

Diurnal activity and diet of Small Indian Mongoose *Urva auropunctata* on the outskirts of Vadodara, Gujarat, India

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Abstract

The Small Indian Mongoose *Urva auropunctata* is a diurnal, omnivorous and opportunistic predator. Native to the Indian subcontinent, it has been introduced to many parts of the world, where it is considered a pest species. Although common, little is known about its ecology in its native range. During the winter months (December to February), in a village in western India, we used a handheld camera to record the activity of a single mongoose. We assessed mongoose diet by analysing faecal pellets in the vicinity of the 10 active burrows identified in the area. We found that the Small Indian Mongoose was active during the entire day, except when it avoided the hot midday temperatures by retreating to a burrow. Outside of the burrow, the targeted mongoose spent its time foraging (72%), basking (24%), grooming (1.8%) and socialising (1%). Faecal analysis revealed that in the early winter the diet was mainly insects (75.4%) but shifted to more plants (64.6%) as winter came to an end.

Keywords: Small Indian Mongoose, diet, diurnal activity, native range

Introduction

The distribution of the Small Indian Mongoose *Urva auropunctata* (see Patou et al. 2009) stretches from the Arabian Peninsula across the northern Indian subcontinent to South-east Asia. It has also been introduced to many other parts of the world, mainly islands (Gilchrist et al. 2009). It has been classified as of Least Concern by the IUCN (Jennings & Veron 2016).

Urva auropunctata is a ground-foraging, burrowing species that lives in intricate burrows or in dense shrub cover (Gilchrist et al. 2009). The species is tolerant of high temperatures (Matsuura et al. 1977); temperatures below 0°C severely stress it (Nellis & McManus 1974, Nellis & Everard 1983). In the Caribbean, the Small Indian Mongoose is an entirely diurnal species (Nellis & Everard 1983).

The Small Indian Mongoose plays a vital role in agro-ecosystems as a predator of insects, snakes, rodents and some birds; it also consumes fruits, tubers and berries and may occasionally scavenge (Feldhamer et al. 1999, Gilchrist et al. 2009). It plays a significant role controlling pest populations (Mahmood & Nadeem 2011). Studies in north-western Pakistan revealed that the Small Indian Mongoose is a highly opportunistic that feeds largely on mammals and prefers habitat close to human settlements (Mahmood et al. 2011). One study in Central Punjab, Pakistan, revealed that the Small Indian Mongoose preferred feeding

in agricultural fields that had a low input of synthetic fertilizers and pesticides. This study also showed that the diet had a high biomass of plant material, followed closely by insects (Rana *et al.* 2005). Studies on Korčula Island, Croatia, revealed that Small Indian Mongooses there consumed more fruits in the winter than during the summer (Cavallini & Serafini 1995). The Small Indian Mongoose was introduced to the Fiji Islands in 1883 (Veron *et al.* 2007, Simberloff & Rejmánek 2011) and has been implicated anecdotally in the decline of many of Fiji's birds (Morley & Winder 2013), such as the Barred-wing Rail *Nesoclopeus poecilopterus* (Gorman 1975), the Pacific Black Duck *Anas superciliosa* (Martin 1938), the Banded Rail *Gallirallus philippensis* (Mercer 1970), the Purple Swampphen *Porphyrio porphyrio* (Clunie & Morse 1984) and the Friendly Ground Dove *Gallicolumba stairi* (Watling 2001).

Most field studies of this species have been conducted within the introduced parts of its range (Gilchrist *et al.* 2009) and generally indicate that the Small Indian Mongoose is a diurnal, opportunistic predator. We hypothesise that the Small Indian Mongoose has an opportunistic diet within its native region, and this study focussed on the diet and activity of the Small Indian Mongoose in an agro-pastoral landscape on the outskirts of the city of Vadodara, Gujarat, India.

