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Diet of Asiatic black bear in its westernmost distribution range, southern Iran

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Abstract: We opportunistically collected and analyzed 80 scats of the Asiatic black bear (*Ursus thibetanus*) from den entrances and other areas at 2 sites within Hormozgan Province, Iran, from March 2010 to February 2011. We identified 27 food items dominated by cultivated date palm (*Phoenix dactylifera*) fruit, oriental hornet (*Vespa orientalis*), and Christ's thorn jujube (*Ziziphus spina-christi*) fruit with frequency of occurrence 55.0%, 30.0%, and 20.0%; and percentage volume 75.0%, 55.8%, and 86.7%, respectively. Our study highlights the potential importance of human-related foods to Asiatic black bear diets. Our findings may help conservation managers to identify areas of notable potential conflict for Asiatic black bears and implement conflict-reducing measures such as installing better protective fences for reducing horticulture loss.

Key words: Asiatic black bear, diet, human–wildlife conflict, *Phoenix dactylifera*, scat analysis, *Ursus thibetanus*, *Vespa*, *Ziziphus*

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The Asiatic black bear (*Ursus thibetanus*) is distributed from Japan westward to Iran in southwestern Asia and is listed in the International Union for Conservation of Nature Red List of Threatened Species as Vulnerable (Garshelis and Steinmetz 2008). The Asiatic black bear is omnivorous, with variation in diet across its geographic range (Huygens et al. 2003, Koike 2010, Ghadirian et al. 2012c). Although the Asiatic black bear's diet has been studied in much of its range (Hwang et al. 2002, Hashimoto et al. 2003, Sathyakumar and Viswanath 2003, Koike 2010, Steinmetz et al. 2013), the species remains understudied in much of its western distribution, where scarcity of food resources brings it into conflict with local people (Zehzad et al. 1999, Ahmadzadeh et al. 2008, Fahimi and Yusefi 2010). Asiatic black bears are known for raiding farms and livestock depredation in southern Iran (Joslin et al. 1974). Retaliatory killing of Asiatic black bears occurs in most of the species' range, making small populations of this species more vulnerable (Joslin et al. 1974, Zehzad et al. 1999). However, the extent and dynamics of this conflict have

not been quantified to date. Our objective was to collect data on the diet of Asiatic black bears in one of the least productive habitats in its geographic range in southern Iran to assess the potential role of human-related foods in its diet.

Study area

The study area comprised approximately 2,000 km² with elevations from 420 m to 1,888 m in Rudan and Bashagard counties, Hormozgan Province, Iran (Fig. 1). The province, particularly in the east and northeast, has hot and arid mountainous landscapes with poor vegetation cover, extreme soil erosion, deep valleys, and steep slopes (Soleimani-Ahmadi et al. 2014, Almasieh et al. 2016). This coastal province receives occasional and irregular monsoon rainfall from July to September (Javanshir 2000, Ghadirian et al. 2012a). In Bashagard County, average annual temperature and rainfall are 25°C and 137 mm; and in Rudan County are 28°C and 221 mm, respectively. Conflict between humans and Asiatic black bears in this part of Iran has a long history, with the first confirmed killing of an Asiatic black bear by local people

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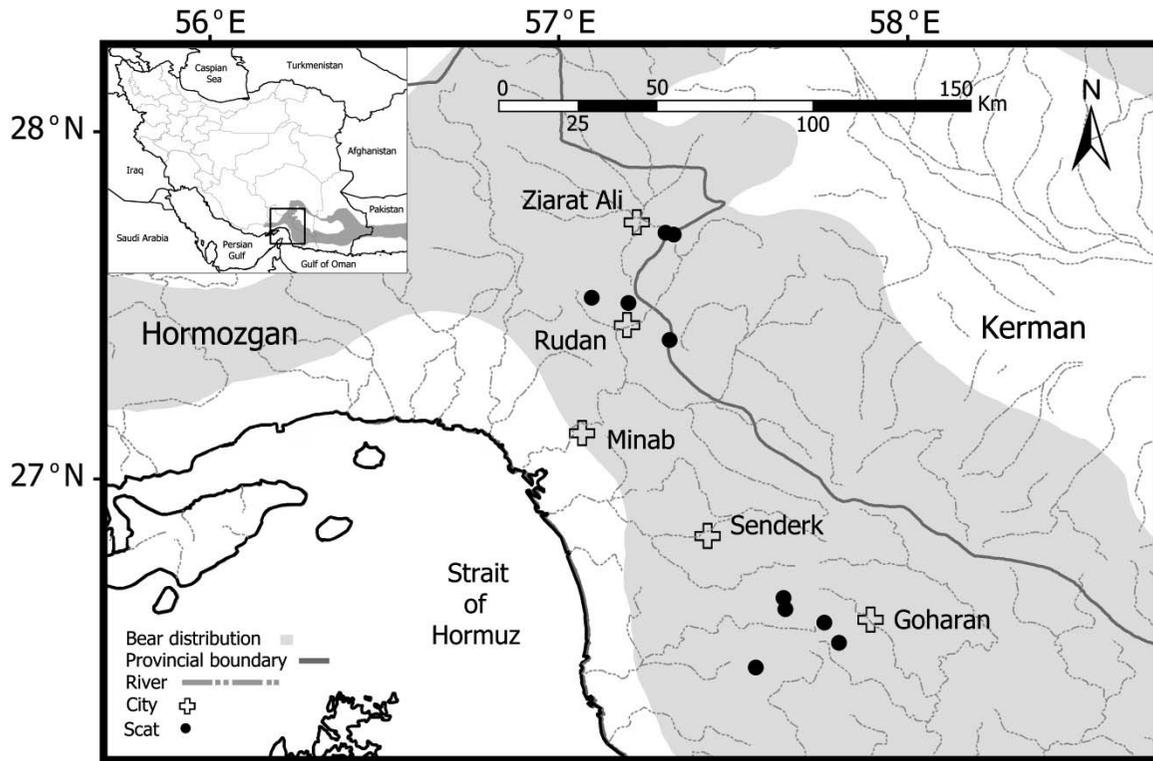


