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December 15, 2000

Ms. Pat Langley, Asst. Regional Director
U. S. Fish and Wildlife Service
Division of Federal Aid
P. O. Box 1306
Albuquerque, New Mexico 87103

Attn: Penny Bartnicki

Dear Ms. Langley:

Enclosed for your review and approval is the performance report for Section 6 grant, E-43, Segment 2 (Population Status, Population Viability, and Habitat Use of the Swift Fox in New Mexico). This report covers the period of October 1, 1999 – September 30, 2000.

Thank you for your continued assistance and cooperation. If you have any questions, please feel free to contact me at (505) 476-0286.

Sincerely,

Lisa B. Evans

Lisa B. Evans
Federal Aid Coordinator

LBE/MLM
Enc.

cc: Tod Stevenson (Conservation Services Division Chief, NMGF)
Chuck Hayes (Conservation Services Division Assistant Chief, NMGF)
Mary Medina (Conservation Services Div. Admin. Asst., NMGF)
C. Greg Schmitt (Endangered Species Biologist, NMGF)

PERFORMANCE REPORT

State: New Mexico Project Number: E-43-2

Grant Title: Endangered Species

Study Title: Population Status, Population Viability, and Habitat Use of the Swift Fox In New Mexico.

Contract Period: October 1, 1999 To: September 30, 2000

I Project Statement

To determine the population status, population viability, and habitat use of the swift fox in New Mexico.

II. Project Objectives

1. Determine the method of population census most appropriate for swift foxes in New Mexico.

2. Determine demographic parameters necessary for assessment of population viability: natality, mortality, and sex ratios.

3. Determine whether or not and under what circumstances swift foxes will use cropland habitats.

4. Determine population density, home range size, diet, and den site selection within study area.

5. Assess threats to swift foxes.

6. Prepare a performance and completion report within 90 days after completion of this project.

Procedures

1. **Determine the method of population census most appropriated for swift foxes in New Mexico.** Activities conducted during the second segment of this project that were directed at determining an appropriate census method for swift foxes in New Mexico are detailed in attached Appendix 1, Overall objective (1): Determine the method of population census most appropriate for swift foxes in New Mexico.

2 **Determine demographic parameters necessary for assessment of population viability: natality, mortality, and sex ratios.** Activities conducted during the second segment of this project that were directed at determining demographic parameters necessary for assessment of population viability: natality, mortality, and sex ratios are detailed in attached Appendix 1, Overall objective (2): Determine demographic parameters necessary for assessment of population viability: natality, mortality, and sex ratios.

3. **Determine whether or not and under what circumstances swift foxes will use cropland habitats.** Activities conducted during the second segment of this project that were directed at determining whether or not and under what circumstances swift foxes will use cropland habitats are detailed in attached Appendix 1, Overall objective (3): Determine whether or not and under what circumstances swift foxes will use cropland habitats.

4. **Determine population density, home range size, diet, and den site selection within study area**. Activities conducted during the second segment of this project that were directed at determining population density, home range size, diet, and den site selection within the study area are detailed in Appendix 1, Overall objective 4): Determine population density, home range size, diet, and den site selection within the study area.

5. **Assess threats to swift foxes**. Activities conducted during the second segment of this project that were directed at assessing threats are detailed in Appendix 1, Overall objective (5): Assess threats to swift foxes.

6. **Prepare a performance and completion report within 90 days after completion of this project.** A performance report for the second segment of this project was prepared.

