KIT FOX
Vulpes macrotis

Description

The kit fox is the daintiest of three species of *Vulpes* in North America (Fitzgerald et al. 1994).

The small-bodied kit fox closely resembles the swift fox (*Vulpes velox*) but has larger ears and a more angular appearance. The skull is long and delicate, and broader at the eyes and more slender at the nose than other North American *Vulpes*. The ears are set close to the midline of the skull (McGrew 1979, Sheldon 1992). The kit fox measures 730 to 840 mm in total length; including a 260 to 323 mm tail, 78 to 94 mm ears, and 113 to 137 mm hindfeet. Adult weight ranges from 1.5 to 2.5 kg. Females are 15 percent lighter on average than males (Fitzgerald et al. 1994), but there is no other obvious sexual dimorphism. Tail length averages about 40 percent of total body length—a distinguishing trait, along with the large ears, from swift foxes (Sheldon 1992).

The kit fox has a light-colored pelage, variable between grizzled-gray, yellow-gray and buff-gray. The shoulders, flanks and chest range from buff to orange. Guard hairs are tipped black or banded. The underfur is lighter buff or white, and relatively heavy and coarse. The legs are slender and thickly furred. The sides of the muzzle are blackish or brownish, and the tip of the tail is black. The soles of the feet are protected by stiff tufts of hair. Because of its relative coarseness, a kit fox pelt has little market value (O'Farrell 1987).

Kit fox hybridize with swift foxes, and some authors have suggested that kit and swift foxes are conspecific. In Colorado, the southern Rocky Mountains serve as a geographic barrier between swift fox populations to the east and kit foxes to the west. Comparative measurements in Colorado support the distinction between kit fox and swift fox (Fitzgerald 1996).

Life history & behavior

Kit fox is a nocturnal, opportunistic meso-predator.

The life history and behavior of Colorado kit foxes appears to be similar to other studied populations (Fitzgerald 1996).

Kit fox survive up to 12 years in zoos. A 7-year old wild fox appeared old and feeble with broken and worn teeth (McGrew 1979 citing

The kit fox is nocturnal and remains in or near its den during the day. Kit foxes use dens year round (McGrew 1979). They dig their own, or sometimes adapt badger diggings or prairie dog burrows into dens (Cypher 2003). Pairs or individuals may use up to 10 dens clustered in a 0.8 to 1.2 ha area. Mating pairs form in the fall or early winter, when each female chooses a whelping den, usually visiting and cleaning out each den within her home range before settling in one (McGrew 1979).

In Delta and Montrose counties, Colorado, shelter dens studied by Fitzgerald's team had 2 entrances (Fitzgerald 1996 p25), and whelping dens had 2, 3, or 4 entrances. An average of 2 to 7 entrances is common for shelter dens in other parts of kit fox range (McGrew 1979). Egoscue (1962) reported 25 entrances for one whelping den in Utah. Den entrances are often small and key-hole shaped, which may prevent easy entry by badgers or coyotes (Egoscue 1962). Fewer entrances to dens may indicate the populations of Delta and Montrose Counties are relatively new colonizers (Fitzgerald 1996).

Breeding season is between December and February, and gestation lasts 49 to 55 days (Egoscue 1962). Litter sizes range from 2 to 6 but are typically 4 or 5 (Sheldon 1992, McGrew 1979). Litters are thought to be smaller in Colorado (Fitzgerald 1996). Pups emerge within 4 to 5 weeks and forage with the adults beginning at 3 to 4 months of age. In Colorado, pups emerged from dens in

others).

May (Fitzgerald 1996). Family groups remain together until fall, when pups typically disperse beyond their parents' home range, and adults move to smaller shelter dens. Dispersal distances are not well-studied, although individuals tagged as pups have been recaptured up to 32 kilometers away (McGrew 1979).

Kit foxes are monoestrous. Young of the year do not breed, and females may take an extra year to reach breeding age compared to males (McGrew 1979). Some pairs appear monogamous, others seem polygamous, and yet others remain solitary (Fitzgerald et al. 1994). Based on the occasional overlapping of home ranges, the species does not appear territorial (Sheldon 1992).

