

Vulpes ferrilata (Carnivora: Canidae)

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Abstract: The canid *Vulpes ferrilata* Hodgson, 1842, is commonly called the Tibetan sand fox, or sand fox. It is widely distributed in the steppes and semideserts of the Tibetan Plateau north through central China. *V. ferrilata* has thick fur adapted for cold climate, and it occurs in semiarid to arid upland plains, on barren slopes and hills at elevations of 2,500–5,200 m, most typically above 3,500 m in China. It is hunted for pelts, which are manufactured into hats in Tibet, and hunting and habitat destruction are the main threats to populations of *V. ferrilata* in Sichuan Province, China. The International Union for the Conservation of Nature and Natural Resources (World Conservation Union) lists *V. ferrilata* as a species of “Least Concern.” DOI: 10.1644/821.1.

Key words: canid, China, sand fox, Tibet, Tibetan sand fox

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Vulpes ferrilata Hodgson, 1842 Tibetan Sand Fox

Vulpes ferrilatus Hodgson, 1842:278. Type locality “brought from Lassa” [Lhasa, Tibet, China].

Vulpes Terrilatus Hodgson, 1842: unnumbered plate associated with p. 289. Incorrect subsequent spelling of *Vulpes ferrilatus*.

Canis ekloni Przewalski, 1883:216. Type locality “northern Tibet.”

Canis ekloni Stein-Nordheim, 1884:111. Incorrect subsequent spelling of *Canis ekloni* Przewalski, 1883.

Vulpes ferrilata: Pocock, 1937:36. Correction of gender agreement.

CONTEXT AND CONTENT. Order Carnivora, suborder Caniformia, family Canidae, genus *Vulpes*. *Vulpes ferrilata* is monotypic (Wozencraft 2005).

NOMENCLATORIAL NOTES. Vernacular names for *Vulpes ferrilata* include sand fox, Tibetan sand fox, Tibetfuchs, wa, and wamo. *Vulpes* is fox in Latin. The specific epithet *ferrilata* is derived from the Latin *ferris* (iron) and *latum* (wide, broad; spacious, extensive). Thus, Hodgson (1842:278) described *V. ferrilata* as an “iron-grey sided” fox.

References to *V. ferrilatus* in the literature (e.g., Nie and Liu 2005; Schaller and Ginsberg 2004a; Xu and Gao 1986) reflect Hodgson’s (1842) original spelling that was subsequently corrected for gender (see the synonymy). Przewalski (1883:216) proposed the name *Canis ekloni* (= *Vulpes ekloni*) for a fox that he found in the northern Tibet. Various



Fig. 1.—An adult *Vulpes ferrilata* from Qinghai Province, China, about 130 km southwest of Golmud. Used with permission of the photographer M. Burcham.

authors included this name in synonymies of *V. ferrilata* and sometimes considered it a nomen nudum. An illustration from Przewalski's book (1883:218) made the name *Canis ekloni* available.

An expedition to Tibet in 1889–1890 reported that “Foxes are relatively rare, while the *korsak* (*Canis Ekloni*) is rather frequently met with” (Roborovsky and Kozloff 1896:168). *Korsak*, in that case, probably refers to *V. ferrilata* because the Tibet expedition occurred outside the current distributional range of *V. corsac* (Roborovsky and Kozloff 1896). Results of a morphological study on Tibetan sand fox skulls led to a conclusion that *C. ekloni* (= *V. ekloni*) is conspecific with *V. ferrilata* (Baryshnikov and Abramov 1992).

DIAGNOSIS

Vulpes ferrilata (Fig. 1) is larger than *V. corsac*, with which it is sympatric in northern parts of its range. *V. ferrilata* has a white-tipped tail, whereas *V. corsac* has a black-tipped tail. Pelage is pale gray agouti on the body and ears of *V. ferrilata*, whereas on *V. corsac* it is russet gray; *V. ferrilata* also lacks the white chin that is found on *V. corsac*. *V. rueppellii* also has a white-tipped tail, but its general body pelage is pale or sand in color with black muzzle patches. *V. bengalensis* is sandy orange with tawny brown legs; *V. cana* is also sandy orange with tawny brown legs, but with a dark middorsal line and brown chin (Macdonald 2001).

Vulpes ferrilata can be distinguished from *V. vulpes* with several characteristics. *V. ferrilata* has a distinct line along the midflank that separates gray from russet color, whereas *V. vulpes* lacks this distinct line (Larivière and Pasitschniak-Arts 1996). From the anterior, *V. ferrilata* has strikingly gray to black bands running vertically between the russet forelegs and white chest, whereas *V. vulpes* lacks this tricolor combination. *V. ferrilata* has slightly smaller ears than *V. vulpes*, which has longer, sharply pointed ears (Larivière and Pasitschniak-Arts 1996). *V. ferrilata* is shorter-legged, and more squat in appearance than the longer-legged, more slender *V. vulpes* (Larivière and Pasitschniak-Arts 1996).

