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RECENT STATUS AND DISTRIBUTION OF RED FOXES (*VULPES VULPES*) IN NORTHEASTERN ARIZONA AND SOUTHEASTERN UTAH

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ABSTRACT—The low number of records and specimens of red foxes (*Vulpes vulpes*) for Arizona and Utah through the 1960s prompted us to collect verified records of the species from the Navajo Nation in northeastern Arizona and southeastern Utah. We compiled and verified 80 visual observations of 88 live and dead foxes, and 21 specimens, from the study area between 1979 and 2001. We also compiled 686 supplemental records of foxes reportedly trapped by permitted furtrappers within the same area and time period. This work verified that the red fox was common to this region despite the low number of records prior to the 1960s and that northeastern Arizona should be included in distribution maps for the species. We analyzed temporal and spatial distributions of fox records and determined the vegetation types and elevational range of records within the study area. Numbers of trapped foxes (and trappers) peaked during the mid 1980s, but the number of observations has remained relatively constant. Foxes occupied a 1,100-m range of elevations and were observed in equal numbers in 3 vegetation types that comprise 95% of the study area. Seventeen of the 21 specimens were measured for 15 standard cranial measurements. A thorough literature review and museum search revealed 8 specimens previously documented elsewhere.

RESUMEN—El número bajo de registros y especimenes del zorro rojo (*Vulpes vulpes*) en Arizona y Utah hasta la década de 1960 nos apremió a recopilar los registros verificados de dicha especie en la reserva indígena Navajo en la región noreste de Arizona, y sureste de Utah. Recopilamos y verificamos 80 observaciones visuales de 88 zorros vivos y muertos, y 21 especimenes, en el área del estudio entre 1979 y 2001. También recopilamos 686 registros suplementales de zorros supuestamente atrapados por pelajadores con permiso dentro del mismo plazo y lugar. Esta investigación verificó que el zorro rojo fue común en la región a pesar del bajo número de registros antes de 1970, y que Arizona debe incluirse en los mapas distribucionales de la especie. Analizamos la distribución espacial y temporal de los registros de zorros, y determinamos el rango de altura geográfica y los tipos de vegetación dentro del área de estudio. El número de zorros atrapados (y pelajadores activos) alcanzó su pico a mediados de la década de 1980, mientras que el número de observaciones visuales permaneció más ó menos constante. Los zorros ocupaban un rango de 1.100 m de altura y fueron observados en cantidades iguales en 3 tipos distintos de vegetación que representan 95% del área del estudio. De los 21 especimenes, 17 fueron medidos por 15 mediciones estándar del cráneo. Una búsqueda extensiva en la literatura y en los museos reveló 8 zorros ya documentados en otras fuentes.

The red fox (*Vulpes vulpes*) is the most widespread wild carnivore on earth (Wilson and Ruff, 1999). It occupies Europe, Asia, northern Africa, and Australia; in North America it occurs in Alaska, Canada, and most of the contiguous 48 states, except for much of the Southwest (Chapman and Feldhamer, 1982; Wozencraft, 1993). The reported distribution in the Southwest includes Colorado, the eastern half of Utah, and a north-to-south swath through the central one-third of New Mexico. The red fox is reportedly absent from Arizona and Nevada, and from parts of California, Oklahoma, and Texas (Chapman and Feldhamer, 1982). This distribution suggests that foxes exist mostly in mountainous areas of the Southwest, and to a lesser degree in deserts.

Cockrum (1960) reported no records of the species from Arizona by 1960. Hoffmeister (1986) believed that the red fox was an uncom-

