A review of ecology and conservation status of Asian cheetah in Iran

We reviewed existing knowledge about the Asiatic cheetah Acinonyx jubatus venaticus, a critically endangered subspecies which once used to live in west and south Asia, now confined to a small population remaining in Iran. Available literatures, reports and hard facts such as images and films were collected to shed light on biology, status and distribution of the cheetahs in Iran. Unlike previous perceptions about the cheetah characteristics, the Asiatic cheetahs are smaller and lighter than their sub-Saharan African cousins. They mainly live in hilly terrains, foothills and rocky valleys where they have access to existing range of prey in deserts. To cope with environmental variability in drylands, they show high mobility in their movement pattern, patrolling some of the largest ranges ever recorded for the cheetahs. On average, 2.7 (SE = 0.2, ranging 1 to 4) cubs younger than 6 months have been seen in each family, predominantly born in March-April. Since 2001, at least 18 areas in the country are known to have evidence of cheetah presence, mostly (n = 16) officially protected. A joint initiative of national and international organisations has been trying to halt major threats, particularly prey and habitat loss since 2001. However, the subspecies remains critically endangered on the verge of extinction with a population of fewer than 40 individuals, occurring across approximately 242,500 km² (i.e. 23.2% of its historical range in Iran). Decreased breeding, retaliatory killing by herdsmen and occasional mortalities due to poachers or road collisions are the major threats for the small population of Asiatic cheetahs in Iran.

The Asiatic cheetah is a critically endangered large felid now exclusively confined to arid environments of the eastern half of Iran (Farhadinia 2004, Hunter et al. 2007). During the second half of the last century, the predator has been experiencing drastic decline both in number and occupancy across most of its Asian range, from India to the Arabian Peninsula, making it the smallest remnant of any cheetah subspecies in the world (Nowell & Jackson 1996).

Iran's cheetahs were also rapidly disappearing from most of their formerly inhabited regions, leaving no doubt that this enigmatic and rare large carnivore is strongly prone to extinction. As a result, several national and international organisations were convinced to jointly take an action to safeguard the Asiatic cheetahs in Iran (Breitenmoser et al. 2009), yet virtually very little is known about the subspecies morphology, biology and status.

In this report, we have reviewed available literature to provide a profile on the Asiatic cheetah biology and natural history. Furthermore, we have collated sporadic records of the Asiatic cheetahs to provide general description about them and to update a fairly comprehensive view of the current status of this elusive carnivore in Iran.

Methods
We reviewed all studies conducted on the cheetahs in Iran, including journal papers, university dissertations, research projects, newsletters, and mission reports compiled by different agencies involved in cheetah research and conservation. Also, we obtained hard facts (i.e. image or film) of cheetah families from Provincial Offices of the Iran Department of Environment DoE to analyse cheetah breeding in the country. Finally, we developed a distribution map for the current range of the cheetahs based on occurrence data generously shared by Yazd, Kerman, Esfahan and Semnan Provincial Offices of the DoE as well as by an ongoing monitoring programme led by the Iranian Cheetah Society ICS since 2001 (see Farhadinia et al. 2014 for more details). Reliability of each record individually was assessed by considering whether any hard evidences (e.g. photo, video, or carcass) are present, or only soft evidences are available. We categorised hard evidences as ‘C1’, and soft evidences as ‘C2’.

