoned immediately after setting. Most stations in

Box Butte and Dawes Counties were rained upon at least once, which significantly obscured potential sign on the tracking substrate. All of the five transects set in Kimball County were abandoned after the first night of operation due to unfavorable weather conditions. The total number of station nights was 431.

Other furbearers detected during the survey included coyote (*Canis latrans*, 8 stations), American badger (*Taxidea taxus*, 5 stations), striped skunk (*Mephitis mephitis*, 32 stations), raccoon (*Procyon lotor*, 4 stations), jackrabbit (*Lepus sp*., 3 stations) and cottontail rabbit (*Eastern floridanus*, 20 stations). Rodent tracks (110), were frequently encountered. Domestic dogs (3 stations) and cats (15 stations) also visited the scent stations. Although birds were frequently detected (69 station), they rarely removed the bait.



Discussion

While this survey was successful in detecting swift fox presence, it should have been conducted at a time during the year when the chance of precipitation is lower.

Seven out of nine positive stations showed swift fox signs after just one night of operation, illustrating the responsiveness to the stations. Given adequate weather conditions, two surveyors should be able to check and set four to five transects (40-50 stations) in a day.
The objective of this survey was to test a technique that may eventually be used to determine the presence/absence and perhaps density of swift fox in Nebraska, and to identify the current range. The purpose of surveying areas with known swift fox abundance in 2001 was to show that this technique is useful for detecting swift fox in Nebraska. Additional surveys should now be targeted at areas believed to constitute the periphery of swift fox range in Nebraska.

Final Report of Investigations of Swift Fox Survey Methods, Demography, and Ecology in New Mexico

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SUMMARY

A three-year study of swift fox (*Vulpes velox*) population survey methods and ecology in northeastern New Mexico has been completed. For presence/absence surveys, the most efficient method is collection of scat, followed by verification of species depositing scat with DNA analysis. Using scat, the detection rates of swift foxes at individual locations was 61.9% and 67.7% during surveys in 2000 and 2001, which were greater than the detection rates using scent stations (31.4% , 47.1%) or trapping (11.5%, 8.4%). We detected swift foxes using scat in 100% of the fox home ranges within the study area. Transects of three scent stations per home range operated for three nights detected swift foxes on as many as 95% of transects, depending upon fox density. Searching for tracks, spotlighting, and calling are much less efficient methods. For absolute abundance surveys, trapping and resighting with cameras was more accurate than counting unique microsatellite DNA genotypes from collected scats. Counting genotypes produced population estimates that were much greater than estimates produced from trapping/resighting, due to unavoidable errors in determining unique genotypes.

Swift fox demography and ecology in northeastern New Mexico was similar to that reported from other areas, although descriptive statistics usually fell closest to those studies conducted where swift fox density was low. The density of swift foxes was 0.105 fox/km^2 in early 2000, and 0.070 fox/km^2 in early 2001. Juveniles comprised the most numerous age class. The average number of pups observed per female was 2.3. Male and female radiocollared swift foxes reached adult weights by at most 9 and 5 months, respectively. For swift foxes within the adult weight range, body length, body plus tail length, hind foot length, and weight were larger in males than females. Body size measurements were generally as large or larger, and weights were smaller, than those reported from other areas. Traumatic injury, presumably by coyotes (*Canis latrans*), was the primary cause of death. Annual survival rates for adults averaged 0.53. Of 36 swift foxes captured during the study, four remained alive on the study area, 21 died, and 11 left the study area by the end of 32 months of field work. No fox lived long enough or was observed enough for home range size estimates to stabilize. The 95% MCP home range size estimate, using all points for foxes with $\geq$60 relocation points, was 1842.3 ha. The annual 95% MCP home range size estimate was 1494.5 ha. Diet was dominated by invertebrates and mammals. At den sites, swift foxes showed preferences for the vicinity of roads, areas with greater road density, low slope, hilltops, and sandy loam and clay soils, when compared with random points. Swift foxes did not show preferences regarding proximity of anthropogenic sites nor soil water holding capacity.

INTRODUCTION

The swift fox occurs in the eastern one-quarter of New Mexico (Finldey 1975, Harrison and Schmitt 1997). There were no studies of swift fox in New Mexico prior to listing as a candidate for endangered species status (Potter 1982). In response to candidacy and the strategy of the Swift Fox Conservation Team (Kahn et al. 1997), the New Mexico Department of Game and Fish initiated a series of studies, including a review of the status of swift fox in New Mexico (J. P. Hubbard 1994, unpublished report to NMDGF), a survey of swift fox distribution and habitat selection (Harrison and Schmitt 1997), and the current study. Using radiocollared swift foxes, we examined relative and absolute abundance survey methods, including collection of scat followed by species confirmation and counting of individuals by genotypes, scent-stations, trapping, track surveys, spotlighting, calling, and mark/resighting using cameras at bait stations. We also examined swift fox demography, home range size, dispersal, den site selection, and diet. We submitted manuscripts for publication to American Midland Naturalist (R. L. Harrison, D. J. Barr, and J. W. Dragoo, Population Survey Methods for Swift Fox in New Mexico), and The Southwestern Naturalist (R. L. Harrison, Swift fox demography, movements, denning, and diet in New Mexico). Below we present the main results of our study. Additional details are available from the authors or in the complete manuscripts.

STUDY AREA AND METHODS

The study area and methods have been described in detail previously (Harrison 2000). Briefly, the study area was located in northeastern New Mexico, in the Kiowa National Grasslands northeast of Roy, NM, in Harding and Colfax counties. Habitat within the study area was entirely shortgrass prairie. Dominant plant species were blue grama (*Bouteloua gracilis*) and hairy grama (*B. hirsuta*). Annual precipitation averages 390 mm, and was 395, 427, and 381 mm in 1998, 1999, and 2000, respectively. Growing season precipitation averages 37.4% of annual precipitation, and was 55.5%, 31.6%, and 33.8% of annual precipitation in 1998, 1999, and 2000, respectively. The entire study area is heavily grazed and cattle are present throughout the year.

We trapped swift foxes during three intensive trapping sessions, one at the beginning of the study (Jan. - Mar., 1999), and two at the beginning of each absolute abundance survey. We conducted two absolute abundance surveys: Sep., 1999, - Feb., 2000 (2000 survey); and Dec. - Mar., 2001 (2001 survey). Captured foxes were radiocollared and a unique portion of their fur was dyed for visual identification.

We placed scent stations in transects of five evenly spaced stations within the known home ranges of radiocollared foxes. We placed automatic cameras with active infrared sensors (Trailmaster 1500 with TM 35-1 camera kit and Tm1500 Photo System, Goodson & Associates, Lenexa, KS) at scent stations to identify visiting foxes. We collected scat during systematic surveys of conspicuous locations, such as road, fence, and trail intersections, along roadways. We determined the species depositing scat and the number of individual swift foxes present using mitochondrial and microsatellite DNA analysis, respectively. To verify genetic techniques, we obtained matching blood and scat samples known to originate from the same individual, from captive swift foxes held at the Northern Prairie Wildlife Research Center, Jamestown, ND.

We searched for tracks along unpaved roads on foot, while slowly driving a vehicle, and while collecting scat. One person attempted to spotlight radiocollared foxes with one 1,000,000 candlepower spotlight, while driving slowly through their home ranges. We also attempted to call foxes within visual or audible range using prerecorded tapes of rabbit distress calls and swift fox vocalizations.

Following the intensive trapping sessions, we estimated the absolute abundance of swift foxes by resighting radiocollared foxes and locating uncollared foxes with automatic cameras using active infrared sensors (above) placed at stations baited with canned mackerel and a lure (cod liver oil - mackerel mixture, Trailing Scent, On Target A.D.C., Cortland, IL).

To compare the efficiency of trapping, scent stations, and scat collection for detecting the presence of swift foxes, we used data from those locations where all three methods were used during the absolute abundance surveys. We used visitation to bait/camera stations as a surrogate for visitation to scent stations. Due to logistic restraints, we were unable to operate scent stations during times of absolute abundance surveys. There are compensating factors when using bait/camera stations as surrogates for scent stations. The detection rates observed at bait/camera stations might have been greater than what would have been observed at scent stations in a statewide survey, because of the presence of bait and because it was not necessary for a fox to step within the area of the prepared tracking surface. We used bait in addition to a lure in order to avoid habituating study foxes to the smell of the lure. In statewide surveys, foxes would likely be attracted to a novel lure, but foxes within the study area were tested repeatedly and might have responded less to the same lure over time. However, some foxes may have been frightened by the appearance or sounds of the camera units, and may have been unwilling to approach close enough or for long enough to be photographed. At scent stations these detractions would not be present.

Age of recovered dead swift foxes was determined by Matson's Laboratory (Milltown, MT), using tooth cementum analysis. To determine fecundity, we counted the number of pups visible at dens of females in early summer and counted placental scars on uteri collected from recovered dead radiocollared females. Cause of death was determined by observations in the field or by necropsy. If foxes died due to non-vehicle traumatic injuries, we assumed that the agent was a coyote, as coyotes were present on the study area. Other potential predators, such as badgers (*Taxidea taxus*) and golden eagles (*Aquila chrysaetos*) were uncommon. We estimated survival rates using a Kaplan-Meier estimator with a staggered entry design (Pollock et al. 1989). To determine the minimum number of relocations required for home range size estimates to stabilize, we calculated cumulative home range sizes at intervals of 10 points. To obtain average annual home range sizes, we calculated one-year home range size estimates, advancing the one-year interval by two months through the period of observation for each fox.

We located den sites during all months of the year by radiotracking swift foxes to their dens. All dens where characteristics were recorded were occupied by swift foxes. We used a stratified random design to locate non-den random points for comparison of site characteristics. Dr. M.

Johnson (Louisiana State University) performed identification of prey items in scat to lowest taxonomic division possible using reference collections.

RESULTS

We captured 34 swift foxes plus 20 recaptures in 804 trap nights (4.2% without recaptures, 6.7% with recaptures). We captured three additional foxes in enclosure traps at dens. There were significant differences of capture success between periods without recaptures (X^2 = 11.163, v = 6, P = 0.087), with fall and early winter producing the greatest success. We radiocollared 36 foxes (18 males, 18 females).

Scent-station tests were conducted in the home ranges of 14 radiocollared foxes (ten males, four females) for 420 station-nights. Seventy-five percent of stations were visited within four nights. Percent of transects visited leveled off after three nights for radiocollared and uncollared foxes combined (Fig. 1), but did not level off for radiocollared foxes only (Fig. 2).

During the 2000 population survey period, we surveyed 40.5 km of roadways, examined 48 potential scat sites, and found scat at 36 of those sites (75.0%). Of 194 scat collected, 141 (72.7%) were identified as swift fox. The median number of scat collected within a single swift fox home range was 21.5 (range 8 - 63). During the 2001 survey period, we surveyed 37.6 km of roadways, examined 39 potential scat sites, and found scat at 25 of those sites (64.1%). Of 137 scat collected, 89 (65.0%) were identified as swift fox and 4 (2.9%) were identified as coyote. The median number of scat collected within a single home range was 8.5 (range 3 - 66). We found scat that was identified as swift fox within all known swift fox home ranges and within all gaps between known home ranges where foxes had not been trapped. Home ranges were not equally surveyed, as the survey routes passed through the central portions of some ranges and peripheries of others.

Scats not identified as swift fox or coyote could not be identified to species due to unclear sequences or lack of PCR product. There were no obvious visual differences of color or size between identified and unidentified scats. The average maximum diameter of scats identified as swift fox (0 = 13.9 mm, SD = 2.8 mm, n = 206) was not different from the average diameter of unidentified scats (0 = 13.6 mm, SD = 2.8 mm, n = 81; *t* = 0.924, df = 285, P = 0.356).

We observed only one clear swift fox track on an unprepared surface during the study. No swift fox tracks were observed during 12.8 km of foot surveys along roads within the home ranges of three swift foxes, during scat surveys, nor during 31 km of road surveys by. We spotlighted for 187 km through the home ranges of $\geq$15 foxes in May - Jul., 1999. No foxes were seen. We made 11 attempts to call radiocollared foxes into visual or audible range in Apr. and May, 1999, and Jan., 2000. One fox responded to swift fox vocalizations by approaching the vehicle and vocalizing. No other foxes responded even though telemetry indicated they were within range of the sounds. The only homeowner within range of the calls was disturbed by the sounds.

During the 2000 and 2001 resighting periods, 15 and 13 radiocollared swift foxes, respectively, were available. In the period Nov. 22, 1999, to Jan. 30, 2000, the estimated population in the study area was 23.9 swift foxes (95% confidence interval: 17.8 - 30.0). During Feb., 2000, the estimated population in the study area was 18.6 swift foxes (95% confidence interval: 11.9 - 25.3). During the period Jan. 14 to Mar. 21, 2001, the estimated population in the study area was 16.2 swift foxes (95% confidence interval: 15.2 - 17.3). Based upon an average fall/winter 95% minimum convex polygon home range diameter of 4.2 km in during the 2000 survey and 4.5 km during the 2001 survey (n = 4 and 8 swift foxes, respectively), the area surveyed was 227.5 km^2 in 2000 and 231.3 km^2 in 2001. The average swift fox density was 0.105 foxes/km^2 in Nov.,1999, to Jan., 2000 (95% C. I. 0.078 - 0.132) and 0.070 foxes/km^2 in Jan. - Mar., 2001 (95% C. I. 0.066 - 0.075). We found 63 and 27 unique genotypes from the 2000 and 2001 scat surveys, respectively. Of these, 10 genotypes appeared in both surveys.

At locations where traps, bait/camera stations, and scat searches were located at the same site, trap success was 11.5% in 1999/2000 (95% C. I. 6.6 - 18.0%; n = 139 trap-nights) and 8.4% in 2000/2001 (95% C. I. 3.7 - 15.9%; n = 95 trap-nights). Visitation rate to bait/camera stations was 31.4% in 2000 (95% C. I. 23.1 - 40.7%; n = 118 station-nights) and 47.1% in 2001 (95% C. I. 36.9 - 57.2%; n = 102 station-nights). At least one scat identified as swift fox was found at 61.9% of locations in 2000 (95% C. I. 38.5 - 81.9%; n = 21), and at 66.7% of locations in 2001 (95% C. I. 43.0 - 85.4%; n = 21). Detection rates for the three methods were not the same in 2000 ($X^2 = 32.157$, v = 2, $P < 0.001$), nor in 2001 ($X^2 = 64.32$, v = 2, $P < 0.001$). In both surveys, detection by scat collection was greater than by bait/camera stations (2000: q = 7.34, $P < 0.001$; 2001: q = 4.56, P = 0.004), and detection by bait/camera stations was greater than detection by trapping (2000: q = 11.122, $P < 0.001$; 2001: q = 18.06, $P < 0.001$).

Juveniles comprised the most numerous age class when captured, at death, and at the time of the maximum number of study animals alive (May, 1999; Fig. 3). Male and female radiocollared swift foxes reached adult weights by at most 9 and 5 months, respectively. The average number of pups observed at dens in June was 2.2 (Range 1 - 4, n = 5). Anecdotal reports from local residents indicate that 2 - 3 pups are commonly seen with females in June. The number of placental scars observed on 4 uteri from radiocollared swift foxes was 0 (juvenile fox), 4 (1 year old fox), 2 (2 year old fox), and 4 (6 year old fox). Placental scars appeared as obvious black spots in the horns of the uteri. No faded scars from previous years were seen.

Observed causes of mortality of radiocollared swift foxes were: non-vehicle traumatic injury (6 adult males, 4 adult females, 4 juvenile females, 1 female of unknown age), vehicle strikes (1 radiocollared adult of unknown sex reported by a motorist, 2 uncollared adults, and 2 uncollared pups), trapping (1 juvenile male), and unknown (2 adult males, 2 adult females, 1 juvenile female).

Confidence intervals for survival estimates were too wide to draw statistical conclusions, but estimates for males appeared to be higher than for females (Table 1). Calculations of juvenile survival were not made because of bias from the circumstance that the only swift foxes known to be juveniles when captured were those that died and were submitted for cementum analysis. Other foxes that left the study area before death may have been juveniles when captured. Of the swift foxes known to be juveniles when captured, three of ten survived to become adults.

Of 36 swift foxes captured during the study, only 4 (2 adult males, 2 adult females) remained alive on the study area at the end of 32 months of field work. These four foxes were initially captured 8-22 months before the end of the study. Of the other 32 foxes, 21 (8 males, 13 females) died in the study area, and 11 (8 males, 3 females) left the area.

Swift fox were located 1427 times (range of locations/fox: 1-154). No fox lived long enough or was observed enough for home range size estimates to stabilize (Fig. 4). Cumulative home range size estimates reached a peak around 60 points, but loss of study foxes to death or emigration reduced the number of animals relocated >60 times. Home range size estimates using all points obtained for foxes with ≥60 relocation points (n = 8: 5 males, 3 females) were: 95% adaptive kernel (AK), 2722.4 ha (range: 1881-3854 ha); 50% AK, 534.4 ha (range: 427-710 ha); 95% minimum convex polygon (MCP), 1842.3 ha (range: 1304 -2298 ha); and 50% MCP, 510.0 ha (range: 311-779 ha). Annual home range size estimates for five males and one female combined were: 95% AK, 2191.9 ha (range: 1428-3735 ha); 50% AK, 465.6 ha (range: 308-796 ha); 95% MCP, 1494.5 ha (range: 1004-2210 ha); and 50% MCP, 339.7 ha (range: 206-625 ha).