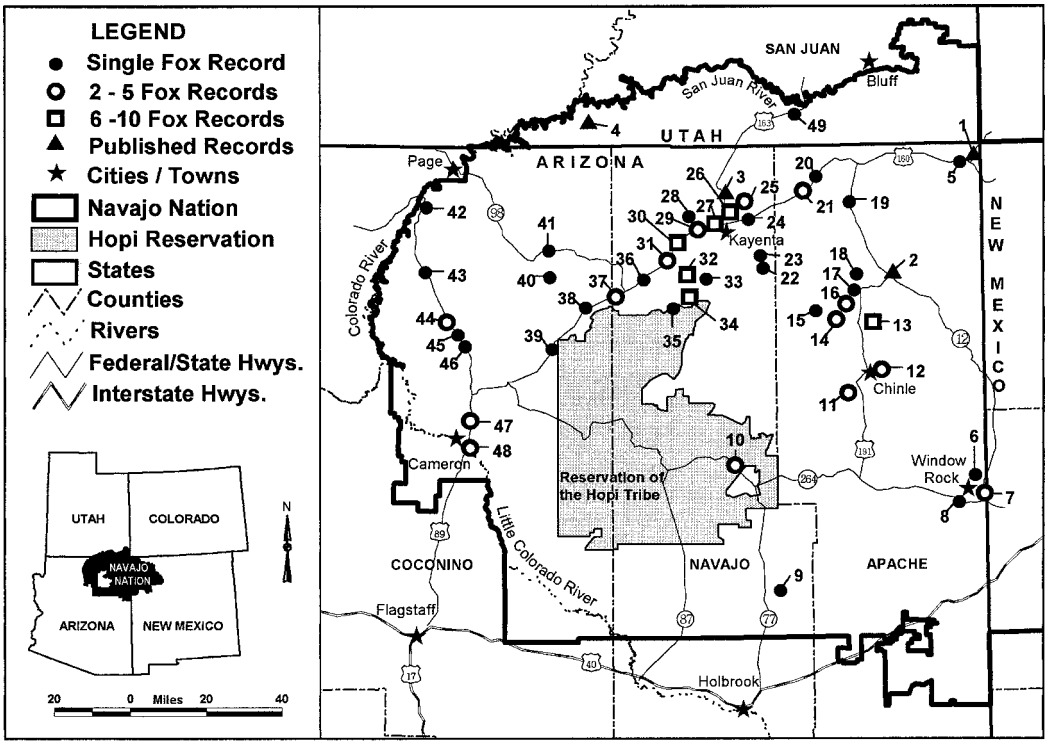

FIG. 1—Locations of 101 current (1979 through 2001) and 4 published red fox records for the Navajo Nation in Arizona and Utah (multiple occurrences include adjacent records within 25 km^2); record numbers correspond to those in Appendix 1.

mon native in Arizona. He listed 4 records for the state; all were in the northeast in Navajo and Apache counties. Two of these records were from the Kayenta area in 1958, as reported previously by Halloran (1962). Hoffmeister (1986:470) provided comments by a former predator-control agent of the Navajo Nation who mentioned that at least 1 red fox was taken every year from Navajo lands, and that they existed on the Navajo Nation "for a long time but not in great numbers." The Navajo Nation occupies 30,883 km^2 within the south-central portion of the Colorado Plateau in northeastern Arizona, southeastern Utah, and northwestern New Mexico (Fig. 1).

Durrant (1952) stated that red foxes were rare in Utah and not well represented in collections. He listed 4 records for Utah, 1 of which was originally reported by Benson (1935) from a location on the Navajo Nation. Durrant (1952) believed that the largest number of native foxes was in southern and southeastern Utah, and that some foxes in Utah were likely escapees from fox farms.

In contrast, the species seems to be well documented in New Mexico. Findley et al. (1975) listed 12 records of red foxes; 4 were near Navajo lands in the San Juan Valley in northwestern New Mexico. Five records were from the northern mountains, where Bailey (1932) reported the species as fairly common. Bailey (1932:297) also reported that a colleague found foxes at several locations in the San Juan Valley in 1908 and that 1 trapper had captured 20 foxes near there the previous year. In addition, we have collected at least 18 visual observations of 22 foxes from northwestern New Mexico since the early 1990s.

Herein, we provide verified records of 56 live and 32 road-killed foxes reported by competent observers between 1979 and 2001 from the Arizona and Utah portions of the Navajo Nation. We have excluded fox records from the portion of the Navajo Nation in New Mex-

ico from this study because we consider the fox to be well documented there. We present standard cranial measurements for 17 intact skulls from a total of 21 specimens verified as red fox that were gathered from the study area between 1982 and 2000. Furthermore, we provide supplemental data on 686 foxes reportedly captured by permitted fur-trappers on the Navajo Nation from 1979 to 2001. We examine the temporal and spatial distributions, including analyses of occupied habitats and elevations, of foxes within the study area.

METHODS—The study area includes those portions of the Navajo Nation within Arizona and Utah, but excludes all Navajo lands in New Mexico. The study area boundaries are the New Mexico state line to the east, the San Juan and Colorado rivers to the north and west, and the southern boundary lies mostly along a line at 35°10′N latitude. The elevational range within the study area is between 853 m and 3,175 m. Brown (1982) recognized 3 ecological zones within this area: cold temperate mountain forest and woodland, intermediate steppe grassland, and arid desert lands. These zones are composed of mosaics of the following biotic communities: subalpine and montane conifer forest types; Great Basin desertscrub and conifer woodlands; and Great Basin grasslands and subalpine grasslands.

Three biotic communities compose approximately 95% of the study area in nearly equal amounts; these include Great Basin grasslands, desertscrub, and conifer woodlands. Great Basin grasslands are shortgrass habitats occupying flat, open terrain within the study area and are dominated by cheatgrass (*Bromus tectorum*), red brome (*B. rubra*), Indian thread grass (*Oryzopsis hymenoides*), galleta (*Hilaria jamesii*), and snakeweed (*Stipa sarothrae*). Great Basin desertscrub typically has flat to rolling terrain and is dominated by sagebrush (*Artemisia*), saltbushes (*Atriplex*), rabbitbrush (*Chrysothamnus*), and blackbrush (*Coleogyne*). Great Basin conifer woodlands are typical of mesa slopes and summits above 1,829 m. These woodlands are composed of monotypic or mixed stands of piñon pine (*Pinus edulis*) and junipers (*Juniperus osteosperma* and *J. monosperma*) (Brown, 1982).

We compiled 3 types of red fox records within the study area: published records and museum specimens, visual observations of live and dead foxes, and success reports from permitted fur-trappers on the Navajo Nation. We searched all relevant publications, museum records from 7 major collections in Arizona, Utah, New Mexico, and Colorado, and 7 other major university and national museums. Documented records of *Vulpes vulpes* were mapped using the locations provided to show their relation to records gathered during this study.

