Journal of Arid Environments 74 (2010) 1348–1350

Contents lists available at ScienceDirect

Journal of Arid Environments

journal homepage: www.elsevier.com/locate/jaridenv

Short Communication

An account of badger diet in an arid steppe region of Mongolia

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ARTICLE INFO

Article history:
Received 25 March 2009
Received in revised form
25 November 2009
Accepted 14 April 2010
Available online 13 May 2010

Keywords:
Asian badger
Earthworm
Food
Foraging behavior
Meles
Scat analysis

ABSTRACT

Badgers (*Meles* spp.) range widely across Europe and Asia and consume a variety of food items. However, most diet studies have occurred in areas characterized by moderate climates and associated with agriculture and few have focused on the colder, drier, and relatively undisturbed biotopes of northern Asia. We described badger diet from an arid region of Mongolia based on an analysis of scats ($n = 116$) collected during the summer and autumn of 2006 and 2007. Badgers consumed several foods, including insects, mammals, birds, reptiles, plant material, and human garbage. However, badger diet consisted mainly of insects, which occurred most frequently and in greatest volume relative to other foods. Orthoptera, in particular, composed most scats, which may have been due to their high abundance. Badgers did not consume earthworms, which represent an important food in other regions. The lack of earthworms probably reflected their rarity or absence in the study area.

1. Introduction

Badgers (*Meles* spp.) range widely across Eurasia and consume a variety of foods that include earthworms, insects, mammals, reptiles, birds, and plant material (Neal and Cheeseman, 1991). However, studies of badger diet have focused mainly on European populations, often in areas associated with agriculture and characterized by moderate climates and high rainfall. Several studies have also documented badger diet across the former Soviet Union (Roper and Mickevicius, 1995), although most concentrated in the west of the country, as well as parts of southwest Asia (Harrison and Bates, 1991) and Japan (Kaneko et al., 2006). By comparison, few studies have focused on badgers in northern Asia, where conditions are colder, drier, and relatively free of large-scale land conversion.

One such region is Mongolia, where badgers (*Meles leucurus*) occupy a variety of arid environments, including grasslands and semi-deserts (Clark et al., 2006). Despite the species' wide range in the country (Fig. 1), few details of badger diet exist. Yet, diet information from Mongolia's arid regions may be important for comparing with other populations to provide a more comprehensive picture of badger ecology. In this short communication, we describe badger diet in an arid region of central Mongolia based on an analysis of scats collected during the summer and autumn of 2006 and 2007.

2. Methods

2.1. Study area

We described badger diet in the Ikh Nart Nature Reserve, Dornogobi Aimag (45°43′N–108°39′E; Fig. 1), which covers 666 km^2 and was established in 1996 to protect a population of argali sheep (*Ovis ammon*) (Reading et al., 2006). Ikh Nart lies as the confluence of 'steppe' and 'semi-desert' eco-zones and includes grasslands and shrublands in open plains, and more rugged, rocky terrain. Climate is highly variable with temperatures ranging from −40 °C to +43 °C, and arid with <200 mm average annual precipitation. No agriculture occurs in the region, although local herders raise livestock for subsistence. Badgers occur throughout the reserve and hibernate in winter (approximately November to April).

2.2. Scat collection and analysis

We collected scats opportunistically from 15 May to 15 September in 2006 and 2007 and aimed to collect >94 to adequately describe diet (Trites and Joy, 2005). Scats were identified based on references collected from live-trapped animals as part

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doi:10.1016/j.jaridenv.2010.04.009

