



Food habits and temporal activity patterns of the Golden Jackal *Canis aureus* and the Jungle Cat *Felis chaus* in Pench Tiger Reserve, Madhya Pradesh, India

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The ability of ecologically similar species to coexist depends largely on the degree to which resources are limiting and how resources can be partitioned as the species become sympatric (Schoener 1974). Empirical studies dealing with mammalian carnivores showed that coexisting carnivores tend to have different dietary and activity patterns, indicating that it is a common phenomenon for coexisting species to have different niches (Maddock & Perrin 1993; Tatara & Doi 1994). In India, most of the studies on dietary and temporal activity patterns of carnivores have been carried out on large carnivores (Johnsingh 1983; Karanth & Sunquist 1995; Biswas & Sankar 2002; Andheria

et al. 2007; Edgaonkar 2008; Ramesh et al. 2009) and very few studies were carried out on meso-carnivores (Sankar 1988; Mukherjee 1989; Balasubramanian & Bole 1993; Mukherjee et al. 2004; Aiyadurai & Jhala 2006).

Food habits and temporal activity patterns of the Golden Jackal *Canis aureus* and the Jungle Cat *Felis chaus* were studied between January 2008 and June 2009 in Pench Tiger Reserve (PTR) (79°09'–79°22'E & 21°38'–21°50'N), Madhya Pradesh, central India. Pench Tiger Reserve connects Kanha with Satpura Tiger Reserve and forms a continuous forest patch in central India which offers one of the important habitats of large and meso-carnivores in the Indian subcontinent (Biswas & Sankar 2002; Qureshi et al. 2006; Acharya et al. 2007). The overall goal of the present study is (i) to determine the frequency of occurrence of different food items in the diet of these two meso-carnivores in PTR, (ii) to examine the implications of these diet profiles and temporal activity for understanding resource partitioning patterns and ecological sympatry among them in PTR.

The Pench Tiger Reserve comprises a national park (292km²), a sanctuary (118km²) and a reserved forest (348km²) covering an area of the 758km². Vegetation in the area is broadly classified as having both tropical dry deciduous and tropical moist deciduous forests (Champion & Seth 1968). Teak (*Tectona grandis* L.) and its associated species in the area represent a transition from tropical dry deciduous to tropical moist deciduous forests. The terrain is undulating in most areas of the tiger reserve (Biswas & Sankar 2002). Pench experiences markedly seasonal climate with a distinct summer (March–June), monsoon (July–September) and winter (October–February) and receives a mean annual rainfall of c. 1400mm. The temperature ranged from 2°C in winter to 49.5°C in summer during the study period.

The Golden Jackal (body weight 8–11 kg) (Prater 1980; Giannatos 2004) ranges from northern Africa and extends across the middle-east to India. The species is included in CITES Appendix II and Schedule III in the Wildlife (Protection) Act 1972 of India. The Jungle Cat (body weight 5–6 kg) has established itself over a wide range from northern Africa through south-western Asia to India, Ceylon and Indo-China

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(Prater 1980). It is included in CITES Appendix II and Schedule II of the Indian Wildlife (Protection) Act 1972. Apart from the Golden Jackal and the Jungle Cat, other carnivore species found in the study area are Tiger *Panthera tigris*, Leopard *Panthera pardus*, Dhols *Cuon alpinus*, Palm Civet *Paradoxurus hermaphrodites*, Ratel *Mellivora capensis*, Small Indian Civet *Viverricula indica*, Common Mongoose *Herpestes edwardsii* and Ruddy Mongoose *Herpestes smithii* (Biswas & Sankar 2002). Rodent species found in the study area are Indian Gerbil *Tatera indica*, Flat Haired Mouse *Mus platythrix* and Bush Rat *Golunda ellioti* (Dungariyal 2008).

The diets of the Golden Jackal and the Jungle Cat can be studied through scat analysis (Reynolds & Aebischer 1991; Mukherjee et al. 1994; Mukherjee et al. 2004). A total of 50 Golden Jackal scats and 85 Jungle Cat scats were collected wherever encountered from the intensive study area (292km²). Scats were mostly collected on roads (65% Golden Jackal scats and 56% Jungle Cat scats), trails (19% Golden Jackal scats and 34 % Jungle Cat scats) and dry stream beds (16% Golden Jackal scats and 10% Jungle Cat scats). Jackal and Jungle Cat scats were identified by their size, shape and associated signs (Weaver & Fritts 1979; Green & Flinders 1981; Danner & Dodd 1982; Mukherjee et al. 2004). Scats, once collected from the field were washed and dried. Hair and prey remains were compared with reference slides and other body parts of different prey species available at the Wildlife Institute of India laboratory.