In Utah, over 94 percent of the diet of a kit fox family consisted of black-tailed jackrabbits during whelping season (Egoscue 1962). Some kit fox populations may be regulated in part by availability of lagomorph prey (Ecoscue 1975 cited in McGrew 1979). Kit fox will prey opportunistically on kangaroo rats, ground squirrels, ground-nesting birds, reptiles, and insects. They may cache food (Sheldon 1992; O'Farrell 1987).

Population trends

In decline in parts of its range, including Colorado.

A literature review and synthesis by Dobkin and Sauder (2004) suggests that kit fox are declining in the Great Basin, and relatively rare and of unknown population status on the Columbia Plateau. No published records of kit fox exist for the Wyoming Basins ecoregion. The San Joaquin kit fox (*V. m. mutica*), a California subspecies, is on the federal endangered species list. Population trends for the southwestern states and west Texas are undocumented but presumed stable.

Kit fox harvest numbers (unverified) reported by trappers returning questionnaires to the Colorado Division of Wildlife (CDOW) during the period of 1975 to 1991 were sporadic, and published reports of kit fox in western Colorado were few, prompting concern and inquiry regarding the species' status in the state. After 4 consecutive years of study ending in 1996, Fitzgerald (1996) speculated that fewer than 100 kit foxes inhabited Colorado, with no evidence that populations were self-sustaining. Follow-up work by Beck (1999, 2000) strongly suggested the already small kit fox population in Colorado had declined sharply and that the species was close to extirpation from the state. No kit fox census has been performed since 2000.

Range

Kit fox remains extant in the states where it historically occurred.

Overall range map re-drafted from Fitzgerald et al. (1994) by permission.

The northern extent of kit fox range in North America is southeast Oregon and southwest Idaho. Its southern extent includes the Baja California peninsula and central mainland Mexico. Kit fox occupies suitable habitat in portions of California, Arizona, Nevada Utah, New Mexico, and west Texas. Western Colorado represents the northeastern extent of kit fox range (Fitzgerald et al. 1994; McGrew 1979).

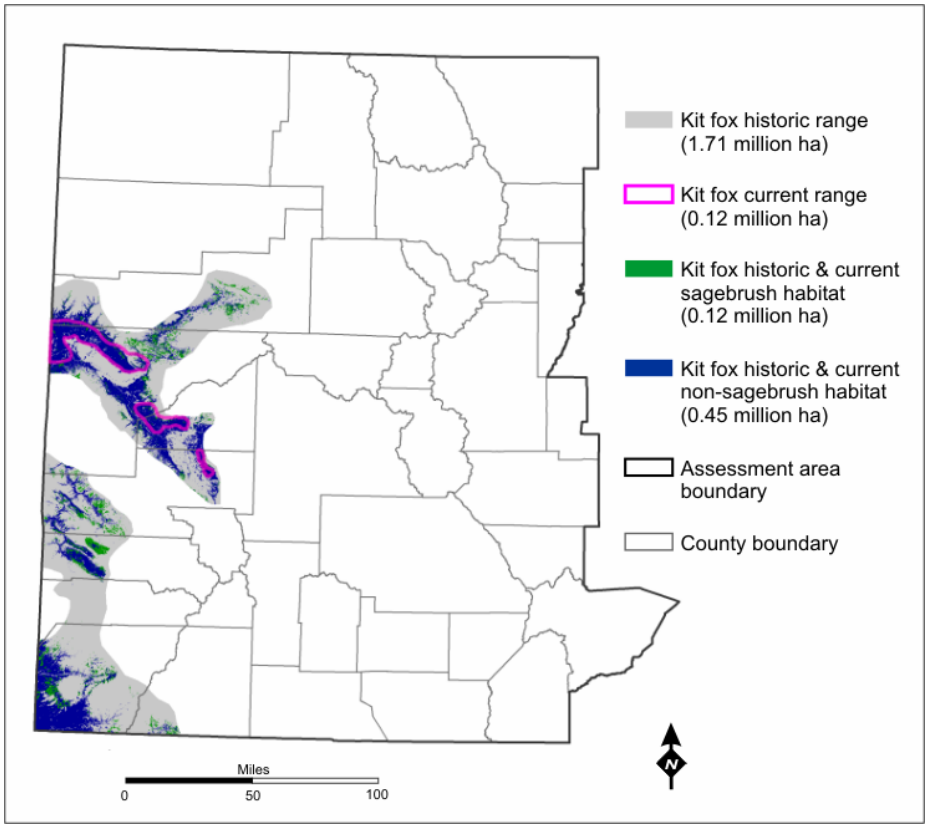
No data documenting continental-scale shifts in historic kit fox range exist, although the range of *V. m. mutica* is much reduced from historical accounts in California's San Joaquin Valley, and other subspecies native to the Los Angeles Basin are extirpated or extinct (McGrew 1979). Range reductions are attributed to agricultural and industrial conversions and ex-urban development of habitat.