We compiled information from all visual observations from 1979 to 2001 of live and dead red foxes within the study area from observers competent in distinguishing red foxes from other native canids. We also contacted at least 6 biologists from areas outside of the study area, including those that manage adjacent lands, for additional records of visual observations. Visual observations were of 3 types: sightings of live foxes; sightings of dead foxes, with or without documentation (i.e., photographs or specimens); and sightings of active dens. We mapped all visual observations on United States Geological Survey 1:24,000-scale topographic maps and estimated the elevation of each observation to the nearest 3 m. Vegetation type was determined for all observations by transferring their locations from topographic maps to a map of the biotic communities of the Southwest (Brown and Lowe, 1994). We tested the hypothesis that foxes were observed more frequently in the open habitats of desertscrub and grasslands with a Chi-square test for goodness of fit at $\alpha = 0.1$ (Gravetter and Wallnau, 1985).

We searched all success reports from permitted trappers from the 1979 (first year of permit and reporting procedures of the Navajo Nation Department of Fish and Wildlife) to 2001 trapping seasons. Reports by trappers are housed at the Department of Fish and Wildlife offices in Window Rock, Arizona. The regulated trapping season extended from October 1 to March 31 of the following year.

Trappers were registered for specific areas of the Navajo Nation, referred to as ''grazing districts'' from 1979 to 1990. From 1991 to 2001, trappers were registered in ''hunt units'' with significantly different boundaries than grazing districts. For permit compliance, trappers were required to submit annual success reports that listed the number of animals captured in each grazing district or hunt unit. Rarely, trappers voluntarily reported the exact locations of captures (rather than the entire grazing district or hunt unit); we treated these records identical to visual observations for mapping and analyses.

We compiled information from reports by trappers on the number of red foxes captured in each grazing district or hunt unit in each year. Because 3 grazing districts and 1 hunt unit extended into New Mexico, only fox records that reported locations from Arizona and Utah were compiled to prevent possible inclusion of records from outside of the study area. We included no records that identified the trapped individual simply as ''fox,'' because the record might have been one of the other native fox species (gray fox, *Urocyon cinereoargenteus*; and kit fox, *Vulpes macrotis*).

All skulls obtained by LaRue during the study period were measured with vernier calipers for 15 standard cranial measurements. Most measurements were taken as described in Jones and Manning

TABLE 1—Annual distribution of red foxes observed (alive and road-killed), collected, and reportedly trapped from 1979 through 2001 on the Navajo Nation in northeastern Arizona and southeastern Utah.

Year	Alive	Road-kill	Collected	Trapped	Number of trappers
1979	0	0	0	1	47
1980	1	0	1	0	15
1981	0	0	0	51	21
1982	4	3	1	7	23
1983	9	1	1	51	31
1984	3	1	1	147	47
1985	1	2	1	104	60
1986	1	0	1	115	70
1987	0	0	0	77	75
1988	2	1	3	45	36
1989	2	0	8	23	20
1990	1	0	1	9	10
1991	1	0	0	1	10
1992	2	2	0	0	9
1993	4	2	0	6	7
1994	7	4	0	20	9
1995	6	1	0	5	12
1996	2	1	0	0	12
1997	1	0	0	4	17
1998	0	4	0	1	17
1999	1	2	1	19	13
2000	7	7	2	0	7
2001	1	1	0	0	11
Total	56	32	21	686	mean = 25

(1992), with subtle differences as described by Hoffmeister (1986) to duplicate his efforts.

We were, at first, concerned about the validity of species identification from commercial and private trappers. We feel justified to use their records because we know several of the trappers, and their identification skills were validated. Also, we reasoned that trappers should be capable of accurately identifying foxes, especially given the price variations for pelts of different species (prices for red foxes averaged $28 for red versus $8 for gray foxes at a January 2002 fur sale; North American Fur Auctions, pers. comm.).

RESULTS—We found no additional published records of red foxes for the study area than those presented by Hoffmeister (1986) and Durrant (1952). These 4 records of 8 foxes are presented in Fig. 1 (points 1 through 4), and corresponding information is summarized in Appendix 1. Through correspondence with museum curators, we located 1 museum record of a red fox skin and skull at the University of Arizona (UA 26656). This specimen originally was gathered by LaRue in 1988 from within the study area; however, location information was too general for inclusion in Fig. 1.

We obtained 80 verified visual observations of 88 red foxes between 1971 and 2001. All observations were of single foxes, except for 3 sightings of multiple individuals at dens (which accounts for the difference between the number of observations and the number of foxes). Of the total, 48 observations were of 56 live red foxes and 32 were observed as road-kills (skulls of 6 were collected as specimens). Another 21 foxes were found dead and their skulls or other distinguishing parts were gathered as specimens, with species identification confirmed by the authors.

By grouping visual observations by year, we found that the number of observations was distributed relatively evenly over each year of the study (Table 1). We mapped all visual observations (Fig. 1), and pertinent information for each is summarized in Appendix 1. Records in Appendix 1 are listed by map-location number and provide the following information: year of

