

Prey composition in the Persian leopard distribution range in Iran

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A study was conducted in 67 protected areas throughout the Islamic Republic of Iran from 2002 to 2006 to investigate diversity and composition of the Persian leopard potential prey species over its distribution range in the country. The study was performed concurrently with leopard distribution studies using direct observations, rapid survey techniques and collection of secondary data. Nine species, namely: wild goat (*Capra aegagrus*), wild sheep (*Ovis orientalis*), Persian gazelle (*Gazella subgutturosa*), chinkara or jebeer gazelle (*Gazella bennettii*), wild pig (*Sus scrofa*), roe deer (*Capreolus capreolus*), red deer (*Cervus elaphus*), Indian crested porcupine (*Hystrix indica*) and Persian wild ass (*Equus onager*) were studied as the leopard potential prey species. Although attack of leopard on the Persian wild ass is recorded, we excluded the species from the results due to its limited distribution range. Results indicated that wild goat and wild sheep followed by wild pig and Indian crested porcupine are the most widely distributed potential prey species in the leopard distribution range in Iran. Moreover, leopard presence is highly correlated with presence of the wild goat and wild sheep. Nevertheless, opportunistic predation on smaller species such as hare and rodents is likely as leopard has a diverse diet. Eleven sites are proposed as the most considerable sites with regard to the diversity of prey communities. It is suggested that a leopard national conservation plan is essential to protect the leopard particularly as an umbrella species in its current proposed distribution range. However, the priorities in allocation of resources could be given to the sites have been identified through this study to have the most diverse prey communities (*i.e.* Golestan, Jahan Nama, Parvar, Touran, Khosh Yeilagh, Sorkheh Hesar, Kavir, Sarigol and Salook).

Key words: *Panthera pardus saxicolor*, Persian leopard, potential prey, prey composition, prey availability, distribution range, Iran

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INTRODUCTION

The Persian leopard (*Panthera pardus saxicolor* Pocock 1927) is listed as a protected species under the Iran's Wildlife Conservation Law enacted in 1999. Leopards have a wide distribution in the country (Sanei 2005, 2007 in Persian) and their presence has been verified in 74 out of 90 protected and non-protected sites (*i.e.* 82%) across the country (Sanei & Zakaria 2011). Kiabi *et al.* (2002) estimated that 550-850 individuals of leopards are present in Iran while 55% of them are found in protected areas. Prey availability in the leopard presence areas in Iran is a critical concern to sustain current leopard population in the country.

Leopards are well known to have a catholic diet as they have been reported to feed on a wide variety of species ranging from small invertebrates and rodents to large prey species the size of a giraffe calf (Ott 2004, Mills & Harvey 2001, Stevenson-Hamilton 1947). Various studies have examined the sizes of preys most preferred by the leopards. Hayward *et al.* (2006) studied 33 published and unpublished studies from 13 countries on leopard diet and suggested that leopards significantly prefer to feed on prey species with 25 kg of mean body mass. Owen-Smith and Mills (2008) revealed that even though leopard, cheetah and wild dog in the Kruger National Park, South Africa feed on prey species of about half to twice their weights, but dietary preferences are different.

Several studies have suggested that leopard is not a non-selective predator in terms of type and size of prey species (Hayward *et al.* 2006, Karanth & Sunquist 2000, Karanth & Sunquist 1995, Hart *et al.* 1996). Karanth and Sunquist (1995) suggested that selective predation by leopards in Nagarahole, southern India is a mechanism which helps them to coexist with other carnivores.

Principally, daily food consumption of an adult leopard is estimated as 2.8 kg/day for a female and 3.5 kg/day for a male which means 1,008 and 1,260 kg/year for one female and one male respectively (Baily 1993). However, this amount could differ as leopard's body weight is highly variable (Stuart & Stuart 2000).