Prepared by: Greg Schmitt
C. Gregory Schmitt
Project Biologist

Approved by:
Chuck Hayes
Assistant Chief,
Conservation Services Division

Approved by: Lisa B. Evans
Lisa Evans
Federal Aid Coordinator

Approved by: Tod W. Stevenson
Tod Stevenson
Chief, Conservation Services
Division

APPENDIX 1

Population Status and Ecology of Swift Fox in New Mexico

Population Status and Ecology of Swift Fox in New Mexico

By

Robert L. Harrison, Ph. D.
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Albuquerque, New Mexico 87107

Section 6 Project E-43-2
Population Status, Population Viability, and Habitat Use
of the Swift Fox in New Mexico

New Mexico Department of Game and Fish
Endangered Species Program
P. O. Box 25112
Santa Fe, New Mexico 87504

Professional Services Contract 99-516.52

20 September 2000

Population Status and Ecology of Swift Fox in New Mexico

2000 Annual Report under Professional Services Contract No. 99-516.52

September 20, 2000

Prepared by: Robert L. Harrison, Ph.D.
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Swift fox research has progressed steadily toward contract goals. No significant setbacks or problems have occurred. A total of 25 swift foxes have been captured and fitted with radio collars in the Kiowa Grasslands study area. A total of 783 independent relocations have been made and home range size estimates are available for 14 foxes. The density of foxes in the study area has been estimated and six methods of counting foxes have been tested. At present eleven foxes are being monitored. Research has been hampered to a minor extent by thunderstorms during summer and premature failure of radio transmitters.

Activities this year included trapping and radio collaring foxes, testing scent stations with automatic cameras, spotlighting, calling, analysis of DNA in scat, observing numbers of pups at dens, collecting dead foxes, assessment of age at date of death and causes of death, determination of sex ratio, reviewing literature, population estimation, density estimation, home range size estimation, collection of scat, lure testing, locating and describing den sites, generating habitat maps, observing habitat outside of the study area, updating landowners on the progress of the study, updating the land ownership database, writing the 1999 annual Swift Fox Conservation Team report, attending the annual Swift Fox Conservation Team meeting, and testing fox blood for plague. Summaries of activities and results are presented below. This report describes activities from September 6, 1999, to September 12, 2000, organized by overall study objectives. All conclusions regarding survey methods should be regarded as preliminary at this time.

Overall objective (1): Determine the method of population census most appropriate for swift foxes in New Mexico.

Methods to census swift fox tested were scent stations, searching for tracks, spotlighting, calling, trapping, and collecting scat.

Tests of transects of scent stations were conducted within the home ranges of seven marked (radio collared) foxes. Deaths and transmitter failures restricted the number of foxes that could be tested. Automatic cameras were used to determine if visiting foxes were marked or unmarked. Five stations were set up within each home range and observed for six nights. A total of 210 station-nights of observation were conducted. Swift fox tracks were first observed on the transects after one night on four transects, and after two, three, and four nights on one transect each. Marked foxes were first photographed and left tracks after one night on three transects and after three and six nights on two transects. On one transect the marked fox was photographed but did not leave tracks. On one transect the marked fox was not photographed. Marked and unmarked foxes combined made 69 visits to stations.

By subsampling data, information was gained about the number of transects that were be visited as a function of the number of nights observed and the number of stations per home range (Figures 1 and 2). Detection rate increased smoothly as the number of stations per home range and number of nights observed increased. Given the observed home range sizes (see Objective 4, below) and assuming circular home ranges, placing five stations in each home range requires a spacing of 0.47 mile, placing four requires a spacing of 0.56 mile, placing three requires a spacing of 0.93 mile, and placing one requires a spacing of 1.4 miles or greater.

Comparison of results of marked-only and combined marked and unmarked provides an indication of the relative number of transects visited between areas of low and moderate or high foxes densities. The scent station method has little ability to discriminate between finer levels of relative density because the actual numbers of foxes visiting transects can not be determined and variation in the number visiting is likely to be high. Observation of marked foxes only provides an estimate of the minimum percentage of transects that will detect foxes if they are present.

Based upon this limited sample and marked foxes only, a spacing of one-half mile between stations and six nights of observation will detect foxes on 71% of transects where foxes occur. Using marked and unmarked foxes combined, a spacing of one-half mile and four nights of observation will detect foxes on 100% of transects where foxes occur. One mile between stations is more practical when surveying large areas. With this spacing and six nights of observation, foxes in low density areas will be detected on approximately 60% of transects, whereas in moderate and high density areas foxes will be detected on approximately 75% of transects where foxes occur.