GENERAL CHARACTERS

The soft, thick pelage on the torso of *Vulpes ferrilata* is pale gray agouti or sandy with a tawny band along the dorsum; ventral pelage is white (Clutton-Brock et al. 1976). The forelegs are russet with the ventral region of the body white. The muzzle, crown, neck, and dorsal region of *V. ferrilata* ranges from tan to rufous. *V. ferrilata* has a pronounced ruff with gray cheeks, body sides, and rump (Schaller and Ginsberg 2004a). The insides of the ears are white, whereas their outsides are similar in color to the rest of the body (Clutton-Brock et al. 1976). The bushy tail

(Mitchell and Derksen 1976) is mostly gray with underfur fulvous to the base (Bonhote 1905) and a white tip. Guard hairs on the tail form a wide, dark band. Between the forelegs and chest are vertical gray to black bands. A tail gland is present, indicated by a dark streak.

The skull (Fig. 2) of *V. ferrilata* is elongated with a narrow maxillary region; the mandible is also long and has little depth. Temporal ridges of the cranium are flat and enclose a narrow, lyriiform sagittal area (Clutton-Brock et al. 1976). Cheek teeth are well developed and widely spaced due to the elongation of the jaw. The canine teeth are pointed and are remarkably elongated relative to other foxes (Bonhote 1905).

Morphological measurements (ranges in mm) of 24 Tibetan sand foxes (sexes combined) are: length of head and body, 630–700 (Cai 1989; Schaller and Ginsberg 2004a); length of tail, 210–330 (Schaller and Ginsberg 2004a); length of ear, 46–70 (Cai 1989; Schaller and Ginsberg 2004a); length of hind foot, 77–151 (Cai 1989). Body mass of *V. ferrilata* is 4.0–5.5 kg (Cai 1989; Schaller and Ginsberg 2004a). The length of the baculum is 42.2–48.7 mm; the bone is longitudinally grooved except for the head (Cai 1989).

Cranial measurements (in mm) of 10 Tibetan sand foxes (sexes combined—Song 1987) are: maximum length of cranium, 149.0–157.8; length of premaxilla to occipital condyle, 132.5–149.0; length of snout (anterior edge of internal nare to anterior edge of 1st incisor), 70.5–80.7; maximum width between left and right upper molars, 37.9–39.6; width of cranium at the zygomatic arches, 65.0–85.9; width of minimum interorbital, 21.5–25.5; width of cranium at tympanic bullae, 34.6–50.3; length of upper toothrow (anterior I1 to posterior M2), 63.5–75.0.

DISTRIBUTION

The Tibetan sand fox is widely distributed in the steppes and semideserts of the Tibetan Plateau from the northernmost boundary of the Ladakh region of India and Tibet in the west; eastward and north through central China, including the southeastern corner of Xinjiang, southwestern corner of Gansu, western two-thirds of Qinghai (Fig. 3; Feng et al. 1980; Namgail et al. 2005; Schaller and Ginsberg 2004a), northern Yunnan Province, and the western one-third of Sichuan Province (Gong and Hu 2003; Wang 2003). *Vulpes ferrilata* is present in Nepal north of the Himalayas and southward through Nepal and northern Bhutan (Mitchell and Derksen 1976; Schaller and Ginsberg 2004a). No fossils of *V. ferrilata* are known.

FORM AND FUNCTION

Vulpes ferrilata has thick fur adapted for cold climates (Alderton 1994; Clutton-Brock et al. 1976). Maximum



Fig. 2.—Dorsal, ventral, and lateral views of cranium and lateral view of mandible of an adult female *Vulpes ferrilata*, age unknown. Photo by Z. H. Wang. Maximum length of skull = 149 mm. Collected on 3 September 2003. Specimen location: School of Life Science, East China Normal University.

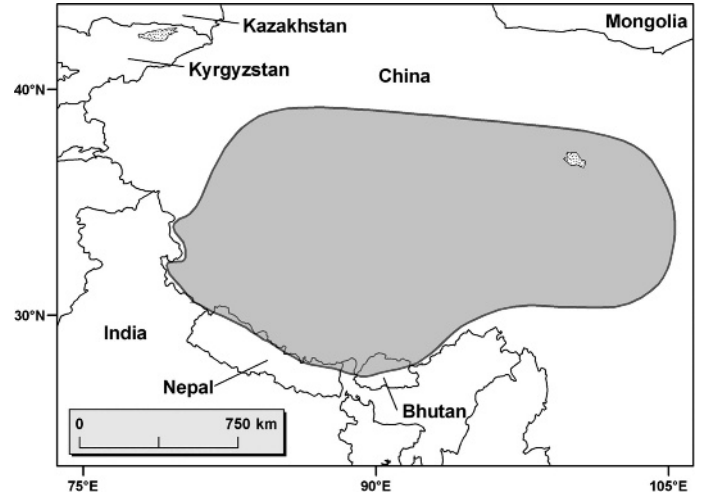


Fig. 3.—Geographic distribution of *Vulpes ferrilata*. Map modified from Schaller and Ginsberg (2004a).

