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Investigating abundance, density and potential threats of Sand cat in the South-Eastern parts of Iran

Samira Ghafaripour[1], Morteza Naderi[2*], Hamid R. Rezaei[3]

[1]Department of Environmental sciences, Faculty of Natural Resources, University of Zabol, Zabol, Iran

[*2]Department of Environmental Sciences, Faculty of Agriculture and Natural Sciences, Arak University, Arak, 38156-8- 8349, Iran
e-mail: ghnadery@yahoo.com

Departmen Enviromental Science, Gorgan University of Agricultural Science and Natural Resources, Gorgan, Iran

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Abstract

Sand cat is known as a rare species mainly due to the destruction of its habitat. Because of its nocturnal and secretive behavior, dense hair in the soles, and the overall characteristics of its habitat, there is little data about this species, especially in Iran. In this study, like the general method for nocturnal mammalian species, spotlight surveying was used to estimate density and abundance of this species. During the study, 660 km strip transects in Samsoor and 615 km in the habitats located in Chahe-Hashem were traversed randomly. Data analysis was performed using Distance 6.2 which resulted that the density and abundance of sand cat in Samsoor area is 0.163 and 45 (CI: 29-72) respectively. Considering the recorded number of individuals and the length of the traversed transects, it can be inferred that the encounter rate with the species is equal with 0.04 individuals per km. To investigate the effect of the moon status, we planned study design and covered all lunar nights. The results revealed that the highest rate of encounter rate with the species occurred at the initial and final phases of the lunar nights while encounter rate with the species was at the lowest level in two middle weeks of the lunar months (0.052 and 0.02 individuals per km respectively). The increased agricultural activities, grazing livestock including camels and goats, and accompanying dogs are some of the main threatening factors. As a solution, we suggest establishing environmental force guard stations in the region and also employing some local peaoples as wildlife protection guards.

Keywords: Abundance, Density, Distance methods, Morphology, Sand cat.

Introduction

As one of the little-known cats with discrete distribution through the deserts of northern Africa, the Arabian Peninsula, and southwest and central Asia (Nowell and Jackson 1996, Sunquist and Sunquist 2002, Wozencraft 2005, Wilson and Mittermeier 2009, Mallon *et al.* 2011), sand cat is a least concern species based on recent data downloaded from IUCN Red List (Sliwa *et al.* 2016).

This species prefers areas of sparse vegetation mixed with sandy and rocky areas, which supports rodent and small prey bird (Sliwa 2013) and with its thickly furred feet, it is well adapted to the extremes of a desert environment, living in areas far from water, and tolerant of extremes of hot and cold temperatures (Nowell and Jackson 1996, Sunquist and Sunquist 2002, Sliwa 2013). Daytime surface temperatures may

approach even near to 124°C and the air temperature can range up to 58°C in the shade, but night air temperatures are much lower, ranging 30 to −0.5°C (Yunker and Guirgis 1969, Goodman and Helmy 1986, Cunningham 2002). In many areas where sand cat occurs, the best vegetation growth is in March and April, and many rodents breed during this time providing an abundant food resource (Roberts 1997). Differences in climate or resource availability influence breeding season length (Cole and Wilson 2015). This species is known as a rare species (Nowell and Jackson 1996, Sunquist and Sunquist 2002, Sliwa 2013) with low density in the desert habitats (Nowell and Jackson 1996). The species low density can be related to the habitat quality (Sliwa 2013) and its severe destruction especially in dune areas (Abahussain *et al.* 2002, Al-Sharhan *et al*. 2003, Mallon and Budd 2011). Ecological and biological status of the species has not been well studied (Cole and Wilson 2015) and there are not sufficient data about the species especially in Iran.

As well as nocturnal and secretive behavior, the existence of long and relatively dense hair on the soles and also general habitat characteristics cause the studies face with some difficulties (Nowell and Jackson 1996). Documented distribution map for the species is not also reliable because of many unknown habitats where host sand cats all over the world (Nowell and Jackson 1996) and certainly Iran. In general, the total population of the sand cat in the world is estimated more than 10000 individuals (IUCN 2015).