Taxonomy and general description
The cheetahs are traditionally classified in four African and one Asiatic subspecies, namely as Acinonyx jubatus jubatus, A. j. raineyi, A. j. soemmeringii, A. j. hecki, and A. j. venaticus (Meester 1971). The latter has been named as the Asiatic subspecies. The classification and taxonomy of Asiatic cheetah have been extensively debated. Formerly, the Asiatic cheetahs have been identified as A. j. venaticus (Griffith 1821) and A. j. raddai (Hilzheimer 1913), the latter assigned as Trans-Caspian cheetah inhabiting Central Asia (Heptner & Sludskii 1992, Mallon 2007). Harrison and Bates (1991), Roberts (1997) and Flint (1988) believed the distinction between Asiatic and African cheetah dubious, whereas some authors proposed that this population form a single subspecies, A. j. venaticus, with North African cheetahs (Pocock 1941, Ellerman & Morrison-Scott 1966). Recent molecular studies based on a combination of archaeozoological and contemporary samples have revealed that...
Asiatic cheetahs (i.e. *A. j. venaticus*) are unambiguously separated from African subspecies some 32,000-67,000 years ago (Charreau et al. 2011). In general cheetahs are described as a tawny felid with spots and tear marks on their face. However, inter-specific morphological variation across the cheetah global range has been subjected to expert controversy. Heptner and Sludskii (1992) noted that morphological differences between African and Asiatic cheetahs were perceptible but not marked while it was considered that Asiatic cheetahs differ in morphology (Dareshuri 1978) from the African subspecies. Some authors proposed that the main difference between Asiatic and sub-Saharan African cheetahs lies in the type of spotting and probably in the frequency of a big white portion on the tail tip (Divyabansingh 1995). Groves (cited in Karami 1992) described that the Asiatic cheetah seems to have clearer, darker "shadow spots", more clearly marked faces, more thickly spotted limbs and more marked manes in the adult (cited in Karami 1992). According to Pocock (1941), possible characteristics to distinguish Asiatic from African cheetahs may include a thinner, less woolly winter coat, the absence of a mane, probably in the summer coat; average smaller size and more inflated tympanic bullae in the Asiatic individuals. In contrast, some authors believed that African cheetahs have denser spotting and larger spots on a brighter or darker ground colour comparing to Asian animals with a very pale background colour, while winter fur is relatively long, soft and dense, and the winter “mane” also long and dense (Heptner & Sludskii 1992). Nevertheless, Salvadori and Florio (1978) considered both of fairly similar size although Asiatic cheetahs are slightly smaller. During the past decades, distinction between African and Asiatic cheetahs was noted as slightly larger body size, darker colouration, and longer fur because of adaptation to a colder climate within the Asiatic subspecies range (i.e. Globers Rule; Dareshuri 1978, Roberts 1997, Karami 1992). Detailed information about the morphological characteristics of wild cheetahs is available from Africa which shows regionalised variation as well as sexual dimorphism (Marker & Dickman 2003). In Iran, we collected morphological data from 18 cheetahs from the subspecies range in Iran as well as literature (Hunter et al. 2007; Supporting Online Material SOM Table T1). Adult Males weight range from 25 to 38 kg while females vary between 23 and 35 kg, resulting in a smaller body size of Asiatic cheetahs than the Africans (SOM T1).

### Habitat and ranging

The Asiatic cheetahs in Iran mainly live in hilly terrains, foothills and rocky valleys within a desert ecosystem (Hunter et al. 2007, Jourabchian & Farhadinia 2008). Cheetahs in central Asia inhabited semi-desert and desert plains and foothills containing a range of vegetation types (Mallon 2007). Traditionally, the Asiatic cheetah has been believed to concentrate on plains where gazelles as their main prey species occur (Firouz 1974, Heptner & Sludskii 1992, Etemad 1985, Harrison & Bates 1991, Ziaie 2008). Therefore, it was concluded that effective recovery of gazelle population resulted in increasing trend of the cheetah population in 1960s and 1970s (Firouz 1974) and the drastic decline in gazelle numbers in Iran made the cheetahs appear to have switched to mountain ungulates as their prey (Ziaie 2008). In central Iran, the cheetahs are known to select mountainous habitats far from open country (Sarhangzadeh et al. 2015). Similarly, the cheetah’s potential habitat in Touran Biodiversity Reserve BR is characterised by high spatial overlap with that of the wild sheep (Nazeri et al. 2015). Besides prey, cover has also been considered to be a main deriving factor for habitat characterisation of the Asiatic cheetahs. Comparison of several combinations of reserves in Iran clearly showed that the cheetahs persist within a number of areas with low density of gazelles, but with more heterogeneous landscapes, such as hilly mountains and rolling terrains. In contrast, they are rarely or never known from nearby areas where remarkably higher gazelle density occur, but mostly in open flat plains (Farhadinia et al. 2008). As a result, a hypothesis is generated that heterogeneous habitats can provide more prey catchability, a key determinant known for many large cats (e.g. lion *Panthera leo*, Hopcroft et al. 2005; leopard *P. pardus*, Balme et al. 2007). Caro (1994) also noted that the availability of sufficient cover for stalking and resting determined territory selection in Serengeti. Ranging patterns of the Asiatic cheetahs in Iran is not properly understood, but sparse photographic data show that they have extensive mobility (Farhadinia et al. 2013). More than half of cheetahs detected since 2010 in