Colorado distribution patterns & abundance

In Colorado, kit fox occupy the lower Gunnison and Colorado River drainages below about 6,000 feet. (Fitzgerald 1996).

Apparently suitable habitat remains unoccupied by kit fox.

Kit fox historic range in Colorado encompasses about 1.83 million ha. Current range is estimated at 120,000 ha.



Recent work funded by the CDOW to clarify the distribution and status of kit fox (Fitzgerald 1996) suggests that the species' range in Colorado has contracted significantly. Based on historic records, anecdotal reports, known occurrences in adjacent counties in Utah, and the availability of suitable habitat, kit fox are

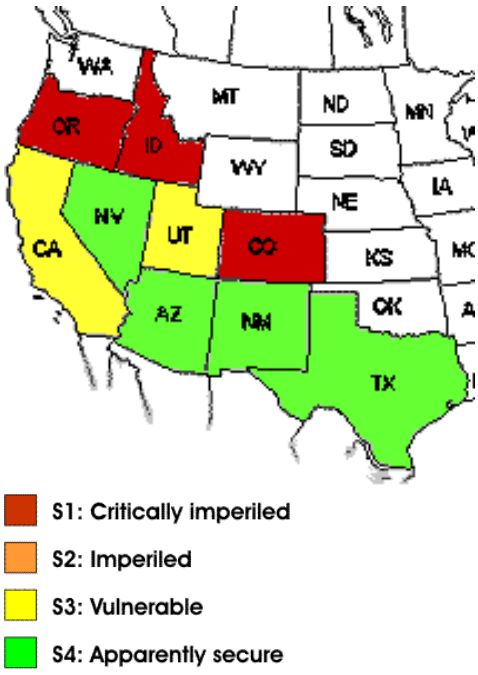
expected in 8 western Colorado counties. However, Fitzgerald (1996) only observed or captured kit foxes in the lower Colorado and lower Gunnison River drainages in Delta, Montrose, Garfield and Mesa Counties. Centers of abundance were southeast of Delta and east of Montrose in the Uncompahgre Valley, although densities were low. Delta and Montrose counties were the only areas where kit fox were captured during all four years of study.

Fitzgerald (1996) did not capture kit fox in all locales where they were predicted. Kit fox were not captured in Montezuma County, where they were expected based on a documented 1964 occurrence (Egoscue 1964 cited in Fitzgerald 1996). Neither were kit fox captured in appropriate habitats in Moffat County, which was included in the study based on unverified kit fox sightings by workers surveying for black-footed ferret in the 1990s and others. Fitzgerald and others speculated that foxes sighted in Moffat County were swift fox or red fox, but no foxes were trapped for verification, and the distribution of these two species in Moffat County remains obscure (Fitzgerald 1996; Fitzgerald et al. 1982). Kit fox were predicted but not captured or observed in Rio Blanco or San Miguel Counties. Trapping efforts were relatively less intensive in these counties than in the counties where kit fox were captured. Our mapping of historic kit fox range in these counties is based on habitat analysis and must be considered provisional. Kit fox likely exist or existed on the Ute Reservation in Montezuma County, but no recent data are available.

Densities of kit fox in Colorado might have been historically low, given the paucity of records. An early biological survey reports the distribution of gray fox in pinyon-juniper woodlands both east and west of the Rocky Mountains (Cary 1911). Swift fox, then considered conspecific with kit fox, was only reported east of the Rockies.

Conservation status

Ranked G4/S1: apparently secure rangewide; some cause for concern due to declines or other factors/ Colorado population critically imperiled (NatureServe 2004).