diameter of the multiple pores of the cortex and medulla of hairs does not exceed $2.0\ \mu\text{m}$ in *V. ferrilata*, similar to other cold-adapted foxes, such as *V. corsac* and *V. lagopus* (Chernova 2003). Morphology of the medulla of hairs is of importance to thermal insulation more so than to mechanical protection. Seasonal differences in the medullae suggest a role in thermal insulation; aeriferous medullae lighten the pelage and enhance its insulative properties (Chernova 2003). The dental formula is $i\ 3/3, c\ 1/1, p\ 4/4, m\ 2/3$, total 42 (Song 1987).

ONTOGENY AND REPRODUCTION

Tibetan sand foxes are monogamous (Schaller 1998). Mating occurs from late February to March, with 2–5 young born in May within dens (Ginsberg and Macdonald 1990; Nowak 1999). In Qinghai Province, China, whelping has been noted in late January through early February (Harris et al. 2008). The gestation period is 50–60 days (Ginsberg and Macdonald 1990). Newborns are altricial and weigh 60–120 g (Nowak 1999). Young do not emerge from their natal dens until they are several weeks old; the exact timing of weaning is not known (Schaller 1998).

ECOLOGY

Relative abundance, determined in driving surveys, ranges from 5 sightings of *Vulpes ferrilata* in $>1,800\ \text{km}$ in northwestern Tibet (Schaller and Ginsberg 2004a) to 15 sightings in $<400\ \text{km}$ along the upper Tuotuo River in southwestern Qinghai, China, an area of favorable habitat and abundant pikas (Schaller 1998). Absolute population densities of *V. ferrilata* have not been determined (Harris et al. 1999). However, they appear to be low and depend on

prey availability and human hunting pressure (Schaller and Ginsberg 2004a). Historically, *V. ferrilata* may have been more common (Roborovsky and Kozloff 1896; see “Nomenclatural Notes”).

Vulpes ferrilata occurs in semiarid to arid upland plains, on barren slopes and hills 2,500–5,200 m above sea level, most typically above 3,500 m in China (Nowak 1999; Schaller and Ginsberg 2004a). Specific habitats of *V. ferrilata* include treeless alpine meadow, alpine steppe, and desert steppe (Schaller and Ginsberg 2004a). In Shiqu County, Sichuan Province, China, Tibetan sand foxes were found primarily in grassland habitat and were rarely observed in shrubs (Wang et al. 2007). The primary use of grasslands is correlated with high densities of small mammal prey and protection from depredation (Wang et al. 2007). Climate within the distribution range of *V. ferrilata* is characteristically harsh; temperatures range from 30°C (summer) to –40°C (winter). Precipitation (100–500 mm) falls mostly during the summer (Schaller and Ginsberg 2004a).

Vulpes ferrilata tends to prefer habitat >1,000 m away from any human disturbance (Gong and Hu 2003). The burrows of *V. ferrilata* occur at the base of boulder piles or large rocks, along beach lines, and low on slopes (Nowak 1999; Schaller and Ginsberg 2004a). Most dens ($n = 91$; 96.3%) of *V. ferrilata* are found in shrubless grasslands with a moderate slope (5°–25°—Wang et al. 2003). Dens have 1–12 entrances, ranging in diameter from 25 to 35 cm (Wang and Wang 2006a). The width, height, and length of the main tunnels of 91 Tibetan sand fox dens in Shiqu County, Sichuan Province, China, were (mean \pm SE; cm) 17.0 ± 2.5 , 24.9 ± 7.2 , and 169.9 ± 88.4 , respectively (Wang and Wang 2006b). Tibetan sand foxes use up to 54 dens during summer months (Wang et al. 2004). These typically are not oriented in any particular compass direction, and are situated low on sunny or partly sunny slopes <500 m from water, with small mammal burrows typically found nearby (Wang et al. 2003). *V. ferrilata* is active throughout the day and at dusk, times that correspond to activity of its primary prey (Gong and Hu 2003; Wang et al. 2004). Tibetan sand foxes usually hunt alone (Schaller 1998); however, hunting pairs have been observed (Nowak 1999).