The average distance of den sites (n = 106) to the nearest road, whether primary or secondary, was less than the average distance of random points (n = 106; Table 2). The average lengths of secondary roads within 1 and 2 km of den sites were greater than the average lengths within 1 and 2 km of random points (Table 2). The average slope at den sites was less than at random points (Table 2). The directions of slope aspect at den sites were not distributed differently than at random points (X^2 = 21.104, df = 105, P > 0.999). Swift foxes preferred den sites with western slope aspects. The distribution of positions of den sites on hillsides was not the same as the distribution of random points (X^2 = 11.584, df = 2, P = 0.004). Most dens and random points were in the middle of hillsides, but den sites were located toward the tops of hillsides more than random points.

Among those six soil textures found at >5% of den sites or random points, the distribution of soil textures was not the same at den sites and random points (X^2 = 19.005, df = 5, P = 0.003). Dens were found in soils with less clay, more sandy loam, and probably more loam, than soils at random points. Average soil water capacity at den sites (0 = 0.171 cm water/cm depth) was not different from average soil water capacity at random points (0 = 0.176 cm water/cm depth; t = -1.310, df = 210, P = 0.192).

In scat, percentage frequency of prey was dominated by invertebrates and mammals (Table 3).

DISCUSSION

The most efficient technique for determining presence/absence or relative abundance of swift fox in New Mexico is collection of scat followed by species verification using DNA analysis. In our study area, scat were easily found, especially when an accumulation was present. We were able to find scat in areas where we had no evidence of swift foxes from other techniques, such as trapping or bait/camera stations. Extracting mitochondrial DNA from scats for species identification is relatively straight forward, depending on the quality of the scat sample. It may require multiple extractions in order to obtain DNA for PCR and sequencing. Using scat, the rate of detection of swift fox within known and probable home ranges was 100% in both the 2000 and 2001 surveys. At the level of individual stations, the swift fox detection rate by scat collection was greater than both scent stations and trapping in both 2000 and 2001. Our results were based upon visual examination of conspicuous locations along the survey route and collection of every scat sighted. We simply collected the scat available and made no effort to ensure that the scat sample was fresh. It was not necessary in our area to use more intensive methods of locating scat (Smith et al. 2001). Sovada and Roy (1996) reported detection rates of 30 - 70% when collecting scat along walking transects on roads within the home ranges of radiocollared foxes. They cleared all scat from transects two weeks prior to surveys, and thus their detection rates may have been much higher if they had used all scat available. Olson et al. (1997) reported a detection rate of 66% when collecting scat on walking 1 km transects within the cores of known swift fox home ranges in Wyoming. Neither Sovada and Roy (1996) nor Olson et al. (1997) verified the species depositing their scat. It is important to verify the species depositing scat, as the diameters of scat of several species overlap. Approximately 60% of the coyote scat samples collected by Danner and Dodd (1982) and 32% of the coyote samples collected by Green and Flinders (1981) had diameters between 10 and 20 mm, overlapping 96% and 41%, respectively, of the scat we identified as from swift fox. Also, the range of diameters of red fox (*Vulpes vulpes*) scat collected by Green and Flinders (1981) is exactly the same (8 - 20 mm) as we found for swift fox.

The number of scat that must be collected to verify presence/absence in a given area depends primarily upon the success of DNA extraction. In our study, collection of at least 10 scat from each site would have been adequate for confirming the presence of swift fox at 98% of sites examined.

Scent station transects are the second most efficient presence/absence-relative abundance technique. Depending upon fox density and level of effort, detection rates varied from 20 - 100% (Fig. 1, 2). Detection rates decreased when the sample based upon all observed foxes (Fig. 1) was reduced to radiocollared foxes only (Fig. 2), indicating that visitation rates will respond to fox density. Schauster (2001) also found that scent-station detection rates correlated consistently with swift fox density. Using transects of four stations placed 0.3 km apart and observed for 7 nights within the core areas of swift fox home ranges, Olson et al. (1999) observed detection rates of 66 - 88%. Using transects of 16 stations placed 0.5 km apart and observed for 3 nights, Sovada and Roy (1996) observed detection rates of 10 - 70%, or 100% if survey periods were combined.

In our study, swift fox detection rate on transects of scent stations was nearly maximized at three nights for all foxes and four nights for radiocollared foxes only. Given the observed swift fox home range size of approximately 2200 ha and assuming circular home ranges, placing five 5, 4, 3, 2, or 1 station in each home range requires a spacing between stations of 1.0, 1.3, 1.7, 2.6, or ≥ 5.2 km, respectively. In practice, the number of stations that may be set will likely be limited by the time available and size of the area to be surveyed. For range-wide surveys in New Mexico, scent station transects consisting of stations spaced at 1.6 km (1.0 mi) intervals and operated for three nights appear to be the most practical. For more intensive examination of specific areas, operation for an additional night would produce approximately the same increase in percent detection as decreasing the spacing to 1.3 km.

Track, spotlight, and calling surveys are not efficient techniques in New Mexico. Precipitation is too irregular and soils in general are too hard and dry to take and hold identifiable swift fox tracks. Harrison and Schmitt (1997) spotlighted one fox per 550 km when surveying the entire range of swift fox in New Mexico. Sovada and Roy (1996) reported spotlighting detection rates of 16 - 32% for radiocollared swift foxes in Kansas. Calling is limited by wind noise, and the potential to disturb homeowners must be considered.

Scat surveys are the most costly of the presence/absence methods examined here. We estimate the cost to survey the complete swift fox range in New Mexico, including obtaining and analyzing a sample of 200 - 400 scats from 90 transects, to be $20,000. - $30,000. Scent-station and trapping surveys require similar levels of effort, and we estimate the cost of a scent-station or trapping survey conducted over four nights to be $15,000. The field time required for a scat survey would be at most two months, whereas the time required for scent-station or trapping surveys conducted over four nights could be as great as 6 to 10 months.

The absolute population size estimates obtained from microsatellite genotypes were considerably higher than those obtained from bait/camera stations. Kohn et al. (1999) also reported a genotype population estimate higher than a population estimate obtained from a conventional survey method (trapping). Two factors may lead to overestimating the number of unique genotypes, and hence individual swift foxes, present. First, scat samples provide nuclear DNA of low quality and quantity, resulting in allelic drop-out, amplification of contamination from other sources, and incomplete amplification, leading to overestimation. Errors in assigning genotypes are difficult to avoid and can affect population estimates dramatically (Waits and Leburg 2000). We have confirmed the prediction of Waits and Leburg (2000) that population estimates based upon genotypes may be much greater than estimates based upon conventional methods. Second, scats may remain recognizable for several months (Kohn et al., 1999). The number of transient foxes included in the microsatellite population estimate potentially includes all those passing through the study area within several months, and not just those foxes present in the survey area when the survey was conducted.

To estimate the absolute abundance of swift fox in New Mexico, transects of bait/camera stations or scat surveys could be used to generate local density estimates, which could be extrapolated to fill available habitat. Assuming that 90 transects and 50 camera units were used or 200 - 400 scat collected, we estimate the cost of one trapping and resighting survey to be approximately $90,000, and one scat survey including microsatellite identification of individuals to be approximately $30,000 - $50,000.

Swift fox age distribution, fecundity, survival, and causes of mortality in northeastern New Mexico were similar to those reported from other areas. Body size measurements of swift foxes in the study area were generally as large or larger, and weights were smaller, than those reported from other areas. Home range sizes of swift foxes in our study area were considerably larger than reported from other areas (Southeastern Colorado: 660 - 940 ha, 95% AK, Kitchen et al., 1999; Schauster, 2001; northeastern Colorado: 430 ha, MCP, Roell, 1999; north-central Montana: 1230 ha, AK, Zimmerman, 1998), with the exception of that reported from Nebraska (3230 ha, MCP, Hines and Case, 1991). Length of observation and number of relocation points were comparable between studies. Accurately estimating home range size for swift fox is made difficult by the dynamic nature of swift fox populations. Many foxes did not live long enough or remain in the study area long enough for home range estimates to stabilize (Fig. 4). In addition, we observed that swift foxes used new areas and abandoned previously used areas throughout the period of observation. Standardization of periods of observation would make comparisons more meaningful. Annual home range estimates may be the most useful and biologically relevant.

The density of swift fox in northeastern New Mexico was lower than reported in other studies. Schauster (2001) reported a swift fox density of 0.18 - 0.30 in southeastern Colorado, Roell (1999) reported a swift fox density of 0.27 fox/km^2 in northern Colorado, and Dieni et al. (1996) reported a swift fox density of 0.16 fox/km^2 in Wyoming.

Swift fox den site selection in northeastern New Mexico was completely consistent with that reported from other areas (see review in Harrison and Hoagland, in press). Swift foxes denned in a variety of situations, but did show some preferences. They preferred sites closer to roads and areas with more secondary roads than random points. Swift foxes showed a preference for den sites of low slope, near the tops of hills, and in sandy loam, clay, or loam soil. Swift foxes preferred den sites with western slope aspects. Other studies have reported non-random slope aspects at dens, but there has been no consistent pattern in the directions preferred.

The swift fox population in NM appears to be very dynamic. Swift foxes generally lived no more than a few years, and there was rapid turnover of the population. In three home ranges, all the radiocollared foxes dispersed or were killed, presumably by coyotes, within a few months. The same three home ranges were occupied by new swift foxes within a few months. Thus, home ranges may be completely vacated and reoccupied very rapidly. Coyotes are themselves subject to heavy mortality from ranchers and U. S. Dept. of Agriculture Wildlife Services agents. In addition, precipitation in New Mexico varies, sometimes dramatically, from year to year. The tracks of individual thunderstorms can provide heavy rains within some home ranges, and no rain in others, prompting variations in growth of vegetation and intensity of grazing. Prey density and swift fox populations probably follow precipitation patterns, as has been found in kit fox (Cypher et al., 2000).

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Table 1. Estimates (S) and upper and lower confidence intervals of survival of swift fox in northeastern New Mexico.

	S	Lower C. I.	Upper C. I.
August 1, 1999, - August 1, 2000			
All adults	0.64	0.37	0.90
Adult males	0.74	0.43	1.00
Adult females	0.38	0.00	0.79
August 1, 2000, - August 1, 2001			
All adults	0.41	0.13	0.69
Adult males	0.44	0.07	0.82
Adult females	0.38	0.00	0.79

Table 2. Characteristics of den sites of radiocollared swift foxes and random points (points) located within the home ranges of radiocollared swift foxes in northeastern New Mexico. [a] $P \leq 0.05$. Additional den site characteristics are described in **RESULTS**.

	n	0	SD	Minimum	Maximum	*t*	df	P
Distance (km) to nearest anthropogenic site:								
Dens	106	1.05	0.59	0.12	3.00	1.059	210	0.291
Points	106	0.96	0.56	0.05	3.20			
Distance (km) to nearest primary road:								
Dens	106	0.66	0.59	0.00	3.11	-1.300	210	0.197
Points	106	0.77	0.65	0.14	3.01			
Distance (km) to nearest road, whether primary or secondary:								
Dens	106	0.37	0.36	0.00	1.44	-2.820	210	0.005 [a]
Points	106	0.51	0.34	0.00	1.40			
Distance (km) to nearest secondary road, if a secondary road was closer than the nearest primary road:								
Dens	39	0.36	0.33	0.00	1.32	-0.707	67	0.482
Points	30	0.41	0.25	0.00	1.07			
Length (km) of primary roads within 1 km:								
Dens	106	1.45	1.13	0.00	3.47	1.790	210	0.075
Points	106	1.19	1.04	0.00	3.59			
Length (km) of primary roads within 2 km:								
Dens	106	4.71	1.88	0.00	8.86	0.686	203	0.494
Points	106	4.51	2.26	0.00	13.20			
Length (km) of secondary roads within 1 km:								
Dens	106	0.90	0.87	0.00	2.99	4.102	188	< 0.001 [a]
Points	106	0.48	0.61	0.00	2.87			
Length (km) of secondary roads within 2 km:								
Dens	106	2.63	1.51	0.00	6.95	5.145	210	< 0.001 [a]
Points	106	1.56	1.52	0.00	8.02			
Slope (%):								
Dens	106	2.63	2.23	0.00	12.70	-1.997	196	0.047 [a]
Points	106	3.35	2.93	0.00	25.50			

Table 3. Percent frequency of prey remains in swift fox scat in northeastern New Mexico. (Additional scat will be examined and identifications will be taken to lower taxonomic levels in the published manuscript.)

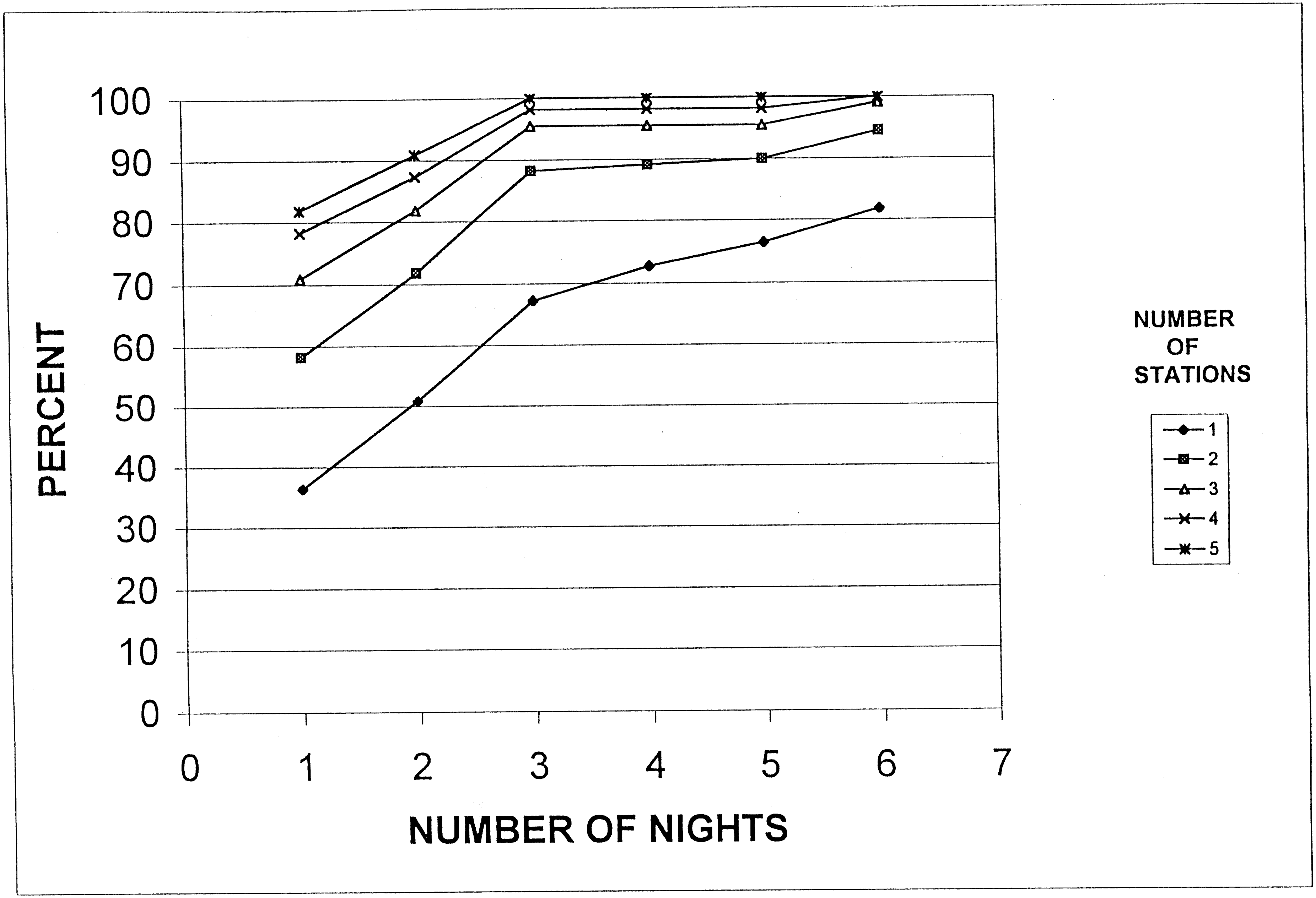
	Annual	Spring	Summer	Fall	Winter
Scat sample size	385	148	45	50	142
Mammals	45.7	33.8	51.1	40.0	54.9
Heteromyidae					
Dipodomys	22.0	20.9	17.8	22.0	24.6
Perognathus	2.3	2.0	2.2	6.0	1.4
Muridae					
Microtus	3.6	1.4	6.7	10.0	2.1
Neotoma	0.3	0.0	0.0	0.0	0.7
unidentified	2.3	1.4	8.9	2.0	1.4
Sciuridae					
Spermophilus	0.8	1.4	0.0	0.0	0.7
Leporidae	11.4	5.4	4.4	0.0	23.9
Unidentified	0.5	1.4	0.0	0.0	0.0
Invertebrates	72.6	80.4	75.6	82.0	62.0
Coleoptera	16.0	12.2	51.1	22.0	7.7
Diptera	0.5	0.7	0.0	0.0	0.7
Orthoptera	56.1	67.6	24.4	60.0	53.5
Birds	19.6	26.7	37.8	16.0	7.0
Passeriformes					
Sturnella	0.3	0.7	0.0	0.0	0.0
unidentified	1.8	2.7	0.0	0.0	2.8
Piciformes	0.8	0.0	0.0	0.0	2.1
Unidentified	16.8	23.6	37.8	16.0	2.8
Carrion					
Antilocapra americana	0.8	0.7	2.2	0.0	0.7
Vegetation					
grass	2.8	4.0	0.0	2.0	1.4
unidentified seeds	0.3	0.0	0.0	0.0	0.7
Reptiles					
Serpentes	0.3	0.0	4.4	0.0	0.0
Feces					
rabbit pellets	1.3	0.7	2.2	0.0	2.1
rodent pellets	0.3	0.0	0.0	0.0	0.7
Other					
paper & string	0.6	0.7	0.0	0.0	0.7
sand	3.6	4.0	15.5	2.0	0.0

Figure 1. Percent of transects of scent stations visited by radiocollared and uncollared swift foxes combined as a function of number of stations per home range and number of nights of observation.

