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Distribution, characteristics and conservation of the jungle cat in Iran

The jungle cat *Felis chaus* is among the least known felids worldwide. A national survey was conducted to assess and document the status and distribution of this species in Iran. A total of 280 jungle cat presence records have been collected, including road kills, injured animals, hunted and trapped specimens and observations and reports made by experts. Observations reported by local communities living inside or close to jungle cat habitats and by inexperienced people were also recorded. We then classified the data into three categories (i.e. C1: confirmed presence, C2: probable presence, C3: unconfirmed presence) on the basis of confirmability of records. Findings indicated that the jungle cat is distributed at least in 23 out of the 31 provinces of Iran. A total of 69 records came from protected areas, i.e. National Parks NPs, Wildlife Reserves WRs and Protected Areas PAs, covering an area of 38,343 km², which is 23.5% of the total area of all protected areas under the auspices of the Department of Environment DoE of Iran. The species was found at altitudes ranging from 45 m to 4,178 m and in a variety of habitat types from plains and agriculture lands to the mountains. However, it was mostly recorded in shrub lands and woodlands. We suppose that the diet of jungle cat in Iran mainly consists of fish, birds (waterfowl, poultry and galliform birds) and rodents. More detailed studies and status assessment of the species on a local scale, particularly in the areas affected by land use changes and severe dry condition are essential. Several conservation measures are recommended to improve the status of the species in Iran.

Among the 10 native felids of Iran, the jungle cat is considered as one of the least known species. It is also known as reed cat or swamp cat. It occurs in North Africa and is widespread in Asia from the Middle East, South-west Asia, Central and South Asia over to South-east Asia, reaching Indochina and possibly the Malayan Peninsula (Nowell & Jackson 1996, Sunquist & Sunquist 2002, Abu-Baker et al. 2003, Duckworth et al. 2005, Sanei & Zakaria 2010). Jungle cats are primarily associated with dense riparian vegetation, especially reed beds and marshes, but cats have also been recorded in shrubby woodland, grassland, evergreen forests, deciduous forest, lowland dipterocarp forests, desert, agriculture lands and forest plantations (Roberts 1977, Tikader 1983, Khan & Beg 1986, Trinh 1991, Abu-Baker et al. 2003, Duckworth et al. 2005, Ogurlu et al. 2010). Its occurrence in arid environments, such as sand deserts, is rare (Rais et al. 2010).

Ten subspecies of the jungle cat have been proposed so far based on the diversity of morphological traits (Pocock 1939, Heptner & Sludskii 1972), but no genetic or cranial analysis was carried out yet to test this hypothesis (Duckworth et al. 2008). The species is

considered as Least Concern LC on the IUCN Red List of Threatened Species (Gray et al. 2016). However, information on its ecology, distribution and status is still sparse (Nowell & Jackson 1996, Sunquist & Sunquist 2002). This paper represents the first compilation of jungle cat records and status assessment, focusing on the distribution, characteristics and conservation of the jungle cat in Iran which could be used to promote species research, conservation and sustainable management in the country.

Fig. 1 A jungle cat in Mianroud, Khouzestan Province in the south-west of Iran in 2012 (Photo B. Farahanchi).

Methods

The most reliable information, e.g. camera-trap pictures, road kills, captive individuals, injured animals, trophies, skulls and stuffed specimens, was compiled to assess the jungle cat status and distribution in Iran. Jungle cat observations, the related habitat characteristics and other information (date, time, weather condition, behaviour of the cat when it was observed, biometry of dead individuals) were recorded during the most recent annual wildlife counts (2010) undertaken by staff and rangers of the DoE in 14 National Parks, 16 Wildlife Refuges, 73 Protected Areas and 164 unprotected and No-Hunting Areas in 31 provinces of Iran. Interviews with hunters and local communities living inside or close to jungle cat habitats were also conducted at irregular intervals during the study. Questionnaires were prepared, sent out to provincial DoE offices and filled out by the responsible a few times per year since 2004.

