Journal of Animal & Plant Sciences, 32(5): 2022, Page: 1469-1477
ISSN (print): 1018-7081; ISSN (online): 2309-8694
https://doi.org/10.36899/JAPS.2022.5.0553

DISTRIBUTION AND DIET COMPOSITION OF TWO SYMPATRIC MONGOOSE SPECIES IN MURREE KAHUTA KOTLI SATTIAN NATIONAL PARK, PAKISTAN.

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ABSTRACT

Understanding the distribution and diet of carnivore is important to consider ecological role of species. As food is a critical resource for carnivore predators and its partitioning among sympatric species is crucial for their coexistence. The current study aimed at exploring distribution, diet composition, and diet breadth, niche overlap among two sympatric mongoose species occurring in Murree Kahuta Kotli Sattian National Park (MKKNP). 82 fecal samples were collected from 23 sites and recognized to species inside field based on morphology, odor, and extra signs. Presence signs of both species recorded from 23 survey sites. However, field diagnosis of small Indian Mongoose and Indian grey mongoose indicated presence at 12 and 14 sites, respectively. Fourteen dietary items were recovered in diet of small Indian mongoose i.e rodents, plant matter, insects and reptiles. The diet of Indian grey mongoose also comprised of (15) dietary items. Among both sympatric carnivores overall dietary breadth of Indian grey mongoose is narrow (BA = 0.5). as compared to small Indian mongoose (BA = 0.6). Moderate overlap was found between both mongoose species (0.62)

Keywords: Small Indian mongoose, Indian Grey mongoose, Seasonal variation, Dietary breadth, Niche overlap.

Published first online April 30, 2022 Published final October 05, 2022

INTRODUCTION

Two species or populations are considered sympatric if they have overlapping geographic distributions (Rivas, 1964). Animals with sympatric distribution often compete for shared resources. This competition is overcome by segregating resources in the area where sympatric carnivores compete (Chamberlain and Leopold, 2005). For mammalian carnivores this competition may be especially strong for those taxa that are closely related, are similar in size, or have a similar foraging ecology. The competition leads predators to develop various strategies in choosing different prey size, variable time of the day or using different habitats. This change in strategies results in niche segregation, reducing competition and allowing coexistance of sympatric species (Sunsquist *et al*., 1989). Studying feeding biology of carnivores through direct observation under field conditions is impossible. Thus, analysis of scats is a noninvasive method usually used to study diet of carnivores (Reynolds and Aebischer, 1991; Ciucci *et al.,* 2004).

Mongoose are small carnivores belong to family Herpestidae. The small Indian mongoose (*Herpestes auropunctatus*) is broadly distributed in south Asia including Afghanistan, Pakistan, Kuwait, Iraq and India to Indochina (Hassinger, 1968; Harrison, 1968; Long, 2003; Wozencraft, 2005) Hainan Island, Java and southern Iran (Corbet and Hill, 1992). In Pakistan, small Indian mongoose is found in three provinces; Punjab, Sindh and Balochistan. In Punjab, it has been observed from districts Lahore, Kasur, Sialkot, Gujranwala and Jhelum, the Salt Range and meagerly in Bahawalpur division. It has not been recorded from Khyber Pakhtunkhwa province (Roberts, 1997).

Indian grey mongoose (Herpestres edwardsi) is widely distributed in Asia including India, Pakistan, Nepal, Afghanistan, Saudi Arabia and Iran (Ewer, 1973; Nowak, 2005; Francis, 2008; Gilchrist *et al*., 2009). It has been introduced to Japan and Peninsular Malaysia (Francis, 2008; Gilchrist *et al*., 2009). In Pakistan, it is common in central and northern parts of Sindh province, particularly inhabiting the desert tracts of Tharparkar. It also occurs in some parts of the Punjab (district Rawalpindi and the Salt Range). In Balochistan, Indian grey mongoose is sparsely found in the southern parts. It also occurs in Peshawar, Kohat, Buner and Bannu districts in the province of Khyber Pakhtunkhwa (Roberts, 1997; Akhtar *et al*., 2018). Both, small Indian mongoose and Indian grey mongoose are categorized as "Least Concern" (IUCN, 2015), and included in Appendix-III of CITES.