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**Acinonyx jubatus venaticus**

| Photo 12062/CACP/Panthera |

| Names: | Yuzpalang-e-Asiayie Asiatic cheetah |


| CITES: | Appendix I |

| Iran environmental conservation laws & regulations: | Endangered species |

| Global population: | fewer than 40 |

| Iranian population: | fewer than 40 |

| Distribution in Iran: | Arid areas of eastern half of Iran and probably parts of Iran-Iraq borderland |
Iran have shown inter-reserve wandering, sometimes up-to 217 km apart (Farhadinia et al. 2016). The mean 100% MCP based on detections by camera traps for 17 adult cheetahs was calculated as 2105.3 ± SE 770.6 km² (males: 2474.7 ± 1005.2 km²; females: 1089.6 ± SE 728.8 km², Farhadinia et al. 2016). Furthermore, Hunter (2011) has reported that a coalition of two adult male cheetahs have patrolled an area of than 1700 km² in five months in central Iran, one of the largest ever recorded ranges for the cheetahs in the world (Houser et al. 2009).

With the exception of Namibia’s semi-arid farmlands where cheetah ranges can measure between 1344 to 2883 km² (Wachter et al. 2006, Marker et al. 2008), most spatial ecology studies in sub-Saharan Africa yielded comparatively smaller cheetah ranges (see Houser et al. 2009 for more details) than recorded here. In contrast, Belbachir et al. (2015) calculated a maximum home range of 1337 km² based on 100% MCP estimation of camera trap detections in the arid areas of the Sahara desert.

Cheetahs’ home range is generally related to the density of available prey (Hunter et al. 2007) which Iranian drylands host the lowest recorded anywhere in the distribution of the cheetah (Schaller & O’Brien 2001). Such a high mobility may follow a “nomadic” ranging pattern, a non-sedentary behaviour with irregular timing and movement directions and it must be considered when designing monitoring efforts to determine population and occupancy trends for this wide-ranging elusive carnivore (Farhadinia et al. 2016).

Males, whether territorial or not, scent-mark to advertise their presence by spray-marking, scratching, and defecating on prominent features in the landscape (Eaton 1970). In Iran, marking behaviour at signing posts mainly by adult males through directional urination has been photo-trapped in multiple localities, such as Dareh Anjir Wildlife Refuge WR, Touran BR, Bafq Protected Area PA, Azir No-Hunting Area NHA, Naybandan WR, and Kazir National Park NP (Fig. 1). This behaviour can cause positive bias towards recording more males in the area by camera traps deployed at signing posts (Marker et al. 2008, Marnewick et al. 2008).

**Reproduction**

Cheetahs show a high rate of reproduction, almost 80% of adults in the wild produce offspring (Laurenson et al. 1992). In contrast, they experience various levels of cub and juvenile mortality across their sub-Saharan African range (Laurenson 1994, Mills & Mills 2014). In Iran, the cheetah cubs are rarely seen in the wild. For example, during 1980s and 1990s, only 15 records of cheetah families are available, with 1 to 3 cubs (Farhadinia 1999).

