

Short communication

Wandering the barren deserts of Iran: Illuminating high mobility of the Asiatic cheetah with sparse data



Mohammad S. Farhadinia ^{a, b, *}, Navid Gholikhani ^a, Pouyan Behnoud ^a, Kaveh Hobeali ^a,
Atieh Taktehrani ^a, Fatemeh Hosseini-Zavarei ^a, Morteza Eslami ^a, Luke T.B. Hunter ^c

^a Iranian Cheetah Society (ICS), POBox 14155-8549, Tehran, Iran

^b Wildlife Conservation Research Unit, Department of Zoology, University of Oxford, Recanti-Kaplan Centre, Tubney House, Oxfordshire, OX13 5QL, Oxford, UK

^c Panthera, 8 West 40th Street, 18th Floor, New York, United States

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ABSTRACT

Mammalian species inhabiting arid landscapes exhibit various levels of mobility in order to cope with unpredictable spatiotemporal dispersion of resources. However, the space use and ranging behavior of many species in drylands is poorly understood, especially for large carnivores in Asia. Accommodating the long-distance movements of mammalian carnivores is a major challenge in conservation, particularly for threatened and highly mobile species. The Asiatic cheetah *Acinonyx jubatus venaticus*, a critically endangered subspecies found only in arid areas of Iran, exhibits high levels of mobility. In the absence of satellite collars, this paper outlines ranging patterns of the majority of the Asiatic cheetah's known population. A total of 17 independent cheetahs (11 males; 6 females) were detected with camera traps that were deployed on eight reserves between January 2011 and May 2016. The animals displayed extensive movements (up to 217 km between furthest known locations) and at least nine adult cheetahs were known to move between multiple reserves in central Iran. This mobility may follow a "nomadic" ranging pattern, a non-sedentary behavior with irregular timing and movement directions. The ranging behavior documented here must be considered when designing monitoring efforts to determine population and occupancy trends for this wide-ranging elusive carnivore. Although preliminary, our results show that improving protection beyond the current network of cheetah reserves, particularly along corridors, should be a top priority to safeguard the persistence of the Asiatic cheetah.

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Many mammals in dryland ecosystems show different types of long-range movement patterns (Harris et al., 2009). Various levels of mobility are associated with accessibility of unpredictable and spatially heterogeneous resources across landscapes (Durant et al., 2014). Long-distance movements of wildlife are important biological phenomena and their integration into conservation measures remains a major challenge (Kaczensky et al., 2011). Therefore, illuminating the underlying factors that shape various movement patterns is critical, particularly in case of endangered mobile species.

Central to efficient use of dryland resources, mobility is inevitable for desert dwelling wildlife (Durant et al., 2014). Presently, scientific knowledge about mammal migrations in Asia's arid ecosystems is limited largely to herbivores (Harris et al., 2009; Kaczensky et al., 2011). These species typically migrate long distances in the arid and semi-arid rangelands of central Asia to cope with the changing productivity and precipitation of their unpredictable environments (Olson et al., 2009; Singh et al., 2010). In contrast, our knowledge about the mobility of carnivores in Asian drylands is very limited. Grey wolves *Canis lupus* are reported to patrol large areas in Mongolian deserts (Kaczensky et al., 2008) and Asiatic cheetahs *Acinonyx jubatus venaticus* move exceptionally long distances in central Iran (Farhadinia et al., 2013). This may be due to the arid, resource-poor Iranian environments that require cheetahs to move long distances to fulfill their resource needs.

Ignoring extensive movements of highly mobile endangered species could result in misinterpretation of species' range changes.

* Corresponding author. Iranian Cheetah Society (ICS), POBox 14155-8549, Tehran, Iran.

E-mail addresses: msfarhadinia@wildlife.ir (M.S. Farhadinia), gho_navid@yahoo.com (N. Gholikhani), pouyaanbehnoud@yahoo.com (P. Behnoud), kavehobeali@gmail.com (K. Hobeali), a.taktehrani@gmail.com (A. Taktehrani), fhosseini806@gmail.com (F. Hosseini-Zavarei), morteza_ed@yahoo.com (M. Eslami).

Researchers caution that total geographic range estimates (i.e. pooling observations over time) do not adequately reflect the more localized, highly concentrated occurrence of nomadic species at any particular point in time and may, therefore, exaggerate true occurrence (Teitelbaum et al., 2015). Thus, without adequate information on discrete spatial patterns, conservation efforts involving terrestrial migrations in fragile dryland ecosystems may easily be misguided and jeopardized.

With a population of fewer than 70 individuals left in Iran (Farhadinia, 2004), the Asiatic cheetah is critically endangered, prompting intensive conservation efforts in the country since 2001 (Hunter et al., 2007). However, their spatial ecology remains poorly understood. Home range sizes of cheetahs have shown large variation (see Houser et al., 2009 for more details), influenced by several factors, such as avoidance of other predators (Durant, 2000), following migratory prey species (Caro, 1994), low rainfall (Marker et al., 2008a) and human disturbance (Houser et al., 2009).

Asiatic cheetahs are known to roam large areas (Farhadinia et al., 2013) and occur at extremely low density (Hunter et al., 2007), both creating considerable challenges for research and monitoring. In the present paper we collated a photographic dataset of cheetahs detected in Iran to outline their spatial behavior. These data will

add to our understanding from a previous case report (Farhadinia et al., 2013) with additional information collected across the majority of the cheetah's confirmed range in Iran. While our data are sparse, it enhances our understanding of one of the rarest carnivore subspecies in the world. One aim was that our work may serve as a stimulus for future studies focusing on high mobility of endangered large carnivores in fragile drylands with highly heterogeneous resources.