Density and abundance of the carnivores depend on several factors such as prey availability (Carbone and Gittleman 2002), competition between species (Creel and Creel 1996), potential anthropogenic threats (Inskip and Zimmermann 2009) and habitat destruction (Cole and Wilson 2015). Species density and abundance estimation is important for management of the species and its habitats. Different direct and indirect methods are employed to estimate the abundance and density of the mammalian species in the desert areas. In this regard, selecting an appropriate method suitable to the species of the interest, locality, and resources also play key roles (Wilson and Delahay, 2001). Although no method is foolproof, the most accurate estimate of population density is whole count (McNeilage *et al.* 2001) or focus group studies on the home range (Fashing and Cords 2000) that require a huge effort, especially in large areas. The spotlight is a technique that is widely used to determine the presence of nocturnal species as well as their density and frequency with a fairly accurate estimate in some desert species (Scott *et al.* 2005). This technique is widely used to check large number of nocturnal mammals, including dingo (*Canis dingo*), foxes (*Vulpes vulpes*), rabbit (*Lepus europaeus*) (Barnes and Tapper 1985, Mahon *et al.* 1998, Edwards *et al.* 2000, Heydon *et al.* 2000), rodents (Ralls and Eberhardt 1997), and communities of African mammals (Duckworth 1992, Monadjem *et al.* 1998).

The strip transects (Short *et al.* 1997) or linear transect (Buckland *et al.* 1993, Heydon *et al.* 2000) are mostly used methods among the appropriate methods introduced in this regard. Several mammalian species are currently of conservation concern due to dramatic population declines and local extinctions as a result of habitat modification and over-grazing (Abu-Zinada *et al.* 1987, Hatough-Bouran and Disi 1991, Qumsiyeh *et al.* 1993). There is an urgent need to assess the presence and abundance of wildlife in these areas at present (Hatough-Bouran and Disi 1991) and develop effective techniques to monitor populations to aid future wildlife conservation. Probably due to the habitat destruction of desert sand cat population and a decrease in the number of the relevant prey items, there is no detailed information on this species (Sunquist and Sunquist 2002, Wilson and Mittermeier 2009, Mallon *et al.* 2011).

Thus, the present study was conducted to estimate sand cat population density in the Bazman region located in Iranshahr (Sistan and

Baluchistan, Iran) and investigating the potential threats of the species in the study area.

Material and methods

Study Area

Iranshahr city is located in the central region of Baluchistan with an area of over 30200 km^2 and has an average elevation of 591 meters above sea level at a distance of 345 km from the provincial capital of Sistan and Baluchistan. In this study, 15% of the province was accounted for the presence of the sand cat in Bazman and Dalgan. Average annual precipitation and mean temperature in Iranshahr is about 2.1 mm and 24.6℃ respectively (Sistan and Baluchistan Meteorological Organization, 2015).

The dominant vegetation consists mainly of *Zygophyllum eurypterum*, *Tamarix sp*, and Hammada salicornica. Based on observations made during the study period, the carnivores coexisting with sand cats are common fox (*Vulpes vulpes*), Sand fox (*Vulpes rueppellii*), Blanford's fox (Vulpes cana), Striped hyaena (*Hyaena hyaena*), Golden Jackal (*Canis aureus*), and Grey wolf (*Canis lupus*). Also, the presence of black bears (*Selenarctos thibetanus*) has been documented in the highlands region. Major rodents identified in this area are Baluchistan gerbil (*Gerbilus nanus*), Persian Jird (*Meriones persicus*), Indian gerbil (*Tatera indica*), Hotson's Jerboa (*Allactaga hotsoni*), and Blanford's Jerboa (*Jaculus blanfordi*).

Field studies were carried out to monitor the sand cat population in the region from the early fall 2012 until late fall 2015. To provide repeatable accuracy and reducing disruption and destruction of habitat, rarely track, was re-surveyed (Scott *et al*., 2004). Field sampling in the area started one hour after sunset and continued to one hour before sunrise. Car cruising was done at a constant speed of 10 km/h (scott *et al.* 2004) by an observer, while a 300-meter strip with a 100w handheld spotlight was scanned and monitored. Once its eye shine was diagnosed, the car was stopped and the species was identified using the binoculars. The distance between the observer and sand cat, sand cat angle relative to the transect line, and weather conditions during the observation time were recorded. In order to determine the density of species by distance methods, functions including half-normal, uniform, and hazard rate simple polynomial and Uniform Hermite polynomial with the lowest Delta Akaike's value was selected.