We were able to develop a photographic database of cheetah families shared by Yazd DoE (6 families), Semnan DoE (6 families) and Iranian Cheetah Society (3 families), summing up a total of 15 families with 39 cubs aging less than six months (Fig. 2; SOM T2). The average number of cubs accompanying their mother was calculated as 2.7 (SE = 0.2, ranging from 1 to 4), somewhat higher than what has already been reported for Asiatic cheetahs as ranging between 2 to 2.5 (Farhadinia 1999). In Africa, average litter size of the cheetahs is 3.6 (Serengeti; Caro 1994) and 3.2 (Namibia; Marker et al. 2003). Our data are based on litter size during their first year of life (usually 3-6 months) whereas African data are based on newly emerged cubs which, progressively in older age classes, litters are less in number (Caro 1994). The cheetahs in northern areas (i.e. Touran BR and Miandasht WR) tend to have larger litter sizes than their southern counterparts such as Bafq PA, Dareh Anjir WR, Naybandan WR and Siahkouh NP (North: 3.0 ± SE 0.2 vs. South: 2.3 ± SE 0.5). Among identified cheetah families, we were able to follow seven cases, unveiling that at least one cub from each family reached the first year, which is higher than in the Serengeti Plains (9.7%; Laurenson 1994) and Kgala Transfrontier Park (45.0%; Mills & Mills 2014). These seven families were accompanied by 17 individuals, mostly survived until their first year of life (88.2%, n = 15, Fig. 3). In Africa, significant difference is seen in post-emergence survival until 14 months, 54.5% in Serengeti (Laurenson 1994) up-to 95.8% in Kgala Transfrontier Park (Mills & Mills 2014). Causes of cub mortality are not known for the Asiatic cheetahs whereas predation by other large carnivores and starvation are two key reasons of mortality for the African cheetah cubs (Laurenson 1994, Mills & Mills 2014). Asiatic cheetah birth time peaks at March-April, based on aforementioned photographic data of the cheetah families (SOM T2) which is consistent to previous hypothesis (Harrington & Dareshuri 1976, Farhadinia 1999). However, such seasonality may vary in regions with different ecological conditions (Eaton 1970). In northern areas (i.e. Touran BR and Miandasht WR) it occurs mainly in late March/early April whereas it can occur in advance in southern areas (i.e. Bafq PA, Dareh Anjir WR and Siahkouh NP). Surprisingly, 26.7% (n = 4) of births took place in non-peak seasons, around late summer and/or early fall.

**Feeding ecology**

Cheetahs generally take down medium-sized prey, within a body mass range of 23-56 kg that can be subdued with minimal risk of self-injury (Hayward et al. 2006). In central Asia, the cheetah range overlapped with that of goitered gazelle *Gazella subgutturosa* habitat (Heptner & Sludskii 1992). Furthermore, it has been reported that wild sheep *Ovis orientalis* (Harrington & Dareshuri 1976, Mallon 2007) was part of the cheetah’s diet.