Materials and methods

Study area

The study was conducted in the small rural settlement of Sripore Timbi (22°18'22.11"N, 73°17'05.64"E) adjoining Timbi Irrigation Reservoir, on the outskirts of Vadodara city, Gujarat, India, where multiple burrows were located close to each other along the edge of the pond. The village is set in an agro-pastoral landscape mixed with scrubland and reed cover. All observations were recorded during the winter months (December 2018 to February 2019).

Locating active burrows

During the pilot study, areas with high mongoose activity were noted through observations of pugmarks (Shrestha & Basnet 2005) and direct observations. The mongooses were seen the most near the pond edge. A strip 10 m in width alongside the pond was searched with the help of local residents and burrows were identified. Burrows had two or three openings, with the exception of one burrow, which had five openings. Dried reeds were placed at the burrow openings at dusk and checked the next day. Burrows with openings where reeds had been displaced were considered active. These active burrows were targeted for the diet study.



Fig. 1. Aerial image of the village of Sripore Timbi, on the outskirts of Vadodara, Gujarat, India. Active burrows of Small Indian Mongoose *Urva auropunctata* that were observed in the study are indicated.

Activity pattern and budgeting

To observe activity patterns, one large male Small Indian Mongoose – the only adult male in the area – was followed at a distance of about 10 m from sunrise to sunset on the last Sunday of December 2018, January 2019 and February 2019 (Kays *et al.* 2010). Mongooses in the vicinity of the village were already to some extent habituated to humans and this and the reed and shrub cover left between the observer and the mongoose ensured that the behaviour of the mongoose was not influenced. Small gaps in the vegetation made it possible to observe and record mongoose behaviour. Each field visit lasted 11 hours and 20 ± 10 minutes. The timing of sunrise (08h12 to 07h44) and sunset (18h03 to 18h38) changed over the course of study (Table 1).

Photographs of the target mongoose were taken in bursts of 10 every 5 minutes, as with a camera-trap in time-lapse mode (Altmann 1974), using a handheld Canon 1200D DSLR camera. The photographs were tagged to reflect the activity seen in them in ExifPro[®] Image Analysis software and a .csv file was made after compiling the spreadsheets exported from ExifPro[®]. These files were run in the activity package of R[®] analysis software. Individual behavioural activities were analysed in a similar manner, by calculating the image captures in the study period. All the software used is open access software available online. For percentage calculations, this formula was followed:

$$\left(\frac{\text{No. of photographs of a given activity during one hour}}{120 \text{ (total number of photographs during one hour)}} \right) * 100$$

The mongoose was considered “active” whenever it was outside its burrow. Each burst of 10 images was categorised as falling within one of the following activities: basking, grooming, foraging and socialising. If the mongoose entered a burrow within the timeframe of a burst of 10 photographs, the mongoose was counted as inactive.

The mongoose was not observed within its burrow.

Diet analysis

To investigate the diet of the Small Indian Mongoose, faecal pellets were collected around the entrances of the 10 active burrows that had been identified (Fig. 1). The mongooses are known to defecate in early morning (Rasa 1983) so scats were collected in the afternoon during each field visit, when the mongooses had retreated in their burrows.

The collected scats were sun-dried and then placed in a warm-water bath of $40^{\circ}\text{C} \pm 5^{\circ}\text{C}$ for 3-4 hours so that the scats loosened. The scats were then washed in a sieve and the components physically separated (Mahmood *et al.* 2017). The plant and insect matter was weighed and insects were identified to class whereas plant matter was largely left unidentified, although seeds were identified to genus level. Lightweight fish, bird and mammal components like scales, feathers and hair were counted instead of weighed.

Results

Activity pattern and activity budget

About nine burrow entrances were observed within a radius of 50 m. Burrows B1, B2 (two openings each) and B5 (five openings) were frequently used by the target mongoose (Fig. 1). The mongoose usually emerged from its burrows sometime after sunrise and retreated back to the burrow almost an hour before sunset (Table 1, Fig. 2). We incidentally observed that other individuals showed a similar activity pattern.