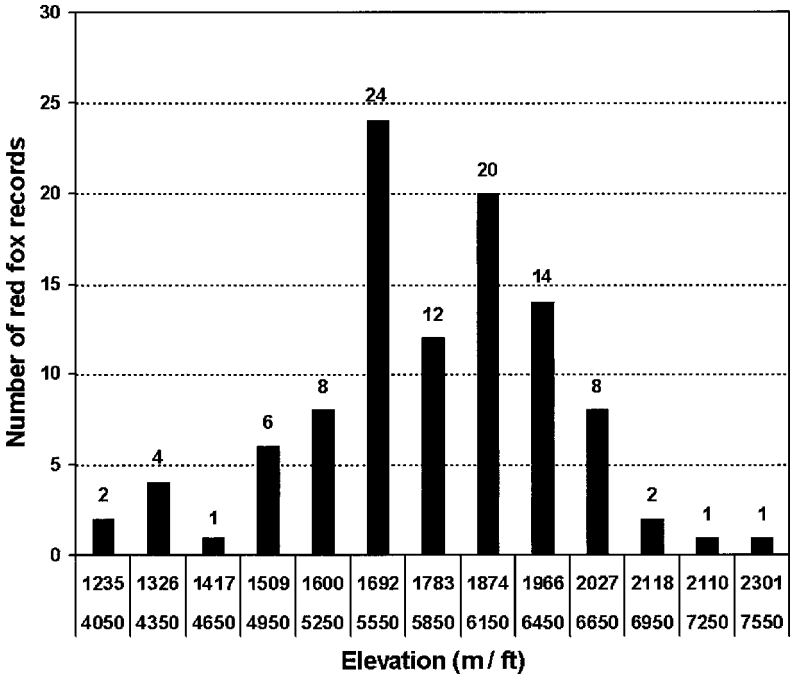

FIG. 2—Range of elevations of 103 red fox records in 300-ft intervals for the Navajo Nation in Arizona and Utah (multiple foxes at dens were treated as single observations).

observation, location and elevation, number of foxes and type of observation, and observer.

We used 103 of the 105 records from Appendix 1 to determine the elevational range of foxes in the study area (2 specimens from published literature listed no elevations, and multiple individuals at dens were treated as single observations). The records spanned a range >1,100 m, extending from 1,207 to 2,378 m (Fig. 2). Two-thirds (67.7%) of the observations spanned a much smaller elevation range of 366 m (1,646 to 2,012 m) that included the median of the range (1,793 m) occupied by foxes.

We determined the vegetation type for 101 of the 104 records from Appendix 1 (the locations of the 4 published records were too general for accurate habitat determination, and multiple individuals at dens were treated as single observations). Forty-two observations were in Great Basin desertscrub, 33 were in Great Basin grasslands, and 26 were in Great Basin conifer woodlands. Foxes were observed in equal proportion in the 3 vegetation types as tested with Chi-square goodness of fit test that predicted an equal number of observations per vegetation type ($\chi^2 = 3.8$, $df = 2$, $P > 0.1$). Nearly 75% of the foxes were observed in the most open desert habitats (desertscrub and grasslands). Although we have no data on shrub densities for sightings within conifer woodlands, we suspect that most red foxes were observed in rather open stands with scattered shrubs.

We located 5 active dens between 1983 and 2000. Three dens were on Black Mesa within the vicinity of an active coal-mining operation; 1 den was located in a bladed dirt pile, 1 was halfway up a 67-m high hillside above a large ephemeral wash, and 1 was beneath debris in a scrap-metal yard. The fourth den was in an alluvial mound associated with a major wash near Kayenta, and the fifth was in a 1.5-m high sandhill atop a short (20 m) ridge within grasslands. All den sites provided foxes with a commanding view of the surrounding terrain. Den entrances ranged from 25 to 30 cm high and 15 to 20 cm wide.

A total of 62 trappers reported capturing 686 red foxes on the Navajo Nation between 1979 and 2001. Four trappers provided exact locations for 17 fox captures (Fig. 1 and Ap-