We classified data into 3 categories: C1 as confirmed presence, C2 as probable presence and C3 as unconfirmed presence (suggested by Moqanaki et al. 2010). Confirmed presence includes photos, videos, injured individuals and carcasses or remains of the species obtained and recognized. Probable presence includes presence records reported by trained people, e.g. park rangers, other DoE staff or wildlife experts. Unconfirmed presence are observations that have not been confirmed by a trained person. Historical occurrence of the species is linked with records provided in old reports and unpublished records of the DoE. We used the records provided by Etemad (1985), Darvish (2001) and Sanei (2007) for historical occurrence of the species. These four main sources (i.e. C1, C2, C3 and historical occurrence of species) were used to map the current and historical distribution of the

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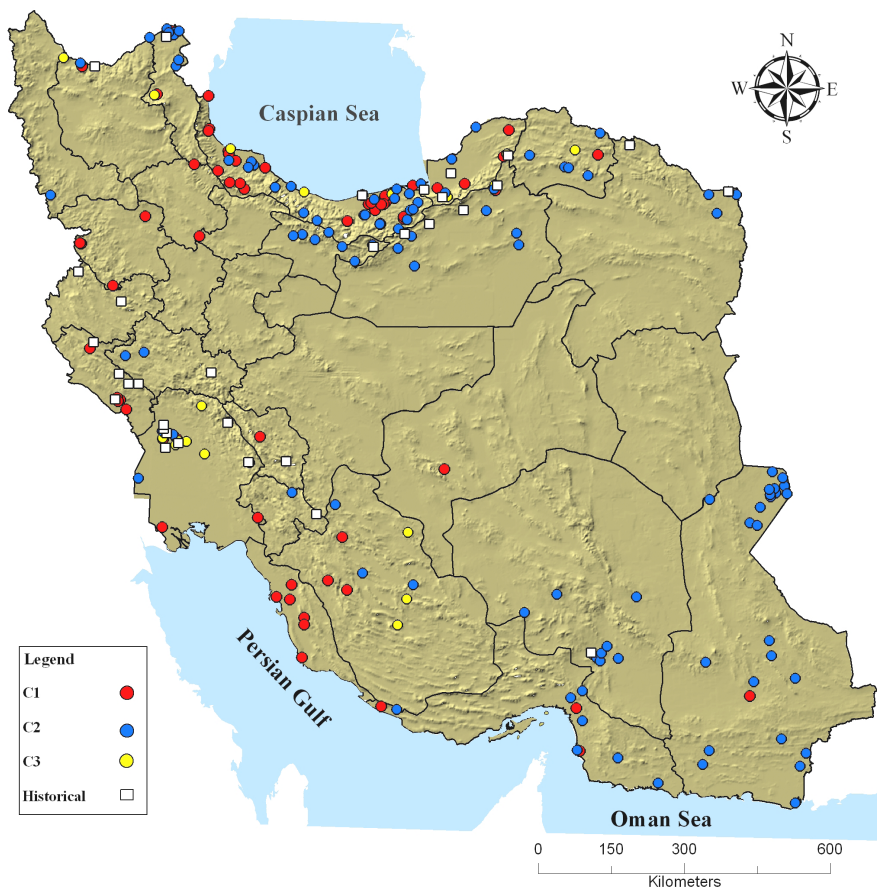
Fig. 2 Distribution of the presence locations of the jungle cat in Iran. C1 refers to the confirmed jungle cat records such as presence of carcasses, road kills and injured individuals, photos and videos (red dots); C2: Observations made by research team members and DoE staff and rangers (blue dots); C3: reports made by untrained people (yellow dots); Reference for historical records (white squares): Etemad (1985), Darvish (2001) and Sanei (2007). Presence records in the map are based on data compiled until March 2012. Repeated records in the same location are represented by one symbol. Division of provinces refers to early 2010.
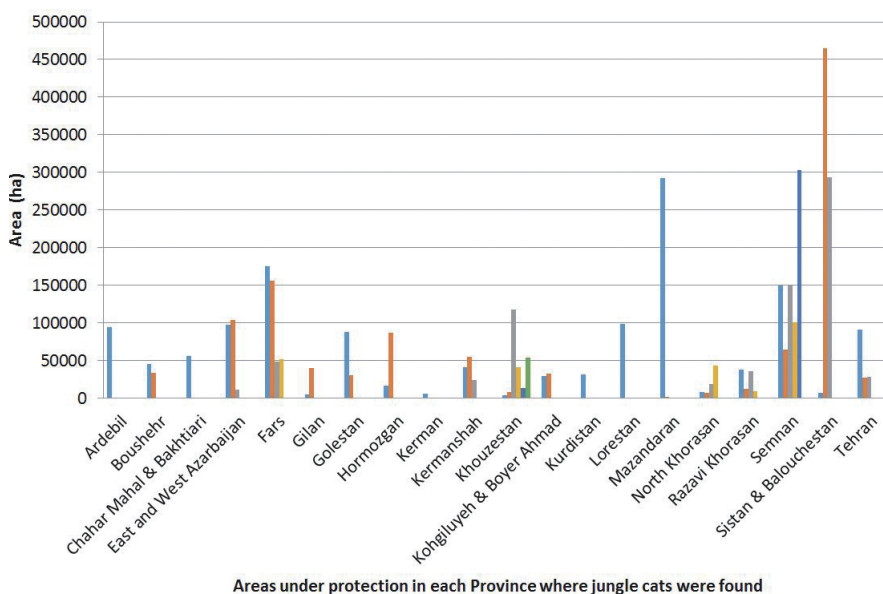