Table 1. Time of sunrise, sunset and first capture, as well as temperature, humidity, wind speed and cloud cover, for each of the three field visits.

Date	Sunrise	Sunset	Time of first capture	Temperature at first capture ($^{\circ}\text{C}$)	Average temperature ($^{\circ}\text{C}$)	Humidity (%)	Wind speed (km/h)	Cloud cover (%)
30-12-2018	07h16	18h03	08h12	14	26	47	9	40%
20-01-2019	07h19	18h17	08h25	16	27	55	5	20%
24-02-2019	07h03	18h38	07h44	17	28.2	75	0	51%

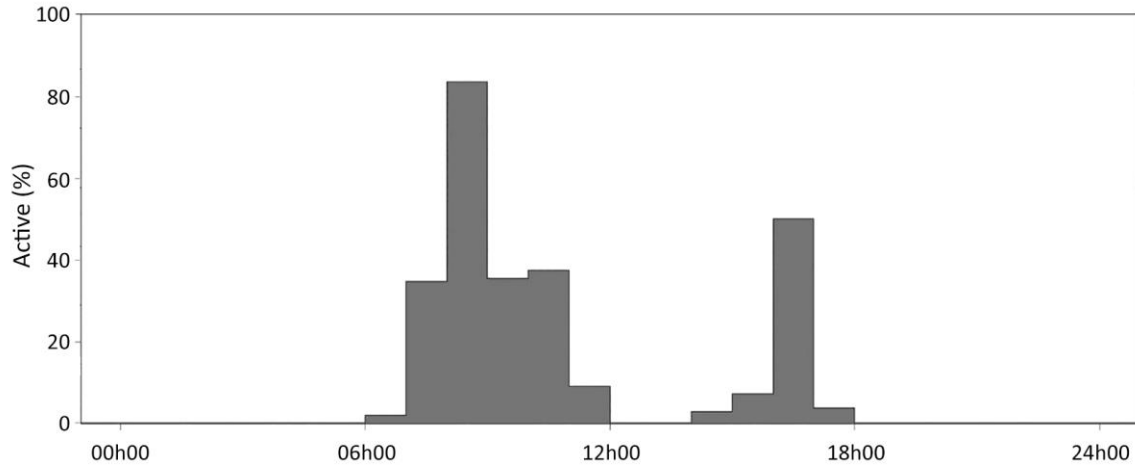


Fig. 2. The percent of each hour (averaged across all three observation days) the targeted Small Indian Mongoose *Urva auropunctata* was outside its burrow, hence “active”, as defined for the purposes of this study in Sripore Timbi, Gujarat, India. As the graph shows, the mongoose was most active during the morning hours, peaking from about 09h00 to 10h00. There was a second bout of activity in the late afternoon, about an hour before sunset.

The mongoose was observed to bask in the sun (Figs. 3-5) between about 08h00 and 09h00 in two favoured spots nearby burrow openings, permitting a quick escape from potential predators, especially feral dogs.



Fig. 3. Small Indian Mongoose *Urva auropunctata* basking in the sun in one of its two preferred basking spots, in Sripore Timbi, Gujarat, India.