Fig. 1. Current distribution of Asiatic black bear (*Ursus thibetanus*) in Iran (Hormozgan, Kerman, and Sistan and Baluchistan provinces) and Pakistan.

for protection of crops and cultivated fruits documented by Joslin et al. (1974).

Methods

We collected scats opportunistically from 10 locations including den entrances, valleys and riverbeds, date palm (*Phoenix dactylifera*) groves, high-elevation woodlands, and thickets by walking on trails from 428 m to 1,878 m elevation ($\bar{x} = 927$ m) during 175 days of fieldwork in March 2010 to February 2011. During scat collection, we collected seeds of wild and cultivated fruits, and hair of some mammals as reference material for identification of potential food items (Mealey 1980). We estimated approximate age of each scat by moisture content, state of decomposition, and fruit and vegetation availability.

We soaked scats in water and liquid detergent for 1–24 hours to soften scats (Paralikidis et al. 2010). We washed scats over sieves (0.5- and 1.0-mm mesh) and identified food items to the lowest possible taxon using seeds, leaves, hairs, feathers, bones, and other animal and plant materials in our reference collection (Hashimoto

et al. 2003, Hashimoto and Anrui 2013). We calculated frequency of occurrence (FO%; percentage of scats in which a particular food item is found; Paralikidis et al. 2010). We also visually estimated percentage volume (V%) and importance value (IV%; importance of consumed food items) for each food item (Mealey 1980, Hashimoto et al. 2003). We categorically estimated the volume of food items in each scat in fractional values (trace, one-half, one-third, two-third, one-fourth, etc.) and then binned volumes into groups (<1, 1–25, 25–50, 50–75, 75–100%, 100%) and used the mean value (1%, 12.5%, 37.5%, 62.5%, 87.5%, and 100% respectively) for analyses following Mealey (1980). We estimated V% and IV% using the following equations for each food item (*i*) in scat (*j*):

$$V_{\text{item}\%} = \frac{\sum \text{percent of volume of item } (i) \text{ in scat}(j)}{\text{number of scat in which food item } (i) \text{ occurred}}$$

$$IV_{\text{item}\%} = \frac{\text{FO\% of item } (i) \times V\% \text{ of item } (i)}{100}$$

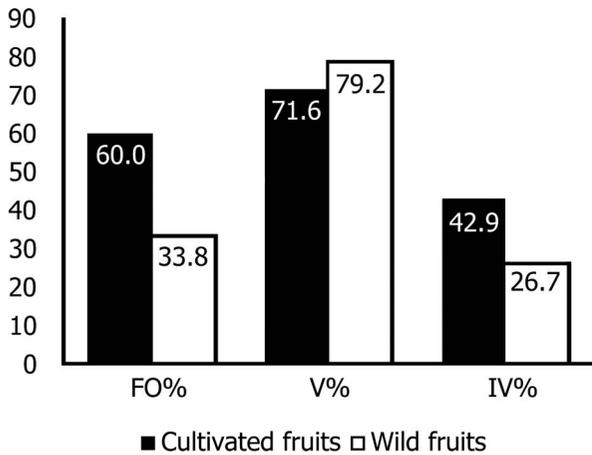


Fig. 2. Total frequency of occurrence (FO%), volume (V%), and importance value (IV%; importance of consumed food items) of cultivated and wild fruits in scats ($n = 80$) of Asiatic black bear (*Ursus thibetanus*) collected from March 2010 to February 2011 on 2 sites in Hormozgan Province, Iran.