Map courtesy of NatureServe (2004)

State natural heritage rankings across its range reflect that kit fox is nowhere abundant, and many populations are vulnerable to extirpation or extinction (NatureServe 2004). Kit fox is fully tracked by the Colorado Natural Heritage Program and is a U.S. Forest Service species of concern (CNHP 2004).

Kit fox populations have been on Colorado's endangered species list since 1998. In Oregon, kit fox has been state-listed as threatened since 1975. California's San Joaquin kit fox (*V. m. mutica*) has been on the federal endangered species list since 1967. At least one subspecies of kit fox that once inhabited the Los Angeles basin is extinct.

Kit fox is a species of concern in Idaho, where hunting and trapping of them are prohibited. Arizona, Nevada, New Mexico, and Utah still have hunting and trapping seasons for kit fox. The CDOW closed hunting and trapping for kit fox in Colorado in 1994.

Habitat

Kit fox occur in a variety of shrubland situations, including semi-desert shrublands, sagebrush shrublands, and shrubby margins of pinyon-juniper woodlands throughout the arid portions of their range in the U.S.

In the Colorado sagebrush assessment area, about 0.57 million ha of suitable habitat exists for kit fox, 0.12

Kit fox is associated with semi-desert shrub and shrubsteppe habitats throughout its range and in Colorado, of which sagebrush may be a component. In Colorado, researchers captured or observed kit fox in landscapes dominated by shadscale, mat saltbush, greasewood-saltbush, big sagebrush, sagebrush-saltbush, mixed pinyon-juniper sagebrush communities, and fringes of pinyon-juniper woodlands (Fitzgerald 1996; Fitzgerald et al. 1994).

In southeast Oregon, kit fox were reported in stands of big sagebrush, mixed stands of big sagebrush and spiny hopsage, greasewood, rabbitbrush, or shadscale shrublands (DeStefano 1992). Across Utah, McGrew (1977) reported kit fox among communities of mountain sagebrush, black sagebrush, pinyon-juniper, creosote bush, and shadscale (cited in Fitzgerald 1996). Egoscue (1962) reported them in rabbitbrush, greasewood, horsebrush, winterfat, shadscale, and shrubby buckwheat with kochia, seepweed, and Indian ricegrass. Others reviewed by Fitzgerald (1996) also found kit fox in budsage, and shrublands with cheatgrass or halogeton understories. In western Arizona, kit fox inhabit sparsely vegetated creosote shrub flats (Zoellick and Smith 1992). Kit fox may also survive in orchards and among hedgerows (O'Farrell 1987), and in or near industrial settings such as oil fields and landfills, although such habitats could function as population sinks.

The preferred physiognomy of the vegetation community of kit fox habitat appears to be scattered short shrubs and sparse herbaceous vegetation. In

million ha of which is sagebrush shrublands (see figure in Colorado Distribution Patterns and Abundance).

The preferred physiognomy of the vegetation community of kit fox habitat appears to be scattered short shrubs and sparse herbaceous cover.

Colorado, bare ground at dens typically exceeded 60 percent, herbaceous cover averaged 20 percent, litter cover was low, and average vegetation height near dens was 23 cm (Fitzgerald 1996). At two den sites in shadscale communities, no plants were intercepted by vegetation transects. Principal understory species at shadscale-dominated den sites included clasping peppergrass, skeleton mustard, cheatgrass, foxtail barley, and galletta (Fitzgerald 1996; Link 1995). In Utah, 75 percent of 92 kit fox reported in a 2-year study occurred in areas with less than 20 percent vegetation cover and light-colored loamy soils (McGrew 1979). Whether the physiognomy or floristics of vegetation around den sites is significantly different from the surroundings or foraging habitat has not been investigated. The low-stature vegetation and open ground around kit fox dens may reduce the frequency of ambush by kit fox predators (Fitzgerald 1996).

Topography and soils appear to play a role in den site selection. Kit fox dens in Colorado occurred in the bottoms of steep-walled or deep washes, and occasionally among rock outcrops and below rimrock (Fitzgerald 1996). Only two foxes trapped during Fitzgerald's (1996) study used den sites at rock outcrops. Most dens had a southerly aspect and were within 1 mile of irrigation canals; some were close to roads. The proximity to the canals may not be related to necessity for water, since kit fox can obtain adequate hydration from its prey (Sheldon 1992). Fitzgerald (1996) reports that placement of dens in western Colorado differs from those described in other regions, which are typically dug on flat or gently rolling terrain.