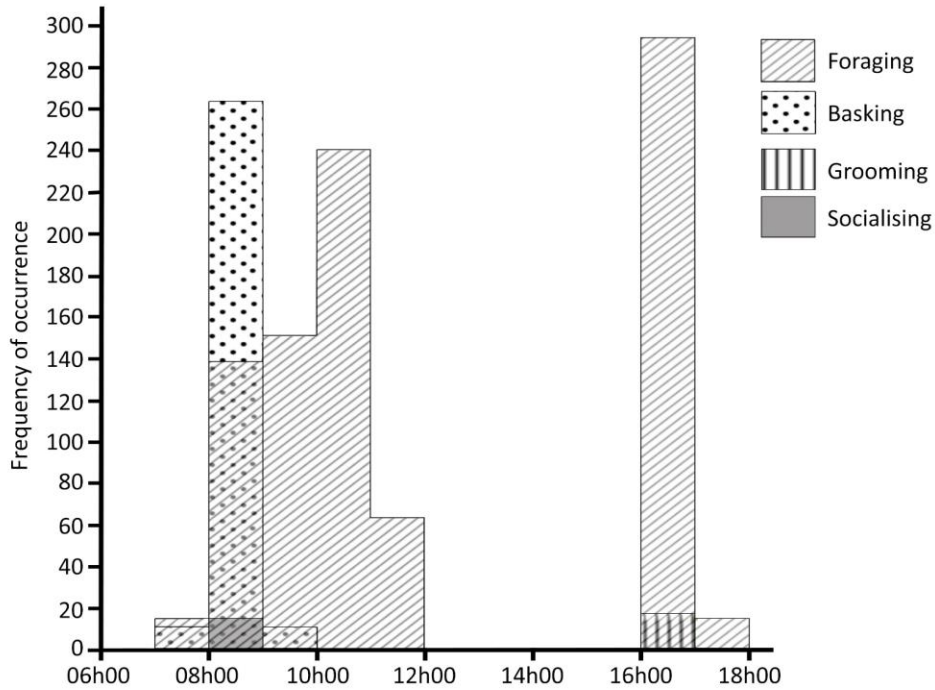


Fig. 4. The frequency of occurrence (the number of photographs showing a given activity within a given hour, totalled across all three observation days) of different activities exhibited by the target Small Indian Mongoose *Urva auropunctata* in Sripore Timbi, Gujarat, India.

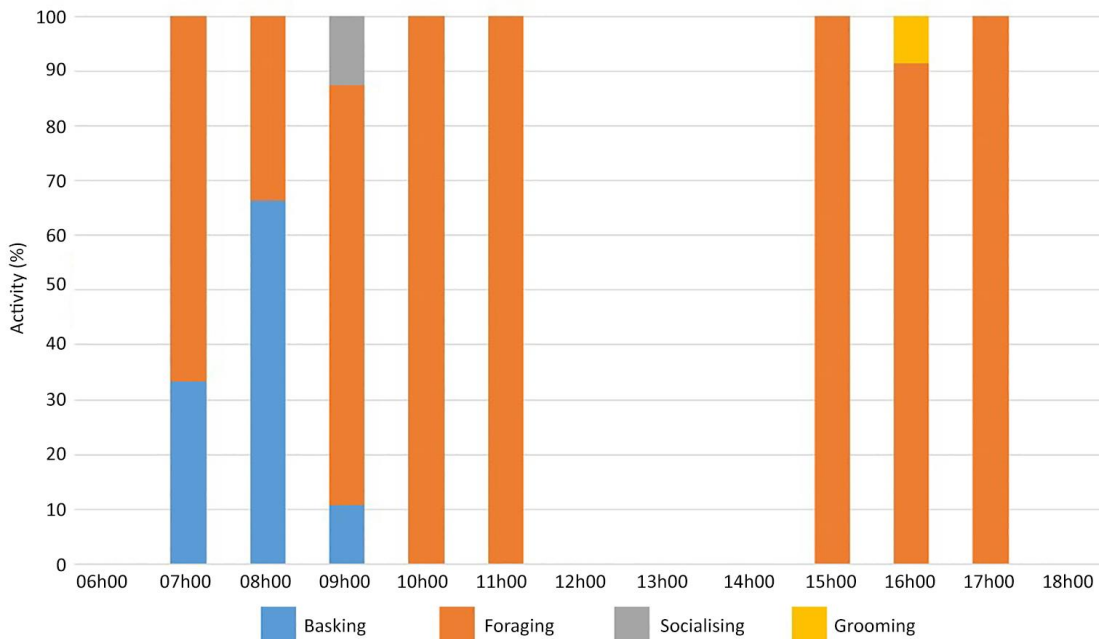


Fig. 5. Activities exhibited by the target Small Indian Mongoose *Urva auropunctata* in Sripore Timbi, Gujarat, India, displayed as a percentage of each hour.