In Iran, the cheetahs prey primarily on mountainous ungulates such as wild sheep (mean weight = 34 kg), wild goat *Capra aegagrus* (mean weight = 36 kg) and two species of gazelles (mean weight = ca. 21 kg), namely chinkara *Gazella bennettii* and goitered gazelle. Wild sheep is the most frequently taken prey for Asiatic cheetahs in most its extant range (Hunter et al. 2007, Jourabchian & Farhadinia 2008, Farhadinia & Hemami 2010). According to sighting reports collected by Jourabchian & Farhadinia (2008), on the basis of 21 cases...
of direct observation of Asiatic cheetahs at kills between 1980 and 2007, 50% of sightings were on the wild sheep, followed by wild goat (22%), Persian gazelle (22%) and chinkara (6%). Scat analysis of more than 400 cheetah faecal samples in Dareh Anjir WR and Naybandan WR also revealed that wild sheep ranked the most frequent prey item (almost 45%), followed by wild goat (almost 26%) and then chinkara (10 to 16%; Zamani 2010). Despite higher percentage of mountainous ungulates in the cheetahs’ diet, all feeding ecology investigations are consistent that chinkaras have highest Jacob’s selectivity index rather than wild sheep and wild goat (Farhadinia & Hemami 2010, Zamani 2010, Rezaie 2014). In north-eastern Iran, the goitered gazelle is the main available prey for the cheetahs (Farhadinia et al. 2012). Content investigation of five dead Asiatic cheetahs in Touran BR and Kalmard PA revealed hare Lepus sp. (n = 2) and goitered gazelle (n = 3) eaten by the predator. Despite the cheetahs’ past co-occurring within onager Equus hemionus onager range in Iran (presently they co-occur only in Touran BR), there is no report of cheetah predation on the species, unlike central Asian range where young kulans E. h. kulan have been occasionally taken by cheetahs (Mallon 2007). Cheetahs are also known to kill livestock including young camel, sheep, and goat within the species range (e.g. Dragesco-Joffe 1993, Marker et al. 2003, Selebatsi et al. 2008). Cheetahs rarely preyed on domestic animals and were not considered a threat to livestock in central Asia (Mallon 2007). In Iran, the cheetahs are known to occasionally kill livestock in north-eastern country (Farhadinia et al. 2012). Recently, a few young camels have been confirmed to be killed by the cheetahs in a few reserves in Dareh Anjir WR, Ariz NHA and Darband WR (usually two cheetahs seen together). Furthermore, two adult female cheetahs were reported to depredate on domestic sheep and goat at peripheries of Touran BR, one was killed in retaliation by local herders in 2012. Additionally, in Ariz NHA two cheetahs were seen on a domestic goat in late 2000s (H. Hasannezhad, pers. comm.).

Status and distribution

Historically, the cheetah occurred widely through much of non-forested Africa, the Middle East and southern Asia (Caro 1994, Nowell & Jackson 1996). The cheetahs have lost 76% of their African historic range (Ray et al. 2005). In Asia, they formerly ranged across southwest and central Asia to India (Nowell & Jackson 1996, Mallon 2007), but it is now restricted to small populations in Iran (Farhadinia 2004, Durant et al. 2015) with some occasional reports from some neighbouring countries (i.e. Pakistan: Roberts 1997, Husain 2001; Afghanistan: Manati & Nogge 2008; Turkmenistan: Flint 1988). The cheetah is globally considered as vulnerable, but the Asiatic cheetah is categorized as Critically Endangered on the IUCN Red List (Durant et al. 2015) and is listed on CITES Appendix I (Nowell & Jackson 1996).

Before World War II, the cheetah population was estimated to be around 400 (Harrington 1971), encompassing almost all of the steppes and desert areas of the eastern half of the country and some western terrains near the Iraqi border (63.4% of the country’s territory; Farhadinia et al. subm.). Since late 1950s, protection was established for the cheetahs and its habitats to halt poaching of cheetahs and their prey (Firouz 1974). As a result, cheetah sightings increased in different localities, revealing a remarkable resurgence of its population and the efficacy of conservation measures (Firouz 1974, Mowlavi 1985). In the 1970s the range was thought to include arid lands of eastern half of Iran as well as some areas at the borderland with Iraq (Firouz 1974) with a population estimate of 200-300 for the whole country (Firouz cited in Goodwin & Holloway 1974). Joslin (1984) considered this estimation to be too high and came up with approximately 100 cheetahs as a more realistic.

In 1979, the country witnessed a revolution, which interrupted wildlife conservation for a few years. So many areas were occupied by livestock that the cheetah and its prey were heavily poached. The cheetah disappeared from many of its former ranges and was limited to some remote areas with a reliable prey population and relative safety (Asadi 1997, Farhadinia 2004). In 2000, the Asiatic cheetah was reported from only seven areas, i.e. Kavir NP & PA, Touran BR, Naybandan WR, Bafq PA, Dareh Anjir WR, Ariz NHA and Kamki Bahabad NHA (Ziaie 2008, Jourabchian & Farhadinia 2008). Several crude population estimates have been proposed for that time, all agreeing to fewer than 100 individuals for the entire country (<60; Schaller & O’Brien 2001, Farhadinia 2004, <40; Jourabchian 1999, 50-100; Asadi 1997, 70-100; Ziaie 2008, 60-100; Jowkar et al. 2008). Nevertheless, as a result of the first country-scale assessment based on intensive camera trapping survey across more than half of the known cheetah reserves between 2010 and 2013, it was concluded that Iran likely hosts a smaller population that perceived before (Farhadinia et al. 2014).