Karanth and Sunquist (1995) reported that leopards in Nagarahole, southern India feed on chital (69%) supplemented by sambar (*Cervus unicolor*), gaur (*Bos gaurus*), muntjac (*Muntiacus muntjac*), langur (*Presbytis entellus*) and Indian crested porcupine (*Hystrix indica*). Grey duiker (*Sylvicapra grimmia*), steenbok (*Raphicerus campestris*), impala (*Aepyceros melampus*), bushbuck (*Tragelaphus scriptus*) and reedbuck (*Redunca fulvorufula*) were reported from leopard diet in Kruger National Park (Owen-Smith & Mills 2008). Feeding on wild boar was reported from the rainforests of Malaysia by Kawanishi (2002). Sanei and Zakaria (2011) found that wild boar is the main factor affecting leopard distribution pattern in a highly fragmented forest in Malaysia. In the Middle East, Khorozyan *et al.* (2005) and Khorozyan and Malkhasyan (2005) reported that in Armenia, leopard feeds upon bezoar goat (*Capra aegagrus*), wild boar (*Sus scrofa*), roe deer (*Capreolus capreolus*), Indian crested porcupine (*H. indica*) and European hare (*Lepus europaeus*). However, its principal prey there is the bezoar goat (*Capra aegagrus*).

Current study conducted in the sites has been reported by Sanei (2005, 2007; Table 1) as the leopard distribution range in protected areas in the country to

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investigate the composition of potential leopard prey species. Null hypothesis indicating non-significant correlation of presence/absence of each potential prey species and leopard presence/absence was tested.

MATERIALS AND METHODS

Study area. Iran has a total area of 1,623,779 km² and is located in the mid-southern portion of the Northern Hemisphere, bounded by the Caspian Sea in the north and the Persian Gulf and Gulf of Oman in the south. Hence, diverse ecological climatic zones are present in this country. Sanei and Zakaria (2008) found that leopards in Iran are mostly found in mountainous habitats with less than 20 days of ice-cover per year. They more often inhabit areas with mean annual temperature of 13 to 18 °C while majority of ecological zones they occupy receive a maximum of 200 mm rainfall per year. However, from 1999 to 2003, the minimum and maximum rainfall per year in the leopard distribution range were 24.00 and 1,364 mm, respectively. Sanei (2005 & 2007) reported that 43 out of 67 protected areas studied throughout the provinces of Iran have leopard detections. We conducted parallel studies to investigate presence of prey in these sites (*i.e.* all 67, Figure 1).

Data collection and analysis. The study was conducted from 2002 to 2006 in 67 protected areas throughout the country and concurrently with leopard distribution (presence/absence) studies. All prey species greater than 10 kg are accounted for in this study based on the lower limit reported by Hayward *et al.* (2006) to be the preferred weight range by leopards in 41 studied locations in 13 countries. To record the potential leopard prey species within the study sites, field surveys were conducted by either the first author or local experts participating in the project and skilled at recording direct sightings of prey species, leopard kills and indirect signs (*e.g.* tracks, scats, scrapes, *etc.*). Data on Persian wild ass (*Equus onager*) was excluded from the results as it had a very limited distribution range within the country.

Interviews with local communities, shepherds and guards of the Department of Environment (DoE) were conducted to assess their knowledge about the prey species present in the area. Questionnaires were filled up by guards working in the protected areas or staff of the Department of Environment, in each province to record new reports of kills, direct observations and indirect signs of preys. Reports of DoE regarding traditional annual counting of prey species in protected areas and daily reports of protected areas about new observations of wildlife species in each habitat, were collected.

Null hypothesis indicating non-significant correlation between leopard and recorded prey species across the identified leopard distribution range was tested for each potential prey species using Spearman's Correlation Coefficient and SPSS version 17.0. ArcGis version 9.3 was used for mapping the distribution of each prey species in leopard range within the protected areas.

RESULTS

Table 2 shows the frequency of eight prey species, namely: wild goat, wild sheep, Persian gazelle, chinkara, wild pig, roe deer, red deer and Indian crested

Table 1. Location of study sites in Iran and their protection category.