Fig. 3 Extent and number of the PAs, WRs and NPs with jungle cat detection in each province. Each bar illustrates size (ha) of one area under the auspices of DoE where jungle cat was detected. Dasht-e-Naz PA (59 ha) with jungle cat detections in Mazandaran Province is not visible on the graph due to its small size. Various colours of the bars are only to facilitate the differentiation of the bars.

species in the country. Mapping was done using Arc GIS 9.3. Biometric measurements were taken from road kills and post-mortem autopsy was carried out whenever possible.

Results

Morphological description

A study conducted by Mukherjee & Groves (2007) has revealed that jungle cats in western parts (≤ 50.0°E longitude) are obviously larger and heavier than those in the eastern parts (> 60.0°E longitude). In Turkey, a jungle cat specimen was reported to be yellowish-brown with a white neck and black-tipped reddish-brown ears (Ogurlu et al. 2010). Individuals of this species are known to have a relatively short body with long legs. They have a plain and uniformly coloured coat, but their legs are marked by clear lines and the tail has rings (Jutzeler et al. 2010).

All trapped, hunted and road killed jungle cats that we recorded had plain greyish colouration and visible stripes on front and hind legs. The coat on the flanks and the belly has tints of yellow and the tail is greyish with black stripes. The throat is light cream and the bottom part of the paws is black (Fig. 1).

A young adult female from western Iran (Zarivar, Kordestan Province 2011) had a total body size of 87 cm, including a tail of 20 cm, and a body weight of 4.89 kg. The height of the shoulder was 39.5 cm, the girth of the head 25.5 cm, the girth of the chest 31 cm and the girth of the belly 30 cm. The canine length measured by callipers (accuracy 0.02 mm) was as follows: 12.24 mm upper right, 12.36 upper left, 10.66 mm lower right and 10.24 mm lower left. The adult male found in western Iran close to Khaeez Protected Area (Kohgiluyeh and Boyer Ahmad Province, 2009) was slightly bigger: total body length 90 cm including tail length 27 cm and shoulder height 44 cm (Supporting Online Material SOM Table T1).

Distribution and habitat

The jungle cat is known to be widely distributed in Iran (Firuz 2000, Ziaie 2008). Darvish (2001) identified the species ranging from the northern parts of the country, from the Provinces of Golestan and Mazandaran westwards along the Caspian Sea coastline and Hyrcanian forests to the West Azarbaijan Province. Sanei (2007) indicated 13 protected areas in the Provinces of Razavi Khorasan, Golestan, Semnan, Chahar-Mahal and Bakhtiari, Kerman, Kermanshah and Khuzestan in northern, central, western and

southern parts of Iran where this species was previously reported.

We have collected a total of 280 single and repeated (i.e. two or more records from the same locality) jungle cat records, of which 74 records were confirmed through road kills, injured individuals and photos captured by DoE staff, rangers, wildlife experts and hunters (C1); 179 observation records were made by experienced rangers and staff of DoE (C2) and 27 records were reported by local communities (e.g. local shepherds and farmers) and inexperienced persons (C3).

Since in most of the cases we do not know whether detected jungle cats in each series of repeated records in the same area are the same or different individuals, all records in this manuscript are counted individually. However, in the distribution range provided in Fig. 2, repeated records fall within the same presence point on the map.

We recorded the species presence in 23 out of 31 provinces of Iran (Fig. 2). A total of 73 records originated from the Provinces of Mazandaran, Gilan and Golestan with Hyrcanian forests in the north (altogether 26.07% of all records). Surprisingly, many records were from Sistan and Balouchestan Province located in the south-east of Iran (53 out of 280, 18.92%). Fewer records were from Tehran and Semnan Provinces located in central Iran (38, 13.57%). Jungle cats killed on roads were found in Sistan and Baluchestan, Semnan, Kordestan, Ilam, Kohgiluyeh and Boyer Ahmad, and Golestan Provinces. All these records are classified as C1 (Fig. 2). A list of the areas where jungle cats were detected in this study is available from the first author upon request.