In order to assess role of particular carnivores in the ecosystem, it is obligatory to gain knowledge on carnivores' diet (Klare *et al*., 2011). This knowledge can provide understanding as to which predators are competing for the prey. Understanding how different species are interacting in the area and knowing which predators are competing for the same prey can help devising future management strategies. Predators can be

associated with each other by different ecological processes, depend on different factors i.e competition for resources, eating each other or have other controlling effects within the community (Polis *et al*., 1989).

In Murree Kahuta Kotli Sattian National Park (MKKNP) no baseline data is available on the distribution and feeding biology of these carnivores. Thus the present study would help to provide knowledge of diet composition, reliance on household and wild prey as food, diet breadth and diet overlap of two species in the area in order to take effective management and conservation measures.

MATERIALS AND METHODS

Study Area: Murree Kahuta Kotli Sattian National Park (MKKNP: 33° 21' to 34° 01' N and 73° 11' to 73° 38' E; district Rawalpindi, Pakistan) is situated on the north-western boundaries of the Himalayas, including large mountains and rivers with elevation ranges from 800 meters to greater than 2100 meters)(Khan, 1994). The climate is generally mild, with average June and January temperatures of 32 °C and 10 °C, respectively. Average yearly precipitation is 1249 mm, most of which falls within the summer monsoon season, which peaks in July (GOP, 2006).

The park contains three principal forest types: sub-tropical broad-leaf forest occurs at lower elevations, sub-tropical chir pine forest at 990-1,800 m asl, and a moist temperate coniferous forest with some admixture of oak and deciduous broad-leaved trees at above 1,800 m asl (Khan, 1994; Siddiqui *et al.,* 2010).

Major wildlife species of the park include common leopard (*Panthera pardus*) Jungle cat (*Felis chaus*), leopard cat (*Prionailurus bengalensis*)), golden jackal (*Canis aureus*), red fox (*Vulpes vulpes*), small Indian civet (*Viverricula indica*), yellow throated marten (*Martes flavigula*), Indian grey mongoose (*Herpestes edwardsi*) and small Indian mongoose (*H. auropunctatus*) (Roberts, 1997; Khatoon *et al.,* 2019).

Distribution of mongoose species: We gathered information from local people and park staff about the distribution and potential sites of mongoose species in the park based on which 23 sites were selected for data collection (Figure1) Scats were collected randomly on during each calendar month for 24 months between 2016 and 2018 (Khatoon *et al.,* 2019). Geographical coordinates and elevation facts were recorded for every site using a Garmin12 - Channel global positioning system (GPS) unit. We used physical caharacters of feces (scats) i.e (shape, length, distance across, structure-segmented/ un-segmented and scat contents- hair, bones, plant counts) identify mongoose species following Jackson and Hunter (1996). Extra standards covered the nature of scat store area and nearness of tracks or symptoms e.g presence of dynamic burrows of mongoose species. Further in the laboratory the size and diameter of the scats were recorded before analysis. (Table 1).

Distribution Mapping: Distribution of species was calculated based on their scats, direct sightings and locating active burrows. Distribution maps primarily based on presence information which was arranged using ArcGIS (ESRI, Redlands, CA, USA) software model 10.0. Fecal samples presence points were mapped based on field-identification localities.

Dietary Composition

Prey Identification: Diet composition of each carnivore was determined by macro and microanalysis of scats, with prey species identified from tooth and bone fragments and by comparing medulla and scales patterns on hair with reference hair slides of wild and domestic prey species occurring in the park (Bagchi and Mishra, 2006; Vanak and Gompper, 2009).

Collection of Reference Material: Hairs of prey species were collected from the Pakistan Museum of Natural History, Islamabad, and were in total tufts from diverse body parts to incorporate a representative sample of hair sorts for the potential prey species. This allowed for the development of a photographic reference key for 24 known species to identify the species preyed by mongoose. All potential mammalian prey species inhabiting the study area were included in the reference key.

Scat Analysis: The carnivore's diet was identified from scats analysis. Scat analysis is commonly used technique in dietary studies of carnivores (Joslin, 1973; Johnsingh, 1983; Ackerman *et al.,* 1984; Leopold and Krausman, 1986; Reynolds and Aebischer, 1991). Diet composition of each carnivore was determined by macro and microanalysis of scats, with prey species identified from tooth and bone fragments and by comparing medulla and scales patterns on the hair remains with reference slides.