Figure 2. Percent of transects of scent stations visited by radiocollared swift foxes only as a function of number of stations per home range and number of nights of observation.

Figure 3. Age distribution of radiocollared swift foxes in New Mexico when captured (n = 20), at death (n = 20), and at the time of maximum number of study animals alive (May, 1999; n = 16).

Figure 4. Average adaptive kernel and minimum convex polygon home range size of swift foxes in New Mexico as a function of number of relocation points. The sample size of foxes is also indicated. .


PERCENT
100
90
80
70
60
50
40
30
20
10
0
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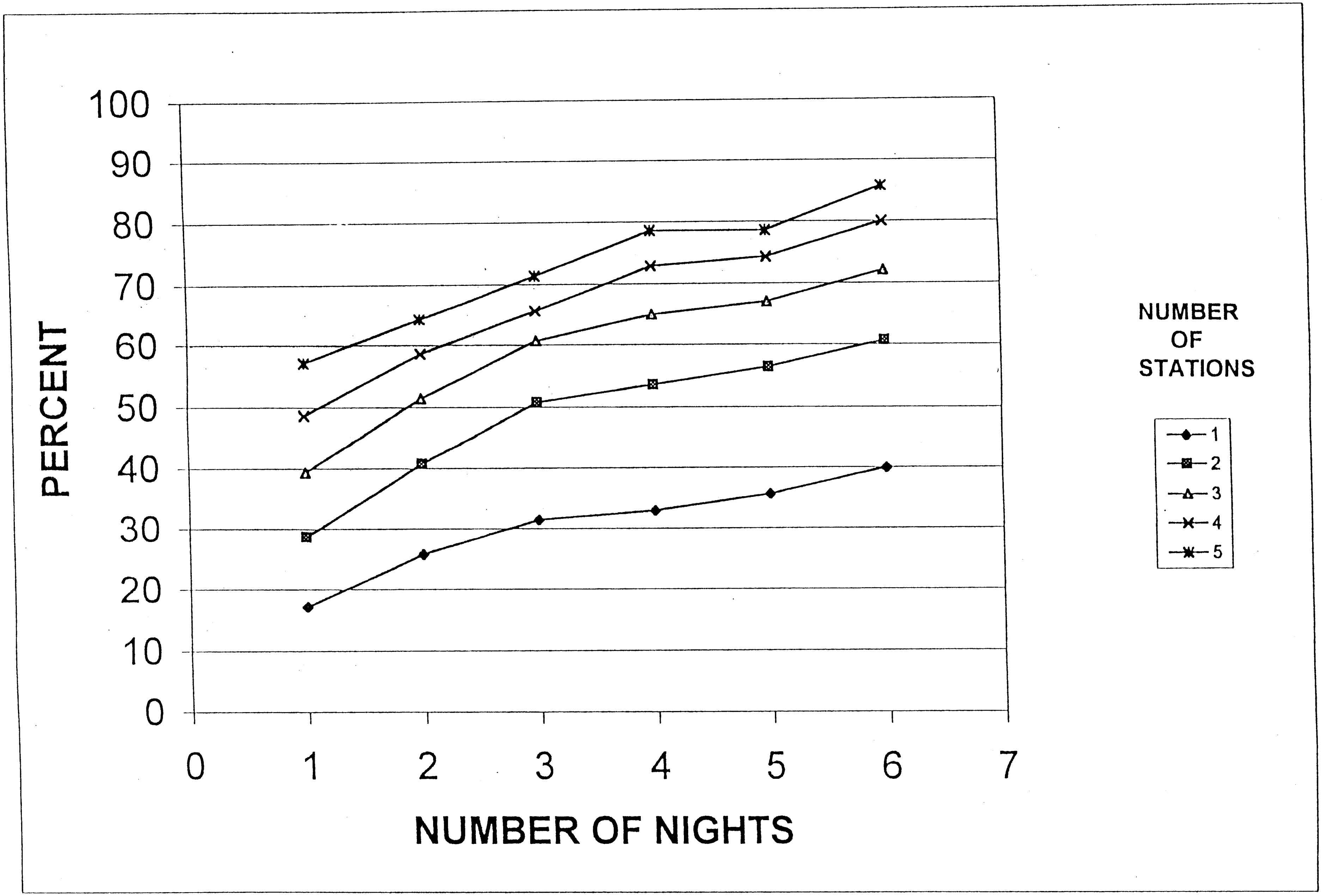
1
2
3
4
5
6
7
NUMBER OF NIGHTS
NUMBER
OF
STATIONS
1
2
3
4
5

Figure 1.


100
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NUMBER OF NIGHTS
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Figure 2.

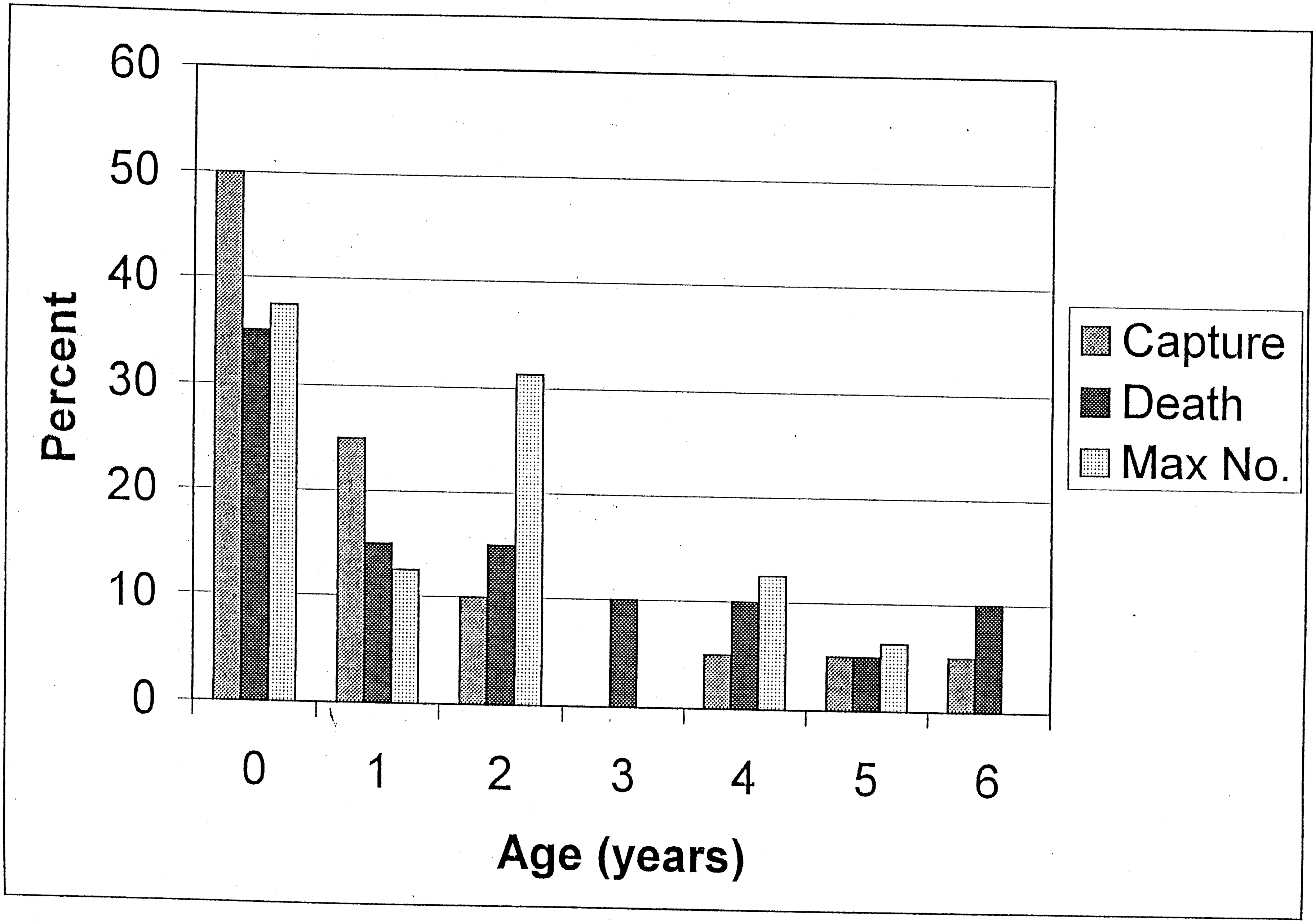
Percent
60
50
40
30
20
10
0
Capture
Death
Max No.
0
1
2
3
4
5
6
Age (years)

Figure 3.

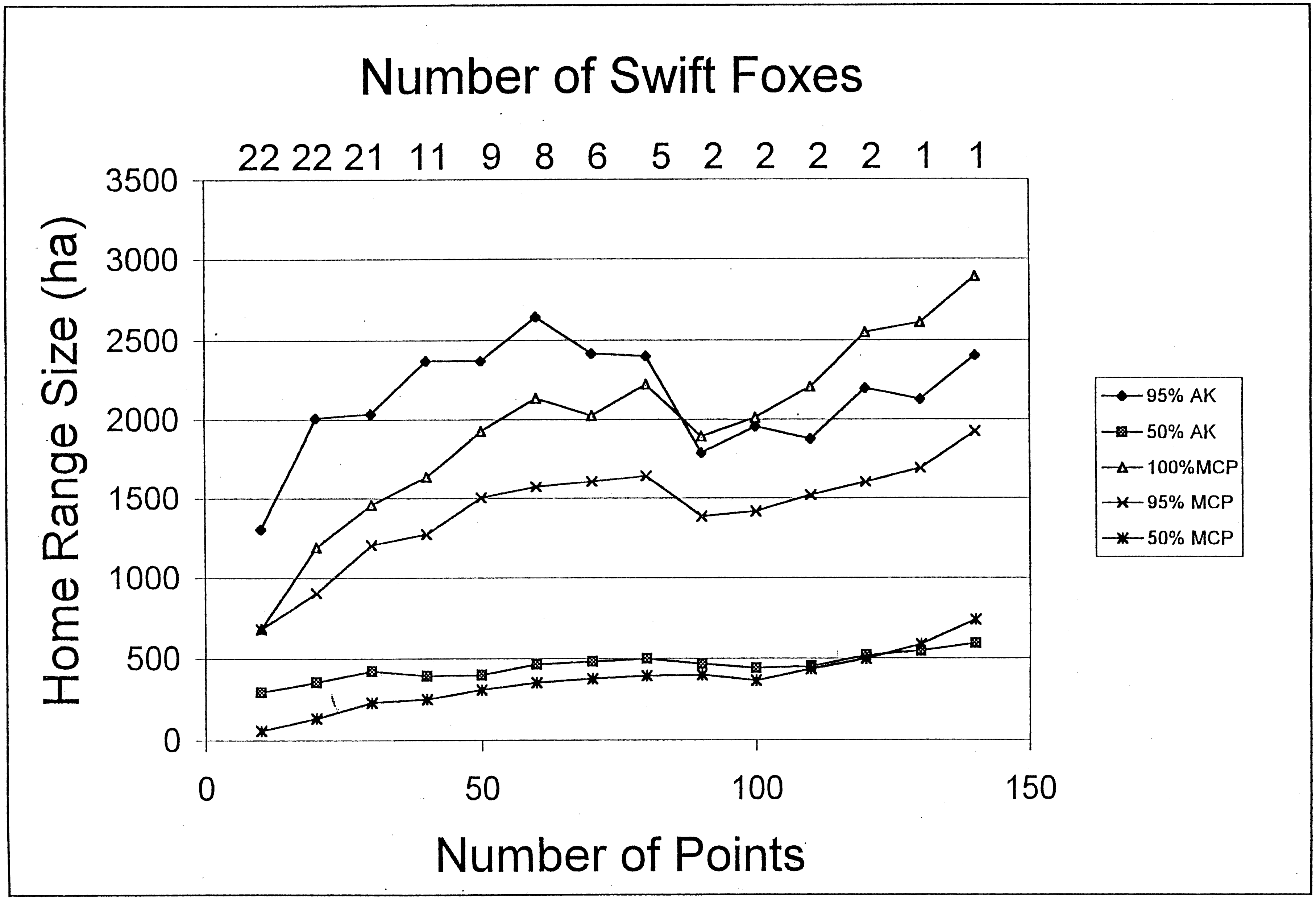
Number of Swift Foxes
22 22 21 11 9 8 6 5 2 2 2 2 1 1
Home Range Size (ha)
3500
3000
2500
2000
1500
1000
500
0
0
50
100
150
Number of Points
95% AK
50% AK
100%MCP
95% MCP
50% MCP

Figure 4.

SWIFT FOX INVESTIGATIONS IN NORTH DAKOTA, 2000

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Due to the Furbearer Biologist position being vacant with the ND Game and Fish Department, no swift fox related activities were conducted in 2001, however, track surveys will resume in 2002. Below are belated results from the 2000 track survey.

ABSTRACT

Track surveys were conducted on randomly selected sections of land, and optimal quarter-sections within those sections were selected on site for surveying (n = 28). Furbearer occurrence was determined by identifying tracks to species. No swift fox were detected. Presence of red fox, coyote, striped skunk, and raccoon were determined. Differential reporting rates for red fox and coyote harvests and confirmed swift fox observations indicate swift fox exist at extremely low densities if at all in North Dakota.

INTRODUCTION

Swift fox (*Vulpes velox*) were common in North Dakota during pre-settlement times (Bailey 1926, Thwaites 1953); however, the species became very rare about 1880-1900 (Bailey 1926). Swift fox are known to be very rare in North Dakota; however, data are being collected annually with which to make inference concerning the occurrence of the species. Since 1970 we have obtained 4 confirmed observations of swift fox in North Dakota. Initially southwestern North Dakota has been selected for study, because of occasional reports of possible swift fox in these areas. The objective of this report is to present the results of the track survey to determine relative occurrence of all furbearer species in this area with special reference to swift fox.

STUDY AREA AND METHODS

Track surveys were conducted in southwestern North Dakota in 2000. The area is characterized by semi-arid prairie grassland with cropland and hayland intermixed. Topography is generally rolling grassland to rough broken badlands; native hardwoods trees and shrubs occur in many of the deeper coulees. Climate in North Dakota is typical of sub-arctic continental interiors with hot summers and cold winters.

Track surveys were conducted to determine relative occurrence of furbearers in each quarter-section surveyed, with special reference to swift fox. The survey was modified from one developed by Sargeant et al. (1993). Timing of the survey minimizes errors in correctly identifying species caused by movement of young, especially in the canids.

Sections were selected randomly for study; within each section one quarter-section study area was selected at the site, which had the best potential for identifying furbearer tracks. Some randomly selected sections had to be relocated to improve field logistics due to remoteness and inaccessibility of some of the original selections or proximity to human habitations. All study areas were surveyed no sooner than 48 hours after a rain. The search pattern consisted of visiting as many locations on each study area as possible on foot within 30 minutes that had potential to reveal furbearer tracks.

Data collected for each quarter-section visited consisted of relative abundance of tracks identified by species (none, scarce, common, abundant), predominant cover type (pasture, hayland, cropland, marsh, idle), relative amount of available track sites (many, moderate, few, almost none), relative soil condition for holding tracks (excellent, good, fair, poor), and the track accumulation period (1 day, 2-3 days, 4-6 days, 7 or more days). Coyote and red fox tracks were distinguished based on size (Allen, unpubl. data). Swift fox tracks are easily distinguished from other canids, because they average about 10 mm shorter than the smallest red fox tracks (Orloff et al. 1993). Data analysis consisted of examining the number of study areas with furbearer track occurrence by species. Population changes and trends are being monitored by spring surveys and computer population modeling.

RESULTS

During the 2000 track survey, 28 quarter-sections were searched for swift fox and other furbearer tracks. Relative occurrence of furbearer species identified (Table 1) consisted of coyotes (*Canis latrans*-18 areas), red fox (*Vulpes vulpes*-2 areas), raccoon (*Procyon lotor*-7 areas), skunk (*Mephitis mephitis*-3 areas), and mink (*Mustela vison*-2 areas). No swift fox tracks were identified on any of the 28 quarter-sections. No visual observation of any furbearer was made on any quarter-section. Twenty of the 28 quarter-sections contained tracks of at least 1 furbearer species. Land cover types on the quarter-sections consisted mainly of pasture; other sites included idle grasslands or croplands. Densities of furbearer species were not determined in this study.

Table 1. Number (% occurrence) of quarter-sections with furbearer tracks by species and county detected on randomly selected study sites in southwestern North Dakota, 2000.

	County				
Species	Bowman (n = 6)	Slope (n = 13)	Golden Valley (n = 3)	Sioux (n = 6)	Total (n = 28)
Red fox	0	2 (15.4)	0	0	2 (7.1)
Coyote	2 (33.3)	9 (69.2)	2 (66.7)	5 (83.3)	18 (64.3)
Striped skunk	2 (33.3)	1 (7.7)	0	0	3 (10.7)
Mink	0	2 (15.4)	0	0	2 (7.1)
Raccoon	1 (16.7)	5 (38.5)	1 (33.3)	0	7 (25.0)

DISCUSSION

Conditions for observing tracks in North Dakota are often far from perfect; however, a few good sites in most quarter-sections are all that is often needed to identify one or more species of furbearer present. This experimental investigation indicates that various species of furbearers occur on almost all quarter-section study areas, and occurrence of coyotes and/or red fox is likely on many areas. Other species such as swift fox may be present, but they appear to exist at extremely low levels.