After basking, the mongoose usually foraged until midday (Figs. 4, 5), with sparse socialising sessions comprising no more than two observed events per field visit. During the hottest hours, the mongoose retreated to its burrow, re-emerging in the afternoon, when the heat was less. Grooming behaviour was mainly observed in the late afternoon (Figs. 4, 5), after which the mongoose would retreat to its burrow for the final time before nightfall.

Diet analysis

Thirty scat pellets were collected every month from the mongoose burrows, amounting to a total of 90 scats. Plant and insect parts constituted a major portion of the scats, while bones, hair, seeds and fish scales were also recovered (Table 2). The mongoose diet consisted mainly of insects in the months of December and January, shifting to more plants in February (Fig. 6).

Table 2. Numbers of hairs, fish scales, feathers, bone fragments and seeds recovered from scats of Small Indian Mongoose *Urva auropunctata* in Sripore Timbi, Gujarat, India.

	No. of scats	No. of hairs recovered	No. of fish scales	No. of feathers	No. of bone fragments	No. of seeds
Dec.	30	15	12	27	9	14
Jan.	30	16	0	0	12	2
Feb.	30	35	0	0	10	2

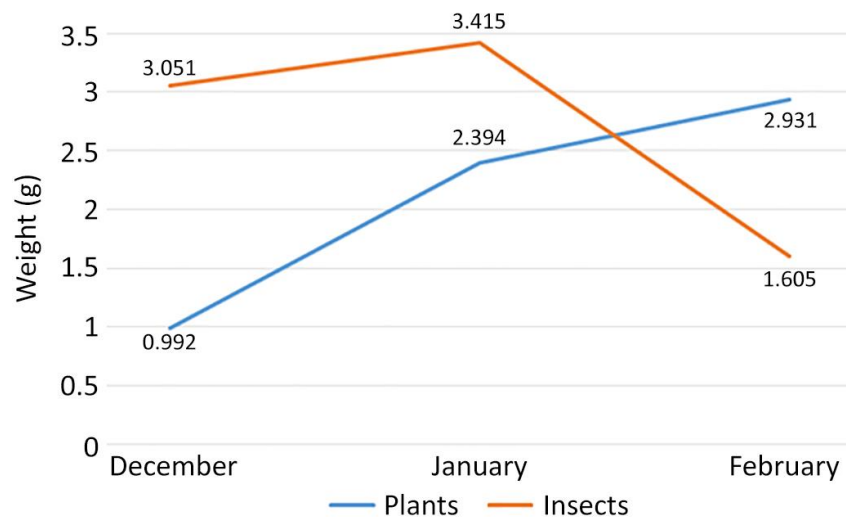


Fig. 6. Shift in the diet of the Small Indian Mongoose *Urva auropunctata* in Sripore Timbi, Gujarat, India, during the winter months.

The minor components included hair, bone fragments, fish scales (cycloids) and feathers (Table 2). These were low in weight and were therefore counted and the frequency of occurrence (no. of components / no. of scat pellets [30]) compared over the time (Fig. 7).

Fish scales and feathers were recovered only from scat pellets collected in December (Fig. 7). Seeds were also found regularly during the study (Table 2).

