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## Research Report

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### Notes on the biology of the Tibetan fox

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#### Abstract

We report on three aspects of the biology of Tibetan foxes *Vulpes ferrilata* for which existing literature is either absent or misleading. Our two field studies in western China each involved capture (and subsequent radio-marking) of foxes, allowing us to refine existing information on body size and mass. Tibetan foxes we captured were somewhat larger and heavier than the current literature suggests is characteristic of the species. Our observations of marked foxes during winter and spring suggested that in our study areas whelping occurs in late January. We also report that brown bears *Ursus arctos*, which also appear to subsist largely on plateau pikas *Ochotona curzoniae*, are frequently accompanied by Tibetan foxes and the foxes seem to benefit from preying on pikas excavated by the bears.

#### Introduction

Until recently, biological data on the Tibetan fox was gained mostly from anecdotal reports, observations of their sign, or hunting records (e.g. Gong and Hu 2003; Schaller and Gisinberg 2004; Wang et al. 2003, 2004, 2007). Because Tibetan foxes live in remote, mountainous environments and are rarely observed in the wild, some aspects of their biology have been difficult to document. Although classified by IUCN as Least Concern, the species remains poorly studied. Within China some zoological museums contain skins and skulls of Tibetan foxes, but poor management and record keeping has limited the usefulness of these specimens. To our knowledge there are no Tibetan foxes held in captivity.

We recently initiated two independent studies of Tibetan fox ecology using radio-marked individuals; handling animals and being able to observe them more frequently have allowed

us to update and improve existing information on this little known canid of the Tibetan steppe (Figure 1). Here we provide information on body size and mass, whelping dates, and associations with other species. In some cases, our more intensive studies allow us to correct information currently in the literature, much of which is poorly documented.



Figure 1. Tibetan fox, Shiqu, Sichuan, China. Photo by Zhang Kejia.

## Study areas

We studied Tibetan foxes in two separate study areas in Qinghai and Sichuan provinces, People's Republic of China. Our Qinghai study was initiated primarily to document relationships between fine-scale habitat selection (i.e. within home-range, second order selection, *sensu* Johnson 1980) and the density of their primary prey, plateau pikas. Our Sichuan study area was selected because of ongoing research on the parasite *Echinococcus multilocularis*, for which the Tibetan fox is an important definitive host (Qiu et al. 1995). In Qinghai, our study site was centred on approximately 35.5° N, 98.7° E, in Gouli Township, Dulan County; we refer to this as the "Dulan site" hereafter. In Sichuan, our study site was centred on approximately 34° N, 98° E in Shiqu County; we refer to this as the "Shiqu site" hereafter. Both study areas consisted of rolling hills and mountains at elevations of 4,000-4,500m, with vegetation typified by grassland (dominated by *Kobresia* spp. and

*Stipa* spp.) and shrubs (mainly *Sibiraea angustata*, *Potentilla fruticosa*, *Spiraea* spp. and *Salix* spp.). Extensive pastoralism by Tibetan herders was the predominant land use in both study areas. In addition to Tibetan foxes, red foxes *V. vulpes* were present at both sites (and occasionally captured).

## Methods

### Capture and handling

At the Shiqu site foxes were caught with snares set at den entrances. Snares were designed with a fixed smallest neck size (15cm) and checked every 12 hours to avoid potential damage to captured foxes. Foxes were immobilized without anaesthetic (Arjo et al. 2002). At the Dulan site, foxes were captured with leghold traps (Victor Soft-Catch®, Woodstream Corporation, Lititz, Pennsylvania, USA), or Belisle® (Edouard Belisle, Sainte-Veronique, Quebec, Canada) and immobilized with ketamine hydrochloride (approximately 6mg/kg) and medetomidine (approximately 0.05 mg/kg). At the Dulan site all capture and handling procedures complied with University of Montana Animal Use Committee Protocols. Fox capture work at the Shiqu study site took place during the last week of September 2003, the last two weeks of May 2006, and 10 May-12 June 2007. At the Dulan site, trapping occurred during 10-20 April and 22-25 September 2006, and 15-26 September 2007.

We captured a total of 18 individual foxes at the Shiqu study site (nine males, five females, four juveniles) and six individual foxes at the Dulan study site (four males, one female, one juvenile; one male was captured in both 2006 and 2007). Body mass was estimated using a spring scale (Figure 2), and standard body measurements were obtained using flexible, cloth tapes. We judged animals captured during April-June trapping periods to be juveniles (animals less than six months old) if they appeared to have large head and paws relative to their body size, very sharp and unworn teeth, and slender tails; we lacked a way to estimate ages of animals older than six months old and considered them all adults.