Estimates were periodically supervised using the reflective objects (Heydon *et al.* 2000). A protractor was used to measure angles between detected points with transect line. Since the cats stayed motionless when exposed to spot light, it was possible to capture and mark them alive (Fig. 1). The identified individuals were marked by coloring the inner part of their ear to prevent the observeration error and double recording (Kei and Baroski 1995).

In line with the estimation of the population abundance and density, we studied activity pattern of the species during the study period. We tried to investigate on the relationship of the species nocturnal activity with the moon brightness in different lunar nights. Encounter rate was calculated given the length of the path traversed and the number of individuals observed. To estimate population size and density, software packages including Distance ver. 6.2 and SPSS ver. 22 were used.

Figure 1. *F. margarita* in the study area (photo by Ghafaripour 2016)

Results

The light reflecting from sand cat's eye shine is yellowish green. This feature can be used to identify this species during the night. Due to the extremely low density of vegetation community in the study area, vegetation cannot be considered as a major factor for the lack of species observed. The density and frequency of two models are shown in Table 1.

Generally, 1275 km transects were traversed randomly (660 km in Samsoor area and 615 km in the Chah-Hashem area) and totally 33 different individuals were recorded and marked (29 individuals in Samsoor and 4 individuals in Chah-Hashem). The morphological parameters measured from male sand cats are: Total Body Length (48-53 cm), Tail Length (23-26 cm), Pes Length (11-12.5 cm), Ear Length (6.5-7.5 cm), and the Weight (2 -2.7 kg). Morphological parameters of the female sand cat ranged: Total Body Length (43-51 cm), Tail Length (22-28 cm), Pes Length (10-12 cm), Ear Length (6.1-7.5cm), and Weight (1.4-2.1 kg).

Table 1. Sand cat's density estimates (N/sq. km), ER is encounter rate (n/transect lenght)

Model fitted	No. observed	Density (95% CI)	SE of estimated density	N (95% CI)	SE of N	ESW (m)	P	ER (95% CI)
Hazard rate Simple polynomial	29	0.165(0.872×10^{-1}-1.385)	0.524×10^{-1}	44.00(24.00-83.00)	14.33	135.50	0.781	0.439×10^{-1} (0.296×10^{-1}-0.651×10^{-1})

The highest encounter rate (0.052 per km) was recorded in the initial and final phases of the lunar months (when the moon completely set up) and the lowest rate impact (0.02 per km) was recorded in the middle of the lunar months. Encounter rate with the species in the Haloxylon habitat type (*Haloxylon ammodendron*) were significantly higher than other habitat-recorded types, such as *Artemisia siberi*, *Zygophyllum eurypterum*, *Hmada salicornica* and *Tamarix sp*. and soft soil (ANOVA: $F_{4,29}$=83.21, P<0.05). The maximum number of sand cats during the study was recorded in the elevation 1000-901 and 1100- 1001 m above sea level.

Discussion

During our study, the number of sand cats observed in Samsoor habitat was more than those recorded in Chah-Hashem habitat. Probably samsoor habitat was safer than Chah-Hashem habitat for regeneration and survival. It looks like that sand cat is sensitive to human disturbance and habitat encroachment (Cole and Wilson 2015). Using traps by illegal poachers in Chah-Hashem habitat caused a disturbance and habitat encroachment, leading to the decreased safety of this species.

This species also is caught in live traps, which decrease the safety of this species and lead to the increased rate of mortality and miscarriage in the females. Illegal poachers of Houbara Bustard (*Undulata chlamydotis*) usually install live traps in the region, while removing souranding vegetation cover which cause the habitat destruction and expose the soft soil to the eroding forces.

Occupying the sand cat habitat, particularly by camels and goats, has caused a further reduction in upland vegetation. In addition, the sheepdogs could potentially threaten this species. Increasing the agricultural disruption typically leads to habitat fragmentation of this species that could threaten sand cats. Vehicle traffic and making new roads are among the other factors destroying the sand cats' habitat. Stress reduces sexual intercross and increases miscarriage. On the other hand, during the time, the traffic on secondary roads crushes soil and driving might be difficult within this kind of roads. To solve this problem, some driving to the margin sidetrack would be useful, which in turn makes further habitat destruction. Furthermore, the sand cat might be run over by vehicles, which leads to the increased mortality in this species. The widespread desert ecosystem degradation is known as a major problem for protection (Abahussain *et al.* 2002, Al-Sharhan *et al.*

2003). Loss of upland vegetation will reduce the hunting, which can reduce sand cat population around 30% (Mallon *et al.* 2011) or cause it leave the habitat completely (Edwards *et al.* 2001, Norbury *et al.* 1998). Such conditions increase the mortality and migration rates (Harper 2004, Poole 1994).