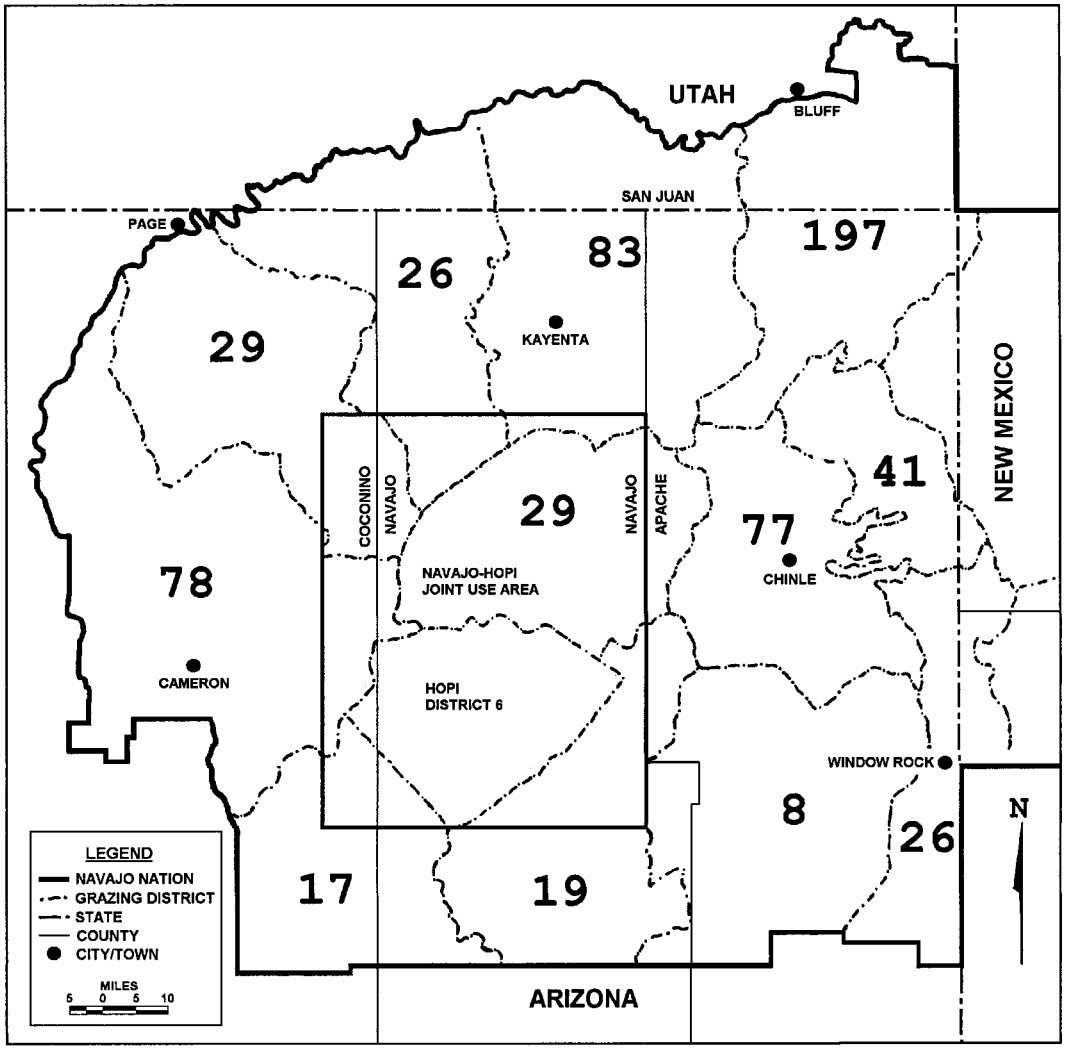

FIG. 3—Spatial distribution of 630 red foxes trapped from 12 grazing districts of the Navajo Nation in Arizona and Utah from 1979 through 1990.

pendix 1), which were included in the analyses of elevation and vegetation type; all other trappers reported capture locations simply as the grazing district number, as required by the reporting procedures. We graphically present the distribution of 630 captures for each specified trapping area (grazing district) from the 1979 to 1990 trapping seasons (Fig. 3). During this period, most foxes were captured from the grazing districts in extreme northeastern Arizona and southeastern Utah, and secondly around the Chinle and Cameron areas; fewer were trapped in the southern part of the study area. We have not presented graphically the distribution of the 56 trap records from 1991 to 2001 because they are a much smaller subset of the total number of trapped foxes and were reported in ''hunt units'' with different boundaries than grazing districts. Nearly 90% of the 56 foxes trapped during these years were from Apache and eastern San Juan counties, and nearly half (46%) of the total were from the southern two-thirds of Apache County on the Navajo Nation.

We analyzed the temporal distribution of all trapped foxes (Table 1). Because trapping sea-

TABLE 2—Summary of cranial measurements (mm) for 17 skulls and 2 mandibles from red foxes collected on the Navajo Nation in northeastern Arizona from 1982 through 2000 (n = 17, unless otherwise indicated by superscript).

	Greatest skull length	Condylo-basal length[14]	Greatest braincase width[16]	Greatest zygomatic width	Least width rostrum	Least interorbital width	Maxillary toothrow length
Mean	140.63	133.07	47.21	71.10	21.36	26.22	63.53
Range	131.0–152.1	125.5–144.1	42.1–51.6	62.4–77.8	20.2–23.2	21.6–29.9	59.5–68.5
SD	5.90	5.01	2.13	3.51	0.69	2.20	2.62

	Length P4	Width P4	Alveolar length upper	Alveolar length lower[19]	Nasal length midline	Least postorbital breadth[16]	Palatal length	Orbito-nasal length
Mean	13.40	5.95	52.30	56.81	49.98	23.25	66.84	46.57
Range	11.6–17.7	5.2–6.7	49.1–56.5	51.0–62.5	45.8–54.9	20.9–24.8	61.2–71.9	42.9–50.3
SD	1.34	0.44	2.26	3.46	3.12	1.46	3.50	2.21

sons extended over 2 calendar years, results for each season were presented with the year at the start of the season (e.g., 1979 = October 1979 to March 1980). The number of foxes, as well as the number of trappers, peaked during the 1984 to 1987 seasons. More recently, the number of trappers has remained rather low compared to this period, and the number of foxes was lower and more variable.

Twenty-one specimens were obtained during this study (including UA 26656); 20 were gathered by LaRue from 1982 to 2000, and 1 by Mikesic in 2000. Sixteen specimens were skulls, 2 specimens were mandibles, 2 included skin and skull, and 1 was the skin of an immature fox. Exact locations for 10 specimens were included in Fig. 1 and Appendix 1; the other 10 specimens were donated to LaRue without exact location information. We measured the 16 intact skulls and 2 mandibles collected by LaRue and the University of Arizona specimen (UA 26656), and we computed the mean, range, and standard deviations of each measurement (Table 2).

We deposited 19 specimens in the mammal collection at Northern Arizona University (NAU 4507–4525). One skull found below an active nest of a golden eagle (*Aquila chrysaetos*) was deposited in the animal collection of the Navajo Natural Heritage Program (NNHP 0115) in Window Rock, Arizona, as evidence of predation or scavenging on red foxes by golden eagles.