### Observations

We made observations incidental to radio-tracking in Dulan on most days between 15 April 2006 and 26 September 2007. Radio-collars were attached to most captured individuals, and foxes were tracked on the ground daily in Dulan and during occasional, intensive tracking periods in Shiqu.



Figure 2. Weighing an immobilized Tibetan fox, Dulan, Qinghai, China. Photo by Marie-Claire Beard.

## Results

### Body size of Tibetan foxes

Mean ( $\pm$  SD) body mass of captured Tibetan foxes was 4.9 ( $\pm$ 0.6) kg for males (range 4.4–5.7kg) and 3.9 ( $\pm$ 0.3) kg for females (range 3.6–4.1kg) (Table 1). Head-body length averaged 67.3 ( $\pm$ 4.4) cm for males and 62.8 ( $\pm$ 3.4) cm for females. Four animals captured in Shiqu during late June and early July, 2007 and judged to be juveniles, had a mean body mass of 2.2 ( $\pm$ 0.1) kg, and a mean head-body length of 52.5 ( $\pm$ 3.1) cm. A female captured in late September 2007 in Dulan weighed 3.4kg, and her head-body length was 57.5cm; we judged her to be less than one year old.

### Mating and whelping dates

According to Ginsberg and Macdonald (1990), mating occurs in February with two to five young born in May. This information was repeated by Nowak (1999), Hayssen et al. (1994), and by Schaller and Ginsberg (2004), who noted however, that the source for these

data had not been given. Our field studies did not provide opportunity for us to observe mating; thus we cannot be sure when this occurs.

Table 1. Body measurements of live, adult Tibetan foxes obtained in Shiqu, Sichuan, and Dulan, Qinghai, 2003–2007. Mass in kg. HB = head-body length, T = tail length, E = ear length (all in cm).

	Males	Females
Mass		
$\bar{X}$	4.9	3.9
sd	0.6	0.3
<i>n</i>	6.0	6.0
HB		
$\bar{X}$	67.3	62.8
sd	4.4	3.4
<i>n</i>	13.0	6.0
T		
$\bar{X}$	27.4	27.5
sd	4.1	3.7
<i>n</i>	13.0	6.0
E		
$\bar{X}$	6.5	6.7
sd	0.8	0.4
<i>n</i>	10.0	5.0

However, we were able to observe three of our radio-marked foxes (two males, one female) at the Dulan site on an almost daily basis during the period January – June 2007. We observed pups (identified visually by much smaller size than adults) with one of the males at a den site as early as 10 February, and observed this male in the company of three pups and an unidentified adult on 11 February. During this time period, this male killed pikas for the pups, often spending time in the company of the pups while the female was absent, suggesting that male Tibetan foxes participate in pup rearing. By 1 May, three pups we were able to observe in the vicinity of this den appeared to be approximately  $\frac{3}{4}$  the size of the adult male. We continued to observe pups in the vicinity of this den until 3 June, after which we no longer observed pups that we could reliably associate with the male or den-site. Our second radio-collared male was ob-

served with a second fox that that appeared to be a pup of similar size to those we had observed during the same time period with the first radio-marked male on 6 May.

We did not observe pups with the radio-marked female until 30 April 2007, at which time we observed a single juvenile following her that appeared to be approximately  $\frac{3}{4}$  her size. However earlier, on 6 April, we had noted marked attentiveness to a known whelping den, as well as barking and vigilance behaviour strongly suggesting that pups were present in the den.

These observations do not allow us to pinpoint the time of mating or whelping in this area, but they are sufficient to suggest that both must be much earlier than the February (for mating) and May (for whelping) periods in the existing literature. If pups remain blind (and presumably underground) for one or two weeks, as is generally reported for other *Vulpes* species, it appears that parturition for Tibetan foxes in this area is no later than early February. If gestation is 50-55 days (Hayssen et al. 1993), this would suggest mating in December.