Searches for tracks during scat surveys have continued since the previous year. Clear swift fox tracks were observed on only one occasion. Precipitation was too infrequent to produce sufficiently wet soils. As observed last year, soils in the study area, and in New Mexico in general, are too hard, sandy, and dry to take and hold identifiable swift fox tracks. Track surveys will not be studied further.

Spotlighting has been conducted for a total of 117 miles through the known home ranges of 15 foxes. No foxes were seen. The area visible by spotlighting comprises a very small portion of a fox's home range and thus this technique is limited by the number of roads available. Spotlighting may be useful in certain situations, such as when food resources are concentrated and foxes are attracted to specific areas. In general, spotlighting is a very inefficient technique and will not be studied further.

Ten attempts to call foxes into visible or audible range using recorded animal sounds were made. One fox responded to the calls, approached the vehicle and vocalized. No other foxes responded even though telemetry indicated they were within range of the sounds. Calling is limited by wind noise and available roads and can disturb homeowners. Foxes appear to be wary of vehicles and may have been reluctant to approach. Calling is not an efficient technique and will not be studied further.

A total of thirty-three captures of foxes, including 10 recaptures, were made during 531 trap-nights to date (6.2%). Without recaptures, the rate drops to 4.3%. Two additional foxes were captured in enclosure traps at dens in the process of recapturing previously collared foxes. Trapping provides positive species identification, but low efficiency precludes its use for statewide surveys unless an absolute population estimate is desired (see below). In addition, trapping is stressful to foxes and may result in injuries to their teeth while struggling to free themselves.

Collection of scat remains a promising but elusive survey option. Scat are readily collected (see Objective 4, below), although, as reported last year, scat may not be found even though foxes are present. In principle, the identity of species depositing scat may be determined by mitochondrial DNA analysis. Individuals may be identified by micro satellite DNA analysis, enabling absolute population estimation with capture-recapture techniques. Methods have been developed for coyotes (Kohn et al. 1999), but not for foxes. In practice, extracting DNA is very difficult and other labs have not been able to duplicate Kohn's (1999) work. At present no professional lab performs this work.

To develop methods necessary for analysis of swift fox DNA from scat, an agreement was reached with Dr. Jerry Dragoo of the University of New Mexico. Dr. Dragoo received control fecal and blood samples from captive foxes at the Northern Prairie Research Center and field scats collected from the study area. To date Dr. Dragoo has not spent as much time on the project as originally promised, although he appears to be spending more time on it recently. He has not yet succeeded in verifying that the control scats are from swift foxes, nor has he been able to identify individual foxes by their scat. A deadline of November 1 has been set, after which the project may be dropped.

DNA analysis is more easily performed with hair than scat. Hair is harder to collect than scat, although recent advances in collection techniques have been made using patches of glue in baited tunnels. If scat analysis proves to not be useful, the use of hair collecting devices will be examined.

Which census method is most appropriate for swift fox in New Mexico depends upon the type of information and the scale desired. For presence/absence at the county level, NMDGF furbearer harvest and Wildlife Services data may be sufficient. At smaller scales or for areas that are not trapped, scent stations are the best method available. For relative abundance estimates at all scales, obtaining the percentage of scent-station transects visited the best method. Furbearer harvest and Wildlife Services data does not have great enough sample sizes to adequately estimate catch per unit effort. Recent unpublished research by Glen Sargeant and Douglas Johnson of the Northern Prairie Research Center has found that randomly-placed individual stations may be more efficient than transects for determining relative density of foxes. This work will be incorporated in this study as soon as it becomes available. For absolute population estimates, mark-recapture using traps and automatic cameras is the best method. The most precise estimates require a spacing of one-half mile and six nights of observation. Scat collection is still unproven due to the inability to determine species. Searching for tracks, spotlighting, calling, and systematic trapping (without cameras) are too inefficient to be used other than in an anecdotal manner.