No.	Site Name	Protection status ¹	Province	Area (ha)
1	Kiamaki	WR	East Azarbaijan	95,742
2	Arasbaran	PA	East Azarbaijan	80,255
3	Marakan	PA	West Azarbaijan	102,966
4	Agh Dagh	PA	Ardebil	4,767
5	Kolah Qazi	NP/WR	Isfahan	50,957
6	Muteh	WR	Isfahan	200,879
7	Qamishlou	WR	Isfahan	90,207
8	Manesht & Ghalarang	PA	Ilam	29,146
9	Khojir	NP	Tehran	10,013
10	Sorkkeh Hesar	NP	Tehran	9,168
11	Lar	NP	Tehran	29,778
12	Jajrood	PA	Tehran	55,077
13	Varjin	PA	Tehran	26,861
14	Kavir	NP/PA	Semnan	693,908
15	Central Alborz	PA	Tehran & Mazandaran	410,790
16	Tang-e-Sayyad	NP/PA	Chahar Mahal & Bakhtiari	50,096
17	Sabz Kouh	PA	Chahar Mahal & Bakhtiari	54,291
18	Tandooreh	NP/PA	North Khorasan & Razavi Khorasan	37,948
19	Ghorkhod	PA	North Khorasan & Razavi Khorasan	43,778
20	Sarani	PA	North, Razavi & South Khorasan	15,895
21	Sarigol	NP/PA	North, Razavi & South Khorasan	28,288
22	Salook	NP/PA	North, Razavi & South Khorasan	19,802
23	Sorkhabad	PA	Zanjan	120,010
24	Parvar	PA	Semnan	66,626
25	Turan	NP/WR	Semnan	362,912
26	Khosh Yeilagh	WR	Semnan	138,118
27	Hormod	PA	Fars	207,961
28	Bamoo	NP	Fars	48,678
29	Mian Jangal	PA	Fars	56,528
30	Rochun	WR	Kerman	28,171
31	Khabr	NP	Kerman	149,934
32	Bisotoon	PA/WR	Kermanshah	95,601
33	Boozin & Markhil	PA	Kermanshah	23,554
34	Varmanjeh*	WR	Kermanshah	28,720
35	Dena	PA	Kohgiluyeh & Boyer Ahmad	92,966
36	Eastern Dena	PA	Kohgiluyeh & Boyer Ahmad	28,202
37	Mount Khiz-o-Sorkh	PA	Kohgiluyeh & Boyer Ahmad	36,234
38	Golestan	NP	Golestan	87,242
39	Jahan Nama	PA	Golestan	38,403
40	Oshtorankouh	PA	Lorestan	98,250
41	Sefidkouh	PA	Lorestan	71,477
42	Haftad Gholeh	PA	Markazi	97,407
43	Naiybandan	WR	Yazd	1,516,994

¹NP = National Park; PA = Protected Area; WR = Wildlife Refuge.

*Protection status during the conduct of research study; status was changed thereafter.

[Source: The study sites were identified by Sanei (2005, 2007) as the leopard distribution range in protected areas in Iran.]

