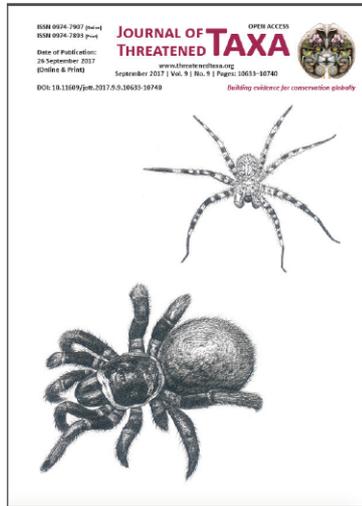


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### COMMUNICATION

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## WINTER FOOD HABITS OF THE GOLDEN JACKAL *CANIS AUREUS* (MAMMALIA: CARNIVORA: CANIDAE) IN PATNA BIRD SANCTUARY, UTTAR PRADESH, INDIA

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### OPEN ACCESS



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**Abstract:** Golden Jackal *Canis aureus indicus* survives in a wide range of environment. Its foraging adaptation varies according to the quality and abundance of food sources and according to season and habitat. This study investigated the diet composition of Golden Jackal using scat analysis method between November 2012 and April 2013 from Patna Bird Sanctuary (PBS), Uttar Pradesh, India. A total of 83 scats of Golden Jackal were collected and analysed. Sixteen food items were identified in Golden Jackal scats. Birds contributed maximum (ca. 38.92%) in Golden Jackal diet followed by rodents (ca. 12.14%), insects (ca. 8.92%), reptile (ca. 8.57%), vegetative matter (ca. 13.56%), Rufous-tailed Hare (ca. 6.07%), cattle (ca. 2.5%), squirrel (ca. 1.42%), Nilgai (ca. 1.07%) and Common Palm Civet (ca. 0.71 %). About 6.07 % of the prey items, however, could not be identified. Out of ca. 38.92% in bird contribution to the diet composition, Egret alone contributed ca.20.35% followed by Garganey ca. 8.93%, Greater Cauca ca. 5.71%, Babbler ca.1.07% and ca. 2.85% remains of birds could not be identified at the species level.

**Keywords:** Food habits, Golden Jackal, Patna Bird Sanctuary, scats.

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**Author Contribution:** The data was collected by NM and KAK while the analysis and paper writing is performed by KAK under the supervision of JAK.

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## INTRODUCTION

Golden Jackal is one of the broadly distributed canid species, occurring in many regions of central, eastern, and southern Europe, northern part of Africa and parts of Asia with a range widening from the Arabian Peninsula into western Europe and east into Middle East, Turkey, Central Asia, the whole Indian subcontinent south to Sri Lanka, and east to Myanmar, Thailand, and some parts of China (Prater 1980; Sillero-Zubiri et al. 2004; Jhala & Moehlman 2008; Katuwal & Dahal 2013).

Thirteen sub species of the Jackal are found worldwide (Wozencraft 2005) out of which three races *Canis aureus indicus*, *Canis aureus naria*, and *Canis aureus aureus* are distributed in the Indian subcontinent. Golden Jackal *Canis aureus indicus* (Image 1) is widely distributed in India. It is an omnivorous, opportunistic forager as well as a scavenger in habit. The diet of the Golden Jackal varies according to season and habitat (Schaller 1967; Jhala & Moehlman 2004; Mukherjee et al. 2004; Alam et al. 2015). Their diet consists of a range of prey species, vegetative matter, fruits and is very flexible depending on the local availability of food items. Golden Jackals are included in Appendix III in CITES and Schedule III of the Wildlife (Protection) Act 1972 of India (Anonymous 2002). The diet of the Golden Jackal includes vegetation, insects, reptiles, birds, rodents and lagomorphs. It preys upon young ones of domestic or wild ungulates and also scavenges (Demeter & Spassov 1993; Jhala & Moehlman 2008). As a scavenger it keeps the environment clean, apart from contributing in many ways to balance the ecosystem (Prater 1980).

Patna Bird Sanctuary (PBS) in Uttar Pradesh is an Important Bird Area (IBA), known for migratory birds. This protected area has a good population of meso-carnivores including Golden Jackal *Canis aureus indicus*, Jungle Cat *Felis chaus*, Fishing Cat *Prionailurus vivverinus*, Indian Fox *Vulpes bengalensis* and Common Palm Civet *Paradoxurus hermaphrodites*. Very little information is available on the ecology including food habits of these meso-carnivores of this area which have a large impact on the migratory bird population in the sanctuary. The preliminary study of the food habits of the common palm civet in PBS has indicated that birds did not contribute significantly to the diet of common palm civet (Khan et al. in press) while it contributes a major part to the Golden Jackal's diet. This study was initiated to find out the frequency of occurrence of different food items in the diet of Golden Jackal in PBS.