Few problems have been encountered with track surveys. We do not always detect tracks of a species even though that species is present, and there is potential for error in correctly identifying tracks to species if inexperienced observers are used. However, the advantage of track surveys is that nothing special is done that requires a behavioral response on the part of the animal to detect its presence; thus, the potential for behavioral bias in the data on the part of the animal is absent. In addition, sample sizes are maximized, because the investigator only needs to visit a sample site once to obtain the desired data. We suspect that all surveys will show swift fox distributions smaller than the true distribution. However, because behavioral bias is lacking, we suspect track surveys will consistently show larger swift fox distributions with the least bias in the data.

Interspecific competition has been well documented between wolves (*Canis lupus*) and coyotes (Carbyn 1982) and between coyotes and red foxes (Sargeant et al. 1987) in the northern plains. Interspecific competition from canids (especially coyotes and red fox) may be a significant limiting factor in currently existing swift fox populations. Ralls and White (1995) noted that although coyote predation on kit fox in California can be severe, they found indications that red fox predation on kit fox may be catastrophic to the population. Data collected in this study indicate that many quarter-section study areas selected in North Dakota likely have red fox and/or coyotes present.

Considering the density and distribution of red fox and coyotes in North Dakota, the potential for viable swift fox populations may be quite remote. Given the magnitude of differences of red fox and coyotes harvested as compared to confirmed swift fox observations, we question if swift fox have very much potential for survival in North Dakota considering the number and distribution of these other canids at present.

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FINAL REPORT

STATE: Oklahoma GRANT NUMBER: E-49-3

GRANT TYPE: Research

SEGMENT DATES: June 17, 2000 - November 15, 2001

PROJECT TITLE: **Population Distribution of Swift Fox in Northwestern Oklahoma Using a Track Search Survey**

I. Abstract:

The swift fox (*Vulpes velox*) monitoring survey was conducted in portions of six Oklahoma counties (Cimarron, Texas, Beaver, Harper, Ellis, and Woodward) in order to investigate the species' distribution within its historical range. Six personnel from the Oklahoma Department of Wildlife Conservation conducted the track search surveys. During 1998, tracks were found in 35 of the 57 townships, within two counties, that were surveyed for swift fox tracks. During 1999, the entire shortgrass High Plains area was surveyed, and swift foxes were detected in 43 of 114 townships. During 2000, swift foxes were detected in 36 of 101 townships surveyed. All townships where swift fox tracks were successfully detected were in the panhandle region of Cimarron, Texas and Beaver counties. Swift fox tracks were observed 59% of the time in the rangeland Land Use and Cover Type in 1998, 68% in 1999, and 74% in 2000. Habitat associated with track point data did not differ significantly from that available. Herbaceous rangeland comprised at least half of the 3 km radius home range buffer circles drawn around the track locations for all three years (range 50.8% to 59.6%), while croplands (including CRP lands) made up anywhere from 37.7% to 44.9% of the buffer circles. Nearly half of the shortgrass High Plains region within the Panhandle was comprised of cropland and the other half rangeland. Herbaceous range may be slightly higher in the buffer circles when compared to the availability because rangeland was surveyed for tracks when it was available.

II. Objectives:

1) Establish a track search survey to monitor population trends of swift foxes throughout the shortgrass prairie ecosystem.
2) Develop a baseline database of swift fox distribution and abundance in northwestern Oklahoma.

III. Introduction:

The swift fox (*Vulpes velox*) is native to the shortgrass and mixed-grass prairies, once occupying most of the Great Plains from west-central Texas to southern Alberta (Sovada and Scheick 1999). Settlement of the prairies led to declines in swift fox numbers and constriction of their distribution. Currently, the swift fox's range is comprised largely of private land. Much of this land is used for cattle grazing or cropland production. Optimal habitat for swift foxes is believed to be shortgrass prairie with relatively level terrain and available holes for shelter and protection (Scott-Brown et al.1987).

The swift fox (*Vulpes velox*) is classified as a furbearer species in Oklahoma with a year-round closed season with regard to take. The swift fox is also designated as a state species of special concern in Oklahoma. The swift fox has been documented to occur in the panhandle region as well as in four counties in the northwestern corner of the body of the state. Historically, the swift fox was considered to occur throughout the Oklahoma panhandle counties of Cimarron, Texas and Beaver, and in the three northwestern counties; Harper, Woodward and Ellis (Caire et al. 1989, Duck and Fletcher 1945). Swift foxes were observed in Texas and Beaver counties during the 1950s and 1960s by several researchers (Cutter 1959, Glass 1959, Kilgore 1969). A 1988 landowner survey conducted by the Oklahoma Department of Wildlife Conservation (ODWC) produced 21 swift fox sightings and eight den locations in the panhandle region (Kocka 1988). Additionally, five verified swift fox sightings by ODWC biologists were reported from Cimarron, Texas, Beaver and Roger Mills counties (Hoagland 1996) between 1988 and 1994.

In 1992, the swift fox (*Vulpes velox)* was petitioned for listing as endangered under the Endangered Species Act of 1973. In 1995, the U.S. Fish and Wildlife Service (USFWS) indicated that listing the swift fox was warranted but precluded, and the species was given a listing priority of 8 (Federal Register / Vol. 60, No. 116 / June 16, 1995). State wildlife agencies, researchers, universities, and representatives from the U.S. Forest Service National Grasslands, Biological Resources Division of the U.S. Geological Survey (USGS), and the Canadian Wildlife Service formed a Swift Fox Conservation Team, committed to ensuring the preservation of this unique species (Kahn et al. 1997). The Team responded to the USFWS 12-month finding by developing and providing a Conservation Strategy intended to be implemented in lieu of listing. The Conservation Strategy provides a framework to develop and intensify current management of swift fox and coordinate future research and monitoring throughout its range.

The need to determine the current distribution of swift fox throughout Oklahoma, and the rest of the North American swift fox range, has been determined as the most important objective by the Swift Fox Conservation Team and the USFWS (Kahn et al. 1997). Because of the wide variety of habitats used by swift fox throughout their range, surveys need to encompass both shortgrass prairie and cropland habitats where swift fox commonly occur. This project complements other investigations underway in Texas, Colorado, Kansas, Wyoming, Nebraska, South Dakota and Montana (Allen et al. 1995, Luce and Lindzey 1996, Giddings 1997, Roy 1998). By replicating similar survey efforts in different locations we will gain a better understanding of the various parameters influencing swift fox populations including habitat characteristics and the presence of other carnivores potentially competing with or killing swift fox. The information acquired from this survey will allow a better understanding of the requirements for maintaining swift fox populations or expanding their distribution in suitable habitats.

To achieve this objective, survey methods to determine present distribution and abundance of swift fox needed to be tested to assess their efficiency and accuracy. A cooperative research project between the Kansas Department of Wildlife and Parks and the Northern Prairie Wildlife Research Center - USGS, was conducted in Kansas in 1996 to test various survey methods (Sovada and Roy 1996, Roy et al. 1997). Results of that research indicated that the most reliable survey technique to determine distribution and relative abundance of swift fox in shortgrass prairie and cropland habitats was a timed track search within the most suitable habitat per township. The survey requires minimal time and effort, yet provides accurate results that can be repeated over time, providing not only swift fox distribution but population trends as well.

Implementing a track search survey in northwestern Oklahoma allowed adequate monitoring of swift fox populations as well as other furbearer populations in the same region. Surveys accounted for all tracks observed with no extra effort, therefore detecting furbearers that may be swift fox competitors or predators. Monitoring the population trends of all furbearer species in northwestern Oklahoma is essential to understanding the various predatory mammal community components that may affect the population trend of swift fox and other potentially vulnerable species.

Another important objective identified by the SFCT in the Conservation Assessment and Conservation Strategy for Swift Fox in the United States was identifying and conserving suitable swift fox habitat. A review of numerous studies on swift fox indicated that range-wide habitat requirements have not been adequately identified. Published information about habitat use by swift foxes is largely descriptions and analyses of study areas or den sites from studies conducted in few select locations. A review of literature describing swift fox habitat associations, habitat selection, and den site selection was compiled by members of the SFCT (Harrison and Whitaker-Hoagland in-press, Whitaker-Hoagland 1997, A review of literature related to swift fox habitat use *in* B. Giddings 1997, Swift Fox Conservation Team Annual Report). This review revealed that swift foxes occupy a variety of habitats, yet are missing from large areas that appear to have suitable habitat. Recovery plans and efforts for swift fox conservation require a biologically sound basis for defining suitable habitats and the composition of habitats in landscapes that are optimal for swift foxes.

IV. Procedures:

Six ODWC personnel, four game wardens and two wildlife biologists, conducted the track search surveys. All ODWC personnel were knowledgeable in reading furbearer tracks and with the area and local wildlife to be surveyed. The study area was defined as the shortgrass High Plains ecoregion that occurred within the historical swift fox range in Cimarron, Texas, Beaver, Harper, Ellis, and Woodward counties. Every other township in the identified study area was surveyed for furbearer tracks. Survey sites within each township were carefully selected, based on areas with the highest probability of finding swift fox tracks if swift foxes were present. Thus, survey locations focused on areas with herbaceous range habitat, flat terrain, the best available substrate for tracks, little vehicle traffic, and a lack of human disturbance. The same tracking sites were used each year unless major changes occurred that required new sites to be selected.

All track surveys were conducted during the months of August and September, during all three years. Fifty-seven townships were identified to be surveyed for swift fox tracks during 1998 while 114 townships were targeted for track searches during 1999. Prior to the 2000 survey, 12 townships in Harper, Ellis and Woodward counties were re-evaluated for their potential as swift fox habitat and whether they occurred within the Shortgrass High Plains ecoregion. If more than 75% of the township was outside of the Shortgrass High Plains ecoregion with habitat unsuitable for swift fox, the township was eliminated from the 2000 survey. As a result, 105 townships were targeted for track searches during 2000.

Track searches were conducted with a minimum search time per township of 30 minutes and a maximum of 2 hours. Once a swift fox track was found, the time of search was recorded.

The tracker continued searching if the track was found during the first 30 minutes of the search period, or moved on to the next township, after the initial 30 minutes. Since survey success was affected by time of day and weather conditions, track searches were conducted when possible during morning hours and 24 hours following a rainfall event, when possible.

For the purpose of selecting track search locations, broad habitat categories were delineated within the study area by using ArcView GIS 3.2a, based on United States Geological Survey (USGS) land use and land cover data at 1:250,000 (USGS 1990). Classification codes used in data analysis included urban/industrial, cropland (including Conservation Reserve Program grasses (CRP)), herbaceous rangeland, shrub rangeland, mixed shrub and herbaceous rangeland, deciduous forest, evergreen forest, and water/wetlands. Habitat categories were ground verified for the townships surveyed. The habitat type where swift fox and other furbearer tracks were located was recorded as range, CRP, fallow, winter wheat, irrigated crop (e.g. corn), other crop (e.g. milo, soybeans), and juniper mesa. All interpretation of digital coverages was done and its accuracy was verified by site visits comparing classified landscapes to actual vegetation.

To examine the habitat associated with the track location point data, a 3 km radius circle was drawn around all track locations. A 2km radius circle was equal to the 95% minimum convex polygon home range size for a family of swift fox, based on swift fox home ranges in Kansas (Sovada pers comm). To be sure to adequately survey habitat associated with the track location point data, a buffer of ½ the radius of the home range circle was added, resulting in a 3km radius circle. The area of each USGS land use and land cover category (USGS 1990) within the 3 km radius circles was measured by using ArcView 3.2a. All lands classified as cropland and tame pasture were ground verified to determine areas that were in Conservation Reserve Program (CRP) lands. This is the first stage in a process to determine what constitutes suitable or optimal swift fox habitat.

V. Results:

During 1998, 57 townships in Cimarron and Texas counties were successfully searched for swift fox tracks. Trackers drove an average of 35 miles per township and averaged 14 days to complete the surveys. Swift fox tracks were detected in 35 (61.4%) of the townships surveyed (Figure 1). For each township where swift foxes were successfully detected, it took an average of 39 minutes to detect the first track (range 4 to 105 minutes). Swift fox tracks were detected within the first 30 minutes in 17 of the 35 townships. In 29 townships, swift fox tracks were found within the first hour. Only six townships found swift fox tracks during the second hour of tracking. Twenty-eight townships had only one set of swift fox tracks observed during the initial 30 minutes; six townships had two sets of swift fox tracks detected, and in one township swift fox tracks were observed up to four times within the initial 30 minute search interval.

During 1999, all 114 townships in the targeted study area were successfully searched for swift fox tracks. Trackers drove an average of 37 miles per township and averaged 8 days to complete the surveys. Swift fox tracks were detected in 43 (37.7%) of the townships surveyed (Figure 1). For each township where swift foxes were successfully detected, it took an average of 46 minutes to detect the first track; range 0 to 103 minutes. Swift fox tracks were detected within the first 30 minutes in 14 of the 43 townships. In 32 townships, swift fox tracks were found within the first hour. Swift fox tracks were found during the second hour of tracking in 11 townships. Forty townships had only one set of swift fox tracks observed during the initial 30 minutes; three townships had two sets of swift fox tracks detected within the initial 30 minute search interval.

During 2000, 101 of the 105 targeted townships were successfully searched for swift fox tracks. Trackers drove an average of 39 miles per township and averaged 8 days to complete the surveys. Swift fox tracks were detected in 36 (35.6%) of the townships surveyed (Figure 1). For each township where swift foxes were successfully detected, it took an average of 36 minutes to detect the first track; range 0 to 117 minutes. Swift fox tracks were detected within the first 30 minutes in 17 of the 36 townships. In 25 townships, swift fox tracks were found within the first hour. Swift fox tracks were found during the second hour of tracking in 11 townships. Thirty-four townships had only one set of swift fox tracks observed during the initial 30 minutes; two townships had more than two sets of swift fox tracks detected within the initial 30 minute search interval.

In Cimarron and Texas counties, where data were available for all three years, the number of townships where swift fox tracks were detected declined from 35 townships in 1998 to 24 townships in 1999 and 21 townships in 2000 (Table 1). The average time it took to detect swift fox tracks, if they were found, however fluctuated only slightly from 39 minutes in 1998 to 46 minutes in 1999 and back to 41 minutes in 2000. The number of townships where swift fox tracks were observed within the first 30 minutes declined from 17 townships in 1998 to five townships in 1999, but rebounded to 11 townships in 2000 (Table 1). Swift fox tracks were not found more than one time within the first 30 minutes in any township during 1999, compared to seven townships where more than one set of swift fox tracks was observed in 1998 and in two townships in 2000 (Table 1).

During 1998, 42% of sites where swift fox tracks were observed in Cimarron and Texas counties had soil tracking conditions that were considered good to excellent, while in 1999, this percentage dropped to 34% (Table 2). The summer of 2000 was an extreme drought year and this percentage dropped to 8% (Table 2). The percentage of surveys conducted within one to three days following a rainfall event also dropped from 74% in 1998 to 51% in 1999 to 5% in 2000, while the percentage of surveys conducted more than three days following a rainfall increased from 21% to 42% to 93% between 1998 and 2000 (Table 2). The percentage of track search surveys conducted while winds were between one and five miles per hour decreased between 1998 and 1999 from 68% to 44%, but increased to 53% in 2000. While the percentage of surveys conducted when wind speeds were greater than five miles per hour increased from 32% to 56% between 1998 and 1999 but decreased to 47% in 2000 (Table 2).

Table 1. Comparison of swift fox track detection statistics in Cimarron and Texas counties from 1998 to 2000.

Swift Fox Tracking Variables Recorded	1998	1999	2000
Townships surveyed	57	57	57
Townships with swift fox tracks	35	24	21
Average time to first track in minutes	39	46	41
Townships with tracks observed within first 30 minutes	17	5	11
Townships with >1set of swift fox tracks observed	7	0	2

Table 2. Soil tracking conditions, days since last rain, and wind conditions recorded during swift fox surveys in Cimarron and Texas counties from 1998 to 2000.

Environmental Conditions	1998	1999	2000
Percentage of swift fox track sites with good to excellent tracking conditions	42%	34%	8%
Percentage of surveys conducted within 1 to 3 days following a rain event	74%	51%	5%
Percentage of surveys conducted greater than 3 days following a rain event.	21%	42%	93%
Percentage of surveys conducted with winds 1 to 5 mph	68%	44%	53%
Percentage of surveys conducted with winds > 5 mph	32%	56%	47%

During all three survey periods, swift fox tracks were detected most often throughout the three panhandle counties on two-track and dirt roads in rangeland land use and land cover types (Table 3). Rangeland was also the most prevalent land use and cover type searched in townships where swift fox tracks were not observed (Table 3). Cropland, including CRP lands, comprised 51.2% of the entire study area (Figure 2). Rangeland comprised 49.1% of the entire study area, with 83.5% of the rangeland existing as herbaceous rangeland, 0.0002% as shrub rangeland, and 16.4% as mixed rangeland (Figure 2). In the panhandle region, cropland comprised 49.9% of the area and rangeland 48.4%; with the rangeland existing as 92.2% herbaceous range, 0.0003% shrub range, and 7.7% mixed rangeland (Figure 2). The rangeland plant community consisted primarily of blue grama (*Bouteloua gracilis*)-buffalograss (*Buchloe dactyloides*), interspersed with sandsage (*Artemesia filifolia*). The mixed rangeland also consisted predominately of blue grama and buffalograss, along with sandsage, yucca (*Yucca glauca*), and cholla cactus (*Opuntia imbricaria*). In the extreme eastern edge of the study area, eastern redcedar (*Juniperus virginiana*) encroachment was evident in the mixed range land use and cover category.