Out of 280 jungle cat records available at the time of writing this paper, only 69 records were from protected areas (i.e. PAs, NPs and WRs) which altogether cover 38,343 km² out of 163,215 km² (23.5%) of all protected areas in Iran (Fig. 3). No Hunting Areas are excluded as their protection status is changing over time. Based on this finding, we suppose that in Iran jungle cats are found largely outside protected areas. They can also live close to humans (e.g. fish farms or irrigation canals) or agricultural landscapes. We have recorded specimens frequently close to fish pools, poultry farms and agricultural lands.

Habitat identification checklists were completed by DoE rangers who conducted annual wildlife counts in 12 provinces (Table 1). Incomplete reports and checklists are excluded from the results. Jungle cats were found in

Felis chaus

Names:
گربه جنگلی Gorbeh Jangali
Jungle cat

Head and body length:
65 cm (mean: 1 female and 1 male)

Tail length:
23 cm (mean: 1 female and 1 male)

Weight:
4.89 kg (1 female)

Global Population:
Unknown

Iranian Population:
Unknown

Distribution in Iran:
Northern, western, southern, eastern and central Iran

IUCN Red List:
Least Concern (2016)

CITES:
Appendix II

Iran environmental conservation laws & regulations:
Protected species

Photo B. Farahanchi

diverse habitat types from plains and agriculture lands to the mountains, however, most of them were detected in shrub lands and woodlands (n = 6, 31.5%). Furthermore, jungle cats were found at different altitudes ranging from 45 m to 4,178 m with an average of 494 m, with 67.0% of detections at altitudes less than 160 m (Fig. 4).

Prey and their extension
Food habits of the jungle cat were studied by Mukherjee et al. (2004). This study has revealed that in a semi-arid environment of western India jungle cats feed largely on rodents and less frequently on birds and invertebrates. However, they are also capable of hunting on larger prey such as young swine, sub-adult gazelles and chital fawns (Sunquist & Sunquist 2002). Ogurlu et al. (2010) reported that in the vicinity of the Lake Egirdir in Turkey jungle cats feed mainly on fish and also on restaurant leftovers and dead waterfowl.

The post-mortem autopsy of a jungle cat killed on a road (Zarivar, Kordestan; by Marashi, Sanei, Mousavi in Tehran DoE, June. 2011) showed that its stomach mostly contained fish and plant material. Since we have recorded jungle cats frequently on the shorelines, close to poultry farms and in pheasant habitats, we suppose that the diet of jungle cats in these habitats mainly consists of birds (waterfowl, poultry and galliform

birds), fish and rodents, well in agreement with Lay (1967).

In general, jungle cats are reported to consume a great variety of prey including rodents, reptiles, amphibians, fish, eggs and fruits (Heptner & Sludskii 1972, Sunquist & Sunquist 2002, Mukherjee et al. 2004). Rodents are very diverse in Iran (e.g. rats and mice Murinae, voles Arvicolinae, squirrels Sciuridae, jerboas Dipodidae, hamsters Cricetinae, jirds and gerbils Gerbillinae, and dormice Myoxidae), just like the lagomorphs (hares Leporidae and pikas Ochotonidae), all of which can provide meals to jungle cats (Firuz 2000, Ziaie 2008).

Threats and conservation implications
The jungle cat is listed as Least Concern on the IUCN Red List of Threatened Species (Gray et al. 2016), but in Iran it is protected under the national Wildlife Conservation Law enacted in 1999.

Unlike most felids, the jungle cat is known to be resistant to some forms of human-driven landscape alteration and is often recorded on cultivated lands (Tikader 1983, Khan & Beg 1986, Rais et al. 2010). These habitats are effortlessly accessible for people and specimens could be easily trapped and hunted. Furthermore, as mentioned above, only a small portion of jungle cat records in Iran come from protected areas where they

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Table 1. Jungle cat habitat identification in 12 provinces of Iran based on regional assessments.

Province		Habitat Type							
		Shrub land/woodland	Forest[1]	Mountain[2]	Hill[3]	Reed beds	Agriculture land	Plain[4]	Pasture
West Azarbaijan		X							
East Azarbaijan		X							
Ardebil		X						X	X
Semnan									X
Mazandaran			X	X	X				X
Golestan			X						
Fars		X							
Kerman				X	X				
Kordestan						X			
Kohgiluyeh & Boyer Ahmad			X						
Khuzestan		X					X		
Sistan & Balouchestan		X							
Total	%	31.5	15.7	10.5	10.5	5.2	5.2	5.2	15.7

[1]Refers to the forests in the plains, on the hills or the mountains. [2]We considered mountains as natural elevated land forms rising abruptly to a peak while [3]hill was defined as a landform extends to some extent higher than the surrounding areas and less craggy than a mountain.