Another threat for the sand cat is that local people use poison for the control of rodent population. Because poisoned rodents are caught easier by the sand cat, they also will die by poisoning. The population of the sand cat was more in Samsoor area with altitudes 1000-901 m and 1100-1001 m, compared to other areas, which is dominated by Haloxylon plant (*Haloxylon ammodendron*). At this level, food is abundant compared to other altitudes. This species is dependent on Haloxylon plants at both altitudes of the study area due to the presence of rodents, especially Jerboas where the soil has a higher strength (Naderi *et al.* 2011) and nests of the rodents are higher, which enhances the effectiveness of rodents capture by predators (Adriana and Motta-Junior 2015). As a result, they receive more energy with less running costs and stay away from their enemies and their food rivals. The rates to deal with the sand cat in different habitat types showed that there are significant differences in the observation of individuals during different nights of the month, which is an evolutionary reason for choosing this behavior; i.e., increasing the activity of rodents (Blair 1943, Kavanau 1967, O'Farrell 1974, Owings and Lockard 1971) and rabbits (Lagomorpha) (Butynski 1984, Gilbert and Boutin 1991) during the dark months.

A larger number of female sand cats, compared to the male ones, were observed in Samsoor area (Fig. 2). The reason for this observation could be the fact that males distribute more than females and males sand cats have larger home ranges compared to females. Moreover, if resources and shelter are suitable, females remain in their home and have a more limited spread than males. It is likely that pups of female sand cat follow their mother home range when they grow up. As also reported by Sliwa (2013), another reason for the higher population of female sand cats compared to the male ones might be the normal pattern in the social structure of the individual cat.

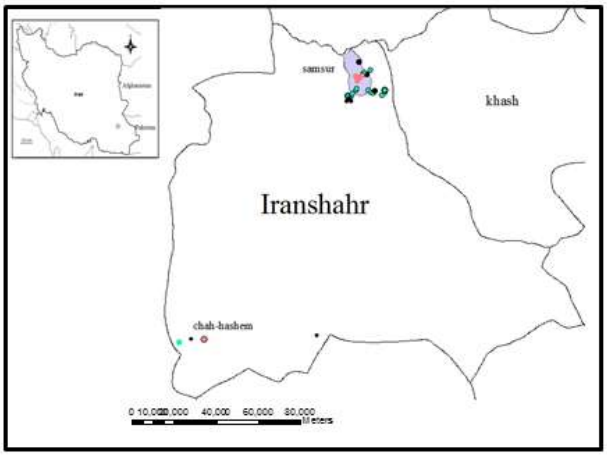

Figure 2. Sampling localities in the study area

Sliwa (2013) also reported that male sand cats are more discreet and when they encounter the vehicle, they stare less or they hide before observation compared to female sand cats, this could be a reason for observing females more than males. Searching and observing female cats by floodlights were also observed in the performance of the black leg cats (*F. nigripes*, Sliwa 2004). According to the studies on the ecology of small cats (feline), females tend to use the habitat-based availability of resources, while males are usually distributed based the territory of female sand cats (Stahl *et al.* 1988, Ferreras *et al.* 1997). Thus, the existence of female in the habitat of Samsoor probably indicates that the quality of habitat is appropriate and gives important information to assess and restore of habitat for sand cats protection. Knowledge of the potential distribution of animals plays an important role in wildlife management and habitat.

Our results emphasize the importance of protecting the sand cat habitat. Since the habitats of Samsoor is covered by a proper density of the sand cats we recommend performing appropriate efforts for its protection. Chahe Hashem habitat needs more protection and putting stringent legislation to prevent the illegal activities of the poachers. It is suggested the prioritized establishment of rangers in both regions for protecting areas under the protection of the environmental organizations.

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