We used Pianka’s index (Pianka 1973) for measuring diet overlap between predators.

$$O_{AB} = \sum p_{iA} * p_{iB} / (\sum p_{iA}^2 + \sum p_{iB}^2)^{1/2}$$

where, pi is the relative frequency of prey item i in the diet of species A and B. This index (O) ranges in value from 0 (indicating no overlap) and 1 (complete overlap).

Information on temporal activity pattern was obtained using camera traps (Gompper et al. 2006; Long et al. 2008). Fifty-two pairs of self-triggered analog cameras (DEER CAM™) were deployed in each 2km x 2km grid in the intensive study area (21.07^o–21.08^oN & 79.02^o–79.5^oE), close to animal trails, between March and June for two successive years. Entire camera trap area (>250 km²) covered a homogeneous teak-mixed and undulating habitat. The cameras had a 35mm lens, and recorded the date and time of each

photograph. The camera delay we kept at a minimum (15 seconds) and sensor activity was set high. We maximized our effort to select the best site for deploying camera traps as per sign intensity of study species and no bait was used to attract the animals. Based on the exact time of the photo-capture for the total number of identified individuals of Golden Jackal and Jungle Cat were pooled into six time categories: 12:00–16:00 hr; 16:01–20:00 hr; 20:01–00:00 hr; 00:01–04:00 hr; 04:01–08:00 hr and 08:01–12:00 hr.

Student t-test (Zar 1984) showed no significant difference on both dietary (p=0.06) and activity pattern (p=0.08) of these two meso-carnivores between two seasons (summer and winter) so we pooled the data of both into one to analyze them for the present study. The analysis of scats revealed the presence of 10 prey species in the Golden Jackal and eight prey species in the Jungle Cat diets (Table 1). Rodents contributed the maximum in the diet of the two predators (40% in Golden Jackal and 63.6% in Jungle Cat). In Jackal scats, 86% contained single prey type, 12% contained two prey types and 2% contained three prey types. For Jungle Cat scats, 84.7% of the scats contained single prey type, 14.1% contained two prey types and 1.2% contained three prey types. The estimated dietary overlap between jackal and jungle cat was 0.9 (90%) (Table 2).

Table 1. Percentage frequency of food items recorded in scats of Golden Jackal and Jungle Cat in Pench Tiger Reserve, Madhya Pradesh.

Food item	No. of scats (Golden Jackal)	% frequency of occurrence	No. of scats (Jungle Cat)	% frequency of occurrence
Rodents	22	40	63	63.6
Langur <i>Semnopithecus entellus</i>	3	5.4	1	1
Hare <i>Lepus nigricollis</i>	6	10.9	11	11.1
Chital <i>Axis axis</i>	13	23.6	6	6.1
Sambar <i>Rusa unicolor</i>	1	1.8	2	2
Nilgai <i>Bosephalus tragocamelus</i>	2	3.6	0	0
Wild Pig <i>Sus scrofa</i>	1	1.8	1	1
Birds	2	3.6	7	7.1
Reptiles	4	7.2	8	8.1
Cattle	1	1.8	0	0

0 - Not present

Table 2. Dietary overlap between Golden Jackal and Jungle Cat as shown by scat analysis in Pench Tiger Reserve, Madhya Pradesh.

Food items	p_{IA}	p_{IB}	C	D	E
Rodents	40	63.6	2544	1600	4044.9
Langur	5.5	1	5.4	29.7	1
Hare	10.9	11.1	121.1	119.1	123.2
Chital	23.6	6.1	144.2	558.6	37.2
Sambar	1.8	2	3.6	3.3	4
Wild pig	1.8	1	1.8	3.3	1
Birds	3.6	7.1	25.8	13.2	50.4
Reptiles	7.3	8.1	58.9	52.8	65.6
			2904.9 (F)	2380.2 (G)	4327.4 (H)
				48.7 (I)	65.7 (J)
					0.90 (L)

p_{IA} - percentage of food item i in the diet of golden jackal; p_{IB} - percentage of food item i in the diet of jungle cat; $C = p_{IA} * p_{IB}$; $D = p_A^2$; $E = p_B^2$; $F = \sum C$; $G = \sum D$ and $H = \sum E$; $I = G^0.5$; $J = H^0.5$; $L = F / (I * J)$; L = Dietary overlap.