Home range sizes of radio-collared kit foxes in Colorado averaged 5.2 km^2 (Fitzgerald 1996). Home ranges were often clustered and overlapping. Individuals generally did not move more than 3 km from their dens during the course of the study, but one adult female and one adult male dispersed 40 km and 32 km from their home ranges, respectively (Fitzgerald 1996). The minimum area needed to sustain a viable kit fox population in Colorado is uncertain, and depends on a combination of landscape- and local-scale variables.

Threats & sensitivities

In western Colorado, threats to sagebrush are not chief conservation concerns for kit fox (T. Beck, pers. comm.).

See Chapter 6 for habitat estimates and predictive threats modeling for kit fox sagebrush habitat in the Colorado assessment area.

Primary threats to kit fox rangewide are habitat loss, coyote predation, and direct and indirect effects of off-road vehicle recreation (McGrew 1979). Threats in Colorado are similar. After habitat loss and fragmentation due to residential development, primary threats in Colorado are incidental take from coyote control actions; illegal trapping, poisoning, and shooting; road kills; and increased competition or predation from red fox, which appear to be moving into kit fox habitat in recent years (T. Beck, pers. comm.).

Of 47 kit fox tracked during a 4-year study in Colorado, only 4 were known to be alive by the end of the study, and 22 were reported dead (Fitzgerald 1996). One death was caused by a research trap injury. Two adults were taken by game trappers. Two deaths were attributed to drowning, 3 to motor vehicle incidents, and 7 to coyote predation. Cause of death was unknown for the remaining 7 kit fox. No marked pups survived beyond 3 years of age, and 89 percent of marked pups were dead or missing by the end of their yearling year. During follow-up work by Beck, no juveniles or pups were documented at the few remaining active dens in Colorado (Beck 1999).

The effects of habitat degradation, grazing, and range management practices on kit fox populations are uncertain.

Work on San Joaquin kit fox has suggested that population numbers, size of home ranges, densities, overlap of ranges, and reproductive success may be tied to prey availability and/or drought cycles (Cypher et al. 2000; White and Ralls 1993). Kit fox numbers varied up to 4-fold in response to environmental factors. The tendency of kit fox populations to fluctuate with environmental conditions, the relatively high mortality rate, and the seemingly low fecundity of kit fox in Colorado could be limiting their ability to sustain their populations or expand into suitable habitat (Fitzgerald 1996).

To its peril, the kit fox is relatively unwary of human activities (O'Farrell 1987).

The conversion of native shrublands to agricultural, urban, and industrial uses was the primary factor contributing to decline of San Joaquin kit fox and the extinction of an additional subspecies in California (Cypher 2003). Habitat conversions and the loss of safe dispersal corridors through the Grand, Uncompahgre, and Gunnison Valleys are a serious concern for kit fox in Colorado (T. Beck, pers. comm.; Fitzgerald 1996). Remaining suitable habitat may not be ecologically functional without effective immigration and emigration of kit fox between sub-populations.

Predators include coyotes, golden eagles and other large raptors, badgers, red fox, bobcats, and domestic or feral dogs (Cypher 2003; Sheldon 1992).

Whether grazing or range management has a beneficial, detrimental, or neutral influence on floristics and physiognomy of kit fox habitat is unknown. The effects of grazing and range management on kit fox population dynamics are likely mediated by effects on kit fox prey base and kit fox predators. In Colorado, areas inhabited by kit fox are or were historically grazed by sheep or cattle (Fitzgerald 1996). Kit fox response to coyote control on sheep range, particularly by poisoning, is probably mixed (McGrew 1979). Reduction in coyote numbers would reduce predation on kit fox, but kit fox may suffer poisoning mortalities themselves. In California and Utah studies, coyote predation was the cause of almost half of observed kit fox mortalities (Cypher et al. 2000; O'Farrell 1987). Long-term use of poisons to control lagomorphs and rodents may also affect kit fox populations, either by direct or indirect poisonings, but no definitive studies have examined this problem (O'Farrell 1987).