Whole Mount Preparation: A bunch of hairs cleaned in carbon tetrachloride (CCl_4) were placed on microscope slide. Individual hairs were separated from each other to avoid untidy jumble of hairs on the slide. Cuticular scale designs of hairs and medullary structure were utilized to recognize the prey (Joslin, 1973).

Scale Replication: Individual hairs were cleaned in CCl_4. Casts of cuticular scales pattern of hairs were made with clear nail enamel polish (Vanak and Gompper, 2009). Two to three drops of medium were placed on a slide, and then a clean hair was placed vertical to the long axis of the slide, with one end of the hair projecting over the edge of the slide so it could be easily grasped for removal. The hair was removed using forceps, leaving the cast. Cuticular scale patterns of hairs and medullary

structure were compared with reference hairs from known species for identification.

Identification of plant matter: A part of carnivore di*et al*so comprises of plant matter (Farrell *et al.,* 2000; Shabbir *et al.,* 2013). Mostly plant matter in the samples was identified from seeds of different fruits found in the scats (Nadeem *et al.,* 2012). While we also performed micro histology for some of the samples. Fecal samples were ground within the laboratory by mortar and pestle. Samples were washed with slight warm water and splashed overnight in a arrangement (1 portion refined water, 1 portion ethyl alcohol, 1 portion glycerin) and pounded once more. Treated the samples by setting in 5 % sodium hydroxide. Further samples were treated with series of alcohol treatments each for 10 minutes i.e (25%, 50%, 75% and 100%). In the next step alcohol was removed and further samples were treated from series of xylene and alcohol mixtures (25%, 50%, 75% and 100% xylene) each for 10 min, except for 100%. Next day material was transferred to clean slide using DPX as mounting medium under a coverslip. Plant species was identified on the basis of shape, size, fibers, trichomes, stomata cells, cell wall, shape pattern and distribution of epidermal cells adjacent to guard cells (Bruno and Apollonio, 1991).

Table 1: Morphological characteristics of scats for small Indian mongoose and Indian grey mongoose

	Length (cm)	Diameter (cm)	Mass (g)	Shape
Indian grey mongoose	1.8±0.1	0.9±0.0	5.9±0.5	elongated/less blunt
small Indian mongoose	1.4±0.1	0.6±0.0	5.5±0.4	elongated/less blunt