Since 2001, conservation efforts were boosted in Iran aiming to safeguard the Asiatic cheetah and its biota. As a result, the species has been known to exist within at least 18 areas since 2001 in Iran, 15 C1 localities based on “confirmed” (i.e. image or film) records and 3 C2 areas where “unconfirmed” presence (i.e. tracks verified by us) was reported (Fig. 4). Expansion of the known range of the Asiatic cheetah over the 2000s is likely due to increased survey effort and the increased use of camera-traps rather than actual range recovery or expansion. Nevertheless, fewer than 40 individuals are supposed to persist (ICS unpubl. report) in an area of approximately 242,500 km² (Fig. 4), which is equal to 23.2% of its historical occurrence (Farhadinia et al. subm.), spread across seven provinces of Yazd, Semnan, Esfahan, North Khorasan, South Khorasan, Khorasan Razavi and Kerman.

Available information on inter-reserve movement patterns (Farhadinia et al. 2016) as
Fig. 4. Distribution of the Asiatic cheetah in Iran. Red patches denote to C1 reserves, i.e confirmed areas based on hard evidences, such as photos, videos, and dead specimens while blue patches refers to C2 localities which have soft evidences, such as reliable field observations, either verified by us or via a trained person. A few dots show approved cheetah occurrence outside of the current network of the cheetah reserves in Iran. Dark areas and their associated numbers represent cheetah areas as: 1) Kavir, 2) Chah Shirin, 3) Khosh Yeilagh, 4) Touran, 5) Takhti Iran, 6) Miandasht, 7) Dorouneh, 8) Boshrouyeh, 9) Naybandan, 10) Darband, 11) Abbas Abad, 12) Siahkouh, 13) Dareh Anjir, 14) Ariz, 15) Bafq, 16) Kalmand, 17) Kamki Bahabad, 18) Rafsanjan.

well as spatial configuration of the cheetah reserves (Fig. 4) supports three population nuclei in Iran which we use to illuminate the status of the cheetahs at reserve level:

Northern Landscape
Known as the main breeding population nucleus of Asiatic cheetahs in Iran, it is composed of Touran BR (14,000 km²) and five smaller areas around, namely as Dorouneh PA (667 km²), Miandasht WR (850 km²), Khosh Yeilagh WR (1380 km²), Chah Shirin NHA (680 km²) and Takhti Iran NHA (350 km²). Touran BR is one of the largest reserves in the country which has been extensively known as cheetah habitat for decades (Etemad 1985, Hajji 1986, Asadi 1997). However, despite three camera trapping seasons in 2003, 2005 and 2009-2010, resulting in a cumulated effort of ca. 5,300 trap nights, only two different individuals were captured on camera, one adult in 2003 (unknown gender) and one adult male in 2009-2010 (Ghadirian et al. 2010). There are also occasional reports of cheetah presence from southern Kavir NP, but still no evidence is available. The Asiatic cheetahs are not confined only to aforementioned landscapes and there are sporadic occurrences beyond these regions, predominantly single individuals without evidence of breeding. However, recent field investigations yielded no evidence of cheetah presence in areas within parts of the historical range of the cheetahs in Iran, such as Bidouyeh PA (Alaigholi et al. 2007), Bahram-e-Gour PA (Shoddousi et al. 2007) and Bajestan (Cheraghi et al. 2007). Addi-
tional surveys are still needed to confirm the species existence in Razavi Khorasan, South Khorasan, Kerman, Hormozgan and Sistan-
baruchestan Provinces.
In western Iran, the cheetah was known
mostly from eastern Zagros range, but there
are a few reports of the species from western-
hilly and plain areas of Zagros Mountain
(Ziaie 2008) with a few sporadic reports from
Kermanshah (M. Atarodi, pers. comm.). There
is no evidence of the cheetah occurrence in
past two decades from the region. On the
other side of the border, it has been sighted
in Iraq, even from Basra, close to the Iranian
territory (Corkill 1929), but it has been consid-
ered as extinct in both Iraq and Kuwait (Dick-
son 1949, Hatt 1959).
Since 2010, evidence of breeding has become
rare across majority of the cheetah range in
Iran; and only confirmed in the Northern
Landscape. Cheetah families have apparently
been reported from Ariz NHA and Naybandan
WR in 2014 and 2015 by game guards, but
without documentation. Additionally, most of
recent camera trapping efforts across major-
ity of the cheetah reserves have yielded no
(Ghadirian et al. 2010) or very few adult fe-
males (Ashayeri et al. 2013, Farhadinia et al.
2014), creating a major challenge for cheetah
conservation in Iran.