Home range buffer circles were drawn around the 114 track locations detected over the three years of the survey (Figure 3). Of the 35 track locations detected during 1998, 94,745 ha within the 3 km radius buffer circles were examined for land use and land cover. Herbaceous range comprised 56.1% of the home range buffer circles while 37.7% of the area contained agricultural land (Table 4). Within the agricultural lands, 32.5% consisted of CRP lands. The other 67.5% of the agricultural land included cropland, consisting primarily of winter wheat, milo, center pivot corn, or was fallow. During 1999, land use and land cover was examined in 122,373 ha surrounding 43 track locations. Half of the total area was comprised of herbaceous range while agricultural land made up 44.9% (table 4). CRP comprised 38.3% of the agricultural land with 61.7% made up of other types of cropland or fallow fields. For the 36 track locations found in 2000, 101,593 ha were examined within the 3km radius buffer circles. Herbaceous range comprised 59.6% of the home range buffer circles while agricultural land encompassed 39.0% (Table 4). While center-pivot crops and fallow fields made up 69.8% of the agricultural land, 30.2% of this land use category consisted of CRP lands.

Other furbearers detected with the survey in Cimarron and Texas counties during 1998 included, coyote (*Canis latrans*) in 55 townships (96.5%), badger (*Taxidea taxus*) in 28 townships (49.1%); raccoon (*Procyon lotor*) in 15 townships (26.3%), striped skunk (*Mephitis*

mephitis) in 12 (21.1%) townships, domestic dog *(C. familiaris*) in 10 (17.5%) townships, domestic cat (*Felis catus*) in 5 (8.8%) townships, and bobcat (*Lynx rufus*) in 2 (3.5%) townships. Tracks of black-tailed jackrabbits (*Lepus californicus*) and eastern cottontails (*Sylvilagus floridanus*) were observed at 39 and 27 townships, respectively, and prairie dogs (*Cynomys ludovicianus*) were seen in 14 townships while surveying tracks. Information concerning jackrabbits, cottontail rabbits and prairie dogs, however, was only noted casually, and not specifically requested.

During 1999 and 2000 throughout the entire shortgrass High Plains study area, other furbearers detected included, coyote (*Canis latrans*) in 87% of the townships in both 1999 and 2000; badger (*Taxidea taxus*) in 37% of the townships in 1999 and 34% in 2000; raccoon (*Procyon lotor*) in 34% of townships in 1999 and 14% in 2000; striped skunk (*Mephitis mephitis*) in 34% of 1999 townships and 29% in 2000; bobcat (*Lynx rufus*) in 18% of townships in 1999 and 9% in 2000; domestic dog *(C.familiaris*) in 16% of townships in 1999 and 10% in 2000; and domestic cat (*Felis catus*) in 5% of 1999 townships and 3% in 2000. Tracks of black-tailed jackrabbits (*Lepus californicus*) were observed in 44 % of townships in 1999 and 2000. Eastern cottontail rabbits (*Sylvilagus floridanus*) were observed in 37% and 47% of townships in 1999 and 2000. Black-tailed prairie dogs (*Cynomys ludovicianus*) were seen in 9% and 18% of townships during 1999 and 2000 while surveying tracks. Information concerning jackrabbits, cottontail rabbits and prairie dogs, however, was only noted casually, and not specifically requested.

Table 3. Land use and land cover types with and without swift fox tracks in the panhandle counties (Cimarron, Texas and Beaver) 1998 - 2000.

Habitat Type	1998*		1999		2000	
	with tracks	no tracks	with tracks	no tracks	with tracks	no tracks
Range	59%	41%	68%	46%	74%	48%
CRP	14%	19%	7%	19%	14%	19%
Fallow	10%	14%	9%	13%	7%	14%
Other Crop	10%	14%	5%	8%	0	6%
Winter Wheat	2%	3%	9%	7%	2%	4%
Irrigated Crop	2%	7%	2%	5%	0	5%
Mesa	2%	3%	0%	1%	2%	4%

*only Cimarron and Texas counties included

Table 4. Habitat found within track buffer circles. CRP is the percentage of the total agricultural land.

Land Use and Cover Type	1998* (n=35)		1999 (n=43)		2000 (n=36)	
	Area (ha)	% Total	Area (ha)	% Total	Area (ha)	% Total
Agricultural Land	35,721	37.7%	55,060	44.9%	37,356	39.0%
CRP**	11,594	32.5%	7,914	28.3%	5,811	30.2%
Herbaceous Range	53,180	56.1%	62,223	50.8%	57,125	59.6%
Shrub Range	1,807	1.9%	2,348	1.9%	347	0.5%
Mixed Range	3,212	3.4%	1,983	1.6%	308	0.4%
Forest	210	0.2%	197	0.2%	223	0.3%
Water/Barren	516	0.5%	562	0.5%	423	0.6%
TOTAL	94,745		122,562		95,822	

* only includes Texas and Cimarron counties in 1998.
** only includes calculations for Texas and Cimarron counties

VI. Discussion

Results from track search surveys conducted for swift fox in Oklahoma confirm those from Kansas (Roy et al. 1997), indicating this method has been an effective technique for conducting landscape-scale presence/absence surveys for swift fox. Because track searches were restricted to habitat believed most suitable for swift fox and most favorable for finding tracks, costs were controlled and high detection rates were achieved. Data quality was enhanced by using experienced ODWC employees as trackers. The use of game wardens to conduct the survey aided tremendously in the ability to access private rangeland throughout the study area.

Swift fox tracks were detected readily throughout the shortgrass High Plains region. But, swift fox tracks were not observed using this survey outside the Panhandle region during 1999 or 2000. Tracks were observed in one township in Harper County in 1999, but the two-hour time limit for the track search survey had already elapsed. A road kill swift fox was also recorded from Ellis County during the spring of 1999, prior to the when track search survey was conducted. Although this information indicates the presence of swift fox in the main body of the state, the extent to which the species occurs in the far eastern reaches of the shortgrass High Plains ecoregion or beyond this ecoregion is unknown.

Swift fox tracks were encountered more often in herbaceous rangeland land use and land cover type than in other land use categories. But, herbaceous rangeland was the land use and cover type searched whenever it was available within a survey township. Swift fox tracks were observed in agricultural areas throughout the study area, but agricultural areas were not searched in proportion to their availability. If cropland and rangeland were both present in a township, only the rangeland was most likely surveyed. The proportion of rangeland existing as herbaceous rangeland in Panhandle was 92.2% while shrub and mixed range comprised only 7.7%. Outside the Panhandle, the percentage of the existing rangeland that occurred as herbaceous range dropped to 57.0%, while the mixed herbaceous/shrub range increased to 42.9%. Because of the increasing vegetation density and height in the mixed herbaceous/shrub range, this land use and cover type is not considered suitable for swift fox when compared to the relatively shorter, herbaceous rangeland vegetation that occurs in the shortgrass High Plains ecoregion.

Herbaceous range also comprised at least half of the 3 km radius home range buffer circles drawn around the track locations for all three years (range 50.8% to 59.6%), while croplands (including CRP lands) made up anywhere from 37.7% to 44.9% of the buffer circles. The proportion of the cropland that was comprised of CRP lands was consistent throughout all three years for Texas and Cimarron counties for which measurements were completed (28.3% to 32.5%). Nearly half of the panhandle region, where all track locations were recorded over the three years, was comprised of cropland and the other half rangeland, with the 92.2% of that rangeland existing as herbaceous range (Figure 2). This is just slightly different from the proportion of the land use and land cover found within the 3 km radius buffer circles of the track locations. Herbaceous range may be slightly higher in the buffer circles when compared to the availability because rangeland was surveyed for tracks when it was available. Further habitat evaluation studies will be conducted in the future to determine habitat characteristics at the landscape level that are necessary to support swift fox in the shortgrass High Plains ecoregion.

In general, the terrain in the Panhandle portion of the study area was flatter than that of the main body of the state (Figure 4). From west to east across the study area, a greater proportion of the available herbaceous range occurred in more rugged terrain where land conversion to cropland was not as economically feasible. On the flatter terrain in the Panhandle portion of the study area, winter wheat was the predominant land use, while in the main body of the state, a greater proportion of the flatter terrain occurred as mixed range rather than as winter wheat. Thus, the amount of optimal swift fox habitat decreases from west to east through the shortgrass High Plains ecoregion within in Oklahoma.

The swift fox track detection rate decreased from 1998 to 2000 in the two counties for which data were available for all years (Cimarron and Texas counties). During the 1998 tracking season, this region received above normal rainfall, allowing 74% of the tracking surveys to be conducted within three days following a rainfall event. In contrast, only 51% of the track search surveys conducted during 1999 were done within three days after a rainfall. And in 2000, only 5% of the track search surveys were conducted within three days after a rainfall. Conducting track searches following rainfall events resulted in better tracking conditions, and thus more swift fox tracks being observed within these counties during 1998 than in 1999 or 2000. The tracking substrate in Texas County was particularly affected by precipitation patterns, and track detection rates dropped from 57% in 1998 to 37% in 1999 to 27% in 2000.

The track search survey did indicate that swift foxes are relatively more abundance as you move east to west throughout the survey area. Since this survey was designed to determine only the presence of swift fox within the study area, it cannot be used to determine population density. The detection rates, however, indicate that swift fox are found readily throughout existing suitable habitat within the shortgrass High Plains region. Data from all three survey-years have supplemented previous information on the distribution of swift fox in Oklahoma. Information has been made available to all members of the Swift Fox Conservation Team and included in the Team's 1998 and 1999 annual reports to the USFWS. Results have also been provided to the

Northern Prairie Wildlife Research Center for use in swift fox population model database. By combining data from all states where track search surveys have been used, it has been determined that this technique can detect changes in swift fox abundance among years by monitoring every third township every third year (Marsha Sovada pers. comm.).

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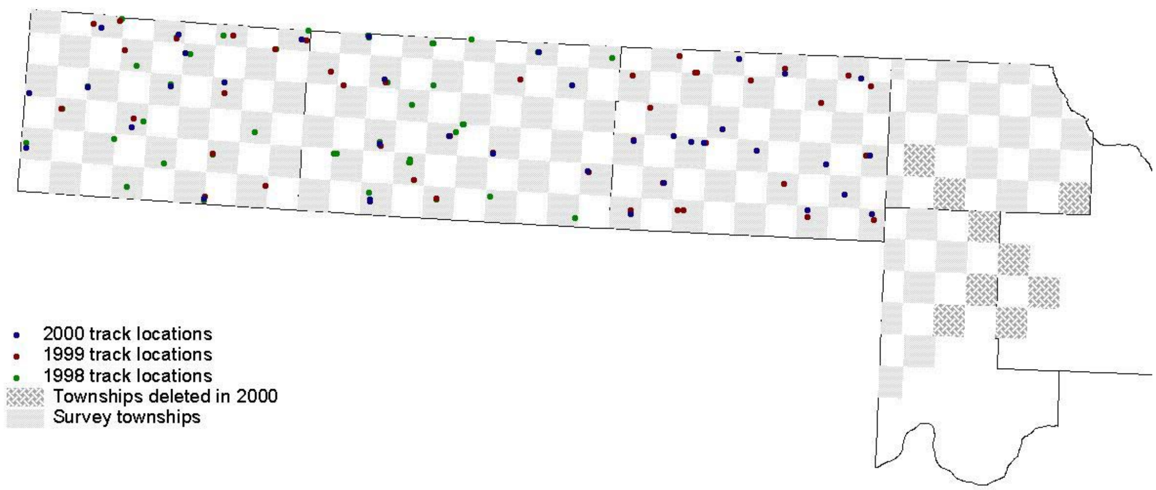

Figure 1. Swift fox track detection sites, 1998 - 2000 (only Cimarron and Texas counties were surveyed in 1998).

CHARACTERISTICS AND BEHAVIOR OF SWIFT FOX (*Vulpes velox*) AT DEN SITES IN FALL RIVER COUNTY, SOUTH DAKOTA

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ABSTRACT

We surveyed for swift fox (*Vulpes velox*) den sites from 25 May to 20 August 2001. Areas searched contained both public (i.e., Buffalo Gap National Grassland and South Dakota School and Public Lands) and private rangeland in Fall River County, South Dakota. We searched quarter sections of land for tracks, feces, and dens of the swift fox. Searching was concentrated around stock dams, ridge tops, cow paths, roads, and areas parallel to creeks. Swift fox sign and den site locations were documented. If den sites were active, individuals (pups and adults) were observed to document behavioral characteristics. Total area searched on public land was 6475 ha (25 miles^2) and 1813 ha (7 miles^2) on private land. Swift fox were observed on both private and public land. A total of 54 dens were found of which 20% (11 of 54) were of swift fox. Of the 11 dens, 4 had $\geq$ 2 entrances; the remaining 7 dens had 1 entrance. The remaining 43 dens consisted of coyotes (*Canis latrans)* (19%), badgers (*Taxidea taxus*) (13%), red fox (*Vulpes vulpes*) (4%), and unknowns (44%). During the observation of a swift fox den, at least one swift fox pup was out of the den 58% of the time the den was observed. The two adult foxes were observed out of the den 5% of the time.

INTRODUCTION

Historically, swift foxes ranged from the prairies of Alberta and Saskatchewan, Canada to the Texas and New Mexico region of North America (Scott-Brown et al. 1987). However, the species has declined in the extreme northern portions (Canada and the Dakotas) of its range. Reasons for the decline include settlement of prairies, rodent control, inadvertent poisoning from strychnine-laced baits, and trapping pressure (Egoscue 1979). Swift fox usually den in areas of scant vegetation and low slopes that provide a clear view of the surrounding area; however, they also have been found in cultivated croplands (Kilgore 1969). Since 1978, the swift fox has been listed as a State Threatened Species in South Dakota (South Dakota Wildlife Diversity Homepage, http://www.state.sd.us/gfp/diversity/index.htm). The purpose of this project was to survey den sites and characterize behavior of swift fox at den sites in southwestern South Dakota.

STUDY AREA

Fall River County is located in the southwestern portion of South Dakota. The county encompasses 451,461 ha (1,743 miles^2) (Kalvels 1982) of land area of which, 6,475 ha (25 miles^2) is public land (e.g., Buffalo Gap National Grassland). Topography is characterized as undulating to gently sloping hills. Temperatures for this region of South Dakota average 21 C (70 F) during summer but can range above 38 C (100 F) (Spuhler et al. 1971). Grasses, such as little bluestem (*Andropogon scoparius*), prairie sandreed (*Calamovilfa lonfifolia*), and needle-and-thread (*Stipa comata*), dominate the landscape (Westin and Malo 1978).

METHODS

Surveys were conducted from 25 May to 20 August 2001. Quarter sections of land searched for swift fox sign and den sites were situated northeast of Ardmore, South Dakota. Lands selected for searches occurred on or in close proximity to quarter sections where swift fox were sighted during previous surveys (Hetlet 1995, Peterson et al. 1999, L. Hetlet, USDA Forest Service, Hot Springs, SD, pers. commun.). Permission to access private land was obtained from landowners prior to searches. Searches were conducted in mornings and evenings by walking through areas with characteristics reported for swift fox den sites (L. Hetlet, USDA Forest Service, Hot Springs, SD, pers. commun.). Within quarter sections, stock dams, creek banks, ridge tops, two-track roads, and cow paths were searched for sign and den sites. When dens were observed, den entrances were measured; measurements (to the nearest inch and converted to centimeters) were taken horizontally and vertically to the opening using a tape measure. If the dirt mound at the den opening was not fanned out, mound height, length, and width were measured. Direction of the den opening and percent slope also were recorded using a Sylva Compass (Sylva Company out of Finland).

Active dens with pups were observed for 2 days/week for 2 weeks. Days were randomly selected. Dens were observed from about 100 m with binoculars (8x30) and a spotting scope (20x50). Active dens were observed for 2 hours in the morning starting at sunrise, for 1 hour during the afternoon, and for 2 hours just before sunset. During observation periods, dens were under observation for 5 minutes of every 15 minutes (total 20 minutes/hour of observation).

RESULTS AND DISCUSSION

Two of nine landowners (22%) granted permission to allow searches for swift fox sign and den sites on their property. Refusals indicated that landowners were associating swift fox with black-tailed prairie dogs (*Cynomys ludovicianus*), a candidate for listing under the Endangered Species Act. In two previous studies on swift fox in southwestern South Dakota (Kruse et al. 1995, Peterson et al. 1999), more private landowners (85 and 67%, respectively) granted permission. During our study, a total of 8,288 ha (32 mi^2) was searched; 6,475 ha (25 mi^2) was searched on public land (e.g., Buffalo Gap National Grassland) and 1,813 ha (7 mi^2) was searched on private land. This area was small compared to that of Kruse et al. (1995) (49,391ha [190.7 mi^2]) and Peterson et al. (1999) (27,971 ha [108 mi^2]).

A total of 54 dens was documented during our study (Table 1). Of these, eleven (20%) were confirmed swift fox dens; four were located on private land and seven were located on public land. Of the remaining dens, 10 (19%) were coyote, seven (13%) were badger, two (4%) were red fox, and 24 (44%) were unknown. Previously, Peterson et al. (1999) documented two swift fox dens whereas Kruse et al. (1995) found a natal den that consisted of two adults and three pups within the Fall River County study area.