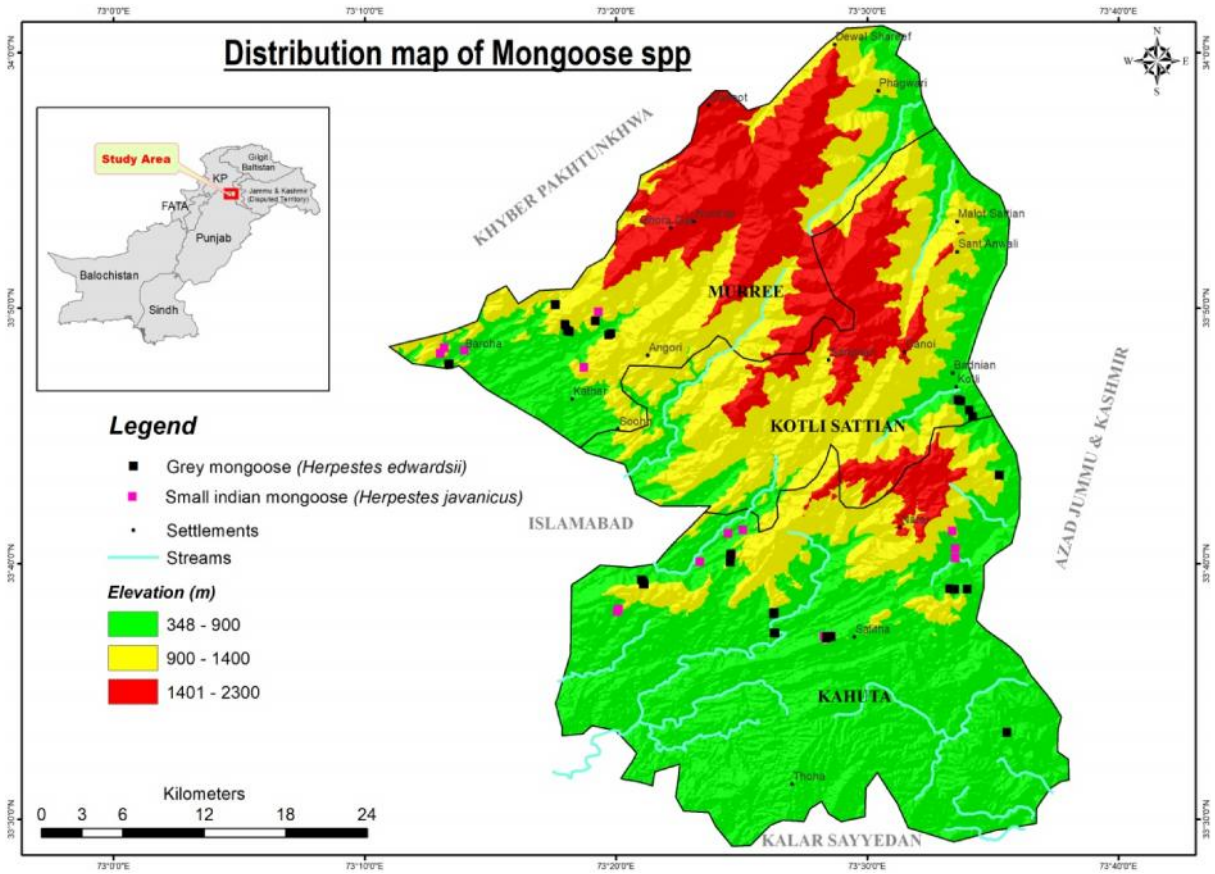

Figure 1: Locations of faecal samples of mongoose species (small Indian mongoose and Indian grey mongoose) in MKKNP.

Microphotography: Microphotographs of all reference hairs or plant cells were taken using a Leica DM1000 LED microscope. A photographic reference key of animal prey and plant species were developed for identification.

Quantitative Analysis: Scat samples of each carnivore species were categorized by season (Summer: April to

September; Winter: October to March). Each prey type in the diet was expressed as frequency of occurrence (FO), defined as

$$FO = S/N$$

where s is the number of occurrences of each prey type and N is the total occurrences of all prey types in all samples (Khatoon *et al.,* 2017; Khan *et al.,* 2017; Khatoon *et al.,* 2019)

For each carnivore species and season we calculated prey species diversity (H'), prey richness (S), the total number of animal prey species consumed by each carnivore in a specific season) and prey evenness (E, calculated as E = H'/lnS) (Khatoon *et al.,* 2019). Prey species diversity was calculated as

$$H' = -\Sigma [p_i \times \ln p_i]$$

where p_i represents the relative percentage of each prey item i.

Feeding niche breadth and niche overlap was calculated by using standardized indexes for each carnivore species occurring in the study area. We measured dietary niche breadth (BA) using Levins' (1968) index:

$$BA = \left(\frac{1}{\Sigma p^2}\right) - 1/n - 1$$

where *n* is the number of food items. Dietary niche overlap between the carnivore species was calculated by using Pianka's index (1973):

$$O_{jk} = \sum P_i \; P_{ij} \; / \sqrt{\left(\sum P_i^2 \sum P_{i_i}^2\right)}$$

where p_{ij} and p_{ik} are the FO of prey item i in the diet of species j and k, respectively (Pianka, 1973). Pianka's index varies between 0 (total separation) and 1 (total overlap). I compared the FO of each food item between species using a chi-square test (Reynolds and Aebischer, 1991).

RESULTS

Presence signs of two species were recorded from all 23 survey sites. small Indian mongoose and Indian grey mongoose presence was indicated at 12 sites (both species exist together) However, Indian grey mongoose was found at two additional sites i.e Samla and Tret where presence of small Indian mongoose was not confirmed. No sign of both species was recorded from nine selected sites including Angori, Phri Granda, Lower Topa, Badnia, Makrosh, Pathriata, Sant Anwali, Narrar and Brohi (Table 3). The detection variability of both species facilitates assessment of co-occurrence patterns. (Fisher exact statistic for small Indian mongoose and Indian grey mongoose, 0.772), there was no statistical support for non-random spatial segregation or co-occurrence ($p > 0.05$) indicating that the two species were more likely to co-occur than expected by chance alone. No sign of both species was recorded from nine selected sites including Angori, Phri Granda, Lower Topa, Badnia, Makrosh, Pathriata, Sant Anwali, Narrar and Brohi. Sample sites are shown in (Figure1).