Overall objective (2): Determine demographic parameters necessary for assessment of population viability: natality, mortality, and sex ratios.

Observations of pups were made at four dens, beginning in early June. Loss of females (see below) limited the number of dens observable. Two pups were observed at two dens and one at each of two dens. One pup disappeared from the former dens by July and one mother died in July, presumably resulting in the death of her one pup. A local Wildlife Services official related that he regularly sees 3-4 pups each year at a den near his home. Observations will begin earlier next year.

Of 25 foxes (11 males, 14 females) radio collared to date, seven (2 M, 5 F) have died due to predation, 3 (all F) have died due to unknown causes, and four (2 M, 2 F) have disappeared. Predation is probably entirely due to coyotes. Badgers rarely attack foxes and are uncommon on the study area. Eagles have not been seen on the study area. Disappearances are probably mostly transmitter failures. It is possible that these foxes emigrated, but they were not found during aerial searches. Efforts to retrap the foxes were unsuccessful. One additional pup was found dead last year due to a vehicle strike.

The sex ratio of all foxes examined to date is 11 males to 14 females. This ratio

does not differ significantly from 1:1.

Six fox mandibles have been submitted to Matson's Laboratory for age analysis. Four females were juveniles, one female was one year old, and one male was two years old. Analysis of two mandibles is pending.

Overall objective (3): Determine whether or not and under what circumstances swift foxes will use cropland habitats.

Cropland occurs within the home ranges of three radio collared foxes. Crops in the study area consist solely of winter wheat without irrigation. To date none of these foxes has been observed in cropland habitat. However, cropland covers a relatively small portion of the home ranges of these foxes.

In a previous study, (Harrison and Schmitt, in prep.), no evidence was found for swift fox occurrence in cropland areas of eastern New Mexico, with the exception of one specimen collected in an area of mixed cropland and rangeland near the western edge of cropland development in Roosevelt County. Whether swift fox populations in cropland areas have been reduced by agricultural development or related factors is not known. Swift fox have been found in areas of mixed agricultural use (Kilgore 1969). Swift fox did occur historically in cropland in northern Texas (Cutter 1958) and in the Oklahoma panhandle (Kilgore 1969) and are currently present in cropland in Kansas (Sovada et al. 1998).

Cropland is often suitable habitat for red fox (*Vulpes vulpes*, Sheldon 1992). Red fox may exclude swift fox (Hines and Case 1991), and have been found to kill kit fox (Ralls and White 1995) and exclude arctic fox (Bailey 1992). We collected three red fox specimens from cropland areas in eastern Roosevelt County. One red fox specimen was collected within 13 km of the swift fox specimen mentioned above that was collected in or near cropland. NMDGF furbearer harvest records indicate the recent presence of red fox in all counties of eastern New Mexico. Swift fox have not been found recently in cropland areas of western Texas (Mote 1996), where it is likely that red fox have expanded their range following introduction into central Texas (Davis and Schmidly 1994). Red fox distribution does not overlap that of swift fox in Kansas (M. Sovada, National Biological Survey, personal communication). The preference of red fox for diverse terrain (Ables 1975) and need for water (Hines 1980) may limit their use of open plains, which are more suitable for swift fox. In areas of mixed rangeland and other habitats, red fox and swift fox may occur in close proximity. Red fox may be responsible for the absence of swift fox from cropland areas.

Swift fox may also be excluded from cropland by farming practices, such as flood irrigation, frequent plowing, or herbicide application which disturbs prey communities.

Swift fox avoid areas with vegetation higher than 25 cm (Harrison and Schmitt, in prep.) and thus areas of tall crops, such as corn, are not likely to be used.

Red fox are not present in the study area nor is there irrigation or frequent plowing of the cropland area. Lack of detection of foxes in the cropland area is probably a result of its small area, but monitoring of foxes whose home ranges overlap cropland will continue.