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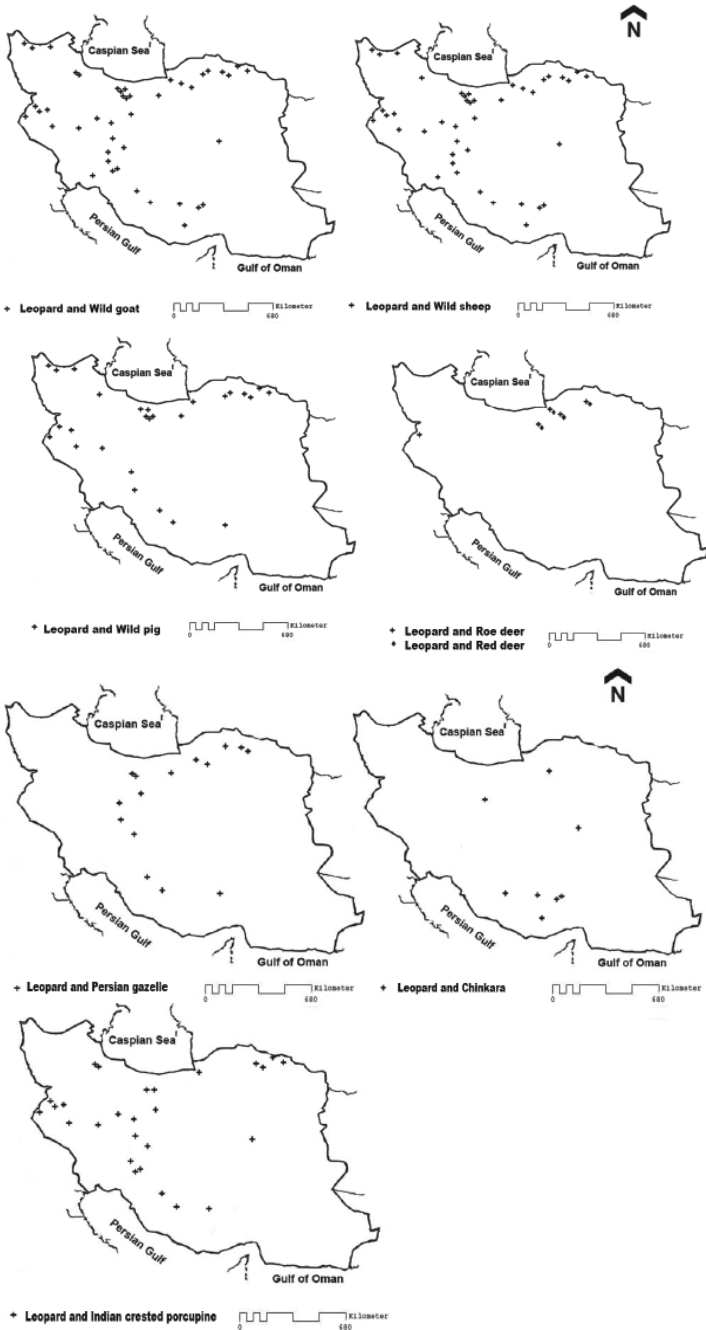


Figure 1. Distribution of prey species within 43 leopard distribution protected sites in Iran.

Table 2. Presence of each prey species in total study sites (*i.e.* 67 sites) and in the leopard distribution range (*i.e.* 43 sites) and their corresponding Spearman's Correlation Coefficient.

Prey Species ¹	WG		WS		PG		CH		WP		RO.D		RE.D		ICP	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Total study sites	55	82	53	79	23	34	14	21	39	58	5	7	4	6	39	58
Sites within leopard distribution	43	100	41	95	15	35	8	19	28	65	5	12	4	9	28	65
<i>p</i> value	0.000		0.001		0.806		0.369		0.341		0.104		0.149		0.341	
Spearman's Correlation Coefficient	0.456		0.300		0.238		0.157		0.086		0.562		0.307		0.112	

¹WG – wild goat (*Capra aegagrus*); WS – wild sheep (*Ovis orientalis*); PG – Persian gazelle (*Gazella subgutturosa*); CH – chinkara (*Gazella bennettii*); WP – wild pig (*Sus scrofa*); RO.D – roe deer (*Capreolus capreolus*); RE.D – red deer (*Cervus elaphus*); ICP – Indian crested porcupine (*Hystrix indica*); n = number of sites.