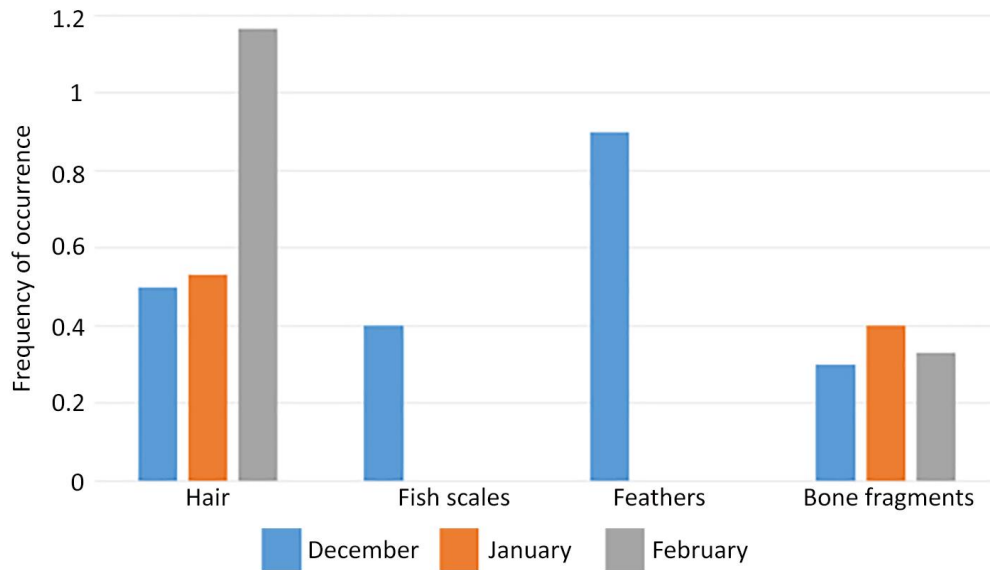


Fig. 7. Frequency of occurrence (number of items in a category divided by total number of scats [30]) of minor components in scat pellets of Small Indian Mongoose *Urva auropunctata* in Sripore Timbi, Gujarat, India.

Discussion

In our study area, the targeted *U. auropunctata* avoided the hottest hours of the day by retreating to its burrow, re-emerging when the heat was more tolerable. There were two distinct peaks of activity: one in the morning and the other in the late afternoon. This activity pattern is similar to that observed in some other mongoose species, such as the Common Dwarf Mongoose *Helogale parvula* (Rasa 1983) and the Short-tailed Mongoose *Urva brachyura* (Jennings *et al.* 2009).

The mongoose's midday retreat to its burrow in our study is attributable to the high daytime temperatures in western India. The morning basking behaviour of the Small Indian Mongoose has never been reported before and could be due to the cold winter mornings. The shift from an insect-based diet to a plant-based diet is similar to the results obtained for the Small Indian Mongoose on Korčula Island, where their diet shifted from mainly vertebrates to frugivory, as winter progressed (Cavallini *et al.* 1995). This shift in diet may indicate that the Small Indian Mongoose is an opportunistic predator, feeding on the most available prey, both in its native and introduced range (Mahmood *et al.* 2017). This could be primarily because of scarcity of insects towards the end of winter.

Soil comprised a significant part of the scats, which may signify that the mongooses may be feeding on burrowing grubs or earthworms.

Feathers and fish scales (cycloids) were found only in December. Small Indian Mongooses have been observed feeding on birds in Punjab, Pakistan (Mahmood *et al.* 2017). The presence of hair and bones was consistent throughout the duration of our study. Some hairs were identified to be of the house rat *Rattus rattus*. Other studies have shown that the Small Indian Mongoose feeds regularly on rodents (Mahmood *et al.* 2017) and that mammals comprised a significant amount of the diet (Cavallini & Serafini 1995).

Most of the seeds recovered from the scats were wheat *Triticum aestivum*; chaff of the seeds was also recovered occasionally. In the agricultural fields surrounding the village, wheat was sown during the winter so that it could be reaped around March–April. Other seeds were of grass, cumin *Cumin umcuminum* and coriander *Coriandrum sativum*. Cumin and coriander were not grown in the fields: the mongooses may have been foraging on left-over food from villagers' homes.

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