Diet of Small Indian Mongoose: The diet of small Indian mangoose comprised of rodents, insects, reptiles and fruits. I identified 13 food items from 63 dietary items recovered from their scats. Animal matter was eaten more (60.3%) as compared to plant matter (32.4%). Among animal matter consumed, rodents were 27.9% in the diet, re house rat (*Ratuus rattus*) was the most dominant species (11.8%). Insects remained (17.6%) in the diet followed by reptiles (8.8%). Seeds appeared more frequently in scats compared with fleshy parts of the fruits. The most dominant fruit in the diet were *Ficus carica* (8.8%) followed by *Zizyphus mauritiana* (5.9%), *Phyllanthus emblica* (4.4%), *Syzygium cumini* (4.4%) and *Carissa opaca* (2.9%) (Figure 3).

Seasonal variation: We found strong seasonality in mongoose diet with significance difference for the consumption of plant matter in both seasons ($\chi^2 = 14.7$, $P < 0.05$, $df = 5$). Frequency of fruits was higher in summer (35.7%) and lower in winter (11.5%). While no significant difference was found in consumption of animal matter in both seasons with $p > 0.005$. Rodents were found higher in winter (38.5%) as compared to summer (21.4%), birds were higher in summer (7.1%) as compared to winter (3.8%) followed by insects higher in summer (17.5%) and low in winter (16.1%), Reptiles were also higher in summer (10.0) than winter (6.4%) (Table 1).

Prey species richness, diversity and evenness: Prey richness (S) for small Indian mongoose was found greater in summer (11) than winter (9). The diversity Index (H') showed that diet of small Indian mongoose SIM was found more diverse in summer (2.1) as compared to winter (1.8). Evenness index (E) indicated higher values in summer season (0.9) as compared to winter season (0.8) (Figure 2).

Diet of Indian grey Mongoose: We investigated diet of Indian grey mongoose from 40 collected scats. Among all dietary items, occurrence of animal matter was higher (78.7%) as compared to plant matter (16.67%). In total animal matter consumed, frequency of occurrence of rodents was (51.5%) followed by Insects (15.15%), reptiles (7.58%) and birds (4.5%). Similarly, in total plant matter consumed, stems were only (3.03%) while seeds of different fruits were higher in occurrence (13.64%), the most dominant were *Ficus carica* (4.5%) followed by *Phyllanthus emblica* (3.03%) (Figure 3).

Seasonal variation: Diet of Indian grey mongoose also showed strong seasonality in diet consumption like Small Indian mongoose. Among all mammals consumed in both seasons, frequency of rodents was higher in winter (54.9%) as compared to summer (48.6%). Insects

consumption was lower in summer (10.8%) as compared to winter (20%) followed by reptiles (10.8) in summer and (3.4) in winter. We identified significant difference in consumption of plant matter ($\chi^2 = 11.9$, $P < 0.05$, $df = 4$). Among all fruits eaten, frequency of different fruits were dependent on fruiting season. The most eaten fruits were *Ficus carica* (8.1%) (Table 2).

Prey species richness, diversity and evenness: Prey richness (S) for Indian grey Mongoose was found greater in summer (13) as compared to winter (10). According to diversity Index (H') more diversity was found in summer (2.3) compared to winter (1.9). The Evenness Index (E) showed high values during Summer season (0.9) and low in winter season (0.84) (Figure 3).

Dietary Breadth and Overlap: 42 scats of dmall Indian mongoose were analysed which revealed that this species prey on variety of small mammals, invertebrates, arthropods and reptiles. Combining both seasons, overall dietary breadth of small Indian mongoose was calculated as (BA = 0.6). Plant matter i.e fruits were significant proportion of the diet. Gray mongoose fed on both animal and plant matter. Overall dietary breadth of Indian grey mongoose was narrow (BA = 0.5) as compared to small Indian mongoose Diet overlap found between both mongoose species was (0.62).