Results

We collected and analyzed 80 Asiatic black bear scats from Rudan ($n = 40$) and Bashagard ($n = 40$; Table S1). In total, we collected 14, 31, 19, and 16 scats in date palm groves, high-elevation woodlands and thickets, den entrances, and riverbeds and valleys, respectively (Table S2). We identified 27 food items in 5 categories: cultivated fruits (4 items), wild fruits (6 items), other plants (7 items), vertebrates (5 items), and invertebrates (5 items). Date palm fruits, oriental hornet (*Vespa orientalis*), Christ's thorn jujube fruits (*Ziziphus spina-christi*), Poaceae spp., unidentified vegetation, and Persian turpentine had the greatest FO% (55.0, 30.0, 20.0, 8.8, 7.5, and 7.5, respectively); and V% of these items was 75.0, 55.8, 86.7, 2.6, 68.9, and 64.8, respectively. Date palm, jujube, oriental hornet, and unidentified vegetation were dominant food items, whereas Persian turpentine (*Pistacia atlantica*; FO% = 7.5%) and Indian olive (*Olea europaea* ssp. *cuspidate*; 6.3%) fruits were less frequently detected in the Asiatic black bear diet (Table S1).

The FO% of cultivated fruits in Rudan and Bashagard were 57.5% and 62.5%; and V% of cultivated fruits in Rudan and Bashagard were 57.7% and 84.5%, respectively. Total FO% and Total IV% of cultivated fruits was greater than total values of FO% and total IV% of wild fruits (Fig. 2). The total FO% of human-related food items (cultivated fruits and livestock) in Rudan and Bashagard counties was 62.5% and 60.0%, respectively;

and the total volume of these items in these counties was 37.5% and 50.0%, respectively.

Discussion

The Asiatic black bear consumed primarily date palm fruit, oriental hornet, and Christ's thorn jujube fruit in Hormozgan Province. Date palm and oriental hornet were the most important food items in summer and jujube fruits appeared most important in winter. Historically, date palm cultivation in Iran began as early as 4000 BC (Hajian and Hamidi-Esfahani 2015); depredation of date palm plantations by Asiatic black bears could be one of the oldest feeding relationships between Asiatic black bear and a cultivated fruit in Asia (Hajian and Hamidi-Esfahani 2015).

Oriental hornet was the most important animal item in Asiatic black bear diet, and it had greater volume and importance value than was recorded in previous studies in the eastern portion of Asiatic black bear range (Hwang et al. 2002, Koike 2010, Hashimoto and Anrui 2013, Steinmetz et al. 2013). Jujube appeared to be an important plant species for bears, likely because of its 2 fruiting seasons each year in the province (Ghadirian et al. 2012b).

Frequency of occurrence and volume of human-related food items in Asiatic black bear diet in this study were greater than in previous studies (Hwang et al. 2002, Hashimoto et al. 2003, Koike 2010, Hashimoto and Anrui 2013, Steinmetz et al. 2013). It appears that Asiatic black bears were attracted to date palm groves as seasonal feeding sites in Hormozgan Province, because 31 of 44 scats contained date palm, including scats collected distant from groves.

Although other anthropogenic foods, such as corn (*Zea* spp.) and banana (*Musa* spp.), are commonly consumed by Asiatic black bears in subtropical countries (e.g., Pakistan, Thailand, and China; Ngoprasert et al. 2011, Perveen and Abid 2013, Malcolm et al. 2014), our results suggest the potential importance of cultivated date palm fruits for Asiatic black bears in southern Iran, possibly because natural food items are limited (Fahimi and Yusefi 2010, Fahimi et al. 2011, Ghadirian et al. 2011). Also, date palm groves are common in our study area and distributed along riparian areas, which may serve as travel corridors.

We suggest the need for additional research on the diet of Asiatic black bears in this area, as well as improved documentation of Asiatic black bear conflicts with humans. These considerations are some of the first steps toward understanding the potential extent and magnitude

of interactions between humans and Asiatic black bears, which can be used in the development of strategies to facilitate coexistence.

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Supplemental material

Table S1. Identified food items in scats of Asiatic black bear (*Ursus thibetanus*) collected in Hormozgan Province, southern Iran, during March 2010 to February 2011. We calculated frequency of occurrence (FO%), volume (V%), and importance value (IV%) of food items in bear scats. We categorized items in 5 groups: cultivated fruits (CF), wild fruits (WF), other plant (OP), vertebrate (VE), and invertebrate (IN).

Table S2. Number of Asiatic black bear (*Ursus thibetanus*) scats collected during March 2010 to February 2011 in different habitat types, and occurrence of date palm fruits in black bear scat samples from Hormozgan Province, southern Iran.