DISCUSSION—Our results indicate that the red fox is common and widely distributed in northeastern Arizona and extreme southeastern Utah. Because current range maps for the fox do not typically include northeastern Arizona (e.g., Chapman and Feldhamer, 1982; Fitzgerald et al., 1994), we propose that this region be recognized as occupied by the species. Distributional range maps should include this region by extending the currently recognized boundaries (Utah and New Mexico state lines) to a western boundary of the Colorado River, and a conservative southern boundary that connects Cameron and Window Rock, but extends south to include our southernmost record (Fig. 1, record 9).

Hoffmeister (1986) and Durrant (1952) believed the species to be native, but rare, in Arizona and Utah. However, limited biological research, potential confusion of this fox with the 3 other wild canids (coyote, *Canis latrans*; gray fox; and kit fox), and its inconspicuous nature (especially its nocturnal habits) might have limited the accumulation of accurate information about the species. For example, most of the records on highways 160, 89, and 98 (Fig. 1) represent road-killed foxes recorded by LaRue during his long-term residency in the region. It seems that considerable variation in population levels might occur, although this is not apparent from our pooled data. For example, LaRue observed only 3 foxes in the 20-month period from October 1986 to May 1988, but saw 17 individuals in the 20-month period from January 1994 to August 1995. Red fox tracks might be found daily in some locations,

but observations and specimen records from these locations might be lacking. We think it is reasonable to assume that previous investigators simply overlooked the red fox.

We agree with the assessment of Hoffmeister (1986) that the red fox has been present in this region for some time. It has been identified from late Pleistocene deposits farther north in Utah (Heaton, 1985; Nelson and Madsen, 1987). Leonard (1989) identified 3 red foxes from the Anasazi archaeological record of northern Black Mesa, 32 km south of Kayenta, for the period A.D. 100–300 (1 individual) and for A.D. 800–1030 (2 individuals). We did not examine the osteological specimens reported by Leonard (1989) and assumed that his identifications were correct. Although the escape of captives held for hunting and the fur market contributed to a marked range expansion in California (Lewis et al., 1999), and releases of foxes in Australia have had dramatic results (Nowak, 1999), it is unclear whether escapes or releases occurred on or near the Navajo Nation. We are unaware of any fox farms currently or formerly operating on or near the study area.

As with the specimens examined by Hoffmeister (1986), all red foxes we observed (including live and dead individuals) were consistently pale in coloration with light-colored faces and limited black on the forelimbs. We have seen no indication of the polychromatism exhibited by the species elsewhere in its range; this consistent characteristic led Hoffmeister (1986) to speculate that foxes from this region might comprise a distinct subspecies. This seemingly distinctive regional phenotype indicates a degree of limited long-term gene flow into the region, supporting the hypothesis of long-term native occupation by the fox and suggesting that there is limited genetic influence from possible fur-farm stock. Our measurements were not sufficient to determine whether a distinct subspecies is present.

Despite the prevalence of most earlier records from the mountain ranges of the Southwest, red foxes are well adapted to the high-desert environment of the southern Colorado Plateau. They were found within a range of elevations of 1,100 m, which is nearly half of the total elevation range of the study area. Foxes existed within the low to mid elevations of the study area and were not recorded in the high-elevation mountains. It is unknown whether the lack of foxes found below 1,200 m and above 2,375 m, and the marked decline of records on the ends of the median elevation range, accurately reflected their elevational limits within the study area. We think that it is unlikely that the high-elevation forests within the study area were devoid of red foxes, because they are found in similar habitats in the nearby mountains of northern New Mexico (Bailey, 1932; Findley et al., 1975). It is more likely that the elevational limits of our records were affected by our non-systematic data collection techniques, because the probability of obtaining records from the elevational extremes was reduced due to the more limited extent, and more difficult access, of these habitats. For example, all of the terrain below 950 m is confined to the rugged canyons of the Marble and Little Colorado River gorges. In addition, we think foxes likely occurred at elevations beyond those that our records indicated, because they appeared to be habitat generalists in the study area. They occurred in equal proportions within the 3 vegetation types that cover approximately 95% of the study area, and the 5 dens we located were in a wide variety of terrains and microhabitats.

Many red foxes were observed relatively near human settlements. We suspect this tolerance might benefit the species by reducing competition for food with the other wild canids (coyote, gray fox, and kit fox) that occupy ranges further from humans. Avoidance of areas occupied by coyotes has been documented for red foxes (Voigt and Earle, 1983; Major and Sherburne, 1987; Sargeant et al., 1987; Harrison et al., 1989). Thus, foxes likely experienced reduced harassment and predation by coyotes with a closer association to humans.

We realize that our study techniques might have allowed for double-counting of some individuals (i.e., visual observations of live foxes later reported as trapped or road-kills); however, this was likely an insignificant effect because only 56 individuals were observed alive, whereas 721 foxes were reported as removed from the population (trapped, road-killed, or found dead). We also note that records of trappers might not provide reliable analyses of distribution and abundance of foxes because of several uncontrollable variables, including number and distribution of trappers, desired

target species, and types of trap-sets. Given the large sample size of foxes and number of trappers, we think that these records provided a reliable index of fox distribution and abundance. We also discovered that the grazing districts with the most foxes trapped from 1979 to 1990 roughly coincided with the largest contiguous sections of Great Basin desertscrub in the study area.