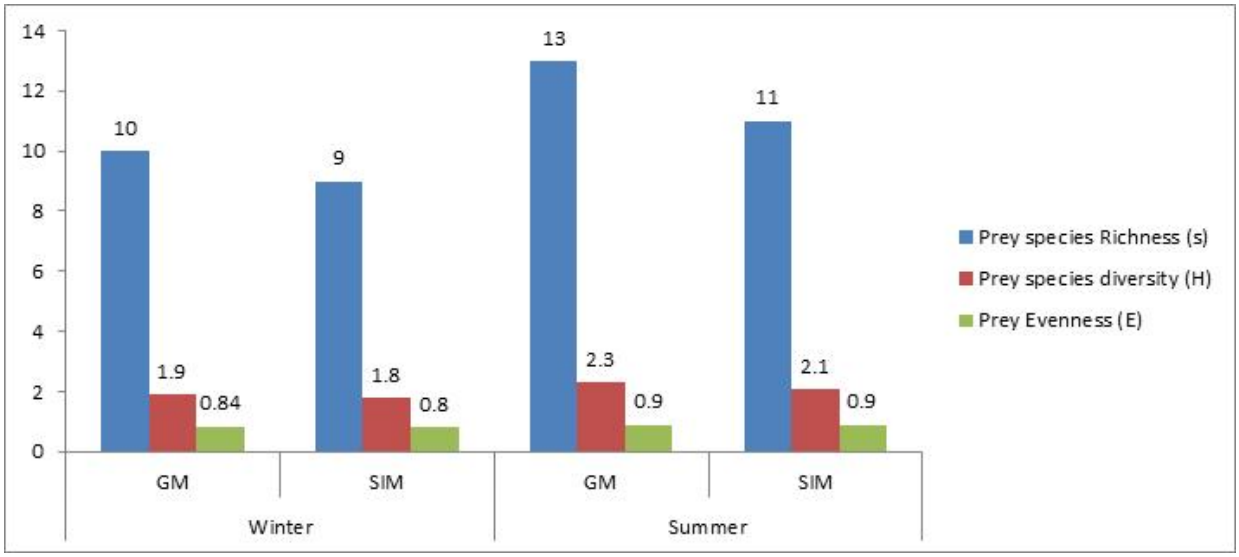

Figure 3: Realtive frequency (%) of prey species recovered from the scats of small Indian mongoose and Indian grey mongoose in MKKNP

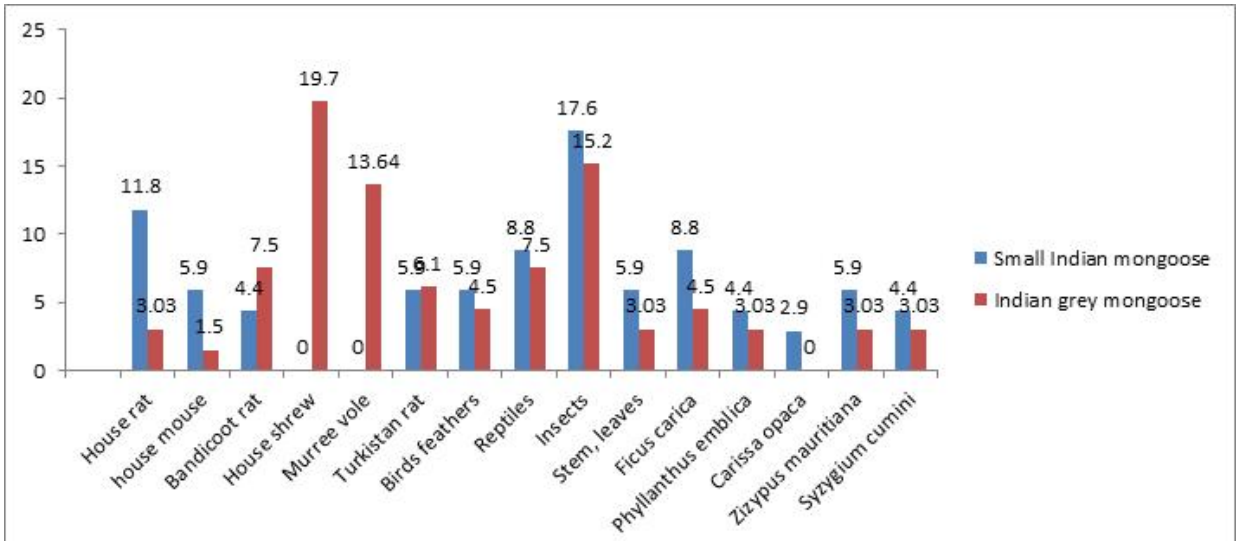

Figure 2. Prey species richness (S) prey diversity (H) and prey evenness (E) calculated for Small Indian mongoose (SIM) and Grey mongoose (GM) in summer and winter

Table 2: Diet composition and seasonal difference in the diet of Small Indian mongoose and Indian grey

mongoose.