Image 1. Golden Jackal *Canis aureus indicus*

## MATERIALS AND METHODS

### Study Area

Patna Bird Sanctuary is situated in Jalesar Tehsil of Etah District in Uttar Pradesh (27.52656 N & 78.32003 E) (Fig. 1) with an area of 109ha which contains a small pool (jheel) along with the track of the Date Palm Trees *Phoenix sylvestris*. The bird sanctuary is named after the village Patna which is situated beside the sanctuary. Patna jheel is a typical rain fed wetland that can be categorised as a natural freshwater shallow wetland or Jheel (Rahmani & Daniel 1997). The eastern part of the sanctuary is covered with dense Date Palm Trees while the boundary of the sanctuary and trails are covered with *Prosopis juliflora*.

More than 180 species of birds were reported from PBS (Ahmad & Javed 2000). Thousands of migratory birds visit this IBA site every winter. The Golden Jackal along with the Jungle Cat, Fishing Cat, Indian Fox and Common Palm Civet are common meso-predators in the area. The study area also has ample prey species like Indian Bush Rat *Golunda ellioti*, Rufous-tailed Hare *Lepus nigricollis ruficaudata* and young ones of Nilgai *Boselaphus tragocamelus* for mesocarnivores.

The vegetation in the sanctuary consists of *Phoenix sylvestris*, *Prosopis juliflora*, *Ficus religiosa*, *Ficus recemosa*, *Acacia* spp., *Ziziphus* spp., *Pithecelobium dulce*, *Moras alba*, *Dulbergia sissoo* and *Azadiracta indica*. Besides these woody plant species the sanctuary contains aquatic vegetation consisting of *Hydrilla verticillata*, *Salvinia*, *Azolla*, *Ceratophyllum demersum*, *Vallisneria spiralis*, *Potamogeton crispus* and *Eichhornia crassipes*. *Ipomea carnea* and *Ipomea aquatica* grow in excess in the outer reaches of the wetland.



**Figure 1. Location map of Patna Bird Sanctuary (PBS), Etah, Uttar Pradesh, India**

## METHODS

It is very complex to find each prey item contributing to the diet of a carnivore species by direct observation in the field. Thus scat analysis method is broadly used to find out food habits of carnivores because of its non invasive nature, easy collection and analysis (Korschgen 1980; Ackerman et al. 1984; Reynolds & Aebischer 1991). As a result scat analysis method was used to determine the food habits of Golden Jackal in PBS.

The scats were randomly collected from the travel routes, carcass sites, trails and den sites which were present in different habitat types of the Sanctuary. Individual Golden Jackals sighted regularly through out the Sanctuaty during the study period numbered 2–8. The scats of Golden Jackal were distinguished from other carnivores (e.g., Common Palm Civet, Indian Fox, stray dogs, Fishing Cat and Jungle Cat) on the basis of their size, shape and associated signs (Weaver & Fritts 1979; Green & Flinders 1981; Mukherjee et al. 2004; Majumder et al. 2011; Nadeem et al. 2012). Ambiguous scats were avoided during data collection.

The scats were collected between November 2012 and April 2013 from the entire PBS and stored in zipped polythene bags. Necessary field information like the habitat type, GPS coordinates, time and date of collection were recorded. The collected scats were sun dried, washed in running tap water with a sieve. The remains like hairs, feathers, seeds, bones, claws, hooves, teeth, grasses were separated and sun dried for identification of species and observed through microscope and macro

lens (Lockic 1959; Korcschgen 1980; Mukherjee et al. 1994; Jethva & Jhala 2003). Hairs are most important to identify prey species consumed by the predators. Different species have dissimilar shape, size, structure of medulla and cuticle in hairs (Teerink 1991). In this method at least 20 hairs are picked randomly from each scat and are treated with xylene in order to see the clear structure of the medulla (Mukherjee et al. 1994; Jethva & Jhala 2003). Accordingly, hairs from study samples were mounted on a permanent slide and observed under the microscope to identify the prey species. The hairs were compared with the already made reference slides (hairs were collected during the study period from PBS) and hair guard manual (Bahuguna et al. 2010). The birds were identified from the remains of bones and feathers while the reptiles were identified from the bones and teeth found in the scats as suggested in Moehlman (1983, 1986). The checklist of avian fauna of PBS were used to identify the birds (Narendra 2013). The percentage of occurrence of a prey item was calculated as the number of items of a specific prey item were found to occur in scat and presented as a percentage of all prey occurrences (Weaver & Fritts 1979; Ackerman et al. 1984). The frequency of occurrence of prey species in the scat was calculated as the number of occurrence of each prey item divided by the total number of scat analyzed and expressed as a percentage (Corbett 1989; Jethva & Jhala 2003). The standard error (SE) was calculated from the percentage occurrence of each prey species and 95% confidence interval was obtained by multiplying the SE by 1.96 (Fowler et al. 2006).

**RESULTS**

A total of 83 scats were analysed and 16 prey items were recorded in the Golden Jackal’s diet in PBS. The occurrence of number of prey items in the Golden Jackal’s diet and the number of prey species per sample recorded in the scat varied between one to six prey items (Table 1). The results indicate that 38.55% samples comprised two prey items followed by three prey items in 22.89% samples, four prey items in 19.27% samples and five prey items in 8.43% samples (Table 1).