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porcupine in the total study sites and those of leopard distribution range. Wild goat and wild sheep were the most common prey species in all sites and in the sites with leopard distribution. The wild pig and Indian crested porcupine were the next most widely distributed species within the leopard distribution sites. Distribution of Persian gazelle and chinkara was limited to 15 and 8 sites, respectively while roe deer and red deer were only available in 5 and 4 sites with leopard presence. Consequently, Spearman's Correlation Coefficient showed a highly significant correlation between leopard presence and presence of wild goat and wild sheep (wild goat: $p = 0.000$, $r = 0.456$; wild sheep: $p=0.001$, $r = 0.300$) while this correlation for the rest of the species was not significant (Table 2). Figure 1 shows the distribution of each species within leopard distribution range in the protected areas. Therefore, null hypothesis indicating non-significant correlation of leopard presence with presence of wild goat and wild sheep was rejected while this hypothesis for other species was accepted. Eleven sites, namely: Golestan, Jahan Nama, Parvar, Touran, Khosh Yeilagh, Sorkheh Hesar, Kavir, Sarigol, Salook, Mianjangal and Khabr were found to have the most diverse potential leopard prey communities (Figure 2). Five or more potential leopard prey species were found to exist in these habitats. This selection was based

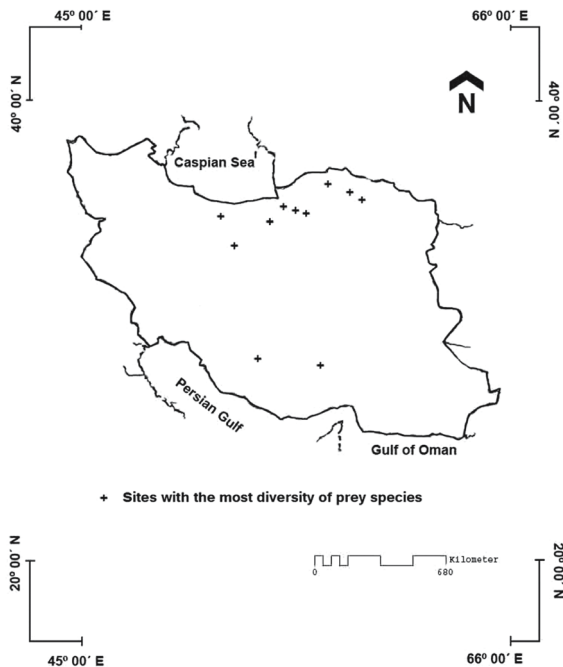


Figure 2. The most valuable sites within the leopard distribution range as far as prey diversity in each area is concerned.

on the idea that four species of wild goat, wild sheep, wild pig and Indian crested porcupine have a wide distribution in the country (Table 1), while the rest of the selected potential prey species have been restricted to some habitats.

Attack on an Indian crested porcupine was reported from Touran in Semnan Province in 2002. In addition, a dead leopard was found in Khuzestan Province in 2002 while it had a porcupine thorn on the front leg. Kills of wild sheep, wild goat, Persian wild ass and Persian gazelle were found while (1) leopard indirect signs were available near the kills; (2) leopard was found when it was feeding on its prey (e.g. Touranl, Semnan Province in 2002) or (3) it was observed while it was on the stalk (e.g. Bamoo, Fars Province in 2004). Attack on domestic horses was reported from Razavi Khorasan where subsequently, the responsible leopard was removed from the habitat by DoE staff. Attacks on dog (Mazandaran Province in 2003; Touran in 2002), jackal (Tange Sayad, Chahar Mahal and Bakhtiari Province), livestock (e.g. Mianjangal, Fars Province in 2005; Khaeez, Kohgiluyeh & Boyer Ahmad; Tarome-sofla, Zanjan Province in 2003), cow (Gilan Province in 2003 & 2004) and camel (Ariz, Yazd Province in 2002 and 2003) were recorded.