Overall objective (4): Determine population density, home range size, diet, and den site selection within the study area.

The size of the swift fox population in the study area was estimated using automatic cameras to observe the numbers of unmarked and marked foxes visiting bait stations and a Lincoln-Peterson estimate for closed populations. The 95% confidence intervals for total population size were 15 to 41 foxes in December, 1999, and 12 to 25 foxes in February, 2000. The area sampled was assumed to be one average home range diameter wide on each side of surveyed roads, based upon fall/winter home range sizes. The area was estimated to be 93.6 mi^2. The 95% confidence intervals for estimated fox density were 0.16 to 0.43 foxes/mi^2 in December, 1999, and 0.13 to 0.27 foxes/mi^2 in February, 2000. These estimates are conservative (i.e., probably slightly low) due to maximizing the estimate of area surveyed.

Home range size estimates are available for 14 foxes (8 M, 6 F). The average home range size is 1587 ha (6.13 mi^2, range 482 - 3875 ha, 1.86 - 14.96 mi^2). Home range estimates appear to stabilize after approximately thirty relocations have been obtained.

A total of 62 den sites have been located and den site characteristics recorded. Characteristics have not been analyzed, but no significant trends in slope, grass height, or orientation have been noticed.

A total of 567 fox scats have been collected for diet analysis. Scat is found most readily at fence corners, cattle guards, and other conspicuous locations. A test of the efficacy of scent lures to increase scat deposition was made. All scat were collected from 64 conspicuous locations. A lure known to attract foxes (cod liver oil and mackerel) was deposited at 33 locations. Scat deposition one month later was insufficient for analysis, so all locations were re-examined six months later. No significant enhancement of scat deposition was found.

Overall objective (5): Assess threats to swift foxes.

No new threats to foxes on the study area have been found since last year. Potential threats to swift fox on the study site include trapping by U.S.D.A. Animal and Plant Health Inspection Service Wildlife Services agents, vehicle strikes, predation by coyotes and other species, being shot, and habitat loss. Wildlife Services activity occurs only in limited areas, and no swift fox have been reported killed. Pan-tension devices can be used on traps to reduce incidental killing of non-target species. One swift fox pup was killed last year by a vehicle on state highway NM 39. The home ranges of three marked foxes cross NM 39 and they frequently are close to the highway, but they have not been killed. Two natal dens have been observed within a few meters of a secondary road, but no vehicle deaths were observed.

Coyotes have been found to be the primary source of swift and kit fox mortality in several studies (Scott-Brown et al. 1987, Ralls and White 1995, White and Garrott 1997, Kitchen et al 1999). However, the abundance of prey as affected by rainfall is a more significant factor in regulation of kit fox population size than coyote abundance (White and Garrott 1997, Dennis and Otten 2000). Swift fox appear to be able to coexist with coyotes due to den use and dietary partitioning (Kitchen et al. 1999). Coyotes are routinely killed by government agents and ranchers and it is unlikely that coyote density will increase significantly in the future.

Based upon conversations with ranchers, the attitude of local people toward foxes appears to be very positive and there has been no indication that they would shoot foxes for any reason. A limited amount of hunting does occur in the study area. Hunters may shoot foxes for sport, but the hunting season is limited to a few days per year. No fur trapping or further conversion of grassland to cropland has been noted on the study site yet.

