

Is Food Availability a Reliable Indicator of Cheetah Presence in Iran?

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It has been widely believed that the Asiatic cheetah occurs wherever gazelles exist. However, most of the present cheetah main habitat in Iran has a low density of gazelles, although there are neighbouring high-density gazelle areas without cheetahs. We found that cover has been usually ignored as an essential need for its hunting success and thus its survival. We propose to conduct more surveys in habitats which provide both food and cover to cheetahs.

As the Asiatic cheetah *Acinonyx jubatus venaticus* is a critically endangered subspecies (IUCN 2006) there have been concerns about its conservation in Iran over the last few years. The historical distribution of the subspecies encompassed the Indian subcontinent, Afghanistan, Turkmenistan, Iran, the Arabian Peninsula and Syria (Nowell & Jackson 1996). Over the past 20 years, the eastern half of Iran has been the last stronghold of the Asiatic cheetah, its presence being confirmed in several areas (Farhadinia 2004).

Cheetahs are known as predators with a preference for open plains habitats. This is not only because they are built for speed (Nowell & Jackson 1996), but also probably because most

of the previous studies on cheetah ecology were conducted in open grassland savannas, with a particular focus on the Serengeti Plains (e.g. Eaton 1970 and Caro 1994) where cheetahs mainly occur on the flat plains on which they can chase gazelles.

Historically, the thinking has been that cheetahs in Iran, as well as in other west Asian countries, probably concentrate on plains gazelles as their main prey species (Firouz 1974, Heptner & Sludskii 1992, Etamad 1985, Harrison & Bates 1991, Ziaie 1996), but the drastic decline in gazelle numbers in Iran means that cheetahs appear to have switched to mountain ungulates as their prey (Farhadinia 2004; Fig. 1).

Iran hosts two species of gazelles, the Persian gazelle *Gazella subgutturosa* and the Jibeer gazelle *Gazella bennettii* (Karami *et al.* 2002), which still occur in high densities in some reserves. Most of the cheetahs' main habitats have a low density of gazelles, although there are neighbouring high-density gazelle habitats without cheetahs. This raises the question why, if the gazelle is the preferred prey species for cheetahs, do cheetahs not occur - or occur only rarely - in neighbouring areas with a higher density of gazelles than that of their present habitats?



Fig. 2. The location of study areas in Iran: Complex A (yellow): 1) Ghorkhod & Behkadeh Protected Area and 2) Golestan National Park. Complex B (purple): 1) Saluk National Park, 2) Miandasht Wildlife Refuge and 3) Khosh Yeylagh Wildlife Refuge. Complex C (green): 1) Mouteh Wildlife Refuge, 2) Ghameshlou Wildlife Refuge and 3) Kolah Ghazy National Park and Complex D (red): 1) Bafq & Ariz Protected Area and 2) Kalmand Protected Area (Iranian Cheetah Society).



Fig 1. The Asiatic cheetah in mountainous habitats of Bafq Protected Area (Photo Ali. A. Karimi).

The present investigation was carried out between 2000 and 2008 in present and past habitats of the Asiatic cheetah to illustrate the main conservation needs of the subspecies in Iran. This would then enable us to develop a more accurate idea of the cheetah's range in the country in order to monitor and evaluate conservation efforts. Meanwhile, the cheetah population seems to be growing in some areas, so identifying potential ranges using RS/GIS techniques could guarantee the dispersal of the subspecies and the integrity of its populations. The results of this survey may even help conservationists in other West Asian countries to ascertain the occurrence of cheetahs outside Iran.

Case Studies

In order to compare habitats, four complexes of reserves were selected, in all of which the presence of a number of cheetahs was confirmed (Fig. 2). For each complex, more data is presented

about the cheetah status, habitat description and prey base.

1. Golestan National Park (NP) and Ghorkhod /Behkadeh Protected Area (PA) in Golestan and North Khorasan Provinces

Golestan NP and Ghorkhod & Behkadeh PA are two integrated reserves comprising mountainous habitats lying in a west-east direction and surrounded by plains. Golestan holds a population of a few hundred Persian gazelles (usually less than 400) on the southern plains, while Ghorkhod & Behkadeh is home to a smaller gazelle population (less than 250).

Golestan NP was known to be a cheetah habitat in the 1970s (Hajji 1986), and it was reported that just before the end of that period at least 3 cheetahs were seen in the area (Kiabi *et al.* 1993). Likewise, Ghorkhod & Behkadeh has been known to be a cheetah habitat (Hajji 1986, Asadi 1997) as well. Despite intense conservation efforts in Golestan and the lack of necessary law enforcement in Ghorkhod & Behkadeh, it is now thought that there are no longer any cheetahs in Golestan, but that a few survive in Ghorkhod & Behkadeh. Golestan's southern plains are quite flat without any significant topographic features, while Ghorkhod's plains comprise various watercourses extending from the mountains into the plains near the Turkmenistan border (Fig. 3a, b).