DISCUSSION

The most diverse potential leopard prey communities were found in the northern parts of the country (Figure 2). Previous studies indicated that compared to the southern area, this region supports a considerable leopard population (Kiabi *et al.* 2002) and leopard presence sites (Sanei & Zakaria 2011). Among the eleven selected sites with the most diverse prey communities, Golestan National Park and Jahan Nama Protected Area with a total area of more than 126,000 ha are partially covered with Hyrcanian forests. All the leopard presence sites were found in the mountainous areas (Sanei & Zakaria 2008) and wild goat has been recorded across the entire leopard distribution range in the country. It is suggested that these two factors (*i.e.* mountainous feature and presence of wild goat) could be considered as the main requirements for a potential leopard habitat in Iran. The importance of wild goat in the leopard diet in Iran is supported by previous studies (Chalani, unpublished data) concerning leopard diet in Tandoureh National Park located in the northeast of Iran. However, the species is known as a flexible species in terms of habitat and prey (Hayward *et al.* 2006, Mills & Harvey 2001, Grassman 1997, Lekagul & McNeely 1977). Therefore, its survival may not be restricted to the presence of these factors only.

After the wild goat and wild sheep, wild pig and Indian crested porcupine were found to be the most available prey species in the leopard distribution sites. However, distribution of roe deer, red deer and chinkara is restricted to a few sites (Table 1).

Although, it was reported by Hayward *et al.* (2006) that leopards mostly prefer preys within 10-40 kg weight range, the possibility that leopards in Iran mostly rely on preys much heavier than this range was suggested. There was a highly significant correlation between presence of leopards with availability of wild goat (up to 120 kg; Ziaie 2008) and wild sheep (up to 85 kg; Ziaie 2008). Even though feedings upon

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kids and lambs were also found, attack on adult wild goat and wild sheep was frequently observed and documented in various habitats. In addition, attack of a leopard on an adult Persian wild ass (normally more than 150 kg; Ziaie 2008) was recorded near Shourab spring in Touran (Semnan Province in 2002) while leopard had moved to the flat area which is a long distance from neighbouring mountains. Feeding on wild pigs (up to 300 kg; Ziaie 2008) is also common in the several places where the prey species is available as wild pig fur was found in more than 70% of collected leopard feces in Golestan National Park, north of Iran in 2006 (Sanei & Zakaria, unpublished data). Average of leopard total body size in 25 individuals (including both male and female) of leopards reported by Sanei (2007) and Etemad (1985) from various parts of the country was calculated as 259 cm. In addition, body mass of a young male individual of leopard from the northern part of the country was obtained as 64 kg. Therefore, it was suggested that the ability to attack on larger preys is possible due to the bigger body size of Persian leopards particularly in the northern parts of the country compared to some other leopard subspecies (*e.g.* total body size of an adult Indochinese male leopard = 211 cm, weight = 40 kg, Grassman 1999; an adult male Indian leopard body size = 223 cm, body weight = 58 kg, Odden & Wegge 2005; an adult male African leopard total body size = 216 cm, Sanei 2007; an adult Malaysian male leopard body size = 202 cm, weight = 52 kg, unpublished data).

Feeding upon larger preys is supported by Karanth and Sunquist (1995) as they found that leopards in Nagarhole National Park, India feed on preys within 30-175 kg. They also suggested that leopard selective predation is a mechanism which helps it to coexist with other carnivores in the area. However, leopards in Iran are considered as the largest carnivore in their distribution range in the country while they coexist with wolves in some habitats. Studies are required to investigate overlapping feeding range of these two carnivores in the habitats which they coexist.

Wild goat inhabits the mountains particularly where there is a mixture of rocky outcrops and vegetation (Genov *et al.* 2009). In addition, it is widely found in the leopard distribution range (*i.e.* 100% of the leopard distribution sites, Figure 1). On the other hand, wild sheep mostly inhabit less slopy mountains and hills (Firuz 2000) and they were found in 95% of leopard distribution range in the protected areas. These habitat types are reported to be the main habitats of the leopards in their distribution range in the country (Sanei & Zakaria 2008). Therefore, a highly significant correlation of leopard presence with presence of wild sheep and wild goat could be due to the wide distribution of these species in the country and the same habitat use. Persian gazelle and chinkara are mostly found in steppes and plains (Nowzari *et al.* 2007). These habitats provide less ambushes to stalk the preys (see also Jenny & Zuberbuhler 2005, Hart *et al.* 1996, Hes 1991) and therefore, possibly it can not be the preferred leopard prey. However, considering the leopard flexible diet (Mills & Harvey 2001) and our records of occasional hunting of gazelles in Bamoo National Park (2004), they still remain as a potential prey for the species, particularly when they move near hills and corridors for the water resources. Feeding upon smaller

species such as rodents and birds were found in the feces collected from Tandoureh National Park, Razavi Khorasan Province (Chalani, unpublished data).