To address conservation and management of the statewide swift fox population, habitat maps were downloaded from the U.S. Geological Survey. Maps of habitat and land use covering the entire range of swift fox in New Mexico were generated. Unfortunately these maps did not delineate habitat categories that were equivalent to those used or not used by swift fox as determined by Harrison and Schmitt (in prep.). No adequate habitat maps have been found. Also, an informal habitat survey by vehicle was conducted in the vicinity of Tucumcari, NM. Harrison and Schmitt (in prep.) found a potential gap between northern and southern populations of swift fox in this area. Unsuitable habitat there was observed to be sufficiently widespread to create such a gap. Whether or not the current habitat is natural or anthropogenic is not known. If it is natural, in the past the northern and southern swift fox populations could have been connected through short-grass prairie areas in Texas. However, the latter areas are now almost entirely converted to cropland and swift fox are not present (Mote 1996). If the southern swift fox population is indeed isolated from other swift fox

populations, over time it will likely become more similar to kit fox populations through hybridization with southern New Mexico kit foxes.

Additional Activities

In addition to the activities described above, a letter was mailed to 85 landowners and grazing permittees in the study area. The letter is an annual newsletter describing study activities and other news pertinent to swift foxes. The letter acknowledged the cooperation of individual ranchers. The data base of landowner addresses was updated prior to mailing the letter. The annual report to the Swift Fox Conservation Team was written and the annual Team meeting in Phoenix was attended. Blood samples were taken with Nobuto strips from seven foxes to test for exposure to plague. Two were negative, one was positive, and analysis of four is pending.

Future Activities

Research effort during the final year of the project will be very similar to that of the past year. Additional foxes will be trapped and emphasis will be placed upon further testing of scent station transects and analysis of DNA from scat. Hair collecting devices may be investigated. A second population size estimate will be made. In addition, an attempt will be made to determine litter size and age at death from swift fox specimens collected by the new Mexico Department of Game and Fish. Diet will be analyzed from scat samples.

Literature Cited

Ables, E. D. 1975. Ecology of the red fox in America. Pages 216-236 *in* M. W. Fox, editor. The Wild Canids. Krieger Publishing, Malabar, Florida, USA.

Bailey, E. P. 1992. Red foxes, *Vulpes vulpes*, as biological control agents for introduced arctic foxes, *Alopex lagopus*, on Alaskan islands. Canadian Field-Naturalist 106:200-205.

Cutter, W. L. 1958. Denning of the swift fox in northern Texas. Journal of Mammalogy 39:70-74.

Davis, W. B., and D. J. Schmidly. 1994. The mammals of Texas. Texas Parks and Wildlife, Austin, Texas, USA.

Dennis, B., and M. R. M. Otten. 2000. Joint effects of density dependence and rainfall on abundance of San Joaquin kit fox. Journal of Wildlife Management 64:388-400.

Harrison, R. L., and C. G. Schmitt. in preparation. Current swift fox distribution and habitat selection within area of historical occurrence in New Mexico. Submitted to Swift Fox Symposium. To be published in 2001.

Hines, T. D. 1980. An ecological study of Vulpes velox in Nebraska. M. S. Thesis. University of Nebraska, Lincoln.

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

Kilgore, D. L., Jr. 1969. An ecological study of the swift fox (*Vulpes velox*) in the Oklahoma panhandle. American Midland Naturalist 81:512-534.

Kitchen, A. M., E. M. Gese, and E. R. Schauster. 1999. Resource partitioning between coyotes and swift foxes: space, time, and diet. Canadian Journal of Zoology 77:1645-1656.

Kohn, M. H., E. C. York, D. A. Kamradt, G. Haught, R. M. Sauvajot, and R. K. Wayne. 1999. Estimating population size by genotying faeces. Proceedings of the Royal Society of London B 266:657-663.

Mote, K. 1996. Swift fox investigations in Texas. Pages 50-52 *in* B. Luce and F. Lindzey, editors. Unpublished annual report of the swift fox conservation team.

Ralls, K., and P. J. White. 1995. Predation on San Joaquin kit foxes by larger canids. Journal of Mammalogy 76:723-729.

Scott-Brown, J. M., S. Herrero, and J. Reynolds. 1987. Swift fox. Pp. 433-441 in M. Novak, J. A. Baker, M.E. Aboard, and B. Maleic, editors., Wild Furbearer Management and Conservation in North America. Ministry of Natural Resources, Ontario, Canada.