We think that, despite the general belief that Golestan NP was historically the main habitat of cheetahs in Iran and its regular citation in literature and reports (e.g. Kiabi *et al.* 1993, Etemad 1985, Ziaie 1996), Ghorkhod & Behkadeh has been the main location of the area's cheetah population. Moreover, since Golestan was regularly visited by experts and tourists as it is one of the most remarkable reserves in the country, the cheetah was seen and reported more often. With a flat plain bordered by the Asian Highway and its vicinity to Ghorkhod & Behkadeh through several main valleys, Golestan seemed to be a temporary habitat for the cheetahs that, dispersing from Ghorkhod & Behkadeh, rarely spent a long time there. However, since Golestan is smaller than Ghorkhod & Behkadeh and flatter, it was easier to see cheetahs there.

2. Mouteh Wildlife Refuge (WR), Ghameshlou (WR) and Kolah Qazy NP in Esfahan Province

The north-central province of Esfahan possesses a number of well-known habitats for ungulates, including the Persian gazelle which has its highest density in three main reserves: Kolah Qazy NP south of the city of Esfahan, and Ghameshlou and Mouteh WRs to the north. All three reserves were established in a series of mountainous chains surrounded by plains, covering approximately 50,000, 85,000 and 200,000 hectares, respectively.

In the mid-1970s the cheetah was only reported from Kolah Qazy (Firouz 1974) and Mouteh (Dareshuri 1978) which was considered to be the consequence of conservation measures (Firouz 1974). The subspecies was even reported until the mid-1980s from both areas (Zand Moghadam, pers. comm. and Afzali, pers. comm.). An experienced hunter was reported to have had a cheetah skin from Ghameshlou WR dating back before the 1970s (Kazerouni, pers. comm.). Kolah Qazy possesses high mountainous walls immediately adjoining flat plains, but the cheetah does not exist there anymore despite the high number of prey animals (about 1,000 gazelles). Mouteh has vast plains with numerous watercourses extending from mountainous terrain into the plains. The Iranian Department of the Environment (DOE) does not think that the cheetah still occurs in Mouteh (which has about 3,000 gazelles), but recently we received reliable reports of cheetah sightings in the area. Other than the reported skin (it was not shown to us), no other reports concerning the subspecies were obtained for Ghameshlou, and in view of its topography, we do not consider it to be a permanent habitat for cheetahs, just a dispersal destination from adjacent Mouteh (Fig. 3c, d).

3. Miandasht WR, Khosh Yeylagh WR and Saluk NP in Semnan and North Khorasan Provinces

Miandasht, Khosh Yeylagh and Saluk areas were established on a trial basis in the 1970s in the north-east of the country in a more or less west-east alignment. As one of the best-known cheetah reserves in the 1970s, Khosh Yeylagh is reported to hold 20 to 25 cheetahs

(Dareshuri 1978). Miandasht has been a famous habitat for both cheetahs and Persian gazelles since its establishment (Farhadinia & Absalan 2004). Khosh Yeylagh consists of mountainous terrain with surrounding plains habitats, where the cheetahs preyed primarily on wild sheep (Harrington 1977). On the other hand, Miandasht lacks any harsh mountainous environment, consisting entirely of plains intersected by a thick network of watercourses. Saluk is famous because of its leopard habitat, mountainous terrains that meet flat plains to the south (Fig. 3e, f).

Khosh Yeylagh was heavily degraded during the early 1980s, so only a small proportion of the 14,000 ungulates living there in the 1970s has survived (Hajji 1986) and the last official cheetah report dates back to 1982 (Amini, pers. comm.). Miandasht is now supposed to be one of the main habitats for the subspecies in Iran with a population of at least 6 individuals (Farhadinia 2007). It is the only plains habitat in Iran where cheetahs live, but further surveys have revealed that the cheetahs seem to avoid the flat plains and are often sighted along watercourses or in hilly terrain. Since Miandasht has a very low density of gazelles (0.2 to 0.4 gazelles/km²) and is close to Saluk which has a high density of gazelles, it seemed logical to presume that cheetahs must occur in the latter reserve. However, surprisingly, no cheetah has ever been sighted in Saluk and the subspecies is quite unknown to local people (Farhadinia 2007). Since Miandasht is not so vast and is limited by human settlements in most directions, it is probable that the cheetahs disperse towards Khosh Yeylagh, not Saluk.