The number of trapped foxes probably peaked in the early 1980s for the following reasons. The largest number of trappers also occurred during these years, which would logically produce a greater number of fox captures. This period also was marked by above-average precipitation, which likely led to increased prey populations. If so, foxes could have experienced greater breeding success by taking advantage of increased prey availability. Also, fur prices were likely greater for red foxes during the early 1980s (perhaps twice the 2002 prices, based on comments of a member of the Arizona Trappers Association, who paid $50 for a red fox in the mid 1980s; F. Riggs, pers. comm.). The decline in trapped foxes in recent years is likely an artifact of reduced fur prices and fewer trappers targeting red foxes. However, it is possible that this region has experienced a decline in the fox population since the peak in the mid 1980s. The cause of such a decline cannot be determined from our data, but might be related to a combination of factors, including increased interspecific competition and predation, over-exploitation by trappers, and lowered prey populations or habitat quality.

The southern and western limits of the current range of the red fox in Arizona remain unknown. Our data suggest that the species might occur west of the Colorado River and south of the Little Colorado River to the White Mountains of eastern Arizona. The species might be limited by the high-elevation Mogollon Rim to the south of the Navajo Nation. We hope that this document inspires others to collect records of the fox in future years. Additionally, genetic investigations and a complete review of the archaeological record might help answer questions concerning the origin of the red fox in this region.

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APPENDIX 1—Records of occurrence corresponding with Fig. 1 for previously documented and current (1979 through 2001) red fox records for the Navajo Nation in Arizona and Utah. Types of observations include: published records (pr), specimens collected during this study (sp), visual sightings of live foxes (si), road-killed (rk) and trapped foxes (tr), and den sites (den). Records 5 through 49 were observed by C. T. LaRue, unless otherwise noted.

[1] 1986; Four Corners; (1-pr); Hoffmeister (1986); [2] 1986, Round Rock-Lukachukai Plateau, 6,000 ft; (1-pr); Hoffmeister (1986); [3] 1958; 7 mi N and "short distance NW" of Kayenta, 6,000 ft; (5-pr); Halloran (1961) & Hoffmeister (1986); [4] 1935; N of Navajo Mountain; (1-pr); Benson (1935) & Durrant (1952); [5] 2000; 1.5 mi NW of Teec Nos Pos, 5,020 ft; (1-si); [6] 2001; 1.0 mi W of Fort Defiance, 6,930 ft; (1-si); Kyselka; [7a] 2000; Window Rock, 6,740 ft; (1-si); Roth; [7b] 1996; 2.5 mi S of Fort Defiance, 6,840 ft; (1-si); Meyer; [8] 1996; 2.5 mi E of Defiance Plateau Summit on Highway 264, 7,410 ft; (1-rk); Mikesic; [9] 1996; 7 mi SE of Indian Wells at Arrowhead Butte, 5,740 ft; (1-si); Stahlecker; [10] 1980; Keams Canyon, 6,200 ft; (1-si & 1-sp); [11] 2000; 9 mi SW of Chinle, 5,780 ft; (4-si & den); Mikesic; [12] 1997; 2.5 mi E of Chinle at Cottonwood Canyon, 5,600 ft; (3-tr); Bia; [13a] 1994; 2 mi E, 4 mi E, and 4 mi SE of Many Farms, 5,320, 5,460, and 5,400 ft, respectively; (7-tr); Deswood; [13b] 1993; 4 mi SE of Many Farms, 5,400 ft; (1-tr); Deswood; [14] 1988; 5 mi and 6 mi W of Many Farms, 5,700 and 5,620 ft, respectively; (2-tr); Spackman; [15] 1992; 3 mi ESE of Rough Rock, 6,000 ft; (1-si); [16a] 1990; 5 mi NW of Many Farms, 5,800 ft; (1-tr); Spackman; [16b] 1989; 4 mi NW of Many Farms, 5,390 ft; (1-tr); Spackman; [17] 1988; 6 mi N of Many Farms, 5,270 ft; (1-tr); Spackman; [18] 1999; 8 mi W of Round Rock, 5,700 ft; (1-sp); Mikesic; [19] 2000; 5 mi N of Rock Point on Hwy 191, 5,060 ft; (1-rk); Stahlecker; [20] 1995; 2.5 mi NE of Dennehotso, 4,960 ft; (1-si); [21a] 2000; 2.5 mi SW of Dennehotso on Highway 160, 5,060 ft; (1-rk); [21b] 1995; 1.0 mi SSW of Dennehotso; 5,060 ft; (1-si); [21c] 1993; 2.5 mi SW of Dennehotso, 5,060 ft; (1-si); [22] 1994; 2.0 mi NE of Chilchinbito, 5,720 ft; (1-si); [23] 1989; 4 mi N of Chilchinbito; 5,700 ft; (1-si); [24] 1992; 8.0 mi E of Kayenta on Highway 160, 5,400 ft; (1-rk); [25a] 1994; Comb Ridge of Monument Valley, 5,460 ft; (1-si); [25b] 1984; Comb Ridge of Monument Valley, 5,540 ft; (1-si); [25c] 1982; Comb Ridge of Monument Valley, 5,500 ft; (1-si); [26a] 2000; 1.5 mi NE of Kayenta at Laguna Creek on Highway 163, 5,560 ft; (1-rk/sp); [26b] 1995; 1.0 mi E of Kayenta, 5,580 ft; (1-si); [26c] 1994; 1.3 mi E of Kayenta on Highway 163, 5,580 ft; (1-rk); [26d] 1985; 1.8 mi NE of Kayenta, 5,620 ft; (1-si); [26e] 1983; 2.0 mi and 4.0 mi NE of Kayenta, 5,680 and 5,520 ft, respectively; (2-si); [27a] 1993; 1.5 W of Kayenta, 5,760 ft; (3-si & den); [27b] 1984; 1 mi and 2 mi W of Kayenta, 5,660