	Small Indian mongoose			Indian grey mongoose		
Prey Items	Winter (%F)	Summer (% F)	Total (%F)	Winter (%F)	Summer (% F)	Total (%F)
Wild prey						
House rat	15.4	9.5	11.8	3.33	2.7	3.03
House mouse	3.8	7.1	5.9	0	2.7	1.52
Bandicoot rat	11.5	0	4.4	10	5.4	7.58
House shrew	0	0	0	17.2	21.6	19.7
Murree vole	0	0	0	13.7	13.5	13.64
Turkistan rat	7.7	4.8	5.9	10.3	2.7	6.06
Insects	19.2	16.7	17.6	20.6	10.8	15.15
Reptiles	7.7	9.5	8.8	3.4	10.8	7.58
Domestic Prey						
Birds feathers	38	7.1	5.9	0	8.1	4.55
Plant Matter						
Stem, leaves	7.7	4.8	5.9	3.4	2.7	3.03
Seeds						
Ficus carica	0	14.3	8.8	0	8.1	4.55
Phyllanthus emblica	11.5	0	4.4	6.9	0	3.03
Carissa opaca	0	4.8	2.9	0	0	0
Zizypus mauritiana	0	9.5	5.9	0	5.4	3.03
Syzygium cumini	0	7.1	4.4	0	5.4	3.03
Unidentified Matter						
	11.5	4.8	7.4	10.3	0	4.55

DISCUSSION

The large and mid-sized carnivore community of eastern parts of Pakistan remains ineffectively resolved, with generally a few detailed community surveys conducted in various regions. Such surveys are fundamental, as expanding human populace pressures result in landscape changes as well as decrease distribution of predator species (Sheikh and Molur, 2004). We identified the presence and distribution of two mongoose species;, small Indian mongoose *(H. auropunctatus)* and Indian grey mongoose *(H. edwardsii)* in MKKNP We recorded presence of small indian mongoose and Indian grey mongoose in 12 and 14 sites, respectively (Table 3) suggests the availability of prey objects to each species in the region whilst there are two sites where Indian grey mongoose is existing however small Indian mongoose do not prefer suggests each species are warding off each other in these sites depends upon the less availability of prey. However co-occurrence pattern in 12 common sites shows that each species has adopted the techniques to decrease the level of competition in order to co-exist in the same environment. Studies conducted elsewhere have suggested the similar mechanisms for coexistence of sympatric carnivores. Several carnivore studies revealed that closely related species have different habitat use, diet and activity pattern (Seidensticker, 1976, Bothman *et al.,* 1984, Sunquist *et al.,* 1989). This resource portioning is significant in ecological segregation compared to spatial and temporal difference in sympatric carnivores (Bothman *et al.,* 1984). Sympatric carnivores living in the same environment partition their food resources for co-existence (Jedrezejewski *et al.,* 1989).

In present study, diet composition, dietary breadth and niche overlap between two carnivore species was also identified in MKKNP. Various studies have been conducted in the world to study niche overlap of sympatric species for different groups of carnivores (Rabinowitz and Walker, 1991; Dayan and Simberloff, 1996; Jones and Barmuta, 2000; Glen and Dickman, 2006; Vieira and Port, 2006; Vanak and Gompper, 2009).