Of the 11 dens found, 4 (36%) had two or more entrances and the remaining 7 (64%) had only a single entrance. Two swift fox dens included actual sightings of swift fox at or in close proximity to dens. One sighting was that of a whelping den that contained both parents and pups while the second was a sighting of a single fox at a den with only one entrance.

Average size of entrances of swift fox dens was 20.3 cm (8 in.) wide by 19.0 cm (7.5 in.) in height. All dens had fanned out dirt mounds at entrances. Slope of dens averaged 1.3 degrees. Number of den openings was variable. Of the 11 dens, 4 had ≥ 2 entrances; the remaining 7 dens had 1 entrance. Generally, natal dens have more openings than non-natal dens (Kilgore 1969), which may indicate that about 36% of swift fox dens observed were natal dens.

One swift fox was observed at a den on private land. On public land, a natal den was found northeast of Ardmore, South Dakota on Buffalo Gap National Grassland on 20 July 2001. The den was occupied by 2 adults and 4 pups and was observed for two days (randomly chosen) during two weeks (Table 2). A total of 20 hours was spent observing the natal den with pups. Both the male and female adult took part in rearing the pups. During observation periods, only the male left the den site, possibly in search of food for the pups. The male conducted all the den maintenance (e.g., digging or "cleaning" at the den entrance). During observations at least one swift fox pup was out of the den 58% of the time the den was observed. The two adult foxes were observed out of the den without pups during 5% of observations (Table 2). The den was abandoned after 10 August 2001. Limited dens and visual sightings of swift foxes support past survey work in this region of South Dakota (Kruse et al. 1995, Peterson et al. 1999).

ACKNOWLEDGMENTS

We want to acknowledge the help and advice from the area landowners that cooperated with this project. We would also like to acknowledge the USDA Forest Service, Fall River Ranger District personnel for all their help and advice, especially R. Hodorff and L. Hetlet. This study was supported by United States Fish and Wildlife Section 6 Funds administered through the South Dakota Department of Game, Fish and Parks.

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Table 1. Dens observed in Fall River County in 2001.

Den Types	n	%
Swift Fox	11	20%
Coyotes	10	19%
Badgers	7	13%
Red Fox	2	4%
Unknowns	24	44%

*Percentages based on total of 54 dens.

Table 2. Overall observations of swift fox on 24 and 27 July and 8 and 10 August 2001 in Fall River County.

Overall Percentage from 4 days of observation.	**Mean**	**SE**
> = 1 Pup out of Den with or without Adult	58%	7.8
> = 1 Pup out of Den with 1 Adult	21%	7.8
> = 1 Pup out of Den with 2 Adults	29%	14.7
> = 1 Pup out of Den Alone	5%	1.2
One Adult out of Den Alone	8%	8.0
Two Adults out of Den Alone	5%	3.5

*Percentage based on 6 hours and 30 minutes of observation.

STATUS OF SWIFT FOX IN TEXAS (2002)

Robert M. Sullivan, Wildlife Diversity Ecologist, TEXAS PARKS AND WILDLIFE, P.O. Box 659, Canyon, TX 79015. robert.sullivan@amaonline.com

INTRODUCTION

In 2001, our efforts focused on completing research initiated in 1999. Additional ongoing investigations are aimed at developing comprehensive guidelines for conservation and management of swift fox in the panhandle, including application of artificial den sites and escape cover for increasing survivability, reproduction, conservation, and providing cost-effective management recommendations for landowners. The recent summary manuscript listed below will be used to construct the ling-term strategic plan for conservation and management of swift fox in the Texas Panhandle:

> SULLIVAN, R.M., J.F. KAMLER, P.R. LEMONS, W.B. BALLARD, K. MOTE, AND R. GILLILAND. 2002. Review of the historical and current status of the swift fox (Vulpes velox) in Texas. Pages XX in M. S. Sovada and L. N. Carbyn, editors. Ecology and conservation of swift foxes in a changing world. U.S. Geological Survey and Canadian Wildlife Service. Canadian Plains Research Center, University of Regina, Regina, Saskatchewan, Canada.

Additionally, current research on remote sensing of black-tailed prairie dog and Lesser Prairie-Chicken habitats in Texas will be used as the GIS base-map for overlaying various swift fox data gathered over the last 6 years. This will include using semi-automated and automated remote sensing tools and ground truthing using standard Global Positioning System techniques. In order to verify the rarity of prairie dog towns in the Texas High Plains, Northern Rolling Plains, and Trans Pecos Eco-regions, a digital baseline data set of precise locality and town size needs to be acquired. Land use/land cover will also need to acquire to quantify short grass prairie, midgrass prairie, and brush community systems prairie dogs and Lesser Prairie-Chicken currently and historically occupied. The applicability of this analytical approach will be used to assess its potential to conserve populations of swift fox in a continuously fragmented shortgrass prairie landscape.

RESEARCH NEEDS

The most urgent research needs for swift fox in Texas are to: (1) delineate the current range of the species in the Pecos and Staked Plains, and Red Rolling Plains; (2) determine the current population size of the species within this region; (3) develop a GIS-based landscape-level map that identifies the quantity, distribution, and quality of residual shortgrass and mixedgrass prairie habitats that currently remain in the region; (4) assess macro- and micro-habitat requirements of swift fox in native prairie to determine how human activities, agricultural practices, and other land use programs affect population viability of the species; (5) develop a long-term program to monitor conversion and fragmentation of remaining prairie habitat and associated populations of at-risk species; (6) continue to gather additional life history information on both swift fox and coyotes at the two study sites in Dallam and Sherman counties (i.e., home range size, daily and seasonal movements, reproductive patterns, growth and development, predation rate, etc.); and (7) document pesticide and toxicity levels currently found in populations of swift fox and their prey species in an attempt to determined what effects bio-magnification has on food webs of prairie systems, thus ultimately on grassland species.

TABULAR SUMMARY OF RESULTS TO DATE

Table 1. Summary of activities, hours, and cost for aerial removal of coyotes by USDA Wildlife Services as part of initial cooperative effort to manage swift fox in the Texas Panhandle (1994 - 2002).

Effort	Hours	Expense	Animals Removed
Person hours for direct assistance	356		
Travel time	49	$7,040.00	
Aerial hunting and ferry time	127	$17,627.50	
Coyotes removed with aerial hunting			366
Coyotes removed with direct hunting			1
Total	531	$24,667.50	367

Table 2. Annual totals of spotlight counts, live-trapping, and radio-collared swift foxes on the Dallam County and Sherman County study sites for the period 1996 to 2001. Data in parentheses below actual data are standardized because there were considerable differences in spotlight surveys and trapnights per year. Live -trapping data include all captures (new and recaptures) along with the total trapnights. All new foxes each year are listed under "radio-collared."

Year	Dallam County Study Site			Sherman County Study Site		
	Spotlight (n/km)	Live-trapping Nights	Radio-collared	Spotlight (n/km)	Live-trapping Nights (Total captures)	Radio-collared
1996	1/94 km (1/94 km)	3 foxes/35 trapnights (1 fox/12 trapnights)	none	none	1 fox/6 trapnights (1 fox/6 trapnights)	none
1997	6/94 km (1/16 km)	0 fox/24 trapnights	none	8/48 km (1/6 km)	5 foxes/20 trapnights (1 fox/4 trapnights)	none
1998	2/52 km (1/26 km)	24 foxes/275 trapnights (1 fox/11.5 trapnights)	n=15	10/48 km (1/4.8 km)	43 foxes/422 trapnights (1 fox/10 trapnights)	n=11
1999	23/260 km (1/11 km)	40 foxes/472 trapnights (1 fox/12 trapnights)	n=12	39/252 km (1/7 km)	59 foxes/494 trapnights (1 fox/8 trapnights)	n=21
2000	36/260 km (1/7 km)	93 foxes/776 trapnights (1 fox/8 trapnights)	n=27	18/252 km (1/14 km)	45 foxes/287 trapnights (1 fox/6 trapnights)	n=15
2001	1/69 km	9 foxes/272 trapnights (1 fox/30.2 trapnights)	n=6	0/60 km	12 fox/176 trapnights (1 fox/14.7 trapnights)	n=8

Table 3. Annual totals of spotlight counts, live-trapping, and radio-collared coyotes on the Dallam County and Sherman County study sites for the period 1996 to 2001. Data in parentheses below actual data are standardized because there were considerable differences in spotlight surveys and trapnights per year. Live -trapping data include all captures (new and recaptures) along with the total trapnights. All new coyotes each year are listed under "radio-collared."

Year	Dallam County Study Site			Sherman County Study Site		
	Spotlight (n/km)	Live-trapping Nights	Radio-collared	Spotlight (n/km)	Live-trapping Nights	Radio-collared
1996	none	none	none	none	none	none
1997	none	none	none	none	none	none
1998	none	none	none	none	5 coyotes/235 trapnights (1 coyote/47 trapnights)	n=5
1999	13/260 km (1/20 km)	13 coyotes/ 360 trapnights (1 coyote/28 trapnights)	n=12	13/252 km (1/19 km)	7 coyotes/125 trapnights (1 coyote/18 trapnights)	n=7
2000	8/260 km (1/33 km)	none	none	11/252 km (1/23 km)	6 coyotes/202 trapnights (1 coyote/34 trapnights)	n=5
2001	0/60 km	none	none	1/60 km	1 coyote/8 trapnights	n=1

Table 4. Goals of the Texas Parks & Wildlife Swift Fox Conservation and Management Plan.

Goal	Description	Progress
1.	Establish a swift fox team	Implemented
2.	Determine current species and distribution	Implemented in 1995; part of our funded ongoing research efforts through 2003
3.	Monitor swift fox population status	Implemented and in progress through 2003
4.	Determine minimum viable population estimates to maintain genetic integrity	Implemented in 2001, through 2003
5.	Identify existing native shortgrass/mid-grass prairie ecosystems and other suitable swift fox habitats	Implemented in 1995, through 2003
6.	Promote habitat conservation and management in occupied and suitable habitat	Implemented in 1995, through 2003
7.	Integrate swift fox conservation strategy objectives with management and habitat objectives of other prairie ecosystem species	Conceived and implemented in 1995 as part of USFWS Section 6 funding of the Texas *Conservation Strategy for the Texas Panhandle Short Grass Prairie – A Multi-Species Approach*, through 2003; coordinated with Lesser Prairie-Chicken and black-tailed prairie dog state working groups, USFWS Partners in Flight, Texas Parks and Wildlife Landowner Incentive Program.
8.	Promote scientific swift fox management and a public education program	Yet to be formally addressed
9.	Implement Research on Swift Fox Biology and Ecology	Implemented in 2001, through 2003

CURRENT FUNDED RESEARCH

Swift Fox And Coyote Interactions in The Short-grass Prairie of Northwest Texas: Population Viability, Den Site Ecology, And Diet Overlap ($17,000)

WARREN B. BALLARD, Range Wildlife, & Fisheries Management, Texas Tech University, Lubbock TX 79409-2125 (806-742-1983); and ROBERT M. SULLIVAN (Co.P.I), Texas Parks and Wildlife, Diversity Biologist, Wildlife Division, Region I (District 2), P.O. Box 659 Cemetery Rd., Canyon, TX 79015 (806) 655-3782/3975

Purpose and Need – Once abundant throughout short-grass and mid-grass prairies of North America, numbers of swift fox (*Vulpes velox*) have declined rapidly with expansion of human settlement. By 1900, swift fox were extirpated from most of its historical range. Over the last half-century, however, populations have begun to recover , largely as a result of reduced poisoning and trapping. In 1992, the U.S. Fish and Wildlife Service (USFWS) was petitioned to list the swift fox as *Threatened* under the Federal Endangered Species Act (ESA). In June of 1995, the USFWS 12-month Finding concluded that listing was warranted but precluded. In December of 1994, the Swift Fox Conservation Team (SFCT) was formed as a pro-active alternative to listing under ESA. Since 1994, SFCT state representatives have met annually to report on research and management activities conducted in their respective states. These activities have generally followed goals and objectives presented in the *Conservation Assessment* and *Conservation Strategy*, yet virtually no information is currently available on estimates of minimum viable population (MVP) size for swift fox. As such, a major priority of the SFCT is to obtain estimates of the MVP size of swift fox populations in each state throughout the species historic range. Because swift fox use dens year-round for shelter, protection from predators, and sites to rear young, it is the most den-dependent and subterranean North American fox. This life-history strategy provides an unique opportunity to assess minimum viable population size through monitoring populations at natal den sites. Data derived from our study, in conjunction with research currently being conducted on distribution, productivity, and survival of swift foxes, will provide the necessary information to begin to assess MVP size in swift fox in the Texas Panhandle. The USFWS's Ecological Service's office has initiated the process of removing swift fox from the warranted but precluded list; however, without continued research from states across the range of the species this goal of removal will not be met.

Objectives:

- Estimate MVP size by use of radio collaring and behavioral monitoring of foxes at natal den sites.
- Monitor use, occupation, and emergence of swift fox at natal dens.
- Determine pup-rearing success and litter size.
- Determine the contribution helpers make to pup-rearing.
- Determine frequency of occurrence of helpers on/off "coyote control" sites.
- Determine diets between foxes and coyotes, among years, among seasons, and on/off coyote control sites.
- Develop comprehensive guidelines for conservation and management of swift fox in the Texas Panhandle, including a: (1) review of all pertinent literature summarizing/tabularizing information on life-history strategies, ecology, habitat management, conservation efforts, and (2) specific set of long-term management recommendations.

Benefits and Anticipated Publications – Our study will provide guidelines for biologists and landowners interested in managing short-grass prairie landscapes and associated communities of grassland species in the Panhandle (Objective #3 above). Additionally, these data will assist in development of more refined habitat recommendations for swift fox, particularly as relates to more effective and efficient use of historical CRP lands. For example, a possible management scenario to facilitate continued range expansion of swift fox may be to suppress local populations of coyotes to increase survival and growth rates of swift fox populations in affected areas. Anticipated publications include:

- Overlap in food items in swift fox and coyote populations in northwest Texas.
- Diet of swift fox in northwest Texas.
- Parental roles in pup-rearing behavior of swift foxes in northwest Texas.
- Pre-emergent pup-rearing success of swift fox in northwest Texas.
- Use of a den probe and its impacts for looking in small canid dens.
- Comprehensive guidelines for conservation and management of swift fox in the Texas Panhandle

Potential for Future Research – In 1996, TPW in cooperation with TTU and USDA Wildlife Services initiated a comprehensive research effort to survey and monitor the distribution and dynamics of swift fox populations in selected regions of the Texas Panhandle. Data from spotlight surveys, live-trapping, radio telemetry, and GIS layering of land use characteristics (i.e, rangeland, cropland, CRP) onto individual home ranges were gathered and continue to be developed. This effort implements specific objectives to insure long-term viability of swift fox populations throughout its historic range in Texas. At present,we have implemented and are gathering data on six major goals. Research proposed herein will contribute greatly to this effort. Several goals are yet to be implemented and additional supplementary information is need to strengthen various actions associated with each objective.

Den Site Ecology of Swift Fox in Northwestern Texas ($47,000)

WARREN B. BALLARD (P.I) and PHIL ZWANK,(Co P. I), Range Wildlife, & Fisheries Management, Texas Tech University, Lubbock, TX 79409-2125 (806-742-1983), and ROBERT M SULLIVAN (Co.P.I), Texas Parks and Wildlife, P. O. Box 659 Cemetery Rd., Canyon, TX 79015 (806) 655-3782/3975.

Swift fox (*Vulpes velox*) were once abundant throughout short-grass and mid-grass prairies of North America, but numbers declined rapidly with expansion of human settlement resulting in this species being extirpated from most of its historic range by 1900. While numbers have increased somewhat in recent years, presumably due to reduced poisoning and trapping, there was sufficient concern for the future of this species that the U.S. Fish and Wildlife Service (USFWS) was petitioned to list it as *Threatened* in 1992. In 1995, the USFWS' 12-month finding concluded that listing was warranted but precluded. Swift fox are the most burrow-dependent canid in North America. Although, dens are used year-round for protection from predators, swift foxes will shift among several (usually a trio) of different den sites. There was probably little competition between wolves and swift foxes because they occupied less closely related niches. Swift fox may have denned or sought refuge in wolf's dens to escape pressure from coyotes. Currently, availability of suitable den sites and escape cover may limit density and distribution of swift fox populations in northwestern Texas.

We propose to install artificial den sites and escape cover to attempt to reduce the effects of predation by coyotes on swift fox. Beginning in early fall 2001, a technician hired by Texas Tech University will trap and attach radio-transmitters to free-ranging coyotes and swift foxes where sympatric on private agricultural land and on the Santa Rita National Grassland. Concomitantly, artificial den sites will be installed on the study area and Wildlife Services personnel will reduce coyote population numbers on one study area by aerial gunning. Beginning January, 2002, a Ph.D. candidate at Texas Tech University and a field technician will monitor locations and survival on a daily basis for one year. A Master of Science degree student will be added to the project beginning autumn 2002. After which data will be analyzed to determine if artificial escape habitats and den sites were effective in increasing swift fox populations where sympatric with coyotes.

U.S. Forest Service, National Grasslands of Region 2: 2001 annual reports

Pawnee National Grasslands Swift Fox report 2001

Annual spotlight trend surveys were completed in September. Indications are that the population is stable.

Contact: Mark Ball

Fort Pierre National Grasslands (FPNG) report 2001

We are not aware of any swift fox presently existing on Ft. Pierre National Grassland. The Forest Service conducted no formal swift fox surveys during 2001.