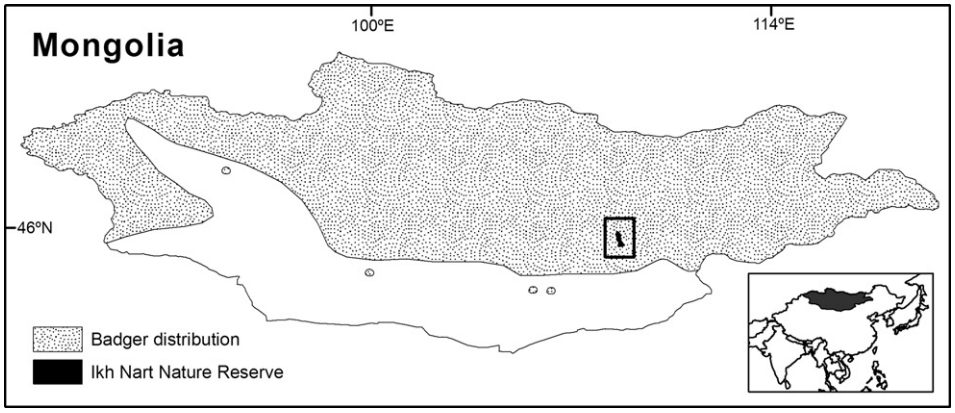

Fig. 1. Location of the study area (Ikh Nart Nature Reserve) relative to badger (*Meles leucurus*) distribution in Mongolia. Badger distribution based on a national conservation assessment of the species (Clark et al., 2006).

of another radio-telemetry study (Reading et al., 2007). We also collected scats at badger latrines and near den entrances of known badgers ($n = 5$) to reduce the potential for misidentification. We collected fresh (<1 week old) scats and stored them in paper bags to dry. Analysis involved soaking scats in water, then straining them through nylon mesh to separate macroscopic and microscopic fractions (Reynolds and Aebischer, 1991). We dissected macroscopic remains and identified food items to species-level when possible using reference collections. We also estimated the volume of macroscopic remains using graduated cylinders (5 and 10 ml). We examined microscopic sediment for the presence of earthworm chaetae and gizzard rings with a low-powered stereoscopic microscope (Reynolds and Aebischer, 1991). Diet was quantified as the percent occurrence (no. of scats with a food item × 100/total scats analyzed) and percent volume (volume of a food item × 100/total volume of scats) of each food item.

3. Results

We analyzed 116 scats, which contained insects, mammals, birds, reptiles, plant material, and human garbage (food wrappers, plastic, and fabric) (Table 1). Insects occurred most frequently and in greatest volume relative to other food items (Table 1). We identified 28 insect species from nine families and three orders (Table 1).

Remains of all other food items each occurred in <34% of scats and combined, accounted for only 21% of total scat volume (Table 1). Mammal remains included rodents (Cricetidae: *Cricetulus* spp., *Lasiopodomys brandtii*, *Phodopus* spp.; Muridae: *Meriones* spp.), pika (Ochotonidae: *Ochotona pallasi*), hedgehogs (Erinaceidae: *Mesechinus dauuricus*), and livestock (i.e., sheep, goat, and cow) (Table 1). Bird remains rarely occurred in scats and included mostly bones and small feathers, although one scat contained egg fragments (Table 1). Reptiles included only toad-headed agama lizards (*Phrynocephalus versicolor*). Plant material occurred relatively frequently, but was present in small quantities (Table 1). Badgers consumed vegetation such as leaves and stalks and also fruits and seeds of Gobi apricot (*Amygdalus pedunculata*) and *Nitraria sibirica* shrubs. We occasionally found human garbage in scats, but in small amounts (Table 1). We found no earthworm chaetae or gizzard rings in the microscopic fraction of any scat.

4. Discussion

Badgers consumed a variety of foods including insects, mammals, birds, reptiles, plant material, and some human garbage. However, insects occurred most frequently and in greatest volume relative to other foods. Insects were highly abundant in Ikh Nart during summer and autumn (Murdoch et al., 2010), perhaps explaining their frequent occurrence in scats. Orthoptera, in particular, composed most scats and exhibited large peaks in abundance during the study. These results are consistent with other studies across arid regions of the former Soviet Union (Roper and Mickevicius, 1995).

Badger diet in Ikh Nart did not include earthworms, which represent an important food item for the species in parts the UK, continental Europe, and Japan (Goszczyński et al., 2000; Kaneko

Table 1
Percent occurrence and percent volume of food items in badger (*Meles leucurus*) scats ($n = 116$) collected in Ikh Nart Nature Reserve, Mongolia from 15 May to 15 September in 2006 and 2007.