Sheldon, J. W. 1992. Wild dogs. Academic Press, San Diego, California, USA.

Sovada, M. A., C. C. Roy, J. B. Bright, and J. R. Gilles. 1998. Causes and rates of mortality of swift foxes in western Kansas. Journal of Wildlife Management 62:1300-1306.

White, P. J., and R. A. Garrott. 1997. Factors regulating kit fox populations. Canadian Journal of Zoology 75:1982-1988.

FIGURE 1. MARKED AND UNMARKED FOXES PERCENT OF TRANSECTS VISITED v. NUMBER OF NIGHTS OBSERVED AND NUMBER OF STATIONS PER TRANSECT

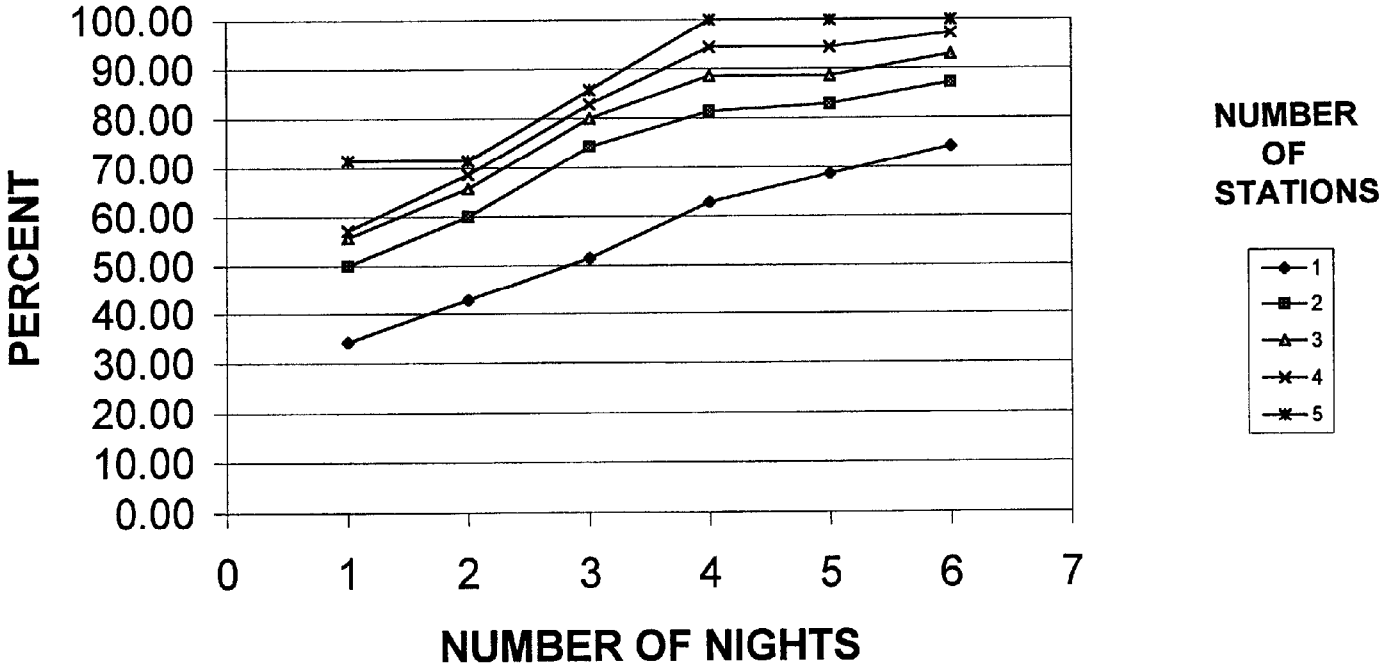

FIGURE 2. MARKED FOXES ONLY PERCENT OF TRANSECTS VISITED v. NUMBER OF NIGHTS OBSERVED AND NUMBER OF STATIONS PER TRANSECT