There is no specific study on possible leopard seasonal migrations in the country following the movements of preys due to seasonal changes in vegetation sufficiency in each habitat. However, evidences of leopard seasonal migrations were found in Marakan in Western Azerbaijan Province and Mirza Arab Mountain in the boundary of Iran and Afghanistan. Further studies are required to investigate the movement behavior of leopards in these areas. We suggest that it is essential to design and conduct a national leopard conservation plan particularly as an umbrella species in its currently identified distribution range as reported by Sanei (2005, 2007). However, high priorities should be given to the sites that were identified in this study to have the most diverse prey communities, particularly those located in the northern part of the country (*i.e.* Golestan, Jahan Nama, Parvar, Touran, Khosh Yeilagh, Sorkheh Hesar, Kavir, Sarigol and Salook). It is worth mentioning that the non-detection of a species in a habitat does not mean that the species is certainly absent there (MacKenzie *et al.* 2002). In addition, presence of various prey species in the study sites does not imply that existing prey biomass is sufficient to supply a viable leopard population in each area. Consequently, further detailed studies are required to investigate the abundance of the prey species and the carrying capacity of each habitat in the leopard distribution range in the country.

CONCLUSION

Nine species, namely: wild goat, wild sheep, wild pig, Persian gazelle, chinkara, roe deer, red deer, Indian crested porcupine and Persian wild ass were selected as the potential leopard prey species in Iran. Wild goat and wild sheep were found to be the most available prey species in the leopard distribution range. Furthermore, there was a high correlation between the presence of the leopard and occurrence of these prey species. The most diverse community of potential leopard prey species was found in the northern part of the country. Eleven localities, namely: Golestan, Jahan Nama, Parvar, Touran, Khosh Yeilagh, Sorkheh Hesar, Kavir, Sarigol, Salook, Mianjangan and Khabr are considered as the most diverse sites in terms of prey species.

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LITERATURE CITED

Bailey, T.N. 1993. *The African Leopard: Ecology and Behavior of a Solitary Felid*. Columbia University Press, New York, USA, 429 p.