[4]Plain was defined as the flat and not elevated topography (i.e. mountainous forests or forests on the hills or plains were still classified as forest).

could be efficiently protected from poaching and trapping.

As a species associated with riparian habitats the jungle cat can be significantly affected by extensive droughts (Abu-Baker et al. 2003). As regularly monitored by Iran Meteorological Organization (http://www.irimo.ir/english/), dry conditions have recently seriously hit the western and southern parts of Iran. Furthermore, according to provincial DoE offices, several springs, some rivers and lakes have dried out because of false agricultural activities, overuse of groundwater resources and establishment of dams. Even though prey is not considered generally as a limiting factor for jungle cats with their catholic diet (Rathore & Thapar 1984, Nowell & Jackson 1996, Mukherjee et al. 2004, Ogurlu et al. 2010), a population reduction in prey species like rodents and birds by either drought or land use changes could be considered as a potential threat to this felid.

As mentioned earlier, in combination with other threat factors, road crashes could also pose a risk to jungle cats in Iran. The development of road networks has been a serious conservation issue for many wildlife species in various regions of the country. In our sample, jungle cats killed on roads were found in the Provinces of Kohgiluyeh and Boyer Ahmad, Ilam, Kordestan, Ghazvin, Golestan, and Sistan and Baluchestan. Some other larger mammals, like leopard (*Panthera pardus*), red deer (*Cervis elaphus*) and others also fall victim to collisions on roads crossing the Golestan National Park (Kiabi et al. 2002, Sanei 2007, our data, unpubl.).

Golestan National Park and several other forests in Iran have been struck by fires which urged jungle cats to leave these areas. They then came close to human settlements and were killed by villagers. Also, as jungle cats often live near poultry farms and crop fields, some of them would undoubtedly be eliminated as pest animals. Even though DoE provides compensation for the loss caused by jungle cats (and other predators) to domestic animals, in some cases local people prefer killing the cat to prevent further attacks rather than to apply to the authorities for refunding as payment procedures are usually very slow. Additionally, in the spots where migratory birds seasonally visit the area (e.g. Fereydoun Kenar wetland), local illegal hunters believe that the presence of jungle cats is disturbing the hunting of birds. Therefore, they live trap and/or execute the jungle cats in the area.

Taking into account Iran's law on wildlife protection and the enforcements of existing regulations, people generally do not respond to claims about hunted animals. Thus, the level of poaching remains unknown, but stuffed jungle cats can still be found in some local tourist shops, particularly in the Provinces of Gilan and Mazandaran (northern Iran).

Since the jungle cat in Iran has received little attention of researchers so far, we suggest a number of conservation measures based on our current knowledge about the species in the country. We also recommend several research topics to improve the understanding about this species in Iran:

Research priorities and conservation measures:

- Local status assessment, especially in areas affected by severe droughts and other threats (conflicts with humans, fires, roads);
- Impact of natural and human disasters (droughts, fires, floods, land use changes) on population viability and resistance;
- Research of human-cat conflicts and ways of conflict resolution such as antipoaching practices using long term awareness raising programs in the areas where trapping and hunting of the jungle cats are affecting the species;
- Estimation of population size, structure, distribution and trend with scientific robust methods;
- Evaluate whether construction and maintenance of underpasses and road fencing, in the hot spots with numerous jungle cat and other wildlife road crashes could be considered as an appropriate conservation measure for the species (e.g. in Golestan National Park);
- Genetic and cranial analysis for taxonomic review and test for the existence of previously morphologically categorized subspecies of the jungle cats.
- Studies on species ecology and biology in the areas of confirmed presence that are reported in this study;

- Establishment and maintenance of waterholes in protected areas of confirmed presence and affected by droughts;
- Acceleration of payment processing in compensation programs to reduce revenge killings and executing the cats by local shepherds and communities because of preventing further attacks on their poultries
- To establish more strict regulations for hunting and killing of jungle cats (e.g. updating amount of financial penalties for each hunted or killed individual regularly).

Fig. 4 A jungle cat in its natural habitat on the coastline of the Zarivar Lake, Kordestan Province (Photo A. Imani, Kordestan DoE Provincial Office).

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Supporting Online Material SOM Table T1 is available at www.catsg.org

[1] Asian Leopard Specialist Society, Tehran, Iran
[2] Department of the Environment, Tehran, Iran
[3] DoE Provincial Office, Mazandaran, Iran
[4] DoE Provincial Office, Qazvin, Iran
[5] DoE Provincial Office, Fars, Iran
[6] DoE Provincial Office, Hormozgan, Iran
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