In captivity
We found reliable reports of at least eleven
cheetahs kept within Iranian zoos and fa-
cilities since 1950. According to Harrington
(1971), a lactating cheetah was captured by
a Tehran zoo expedition in Abarguh (Abark-
ouh) desert, Yazd Province in central Iran. A
cheetah cub was also captured in 1969 in
Kerman and sent to Tehran zoo which acci-
dentally died. Then in 1970, a young female
was found injured in Khosh Yeilagh WR and
sent to Tehran zoo after treatment. An
another female cub estimated to be around
6 months was confiscated by game guards
from a shepherd in Touran BR. Both are now
kept in Pardisan Park, Tehran for breeding
purposes by the Conservation of Asiatic
Cheetah Project CACP.
Formerly, several plans have also been pro-
posed by Iranian senior experts in mid-1990s,
such as Kaboudan Island (Lake Urmia, plan
drafted by H. Ziaie), Kolah Ghazi (plan written
by M. T. Moeinian/Esfahan DoE), Touran, and
Bamou NPs (managed to be built by B. Dare-
shuri) with the aim of establishing breeding
centres. However, the first two cases were
abandoned in the planning phase and the lat-
ter two resulted in construction of large en-
closures, but no cheetah was released within
these sites.

Main threats
Presently, two types of threats affect the
cheetah survival in Iran. Direct threats are
underlying factors directly targeting the cheet-
ahas which can result in individual casualties.
In contrast, indirect threats affect the species
through suppressing habitat suitability or
prey abundance. Nevertheless, we acknow-
ledge that while both kinds of threats are
likely interrelated, direct threats can be to
some extent the result of indirect ones.

Direct threats
We were able to obtain 47 records of
cheetah mortality between 2001 and 2016,
70.2% (n = 33) confirmed based on available
evidences such as photo or carcass whereas
the rest (n = 14) have been approved by
trained game guards or local experts, but
no evidence exist. Only seven individuals
(14.9%) were considered to be due to natural
causes in contrast to majority of casualties
mediated by human.
Most of the cheetah range does not host high
density of livestock, except Touran BR and
Miandasht WR which have large numbers of
domestic sheep and goat and are permitted
to graze in parts of the areas during winter.
Generally shepherds tend to have more posi-
tive attitude toward the cheetahs comparing
with other larger predators (Hamidi & Nezami
2009), probably due to their low density, shy
behaviour as well as people’s comparatively
less loss to the cheetahs comparing to other
larger predators.
Nevertheless, as cheetahs recover, conflict
with livestock could emerge as a threat
over time and that livestock management

Fig. 5. A coalition of two cheetah brothers which have been detected in five different
reserves between 2009 and 2016 in central Iran (Photo ICS/DoE/CACP/Panthera).
and herder education should be considered. Thus, between 2002 and 2016, at least 21 cheetahs are known to be killed by herders in different reserves, 66.7% (n = 14) are approved based on hard fact such as carcass or photo, just a few have received penalty. As a result, local herders are currently the single most remarkable cause of human-induced mortalities of cheetahs in Iran, typically in companion with herd dogs. At least 13 cheetahs were known to be killed only in Touran BR, equal to 61.9% of country's herders-caused mortalities of the cheetahs.