Our study was conducted at 12 different cheetah reserves in the eastern half of Iran (Fig. 1 and Table 1). These landscapes are characterized by a mixture of arid plains, hilly terrain and undulating mountains. Vegetation predominantly comprises wormwood *Artemisia sieberi* and bean caper *Zygophyllum* sp. Persian ibex *Capra aegagrus* and wild sheep *Ovis orientalis* are the main wild ungulates whilst small numbers of chinkara *Gazella bennettii* and goitered gazelle *Gazella subgutturosa* also occur (Ziaie, 2008).

In order to monitor cheetahs, motion-triggered camera traps were deployed between January 2011 and May 2016. In total, 11 reserves with confirmed cheetah presence were selected to carry out camera trapping surveys. Eight reserves hosted systematic surveys, i.e. with an approximate average of 20 (ranging 10–43; Table 1) cameras that were strategically deployed for a period of

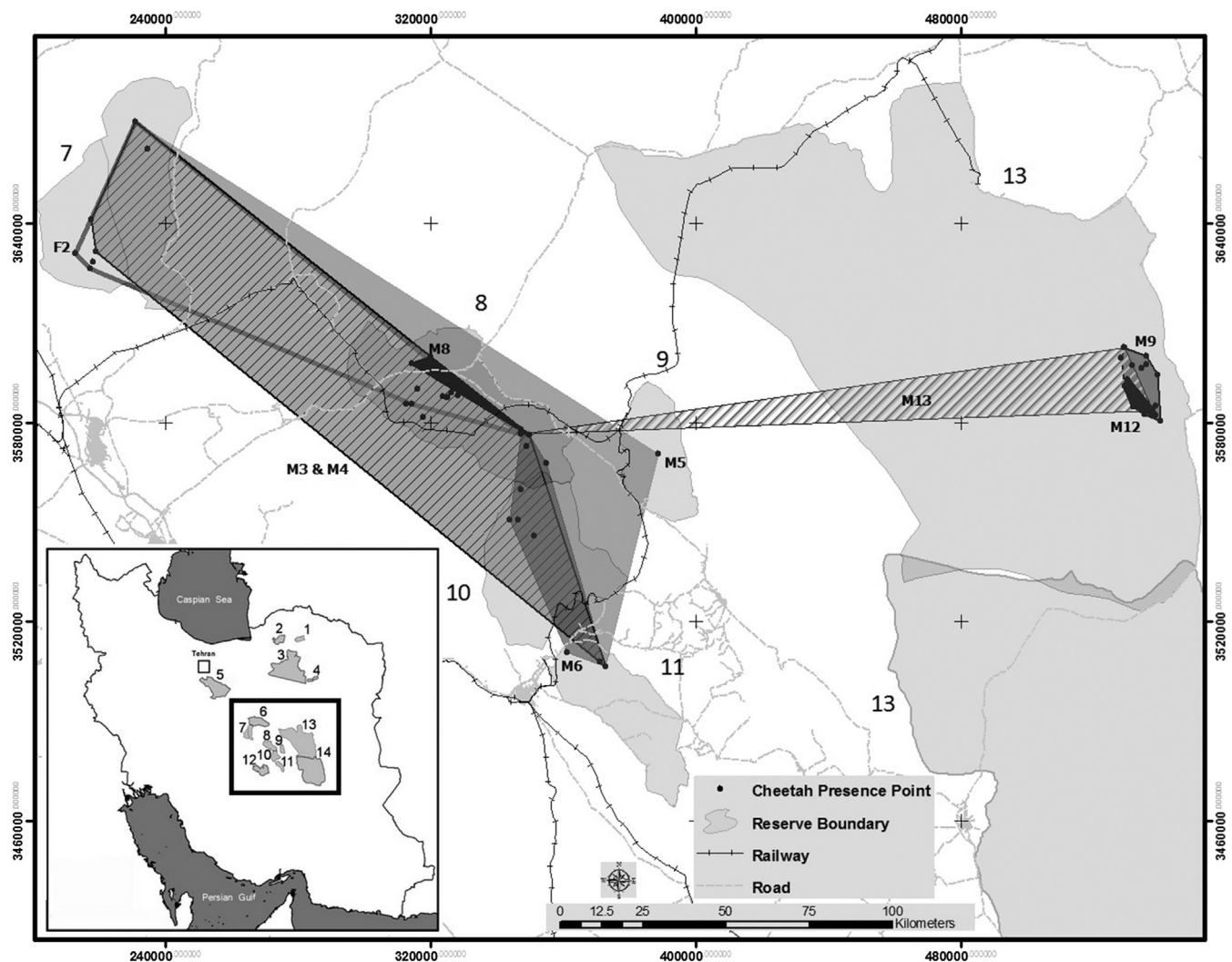


Fig. 1. Ranging patterns of identified cheetahs in central Iran. Each MCP code refers to the relevant cheetah ID in Table 2. Numbers in the map represent cheetah reserves in Iran: 1) Miandash, 2) Khosh Yeilagh, 3) Touran, 4) Dorouneh, 5) Kavir, 6) Abbas Abad, 7) Siahkouch, 8) Dareh Anjir, 9) Kamki Bahabad, 10) Ariz, 11) Bafq, 12) Kalmang, 13) Naybandan, and 14) Darband.

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