The diet of *V. ferrilata* consists primarily of pikas (*Ochotona curzoniae*—Pech et al. 2007) and small rodents (*Alticola*, *Cricetulus*, and *Pitymys*—Schaller and Ginsberg 2004a). When pika populations decrease, plateau zokors (*Eospalax fontanierii*) are a common alternative (Zhang et al. 2003). Tibetan sand foxes are known to scavenge the carcasses of wolf (*Canis lupus*) kills (Schaller 1998). Scavenged food items include Tibetan antelope (*Pantholops hodgsonii*), musk deer (*Moschus moschiferus*), blue sheep (*Pseudois nayaur*), and livestock (*Bos*—Schaller and Ginsberg 2004a). A Tibetan sand fox was observed following a brown bear (*Ursus arctos*) that was excavating pika burrows.

The fox appeared to be attempting to capture pikas that escaped the bear (Harris and Loggers 2004). *V. ferrilata* meanders through Tibetan antelope and gazelle (*Procapra picticaudata*) herds, eliciting little to no response from herd members (Schaller 1998). Other food items include insects, vegetation, *Ephedra Gerardiana* berries (Schaller 1998), Tibetan woolly hares (*Lepus oiostolus*), agamid lizards (*Phrynocephalus*), marmots (*Marmota himalayana*—Schaller and Ginsberg 2004a), and birds (*Eremophila*, *Montifringilla*, *Perdix*, and *Pseudopodoces*—Cai 1989). Scat samples from Qinghai Province, China, ($n = 29$; 12–18 mm each) included insects (Aphodiidae, Scarabaeidae, and Locustidae), mammals, and grass. *Capra hircus*, *Cervus*, *M. himalayana*, *Moschus chrysogaster*, *Poephagus grunnieus*, *P. nayaur*, and Tibetan sheep (Zheng 1985) were each identifiable in <5 scats; *Carex scatirostris* (a grass) was found in 2 scats; and *Kobresia royleana* (a plant) in 1 scat (Zheng 1985). In some areas where geographic distributions overlap between *V. ferrilata* and *V. vulpes*, so do diets (Schaller and Ginsberg 2004a). Stray and domestic dogs (*C. l. familiaris*) are known to kill Tibetan sand foxes (Xiao et al. 2005). Other potential predators include the gray wolf and various raptors (Schaller and Ginsberg 2004a).

Parasites of *V. ferrilata* include the helminth *Echinococcus multilocularis* (causative agent of alveolar *Echinococcus*—Jiang 2002; Wen et al. 2002), and *E. shiquicus* (Xiao et al. 2005). In areas of Sichuan Province, China, about 59% of the population of *V. ferrilata* carries *E. shiquicus* (Qiu et al. 1995). *V. ferrilata* hosts *Callospsylla dolabraris* and *Oropsylla silantiewi*, principal vectors for plague (*Yersinia pestis*—Dennis et al. 1999). *V. ferrilata* can suffer from canine epilepsy (Lohi et al. 2005) and displays gingival pocketing (Miles and Grigson 2003).

Tibetan sand foxes are not known to actively defend territories (Nowak 1999), and many pairs have been found living in close quarters and sharing hunting grounds (Nowak 1999; Schaller 1998). Vocalizations in the form of short yips are exchanged between Tibetan sand foxes to communicate over short distances; no long-distance communication is known (Nowak 1999). Tibetan sand foxes often deposit their droppings in conspicuous places, but given the lack of territoriality this behavior would not appear to be for purposes of delineating individual territory (Schaller 1998).

GENETICS

The diploid number (2n) for *Vulpes ferrilata* is 36 (Xu and Gao 1986). Chromosomes 1–15 are metacentric and 16–18 are submetacentric. Chromosomes 3–6 are easily identified by their obvious G-bands (Xu and Gao 1986).

Stains (1993) suggested that *V. ferrilata* might be a subspecies of *V. vulpes*. However, more-recent parsimony analyses of phylogenetic information already available reveal

that *V. ferrilata* and *V. corsac* are closely related to each other and have no subspecific relationship to *V. vulpes* (Bininda-Emonds et al. 1999). Clutton-Brock et al. (1976) suggest that *V. ferrilata* diverged evolutionarily from *V. corsac*.

CONSERVATION

Vulpes ferrilata is hunted for pelts, which are manufactured into hats in Tibet (Alderton 1994). Hunting and habitat destruction are the main threats to populations of *V. ferrilata* in Shiqu County of Sichuan Province, China (Gong and Hu 2003). The International Union for the Conservation of Nature and Natural Resources (World Conservation Union) lists *V. ferrilata* as “Least Concern” (Schaller and Ginsberg 2004b). The Convention on International Trade in Endangered Species of Wild Fauna and Flora does not have a listing for *V. ferrilata* (United Nations Environment Programme, World Conservation Monitoring Centre 2007). There are no captive breeding records for *V. ferrilata* (Sillero-Zubiri and Macdonald 1997).

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