4. Bafq & Ariz PA and Kalmand PA in Yazd Province

Probably possessing the highest density of cheetahs in Iran, Bafq & Ariz PA (approximately 200,000 hectares) is located in the eastern part of the central province of Yazd and is mainly well known for a good abundance of leopards. As one of the main gazelle habitats in Yazd, Kalmand PA is located in the western neighbourhood of Bafq and holds several hundred Persian gazelles. The only official record of cheetah existence in Kalmand dates back to the mid-



Fig. 3. Typical cheetah habitats in the different study areas. a) The flat plains of Golestan versus b) the hilly plains of Ghorkhod & Behkadeh; c) The watercourse plains of Miandasht versus d) the flat plains of Saluk; e) the high rocky walls of Kolah Ghazy versus f) the light topographic conditions in Ghameshlou; g) the mountainous terrain of Bafq versus h) the flat areas of Kalmand (Photos a to g M. Farhadinia, photo h M. Eslami).

1970s when a dead one was found in the area (Mortazavi pers. comm.); however, no cheetah sightings were officially reported until the early 2000s. Since the area is adjacent to Bafq, which has the highest density of the subspecies (Farhadinia 2004), it is supposed that the recolonization of Kalmand has probably resulted from cheetah dispersal from there. Bafq & Ariz consists of high mountainous terrain with numerous valleys and watercourses intersecting the area. Kalmand has the same topographic conditions, but has fewer watercourses (Fig. 3g, h). However, in view of the existence of a large number of Persian gazelles in the vicinity of Bafq & Ariz as well as conservation efforts there since the 1970s, one would have expected that the cheetahs would have selected Kalmand as a suitable habitat, but the creature has been quite unknown there until just recently.

Conclusion

The above case studies indicate that the general, well-accepted idea that links the number of Asiatic cheetahs to gazelle density may not describe the habitat selection and ranging activities of cheetahs in Iran. There are various areas located within the main range of the cheetah in the country and holding good numbers of gazelles, but the subspecies is not known to have established populations there. In contrast, there are 'mosaic' areas of plains and rolling mountains intersected by numerous watercourses where cheetahs do live, even where there is a very low density of gazelles. Farhadinia (2007) found in Miandasht WR that the cheetahs seem to concentrate mainly on the habitats with higher gazelle 'catchability' rather than greater abundance. Hopcraft *et al.* (2005) noted that Serengeti lions select areas where prey is easier to catch, rather than areas where prey densities are highest. On the Serengeti Plains, where the male cheetahs establish their territories and where there is some cover, Caro (1994) considered that the availability of sufficient cover for stalking and resting determines territory selection.

Food and cover are two essential requirements for animals' survival, but it seems that most attention has been paid to food without considering cover. According to Bolen & Robinson (1999),

"cover is referred to any physical or biological features or arrangements of features that provide shelter from weather or concealment from or for predators". Elton (1939) noted that "cover is a magic word in wildlife management. It is, indeed, often a magic wand with which wild animals and birds are made to populate places formerly uninhabitable. ... It seems desirable that we should seek to analyze the complex nature of cover more carefully".

The cheetah is known to obtain a proportion of its food from small mammals, especially hares *Lepus capensis* (Karami 1992, Farhadinia 2007) which rest during the day in shallow depressions poorly shaded by desert shrubs (Kronfeld & Shkolnik 1996). This is more usual in hilly terrain rather than on flat plains, where we have regularly encountered hares along watercourses where they can find shelter from predators and the harsh environmental conditions. Meanwhile, prey concentrations occur (periodically, at least) in the dry watercourses and in the foothills of mountains, so these are areas in which cheetahs are likely to concentrate their hunting efforts (Hunter *et al.* 2007).

We emphasize the high importance of considering various microhabitat parameters for cheetahs that provide them with an appropriate combination of both of their essential needs before evaluating the most suitable habitats or searching for potential ranges. It seems that before conducting a search for cheetahs based on gazelle abundance, it is more critical to look for areas that have good networks of rolling terrain and watercourses that the cheetahs usually walk along to search for prey. With this new point of view, we think that we have to redefine cheetah distribution in the country, and that more areas seem to be included within the subspecies' range, particularly on the western and southern boundaries of its present distribution in Iran.

Although at present the cheetah is regarded as 'extinct' in some of its previous habitats owing to a lack of any reliable direct sightings for several years or a significant reduction in the gazelle population, we confirmed the cheetah's existence during the period it was reported to have totally disappeared (e.g., in Miandasht WR, Ghorkhod & Beh-

kadeh PA, Mouteh WR, etc). Thus we propose to wildlife agencies and experts in Iran that they investigate previously reported habitats for signs of cheetahs, particularly Khosh Yeylagh, Hormod, Bahram Gour, Saqand, Ravar, etc. Also, we suggest that wildlife conservationists in other Asian countries within the historical range of the subspecies, particularly in Afghanistan, Pakistan and Turkmenistan, to search any habitats that have the necessary food and cover for cheetahs, because it seems that *Acinonyx jubatus venaticus* is still the Asiatic cheetah and is not just limited to Iran.

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