and 5,780 ft, respectively; (2-si); [27c] 1983; 3 mi S of Kayenta, 6,000 ft; (1-si); [27d] 1982; 2 mi W of Kayenta, 5,800 ft; (1-si); [28] 1989; 7 mi W of Kayenta, 6,080 ft; (1-tr/sp); Morford; [29a] 1998; 6.0 mi WSW of Kayenta on Highway 160, 6,000 ft; (1-rk); [29b] 1989; 6.0 mi SW of Kayenta at Lolomai Point, 7,800 ft; (1-sp); [29c] 1985; 4.0 mi SW of Kayenta on Highway 160, 5,960 ft; (2-rk); [30a] 1998; 1.5 mi SW of Tsegi on Highway 160, 6,240 ft; (1-rk); [30b] 1994; 0 mi, 1.5 mi, 2.0 mi, and 2.5 mi SW of Tsegi on Highway 160, 6,240, 6,250, 6,280, and 6,280 ft, respectively; (3-si & 1-rk); [30c] 1986; 1.5 mi SW of Tsegi, 6,250 ft; (1-si); [31a] 1994; 4.5 mi SW of Tsegi on Highway 160, 6,390 ft; (1-rk); [31b] 1993; 4.5 mi SW of Tsegi on Highway 160, 6,390 ft; (1-rk); [31c] 1990; 5.5 mi SW of Tsegi, 6,520 ft; (1-si); [31d] 1988; 4.2 mi SW of Tsegi, 6,400 ft; (1-si); [31e] 1982; 7.2 mi SW of Tsegi, 6,900 ft; (1-si); [32a] 1994; 7.8 mi SSE of Tsegi on Black Mesa Peabody Coal Mine (BMPCM), 6,600 ft; (1-si); [32b] 1992; 8.0 mi and 9.0 mi S of Tsegi on BMPCM, 6,600 and 6,640 ft, respectively; (1-si & 1-rk); [32c] 1991; 8.3 mi S of Tsegi on BMPCM, 6,640 ft; (1-si); [32d] 1989; 8.3 mi S of Tsegi on BMPCM, 6,680 ft; (1-si & den); [32e] 1988; 9.8 mi S of Tsegi on BMPCM, 6,560 ft; (1-rk/sp); [32f] 1983; 8.0 mi S of Tsegi on BMPCM, 6,560 ft; (4-si & den); [32g] 1982; 10.9 mi S of Tsegi on BMPCM, 6,480 ft; (1-si); [33] 1988; 15.0 mi S of Kayenta on Black Mesa, 6,800 ft; (1-si); [34a] 1994; 13.7 mi S of Tsegi on BMPCM, 6,460 ft; (1-si); [34b] 1986; 13.5 mi S of Tsegi on BMPCM, 6,240 ft; (1-sp); Elliot; [34c] 1983; 13.2 mi and 13.7 mi S of Tsegi on BMPCM, 6,340 and 6,300 ft, respectively; (2-si & den); [34d] 1982; 15.5 mi and 13.2 mi S of Tsegi on BMPCM, 6,380 and 6,560 ft, respectively; (1-rk/sp, 1-rk); [35] 1984; 17.0 mi S of Tsegi on Black Mesa, 6,140 ft; (1-rk/sp); [36] 2000; 13.5 mi ENE of Cow Springs on Highway 160, 6,590 ft; (1-rk); [37a] 1997; 5.0 mi ENE of Cow Springs, 6,140 ft; (1-si); [37b] 1994; 4.0 mi ENE of Cow Springs on Highway 160, 6,020 ft; (1-rk); [37c] 1983; 6.5 mi ENE of Cow Springs on Highway 160, 6,100 ft; (1-rk/sp); [38] 1995; 3.0 mi SW of Cow Springs, 5,660 ft; (1-si); [39] 2000; 14.0 mi NE of Tuba City on Highway 160, 5,670 ft; (1-rk); [40] 1999; 6.0 mi SSE of Kaibeto, 6,580 ft; (1-si); [41] 2000; 2.0 mi NE of Kaibeto on Highway 98, 6,000 ft; (1-rk); [42] 2000; 3 mi SSE of Marble Canyon at Navajo Spring on Highway 89A, 3,960 ft; (1-rk/sp); [43] 1999; 10.8 mi N of Cedar Ridge on Highway 89, 5400 ft; (1-rk); [44a] 1999; 2.0 mi N of The Gap on Highway 89, 5,400 ft; (1-rk); [44b] 1998; 3.0 mi N of The Gap on Highway 89, 5,560 ft; (1-rk); [45] 2000; The Gap, 5,300 ft; (1-si); [46] 1998; 3.6 mi S of The Gap on Highway 89, 5,150 ft; (1-rk); [47a] 2001; 5.8 mi N of Cameron on Highway 89, 4,320 ft; (1-rk); [47b] 1995; 6.4 mi N of Cameron on Highway 89, 4,330 ft; (1-rk); [48a] 1995; 1.0 mi N, and 1.5 mi SE of Cameron, 4,200 ft; (2-si); [48b] 1993; 1.0 mi N of Cameron on Highway 89, 4,160 ft; (1-rk); [49] 1982; 3.5 mi S of Mexican Hat on Highway 163, 4,680 ft; (1-rk).