Almost equally important, growing network of roads is an emerging major problem for the cheetahs in the country. Between 2004 and 2016, road collisions have been accounted for 14 cheetahs casualties (29.8% of total cheetah mortalities) in different parts of Iran, including 8 (6 males vs. 2 females) in Yazd Province, one in Darband WR (1 male) and 5 in Touran BR (4 females vs. 1 male), which are unlikely to be afforded by the current small number of the cheetahs in Iran. With respect to our updated knowledge about high mobility of the cheetahs across different reserves (Farhadinia et al. 2013, 2016) and growing network of roads in different parts of the country, particular attention is essential to deal with this challenge.

We are suspicious that available evidences of cheetah poaching (n = 5) is thoroughly representative of the actual level of the threat. Few of poaching cases are trapping and poisoning, not specifically targeting the cheetahs. Purposeful shooting to the cheetahs is apparently uncommon in Iran, simply because the cheetah encounter is quite accidental in the wild. There are occasional rumors of cheetah shooting in remote areas which expectedly are not associated with evidences such as photo or confiscated carcass due to high legal penalty. Nevertheless, even unverified reports can be an alarming indicator that poaching still can be a major concern for the tiny number of the cheetahs in Iran. Also, there is no evidence available of cheetah trade from Iran.

Protection measures

Since 1959, the Asiatic cheetah has been officially protected in Iran. However, it has never been subject to any specific conservation initiative in the country. In September 2001, a partnership between Iran DoE, and Global Environment Facilities GEF United Nations Development Programme UNDP was established to form the Conservation of Asiatic Cheetah Project in which various international and national NGOs have been involved. The goal of this project was formulated as “securing the conservation of the Asiatic cheetah in the I. R. of Iran and the related complex of rare and endangered wild species and their natural habitats with the support and collaboration of local communities”. Currently, some 125 game guards, mostly from communities around the cheetah reserves are hired to afford anti-poaching efforts within the confirmed cheetah range in Iran. Currently, 16 out of 18 confirmed cheetah reserves in Iran (Fig. 4) are officially protected by the Iran DoE, with basic law enforcements infra-structures. Additionally, recent establishment of several conservancies, managed by communities around the cheetah reserves in central country has resulted in an reported increase of prey number. Also, strong deterrents have been approved by the government regarding the killing of cheetahs, including jail time and high fines (currently 1 billion IRR equal to US$ 28,570) which is the highest fine on a violator compared to any other wildlife species in Iran. Public awareness campaigns, including Asiatic Cheetah National Day on 31 August have been established both nationally and locally in communities inside and around the cheetah habitats to increase people’s knowledge about the cheetah and its ecosystem and dispel misconceptions and myths. In 2014, the Iranian national football team announced that their official kits are imprinted with pictures of the Asiatic cheetah in order to bring attention to conservation efforts. Also, a comprehensive insurance programme has been launched by the CACP to compensate people who suffered from cheetah depredation.

The Asiatic cheetah has provided the Iranian community as a milestone to enter modern wildlife conservation. Based on the CACP terminal evaluation for its first phase, “The conservation of the Asiatic cheetah has definitely created more national and international awareness than any other wildlife conservation project in the region. In Iran, it has generated wide interest among young researchers for cat, carnivore and wildlife conservation and research in general, and it has the potential to help spread this interest across the national borders to the whole region” (Breitenmoser et al. 2009). Nevertheless, the subspecies’ small and fragile population is unlikely to be independent from protection measures for decades to come.

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Supporting Online Material SOM Table T1 and T2
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