However, Turner Endangered Species Fund plans to re-introduce swift fox to Ted Turner's Bad River Ranch west of FPNG. Last Spring, the Forest Service entered into a memorandum of understanding with TESF that will provide release sites on FPNG if TESF eventually wants to release swift fox on federal land.

TESF conducted a swift fox feasibility assessment that included FPNG. This involved a spotlight survey for prey species, mostly leporids, and scent station and fecal line surveys for predators.

Contact: Glenn Moravek

Oglala National Grasslands report 2001

No formal surveys were completed.

A denning swift fox with pups was located on a school section between Federal pastures. There are incidental sightings of swift on the Oglala but there is no evidence of a resident population.

Contact: Jeff Abegglen

Thunder Basin National Grasslands report 2001

No formal surveys were completed.

There is a resident population of swift foxes on the Thunder Basin Grasslands. Indications are the population is stable.

Contact: Tim Byer

Cimarron National Grasslands report 2001

No formal surveys were completed.

There is a resident population of swift foxes on the Cimarron Grasslands. Indications are the population is stable.

Contact: Dan Garcia

Comanche National Grasslands report 2001

No formal surveys were completed.

There is a resident population of swift foxes on the Comanche Grasslands. Indications are the population is stable.

Contact: Dan Garcia

Buffalo Gap National Grassland report 2001

Wall Ranger District
No formal surveys were completed.

Conata Basin is a Black-footed Ferret reintroduction site and many hours of spotlighting were completed on the prairie dog colonies in Conata Basin and the surrounding areas (including Badlands National Park).

No swift fox observations were made in 2001.

We are unable to confidently state whether or not a population exists on or near the Wall Ranger District at this time due to the lack of field observation data. Further, we strongly suspect that no swift population exists on the Wall Ranger District.

Contact: Doug Sargent

West ½ Fall River Ranger District.

Formal surveys were conducted in summer of 2001. See attached report.

Contact: Bob Hodorff

2001 SWIFT FOX SURVEY: FALL RIVER RANGER DISTRICT,
BUFFALO GAP NATIONAL GRASSLAND, NEBRASKA NATIONAL FOREST

LYNN ALLAN HETLET

INTRODUCTION

Surveys to determine locations of swift fox (*Vulpes velox*) were conducted on the Fall River District of the Buffalo Gap National Grassland from 1989 through 2000. Additional new areas were surveyed in 2001, as well as the only annual route established in 1994 that still shows evidence of a swift fox population.

SURVEY AREAS

The areas of Fall River County previously not surveyed for swift fox that were surveyed in 2001, coincided with two Breeding Bird Survey routes, which together surveyed 6,250 acres (Maps 1&2). An additional 2,500 acres were surveyed in Custer County by a Fall River District seasonal employee, in the Triple Seven Allotment (Map 3), since tracks of swift fox had been seen on the nearby Triple Seven Ranch in the last couple years. The Ardmore route surveyed annually surveys 2,720 acres (Map 4).

METHODS

Approximately 150 man-hours (including travel time) were spent establishing and utilizing bait stations. A bait station consists of a circular area 18 to 20 inches in diameter cleared of all vegetation. A mixture of fine masonry sand and vegetable oil is spread over the area and smoothed. The mixture consists of one cup of oil to one gallon of sand.

Approximately one-half ounce of Jack mackerel is placed in the center of the station to serve as bait. Because of the swift fox's primarily nocturnal habits, the stations are baited during the early evening hours to decrease the time of drying and insure a high degree of scent dispersal.

This sand/oil mixture will hold a track impression quite well, and if insects such as grasshoppers and carrion beetles are not abundant enough to be disturbing the bait and sand, (through either digging or simply hopping through it), it is not necessary to check the sites early; however, the slanting light of the early hours greatly facilitates in seeing details in the track.

Bait stations were placed approximately 1/4 mile apart in the Ardmore area and the Triple 7 area, following ridge tops where possible to give better scent dispersal on the evening downdrafts. Bait stations in the other areas surveyed were placed approximately ½ mile apart.

RESULTS AND DISCUSSION

The area newly surveyed in the Pioneer Grazing District (Maps 1&2) resulted in tracks of striped skunk at 1 station, cottontail species at 2, American badger at 2, coyote at 6, bobcat at 1, raccoon at 2, and domestic cat at 8, from a total of 300 bait station-nights. (Tables 1 & 2). While no swift fox tracks were found, it is interesting to note that remains of one juvenile swift fox were found in the Lone Butte area, approximately 8 miles south-east of Oelrichs (T.11S. R.8E. NE,SE,S1). It was judged to be a juvenile by the unfused epiphyseal growth plates on several of the bones. I would estimate that it had died the previous fall or winter, and probably was a dispersing animal.

The new area surveyed on the Triple Seven allotment yielded tracks of 1 American badger, 1 coyote, 2 bobcats, and 3 tracks that fit the size parameters for swift fox, but were too indistinct to be identified (I suspect this was due to an improper sand-oil ratio, due to inexperience). These results were from 75 bait station-nights (Table 2).

The annual survey in the Ardmore area resulted in swift fox tracks at 22 bait stations over the three nights, and striped skunk at 9 stations, out of a possible 93 bait station-nights (Table 3). One active den was found, and, as in recent years, it was located in the north part of the survey area (Map 4). This correlates with the concentration of tracks found in the northern area, and again strengthens my belief that there may be a larger population of swift fox on private land to the north.

Bait Station	Day 1	Day 2	Day 3
1	SYSP		
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			CALA
27			
28			
29			
30			
31			
32		MEME	
33			
34			
35			
36			
37			
38			
39			
40			
41			
42			
43			
44			
45			
46			
47			
48			
49			
50			

TABLE 1. Tracks on North Pioneer Breeding Bird Route

Bait Station	Day 1	Day 2	Day 3
1			
2			
3			
4			
5			
6			
7			
8			
9	PRLO		
10			CALA
11			
12			
13			
14	#		
15			
16			
17			CALA
18			
19			
20			
21			
22			
23			
24	SYSP	TATA	
25			
26			
27	FERU		FEDO
28			
29			
30			
31			
32			
33		CALA	
34		CALA	
35			
36			
37			
38			
39			
40		CALA	
41		FEDO	FEDO
42			
43			
44	FEDO		
45	PRLO		
46		FEDO	FEDO
47	TATA		FEDO
48			FEDO
49			
50			

TABLE 2. Tracks on South Pioneer Breeding Bird Route

Bait Station	Day 1	Day 2	Day 3
1			
2			
3			
4			MEME
5			MEME
6			
7			
8			
9			
10			
11			VUVE
12			
13			
14			
15			
16			VUVE
17			VUVE
18		MEME	MEME
19		VUVE	VUVE
20		VUVE	
21			
22	VUVE	VUVE	
23	MEME		VUVE
24	VUVE		VUVE
25			MEME
26	VUVE		VUVE
27		VUVE	
28	MEME	VUVE	VUVE
29	VUVE	VUVE	VUVE, MEME
30		MEME	VUVE
31		VUVE	VUVE

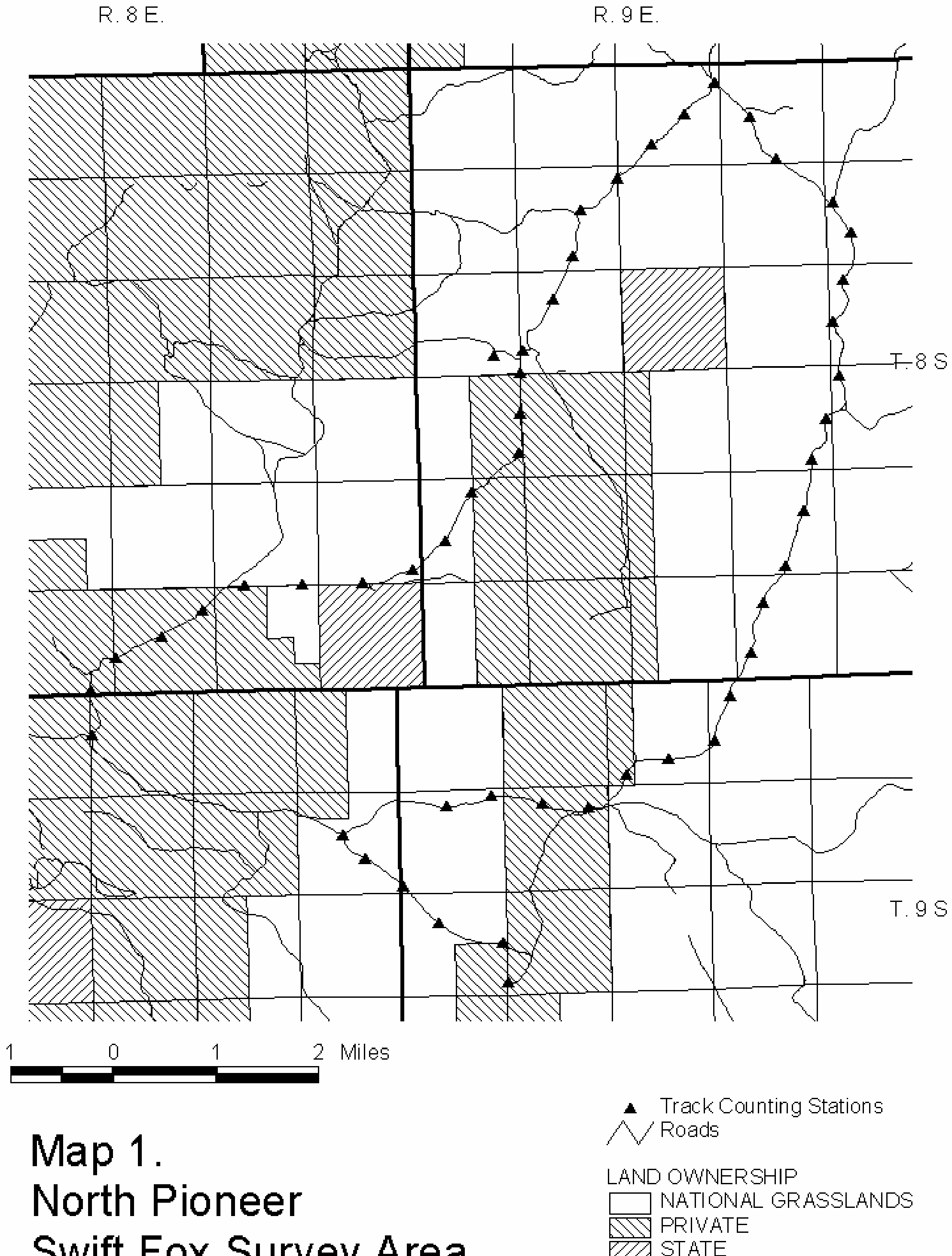
TABLE 3. Tracks on Ardmore Survey Area

Bait Station	Day 1	Day 2	Day 3
1			
2			
3			
4			
5			
6		TATA	
7			
8	FERU	FERU	
9			
10	*	*	*
11			
12		CALA	
13			
14			
15			
16			
17			
18			
19			
20			

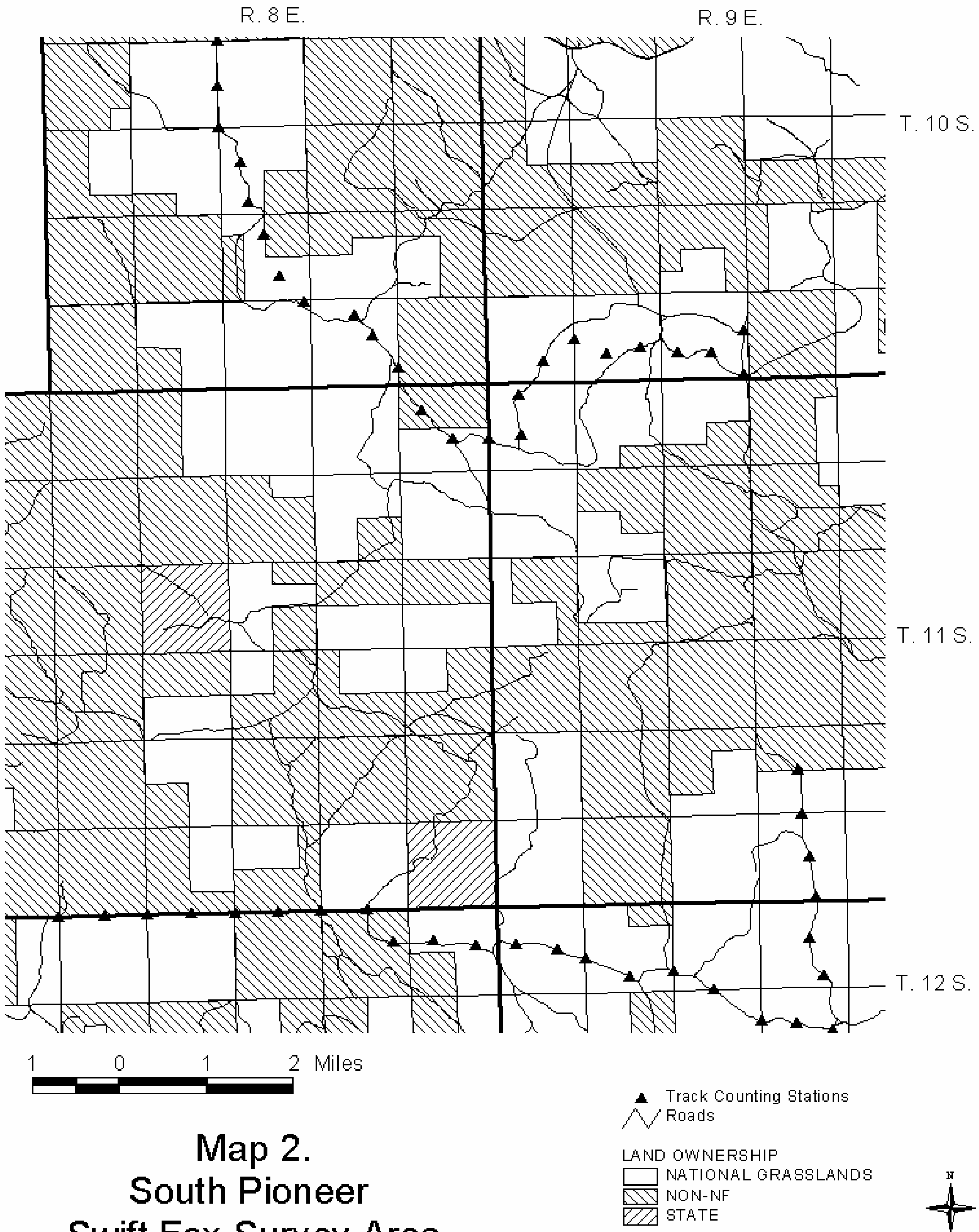
TABLE 4. Tracks on Triple Seven Allotment Survey Area

CALA – coyote
FERU – bobcat
FEDO – domestic cat
MEME – striped skunk
PRLO – raccoon
SYSP – cottontail species
TATA – American badger
VUVE – swift fox

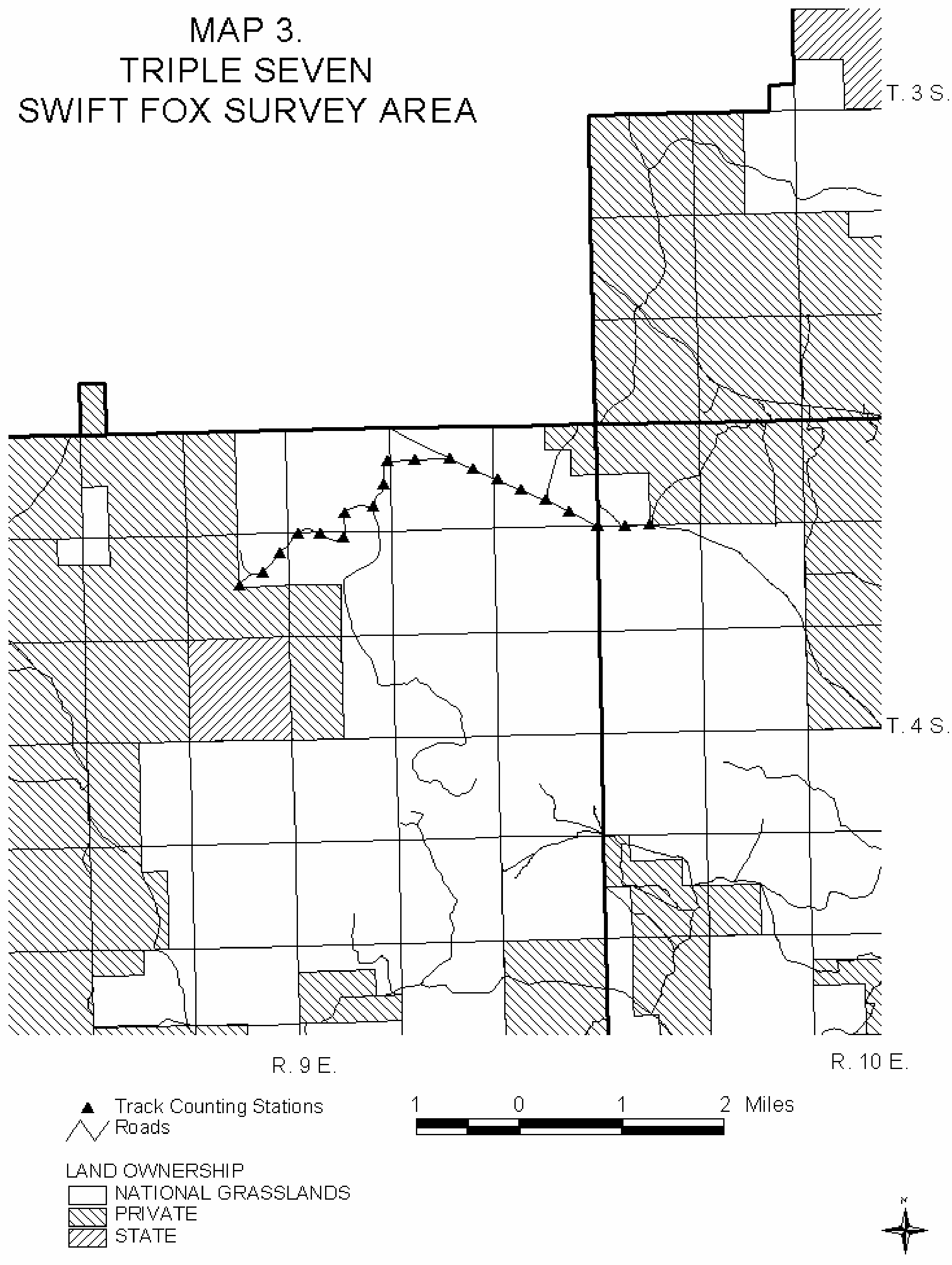
remains of juvenile swift fox
* indistinct tracks that fit swift fox size parameters.