Eight-thousand-five-hundred-and-sixty camera trap nights revealed 49 Golden Jackal captures and 189 Jungle Cat captures. G-test showed (Zar 1984), Golden Jackal and Jungle Cat had different activity patterns ($\chi^2 = 28.6$, degree of freedom or $df = 5$, $P = 0.0005$) (Fig. 1). The Golden Jackal had two major activity peaks, one in the early morning (04:01–08:00 hr) and the other at night (20:01–00:00 hr). The Jungle Cat was found active mostly in the night hours (20:01–00:00 hr) and (00:01–04:00 hr).

Scat analysis revealed that these two meso-carnivores primarily consumed mammals (>80%). Rodents formed the most important prey in their diet especially in the case of the Jungle Cat (Table 1, Image 1). The nocturnal habits of the Jungle Cat might be one of the reasons why they consume more rodents which are largely nocturnal as compared to the Golden Jackal. A similar observation was made by Mukherjee et al. (2004) in Sariska Tiger Reserve. The Golden Jackal also might have scavenged on carcasses of large and medium sized mammals such as Chital *Axis axis*, Sambar *Rusa unicolor*, Nilgai *Bosephalus tragocamelus*, Wild Pig *Sus scrofa* and Common Langur *Semnopithecus entellus* (Image 2). As the Golden Jackal is a group living canid (Lanszki & Heltai 2010) the observed hairs of Chital in the jackal diet might also be the result of predation on chital fawn. On several occasions, jackals were found chasing chital fawns

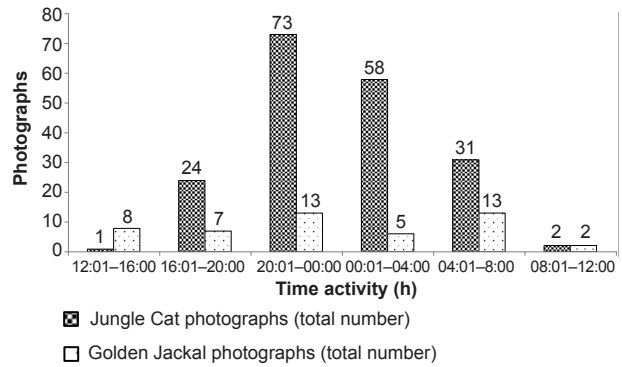


Figure 1. Golden Jackal and Jungle Cat overall temporal activity pattern in Pench Tiger Reserve, as determined from camera trap data.



Image 1. Jungle Cat carrying a rodent in Pench Tiger Reserve, Madhya Pradesh.

and killing them in the study area. Though there was no livestock grazing in the study area, the observed occurrence of livestock remains in Golden Jackal scats during the study period were possibly due to scavenging in surrounding villages. Remains of reptiles and rodents up to species level could not be identified in the scats of jackal and jungle cat because of time constraints. Remains of birds such as doves *Streptopelia* sp. and partridges (*Francolinus* sp.) were identified in the scats of the jackal and the jungle cat. Seeds of *Dyosphyros melanoxylon* and *Zyzyphus mauritiana* were identified in jackal scats. Similar findings were also reported from other areas (Sankar 1988; Balasubramanian & Bole 1993; Mukherjee et al. 2004). Although a high degree of overlap was observed between these two sympatric species, there was an overall difference in dietary composition as smaller body sized rodents and birds were found more in the diet of the Jungle Cat (71%) than in that of the Golden Jackal



Image 2. Golden Jackal feeding on Hanuman Langur in Pench Tiger Reserve, Madhya Pradesh.

(48%), utilization of fruits by the jackal and variation in temporal activity patterns enabled them to coexist in Pench. A long term ecological study is the need of the hour on these mesocarnivores covering population estimation, seasonal food habits and temporal activity patterns using comparable scientific methods

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