The diet of *H. auropunctatus* has been reported broad range from fruits, birds,and reptiles, eggs and rodents (Gorman, 1975 Abrrevitaed spell foe the two species will be convenient??, 1975; Nellis and Small, 1983; Hoagland *et al.,* 1989), carrion (Creekmore *et al.,* 1994) and salvaging edible material from the dung of large vertebrates (Haque, 1990). Diet analysis of *H. Auropunctatus* and *H. edwardsii* in MKKNP revealed the presence of small mammals, invertebrates, arthropods, reptiles and fruits. Among all animal matter consumed frequency of occurrence FO of rodents was higher in the diet of both species followed by plant matter, insects and reptiles. FO of rodents in the diet of *H. auropunctatus* constituted (27.9%) followed by insects (17.6%), reptiles (8.8%) and plant mattar (32.4%). Diet of Indian grey mongoose also comprised of rodents, birds, insects, reptiles and fruits. Rodents constituted (51.5%) followed

by insects (15.15%), reptiles (7.5%) and plant mattar (16.68%) in the diet of *H. edwardsii.* Animal matter was found more in the diet of both species as compared to plant mattar. Other studies conducted elsewhere also reported similar dietary items in the diet of mongoose species (Cavallin and Serafin, 1995; Feldhamer *et al.,* 1999) who reported that various predators i.e Herpestes, feed on a varied prey items including rodents and birds, reptiles insects and crabs. Some vegetable materials are also found in their diets, i.e fruits, and berries.

Diet of both species overlap with each other which may be due to having similar prey choices. Mongoose differs in their diet in order to maximize seasonal and spatial variation in food availability. An earlier study conducted in Mauritius identified that mongoose diet comprised of more insects in wet season, and reptiles are the dominant prey in dry season (Roy, 2001). This capability to take advantage of seasonal gluts in food availability is a common feature to many small carnivores (Joshi *et al.,* 1995; Lodé, 2000).

Strong seasonality was identified in consumption of both animal and plant matter in mongoose diet i.e frequency of occurrence of rodents, insects and reptiles were higher in summer as compared to winter. However, the consumption of fruits remained higher in winter as compared to summer. This can be either having higher nutrition value and important vitamins in the fruits which made it preferable for these species in winter or it may be depending upon the availability of other food items in winter season. These results are similar to the study of Cavallin and Serafin (1995) who concluded that winter diet of small Indian mongoose in Korcula was diverse, and dominated by vertebrate and plant matter. Prey species richness and diversity indices for both species suggested that prey species richness is higher in summer and mongoose diet was found more diverse in summer, however, the evenness indices showed higher values for winter season. This may depend on the availability of food in different seasons or spatial segregation of food resources between the species having similar diet for their co-existence.

Table 3 Locations and Species Detection Results (presence or absence) for 23 Survey Sites within MKKNP.

Site	Latitude	Longitude	*H .auropunctatus*	*H. edwardsii*
Angori	33°47.293	073°20.322	-	-
Phrigranda	33°49.005	073° 20.037	-	-
Baroha	33°49.464	073° 17.977	+	+
Kathar	33°48.366	073° 19.316	+	+
Numb	33°49.285	073° 18.819	+	+
Tret	33°50.110	073°17.585	-	+
Lower topa	33°54.433	073° 25.452	-	-
Thune	33°46.345	073° 33.727	+	+
Badnian	33°47.460	073°33.394	-	-
Makrosh	33°45.982	073° 34.083	-	-
Pathriata	33°50.814	073° 28.897	-	-
Dalithar	33°39.080	073° 20.844	+	+
Samla	33°40.045	073°24.55.2	-	+
SantAnwali	33°50.890	073° 34.237	-	-
Thoha	33°42.951	073° 04.882	+	+
Soohn	33°40.397	073° 33.461	+	+
Narar	33°42.394	073°31.592	-	-
Slitha	33°37.545	073°27.395	+	+
Karral	33°37.262	073°26.301	+	+
Sang	33°40.36	073°24.58	+	+
Bhroi	33°42.261	073° 34.354	-	-
Ghoon Bangla	33°33.128	073° 35.413	+	+
Jalatal	33°43.092	073°32.057	+	+

Conclusion: Current study conclude that diet of Small Indian mongoose was broader than Indian grey mongoose, both species have considerable overlap due to presence of similar prey items in the diet of both species which indicates potential of increase competition between small Indian mongoose and Indian grey mongoose in Murree Kahuta Kotli Sattian National Park, so there is dire need of conservation of their habitat and prey species, current study will provide the base line data about the distribution and diet composition of both species which is important step toward their conservation.

Acknowledgement: We are obliged to Higher Education Commission Pakistan for the funding support. We are

also thankful to Punjab Wildlife & Parks department for providing assistance in data collection during field survey.

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