Persian leopard prey availability

- Etemad, I. 1985. *Mammals of Iran*. Volume 2, Department of Environment of Iran, Tehran.
- Firuz, E. 2000. *Wildlife of Iran (Vertebrates)*. University Publication Center, Tehran, Iran.
- Genov, P., G. Georgiev and V. Georgiev. 2009. Persian wild goat (*Capra aegagrus* Erxleben) – Biology, ecology and possibilities for its re-introduction in Bulgaria. *Biotechnology and Biotechnological Equipment Special Edition (on-line)*, pp. 341-342.
- Grassman, M.L.I. Jr. 1997. Ecology and behavior of four sympatric carnivores (Mammalia: Carnivora) in Kaeng Krachan National Park, Thailand. M.Sc. Thesis, Kasetsart University, Yanisa, Thailand. (unpublished)
- Hart, J.A., M. Katembo and K. Punga. 1996. Diet, prey selection and ecological relations of leopard and golden cat in the Ituri Forest, Zaire. *African Journal of Ecology* 34: 364-379.
- Hes, L. 1991. *The Leopards of Londolosi*. Struik Winchester, Cape Town, South Africa, 168 p.
- Hayward, M.W., P. Henschel, J. O'Brien, M. Hofmeyr, G. Balme and G.I.H. Kerley. 2006. Prey preferences of the leopard (*Panthera pardus*). *Journal of Zoology* 270: 298-313.
- Karanth, K.U. and M.E. Sunquist. 1995. Prey selection by tiger, leopard and dhole in tropical forests. *Journal of Animal Ecology* 64: 439-450.
- Karanth, K.U. and M.E. Sunquist. 2000. Behavioural correlates of predation by tiger (*Panthera tigris*), leopard (*Panthera pardus*) and dhole (*Cuon alpinus*) in Nagarahole, India. *Journal of Zoology* 250: 255-265.
- Kawanishi, K. 2002. Population status of tigers (*Panthera tigris*) in a primary rainforest of Peninsular Malaysia. Ph.D. Thesis, Department of Wildlife Ecology and Conservation, University of Florida, USA. (unpublished)
- Khorozyan, I. and A. Malkhasyan. 2005. Persian leopard photographed in Armenia. *Cat News* 43: 13.
- Khorozyan, I., A. Malkhasyan and S. Asmaryan. 2005. The Persian leopard prowls its way to survival. *Endangered Species Update* 22: 51-60.
- Kiabi, B.H., B.F. Dareshouri, R.A. Ghaemi and M. Jahanshahi. 2002. Population status of the Persian leopard (*Panthera pardus saxicolor* Pocock 1927) in Iran. *Zoology in the Middle East* 26: 41-47.
- Lekagul, B.M.D. and J.A. McNeely. 1977. *Mammals of Thailand*. Association for the Conservation of Wildlife, Bangkok, Thailand, 758 p.
- MacKenzie, D.I., J.D. Nichols, G.B. Lachman, S. Droege, A. Royle and C.A. Langtimm, 2002. Estimating site occupancy rates when detection probabilities are less than one. *Ecology* 83: 2248-2255.
- Mills, M.G.L. and M. Harvey. 2001. *African Predators*. Struik Publisher, Cape Town, South Africa, 160 p.
- Nowzari, H., B. Behrouzi Rad and M. Hemami. 2007. Habitat use by Persian Gazelle (*Gazelle subgutturosa subgutturosa*) in Bamoo National Park during autumn and winter. *Acta Zoologica Mexicana* 23: 109-121.
- Ott, T. 2004. *Dietary ecology of leopard Panthera pardus in the Baviaanskloof wilderness area*. Honours thesis, University of Port Elizabeth, South Africa.
- Owen-Smith, N. and Mills, M. G. L. 2008. Predator-prey size relationships in an African large-mammal food web. *Journal of Animal Ecology* 77: 173-183.
- Sanei, A. 2005. *Analysis of Leopard (Panthera pardus) Status in Iran (No.1)*. Tabalvor (In Persian), Tehran, Iran, 293 p.
- Sanei, A. 2007. *Analysis of Leopard (Panthera pardus) Status in Iran (No.1)*. Sepehr Publication Center, Tehran, Iran, 298 p.
- Sanei, A. and M. Zakaria. 2011. Distribution pattern of the Persian leopard (*Panthera pardus saxicolor*) in Iran. *Asia Life Sciences Supplement* 7: 7-18. (this issue)

- Sanei, A. and M. Zakaria. 2008. Distribution of *Panthera pardus* in Iran in relation to its habitat and climate type, p. 54. *In: Saiful, A., M.O.Norhayati, A.K. Shuhaimi, Ahmad and A.R. Zulfahmi (Eds.). Third Regional Symposium on Environment and Natural Resources, Universiti Kebangsaan Malaysia, Malaysia.*
- Stevenson-Hamilton, J. 1947. *Wildlife in South Africa*. Cassell, London, U.K., 364 p.
- Stuart, C.T. and T. Stuart. 2000. *Field Guide to the Larger Mammals of Africa*. Struik Publishers, Cape Town, South Africa, 320 p.
- Ziaie, H. 2008. *A Field Guide to the Mammals of Iran*. Iran Wildlife Center, Tehran, Iran, 432 p.

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