Food item	No. of scats	% Occurrence	% Volume
Insects	112	96.6	79.3
Blattodea	53	45.7	7.7
Polyphagidae	53	45.7	7.7
Coleoptera	75	64.7	15.6
Buprestidae	1	0.9	0.0
Carabidae	19	16.4	0.3
Cerambycidae	1	0.9	0.0
Curculionidae	1	0.9	0.5
Scarabaeidae	24	22.4	6.2
Tenebrionidae	58	50.0	8.5
Unknown	1	0.9	0.0
Orthoptera	84	72.4	56.0
Acrididae	84	72.4	56.0
Mammals	26	22.4	8.6
Erinaceomorpha	1	0.9	0.4
Erinaceidae	1	0.9	0.4
Lagomorpha	2	1.7	0.3
Ochotonidae	2	1.7	0.3
Rodentia	21	18.1	7.8
Cricetidae	4	3.4	2.8
Muridae	6	5.2	2.3
Unknown	12	10.3	2.7
Livestock	3	2.6	0.1
Reptiles	22	19.0	4.6
Squamata	22	19.0	4.6
Agamidae	22	19.0	4.6
Birds	7	6.0	0.5
Bones and feathers	6	5.2	0.5
Egg remains	1	0.9	0.0
Plant material	39	33.6	3.6
Fruits and seeds	9	7.8	1.2
Vegetation	30	25.9	2.4
Garbage	6	5.2	3.3

et al., 2006; Kruuk and Parish, 1981). In some of these areas, badgers consume earthworms almost exclusively, which led researchers to suggest that they are earthworm specialists (Kruuk and Parish, 1981). However, badgers readily consume other food items throughout their range and follow a more generalist feeding strategy (Roper, 1994). The lack of earthworms in diet probably reflected the low abundance, availability, and possibly absence of earthworms in the region. While we are unaware of any systematic survey of earthworms in Mongolia, we suspect that earthworms were rare or absent in the reserve because of the cold climate, sandy and gravely soils, and low quantity and quality of vegetative litter, which limit earthworm distribution elsewhere (Curry, 1998). Our results suggest that earthworms do not constitute an important food resource for badgers in the arid regions of Mongolia, and are important from a broader perspective as few studies have shown a lack of earthworms in diet. They are also consistent with studies from nearby regions in the former Soviet Union that showed the rare occurrence and absence of earthworms in diet (Roper and Mickevicius, 1995).

Small mammals occurred infrequently in scats, in small amounts, and included mainly rodents, which occurred in low density in the study area (Murdoch et al., 2010). Lizards also occurred infrequently and included only toad-headed agamas. Although at least three other lizard species live in Ikh Nart, toad-headed agama was most common and attained relatively high density in summer, which may partly explain its occurrence in scats. Similarly, badgers rarely consumed birds, which was surprising as at least 110 species have been documented in Ikh Nart (Reading et al., 2006), but consistent with badger diet elsewhere (Hounsome and Delahay, 2005). Birds may be more difficult to catch compared with other food items like insects and lizards during colder nighttime hours, when badgers are most active.

Plant material occurred frequently in scats, but in low volume, suggesting diminished importance in diet (or inadvertent consumption). However, we occasionally found seeds in scats, including from Gobi apricot, which has relatively fleshy fruits. Fruits may be consumed when available, but those of apricot and other species are not ripe until late autumn or early winter when badgers are largely inactive, perhaps explaining their rarity in scats. A majority of seeds in scats were whole and intact, suggesting that badgers may play a role in seed dispersal of some species through endozoochory (van der Pijl, 1972). Small amounts of garbage also occurred infrequently in diets. Herder ger (i.e., yurt) sites represent the only sources of garbage and are typically guarded by large dogs, which probably deter badgers.

The study indicated that badgers in Ikh Nart consumed mainly insects and occasionally other food items, but not earthworms. We contend that the high degree of insect consumption, occasional consumption of mammals, birds, and reptiles, and lack of earthworms in diet probably related to abundance and availability of these foods and, thus, that badgers forage opportunistically. However, further studies that evaluate food abundance relative to occurrence in diet will be needed to examine the food preferences and foraging strategy of badgers in the region.

Acknowledgements

We thank the Denver Zoo and Rufford Foundation for supporting the project. We also thank T. Munkhzul and N. Javzmaa for help identifying food remains. We conducted the study in collaboration with the Mongolian Academy of Sciences – Institute of Biology and thank T. Janchiv and B. Lhagvasuren for their support.

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