Kit fox seem to be fairly tolerant of human presence, although Link (1995) noted that Colorado kit foxes seemed to spend longer periods in their dens during weekend peaks of noise and disturbance by off-road vehicles or other forms of recreating. Vehicles passing on roads did not cause foxes to alter their behavior unless people stopped to watch them. Link (1995) located one occupied whelping den within 4 meters of a busy road. As the increase in human population in the Grand Valley and surroundings brings increased highway and off-highway travel, the likelihood of vehicle-related kit fox mortalities will rise (Fitzgerald 1996). Road and off-highway vehicle kills accounted for about 14 percent of kit fox deaths in a Utah study (Fitzgerald et al. 1994 citing others). Beck (pers. comm.) was aware of at least 3 kit fox highway mortalities around Delta, Colorado during the late 1990s. Human presence may also bring higher numbers of red fox and domestic dogs—additional sources of predation, competition, and canine disease (T. Beck, pers. comm.).

Although kit fox hunting and trapping seasons have been closed in Colorado since 1994, incidental takes in traps, hunters mistaking them for coyotes, and illegal shooting could result in significant takes of kit fox.

Research needs

Our knowledge of the distribution and abundance of Colorado's kit fox population has lapsed since the year 2000. Whether kit fox occurs in appropriate habitat in northwest Colorado is still unresolved. Better methods of aging and census would improve our ability to reliably model kit fox demographics (Fitzgerald 1996). Interspecific interactions and their impacts on Colorado's kit fox population are poorly understood, as are the effects of grazing, range management, off-road motorized recreation, and the pioneering of red fox into kit fox habitat.

Management issues

Management of sagebrush habitat in western Colorado will likely be of little consequence to the recovery of kit fox in the state.

The direct and indirect affects of relatively rapid rural residential development in semi-desert shrublands, the kit fox's primary habitat, and the loss of safe dispersal corridors between sub-populations, greatly diminish the likelihood of an ecologically viable kit fox population in Colorado.

Fitzgerald (1996) set forth guidelines for conservation and management of the kit fox in Colorado, recommending a minimum population target for the Colorado-Gunnison drainages of 8 sub-populations of 15 to 25 individuals, each with a reasonable chance for interchange among groups, and each with protection from human and environmental perturbation. This target represents a 100 percent increase in the population size estimated in 1996 after 4 years of study (Fitzgerald 1996). Fitzgerald also recommended that approximately 52,000 ha (200 mi^2) in each of the Colorado and Gunnison drainages be recognized as critical habitat for kit fox and managed accordingly by agencies with jurisdiction. Whether Fitzgerald's recommended minimum population is self-sustaining should be periodically re-evaluated once the goal is attained. Beck (Beck 2000) investigated the potential for augmenting kit fox populations in western Colorado, but CDOW organizational priorities precluded preparation of a formal augmentation plan.

Fitzgerald's observation that "the species does not seem to disperse and colonize well," underscores the need to identify and protect dispersal corridors of kit fox through the Grand Valley from Utah and into Delta and Montrose counties. Fitzgerald also recommended releasing additional animals in Colorado to help improve reproductive success of the existing population.

O'Farrell (1987) notes the importance of protecting kit fox whelping dens from destruction or disturbance by human activities. Permanently or seasonally closing kit fox whelping den areas to off-road vehicles during the whelping season and until after pups are weaned would likely benefit Colorado's kit fox population. Reducing grazing and predator and rodent control in kit fox centers of abundance may also benefit the species.

Prior to its extirpation from Colorado, the gray wolf may have kept coyote abundance in check. The absence or perturbation of this and other important interspecific interactions may be contributing to limitations on kit fox abundance and distribution in Colorado, and posing challenges to effective management or long-term sustainability of an ecologically viable population (Cypher 2003; Soule et al. 2005).

In a study of the effects of radio-collaring on San Joaquin kit foxes, Cypher (1997) found higher body mass loss among newly collared foxes and higher survival rates among foxes surviving the first 30 days post-collaring, suggesting an acclimatization period should be factored into investigations of kit fox population dynamics. Collaring should be avoided during periods of increased stress or vulnerability. Fitzgerald (1996) suggested that continual monitoring of kit foxes near Montrose, Colorado, possibly contributed to individuals leaving the area, and recommended researchers monitor

populations on an infrequent basis from as far away as possible to minimize disturbance. Beck's (1999) infra-red-activated camera system may prove indispensable in this regard.

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