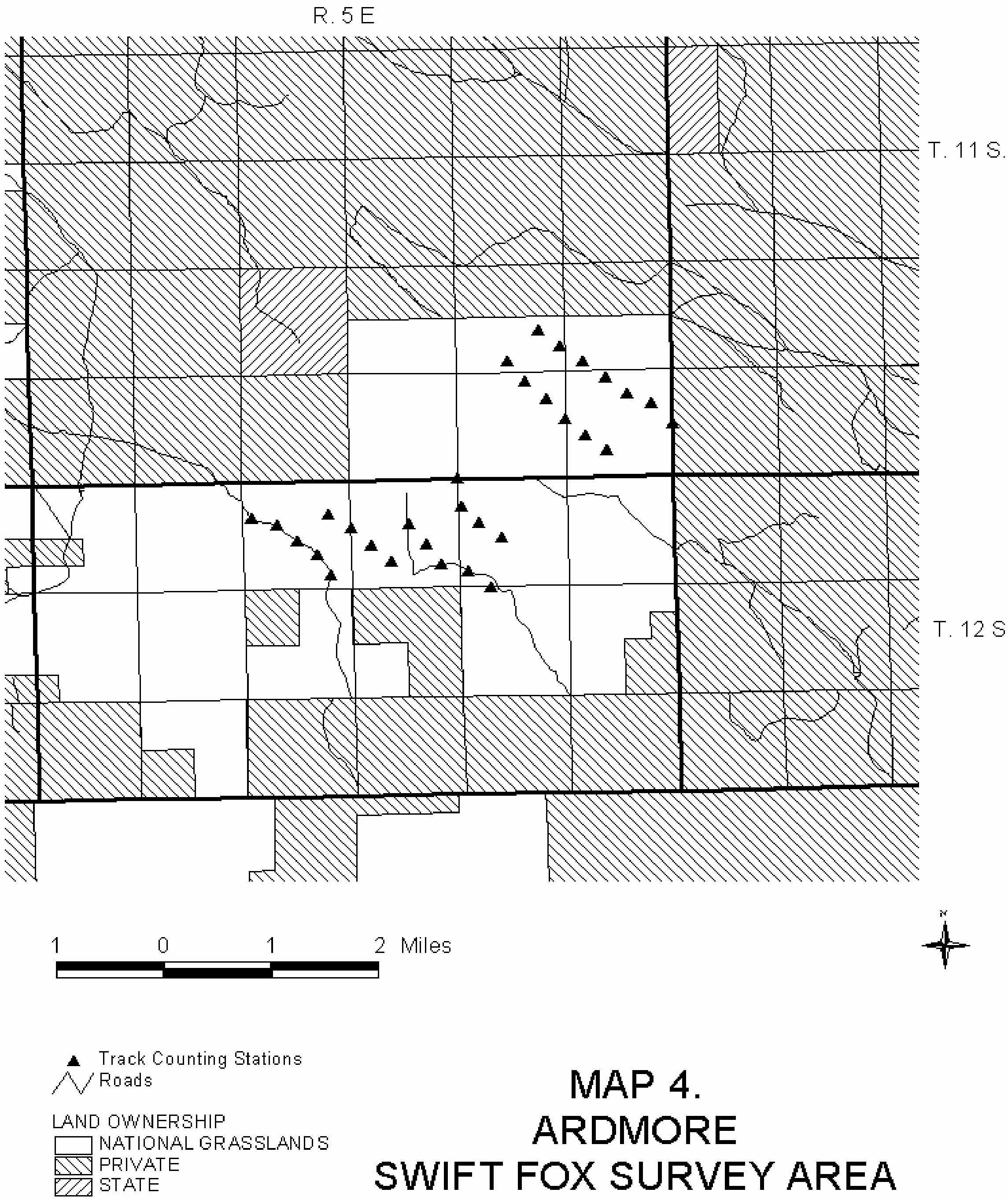


Map 1.
North Pioneer
Swift Fox Survey Area



Map 2.
South Pioneer
Swift Fox Survey Area


MAP 3.
TRIPLE SEVEN
SWIFT FOX SURVEY AREA
T. 3 S.
T. 4 S.
R. 9 E.
R. 10 E.
Track Counting Stations
Roads
1 0 1 2 Miles
LAND OWNERSHIP
NATIONAL GRASSLANDS
PRIVATE
STATE



MAP 4.
ARDMORE
SWIFT FOX SURVEY AREA

SWIFT FOX COMPLETION REPORT

STATE OF WYOMING NONGAME MAMMALS – Species of Special Concern

PERIOD COVERED: 15 April 2001 – 14 April 2002

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Laurie Van Fleet, Nongame Biologist

INTRODUCTION

The purpose of the distribution surveys conducted in 1999, 2000 and 2001 were to document recent locations of swift fox (*Vulpes velox*) in Wyoming**.** Baited track plates placed in a continuous transect up to several miles long with a track plate spacing of 1.6 km (1 mi) between plates was found to be the most effective method for documenting swift fox in areas with potential habitat but unknown population status (Dieni et al. 1997). To establish transect locations, suitable areas of swift fox habitat were determined and randomly selected sections (1 mi^2) within the areas identified (Olsen et al. 1999).

Surveys to develop baseline transects for monitoring long-term population trends were initiated in 2001. These trend surveys occurred in locations documented to have swift fox during the 1999 and 2000 distribution surveys. Survey methods previously developed were used (Olson et al. 1999). Transects for monitoring population trend utilized a more intensive survey method (five track plates at a spacing of .8 km (.5mi) between plates). Approximately 20 transects will be surveyed in each of three geographic regions with each transect no closer than 5 miles to another. The method is based on previous findings and estimates that there is an 88% probability that a swift fox will be detected if it occupies an area.

According to Woolley et al. 1995, the current population occurs primarily in three geographic regions: Region 1) Laramie Valley and Shirley Basin in Albany and Carbon counties, Region 2) Southeastern Plains–parts of Laramie, Platte and Goshen counties, and Region 3) Powder River Basin- parts of Converse, Natrona, Weston and Niobrara counties. Surveys were conducted in the Laramie Valley and Shirley Basin areas in 1999. The Regions 2 and 3 were surveyed in 2000 and 2001.

Future trend surveys will be completed on an annual basis with the cooperation of Turner Endangered Species Fund, while the swift fox translocations to Bad River Ranch, South Dakota are on going (3-5 years). Following the translocation effort, surveys will then be scaled back to once every three years to monitor long-term swift fox trends.

METHODS

Track plates were made of 16-gauge sheet steel, measured 61cm x 61cm (2ft. x 2ft.) painted with two coats each of gray primer and gray paint. A one-gallon weed sprayer was used to coat the plates with talc/carpenter's chalk and ethyl alcohol mixture, the ratio used was 1 cup talc: 1.5 cups carpenter's chalk : 1 gallon 95% ethyl alcohol. This mixture will prepare 40-50 plates. Approximately 15g of stirred jack mackerel were placed in the center of the plate as an attractant. Plates were spaced 0.8 km (0.5 mi) apart within public road easements where tracks could be observed without requiring private land access. Track plates were placed along an existing fence if one was present. When a fence was not present, plates were placed 10 m to 25 m from the centerline of the road.

Flagging marked locations of plates and a GPS location in UTM coordinates were recorded for all track plates in each transect. Transects were observed for a maximum of six days, but monitoring ceased the day after swift fox presence was confirmed. This method is designed to detect declines in the population under the assumption that there is an 88% chance that a fox will remain in or return to the same area from one year to the next (Olson et al. 1998). During periods of heavy rain and snow plates were left in-place for up to two additional nights. If rain or snow persisted for more than two nights, the survey effort was abandoned and postponed until favorable weather conditions returned.

Eastern Wyoming was divided into three study regions encompassing 10 counties: Study Region 1 – Portions of Albany and Carbon Counties; Study Region 2 – Portions of Goshen and Laramie Counties; and Study Region 3 – Portions of Campbell, Johnson and Niobrara Counties (Woolley et. al 1995).

Tracks of swift fox were recorded and lifted for future reference and measurements with 2-inch clear packing tape. In some cases, clear contact paper was used to preserve an entire track plate for future use in identifying tracks. Plates were cleaned with a stiff brush or steel wool before reuse.

Baseline transects used during the 2001 trend monitoring survey were those locations with positive identification of a swift fox track on a track plate during the 1999 and 2000 surveys or known den sites. Recorded den sites along roads were used as center locations for baseline transects. Short and mixed grass prairies mostly devoid of heavy shrub coverage characterized areas where swift fox were most commonly found. Selection of survey routes took into account accidental swift fox observations made by USDA -Wildlife Services, Wyoming Game and Fish Department, and Wyoming Cooperative Fish and Wildlife Research Unit personnel.

RESULTS

The long-term swift fox, monitoring program was initiated the third week of September and terminated by the second week of October 2001. Surveys were completed in 3 study regions and 10 counties in eastern Wyoming. The survey totals for all regions combined are as follows: 2,002 track plate nights; 438.5 miles surveyed; swift fox were detected at 37 of 48 locations; a minimum of 41.7 track plate nights (4.7 nights), were required to detect swift fox (Table 1).

<u>Study Region 1:</u> Prior to the initiation of the survey there existed 18 recent locations/sightings. Swift fox were detected at 14 of the 18 locations. A total of 265 track plate nights were utilized. A minimum of 14.7 track plate nights (2.9 nights), were required to detect swift fox.

Study Region 2: Prior to the initiation of the survey there existed 10 recent locations/sightings. Survey efforts in 2001 were also aimed at finding between 5 and 10 new locations. Swift fox were detected an additional 7 locations in 2001. A total of 17 swift fox locations were utilized and swift fox were detected at 14 of the 17 locations. A total of 956 trap nights were utilized. A minimum of 56.2 track plate nights (5.9 nights), were required to detect swift fox.

Study Region 3: Prior to the initiation of the survey there existed 7 recent locations/sightings. Survey efforts in 2001 were also aimed at finding between 8 and 13 new locations. Swift fox were detected an additional 6 locations in 2001. A total of 13 swift fox locations were utilized and swift fox were detected at 9 of the 13 locations. A total of 781 trap nights were utilized. A minimum of 60.1 trap nights (5.7 nights), were required to detect swift fox.

DISCUSSION

Surveys for swift fox in 1999 and 2000 were designed to establish a sufficient sample size (15 to 20 locations) of occupied swift fox locations to serve as transect locations for monitoring population trends. However, due to small sample sizes, 10 locations and 7 locations, in Study Region 2 & 3 respectively, prior to the start of the 2001 monitoring effort, additional effort was spent on establishing new survey routes in 2001. Future survey results in Region 2 can be expected to closely resemble those of Study Region 1. Study Region 3 will require an additional 2 – 7 new locations in the 2002 survey before survey trends mimic the 2001 Study Region 1 results.

In contrast with other prairie mammals in Wyoming swift fox tracks demonstrated unique characteristics. A Key to Mammal Tracks on Chalk/Talc Covered Track Plates in Eastern Wyoming was developed and utilized in identifying mammal tracks (Appendix I). Swift fox tracks were differentiated from red fox in that swift fox prints were considerably smaller and never exceeded 34 mm long and/or 31 mm wide. Coyote tracks are similar to red fox though they have slightly wider measurements and less hair between paw pads than do red fox. Claw impressions of canines on track plates are rarely detected compared to tracks of the same animal in softer substrates. White-tailed jackrabbit front tracks were similar to swift fox but distinguishable by the amount hair distorting the shape of toe and palm pads. These tracks looked similar to pressing a cotton ball on the surface of the track plate. Usually the front tracks were accompanied by the much longer hind tracks. Rodents and cows may have affected the number of fox detections by taking attractant or smudging plates. Since impressions of grassland mammal tracks appear slightly different on track plates than on softer surfaces such as mud, sand, and snow, it is recommended that each project preserve track plates of separate species for comparison.

ACKNOWLEDGEMENTS

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Table 1. Summary of Swift Fox (*Vulpes velox*) Surveys By Study Region in Eastern Wyoming, 2001.

Study Region	County		Total # Transects Run	Total # Track Plates	Ave # of Plates/ Transect	Total # Nights Run	Total # of Track Plate Nights	Total Miles of Transects	Previous Swift Fox Locations	2001 Swift Fox Detections
1	Albany		11	55	5.0	35	175	22	11	8
	Carbon		7	35	5.0	18	90	14	7	6
		Total	**18**	**90**	**5.0**	**53**	**265**	**36**	**18**	**14**
2	Goshen		17	205	12.1	73	646	231	8	5
	Laramie		15	154	10.3	27	310	68	9	9
		Total	**32**	**359**	**11.2**	**100**	**956**	**299**	**17**	**14**
3	Campbell		10	58	5.8	40	230	24	8	4
	Johnson		4	76	19.0	19	335	36		
	Niobrara		6	92	15.3	15	216	43.5	5	5
		Total	**20**	**226**	**11.3**	**74**	**781**	**103.5**	**13**	**9**
		Total (all regions)	**70**	**675**	**27.5**	**227**	**2002**	**438.5**	**48**	**37**

APPENDIX I. KEY TO MAMMAL TRACKS ON CHALK/TALC COVERED TRACK PLATES IN EASTERN WYOMING

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Laurie Van Fleet, Nongame Biologist

The criteria listed are based on evaluation of tracks collected in Wyoming during past survey years (Luce et al. 2000, Van Fleet et al. 2001, Grenier et al. 2002) as well as Taylor and Raphael (1988), Orloff et al. (1993) and Halfpenny et al. (1998).

1a. Four toes on fore feet (FF) and four toes on hind feet (HF). — 2
1b. Four toes on FF and five toes on HF or five toes on FF and HF. — 8

2a. General shape is square and/or longer than wide in appearance. — 3
2b. General shape is round and/or wider than long in appearance with a 3-1 toe arrangement (3 outer toes are closer than the inside toe). Also, generally one toe is slightly more forward than the other 3. Heel pad anterior end is bi-lobed and posterior end is tri-lobed. (Felidae) — 7

3a. If a line is drawn down the center of the track, approx. 2 ¼ toes are on one side and ¾ are on the other side of the line. Track appears smudged and distorted similar to pressing a cotton ball on the surface of the track plate. — White-tailed Jackrabbit (*Lepus townsendii)*
3b. If a line is drawn down the center of the track the toes are evenly split. Track has a 1-2-1 toe arrangement (middle two toes approximately evenly spaced). Heel pad is generally triangular shape. (Canidae) — 4

4a. Track Length > 64 mm and/or Track Width > 54 mm — Domestic Dog (*Canis familiarus*)
4b. Track Length < 64 mm and/or Track Width < 54 mm — 5

5a. Track Length > 52 mm and/or Track Width > 42 mm — Coyote (*Canis latrans*)
5b. Track Length < 52 mm and/or Track Width < 42 mm — 6

6a. Track Length > 35 mm and/or Track Width > 31 mm — Red Fox (*Vulpes vulpes*)
6b. Track Length < 34 mm and/or Track Width < 3 mm — Swift Fox (*Vulpes velox*)

7a. Track Length and Width > 38 mm — Bobcat (*Felis rufus*)
7b. Track Length and Width < 38 mm — Domestic Cat (*Felis catus*)

8a. Five toes on FF and HF. General shape is wider than long. Toes appear crowded with a 1-3-1 toe arrangement. Heel pad appears generally longer on one side. Commonly registers only 4 toes. (Mustelidae) — 9
8b. Toes and/or heel pad appears elongated. FF resembles a human hand. HF resembles the foot of a small child. — Raccoon (*Procyon lotor*)

9a. Track Length > 48 mm and/or Track Width > 32 mm. Track appears to be pigeon-toed. Badger (*Taxidea taxus*)

9b. Track Length < or = 48 mm and/or Track Width < or = 32 mm. Track does not appear to be pigeon-toed. 10

10a. Track Length is approx. 38 mm. Track Width is approx. 32 mm. FF has large heel pad that is wider than long. HF may register a secondary heel pads. Striped Skunk (*Mephitis mephitis*)

10b. Track Length is approx. 19 mm. Track Width is approx. 19 mm. Track generally appears an organized collection of small dots. Long-tailed Weasel (*Mustela frenata*)

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