#### *Associations with brown bears*

Brown bears living on the Tibetan plateau are also reported to eat primarily plateau pikas (Smith and Foggin 1999; Xu et al. 2006; Harris 2007), but are rarely observed by researchers. Although we have observed spoor, we have yet to observe brown bears directly at either Dulan or Shiqu sites. However, surveys the first author has directed since 1991 in a valley approximately 400km west of the Dulan site, called Yeniugou ("Wild Yak Valley") have yielded multiple observations of brown bears hunting pikas (Figure 3). Although we have not quantified the success with which bears unearth and eat pikas, we have observed that pikas often escape into nearby burrows and that bears often dig for 15-30 minutes before

successfully capturing a pika. In September 2002, we first documented a Tibetan fox associating with a brown bear that was digging pikas (Figure 4), apparently in an attempt to prey upon pikas that fled from the bear's excavations, but were unable to draw any conclusions about how common this behaviour was.



Figure 3. Brown bear excavating for plateau pikas Yeniugou, Qinghai, China. Photo by Milo Burcham.

However, in May 2007 while assisting a TV crew filming bears for a nature documentary in Yeniugou, we made eight behavioural observations of brown bears excavating for pikas. In all but one of these, we observed at least one Tibetan fox in close proximity to the bear (in two cases, two foxes were involved). In all seven cases foxes would vary their distance from the bear depending on the latter's hunting behaviour, closing to within approximately two metres when the bear placed its head in a burrow or was focused on its excavation, but often moving to greater than 30m distant when the bear walked within or among pika coterries. In all cases foxes were observed following the focal bear for at least 300m as it moved among the pika burrows. Bears often looked at the foxes in their vicinity, but we did not observe any overt aggression or direct interaction between the two species.



Figure 4. A Tibetan fox (indicated by arrow) sitting near a brown bear excavating for pikas, Yeniugou, Qinghai, China. Note numerous pika burrows (dark areas) in the vicinity. Photo by Milo Burcham.

## Discussion

Body mass of Tibetan foxes is commonly reported as roughly 3-4kg and head-body length as 49-65cm (Ginsberg and Macdonald 1990; Nowak 1999; Schaller and Ginsberg 2004). Our sample of captured foxes generally exceeded these values by 12-25%. The maximum head-body length previously published (Feng et al. 1986; Li et al. 1989; reproduced by Schaller and Ginsberg 2004) was 65.0cm, whereas four of our 13 males exceeded 70cm, and two of our six females exceeded 65cm.

We can only speculate on why our weights and measurements suggest that the Tibetan fox is a somewhat larger animal than previously reported. Specimens available to Chinese scientists may not have been fresh, or comprised of juveniles and well as adults. We know of one specimen included in Li et al. (1989) that was later shown to have been misidentified and correctly identified as a corsac fox (*V. corsac*; X. C. Chen, Northwest Plateau Institute of Biology, personal communication, May 2006). Although measurements of live animals may be prone to error, we believe our

weights to be more accurate than those of dead animals.

Our observations suggest an earlier mating and whelping season for Tibetan foxes than has been reported elsewhere. It may seem counter-intuitive that Tibetan fox pups are born as early as late January. However, if parturition is timed so as to allow for lactation when prey availability is high (Cypher 2003) as seems likely, and pika density declines as winter progresses (Wang and Smith 1988), it may be adaptive to whelp earlier rather than later. Additionally, winters on the Tibetan plateau, although very cold, are characterized by very low precipitation. Newborn pups above-ground in February would be exposed to cold ambient temperatures, but rarely have to deal with appreciable snow cover. We emphasize that our hypotheses on the timing of parturition are speculations that should be tested with additional data.

Although we cannot be sure of motives, it appeared to us that foxes following bears did so in order to facilitate their own detection and capture of pikas, maintaining sufficient dis-

tance from the bear only to ensure their own safety. We have observed Tibetan foxes digging for pikas, usually after a short chase in which the pika took cover in a burrow. However, the ability of foxes to excavate burrow systems must surely pale in comparison to that of brown bears. Conversely, our observations suggest that bears capture only a fraction of those pikas they dig for. Thus, as long as Tibetan foxes can avoid becoming prey themselves, they probably make an energetically-wise investment by following pika-excavating bears and attempting to capture unearthed pikas. This behaviour is similar to that previously documented for arctic foxes *Alopex lagopus*, which are known to follow polar bears *Ursus maritimus* (Stirling and Archibald 1977; Nowak 1999), except that Tibetan foxes appear to be interested in live prey rather than carrion. Brown bears on the Tibetan Plateau exist at much lower densities than Tibetan foxes, so this opportunity is probably only available occasionally.

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