The study indicates that among scat samples containing bird remains, egrets were found to be the most common. Occurrence of Egret was 20.35% followed by Gargeny with 8.53% and Greater Coucal 5.71%; however, 2.85% scat samples containing presence of bird in the diet remained unidentified. Among mammals, rodents contributed the maximum with 12.14% occurrence followed by Rufous-tailed Hare 6.07%, cattle 2.5%, squirrel 1.42%, Nilgai 1.07% and Common Palm Civet 0.71% in Golden Jackal’s diet. Reptiles and insects contributed 8.57% and 8.92%, respectively, whereas, vegetative matter mainly fruits of *Prosopis juliflora*, *Ziziphus* sp., *Phoenix* and grasses contributed 13.56% (Table 2 and Fig. 2).

The occurrence frequencies show that aves constitute the most consumed class with 38.92%, followed by mammals 23.93%, vegetative matter 13.56%, insects 8.93%, reptiles 8.58% and unidentified 6.07% (Fig 3).

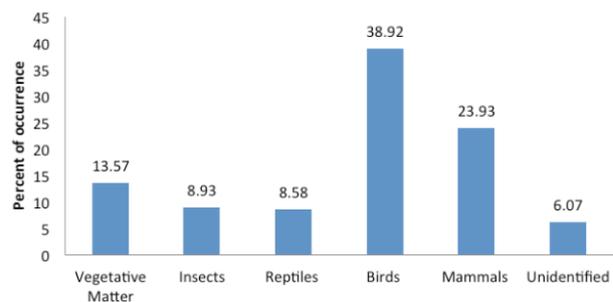
**DISCUSSION**

A precise knowledge of a carnivore’s diet is essential to assess the species’ role in the ecosystem, potential competition with other carnivores and impact on prey populations (Klare et al. 2011). Results of diet analyses therefore might have a far-reaching impact on the development of carnivore management plans, especially if economically important or endangered species are involved. But direct observations of feeding behaviour are often impossible under field conditions. Scat analysis is one of the primary tools used to assess carnivore diets, especially when focusing on individual prey items. Scat analysis has been used to know the dietary composition of major carnivores through out the world (Schaller 1967; Jethva & Jhala 2004; Giannatos et al. 2005; Habib 2007; Nadeem et al. 2012).

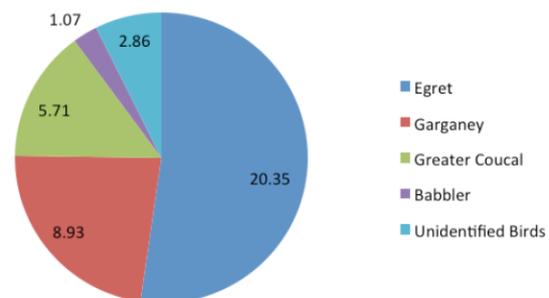
Patna Bird Sanctuary encompasses ample number of prey items for the Golden Jackal. The high concentration of birds in the scats confirm high bird consumption. There is high congregation of birds in PBS during the winter,

**Table 1. Occurrence of number of prey item in the scat of Golden Jackal in PBS.**

Number of prey items	Number of scat samples with specified category (column-1)	Percentage of scat samples in the category (2)
(1)	(2)	(3)
One	06	7.22
Two	32	38.55
Three	19	22.89
Four	16	19.27
Five	07	8.43
Six	03	3.61
Total	83	



**Figure 2. Frequency of occurrence of different food items in the scat of Golden Jackal in PBS (n=280).**



**Figure 3. Percentage of occurrence of bird species in Golden Jackal diet in PBS (n=280).**

however, low content of birds in the scat of Golden Jackal was found in other studies (Demeter & Spassov 1993) and it may be due to the seasonal variation, availability of other easy prey and observations from long duration studies.

Egrets appear to have provided the best opportunity as food in the search area of jackals in Patna Bird Sanctuary. Previous research indicates that the flexibility of jackal in their food selection and their ability to adopt suitable foraging behaviour enable them to survive in a

**Table 2. Overall diet composition of Golden Jackal in PBS (n=280).**

Prey Items	Count of occurrence	Frequency of occurrence $\pm$ CI	Percentage of occurrence
Egret	57	68.67 $\pm$ 5.34	20.35
Garganey	25	30.12 $\pm$ 1.01	8.93
Greater Coucal	16	19.27 $\pm$ 0.20	5.71
Babbler	03	3.61 $\pm$ 1.96	1.07
Unidentified birds	08	9.63 $\pm$ 1.29	2.85
Reptiles	24	28.91 $\pm$ 0.87	8.57
Grass	19	22.89 $\pm$ 0.19	6.78
Fruit	19	22.89 $\pm$ 0.19	6.78
Insect	25	30.12 $\pm$ 1.01	8.92
Rufous-tailed Hare	17	20.48 $\pm$ 0.07	6.07
Cattle	07	8.43 $\pm$ 1.42	2.5
Nilgai	03	3.61 $\pm$ 1.96	1.07
Squirrel	04	4.81 $\pm$ 1.83	1.42
Rodents	34	40.96 $\pm$ 2.22	12.14
Civet	02	2.4 $\pm$ 2.10	0.71
Unidentified hair	17	20.48 $\pm$ 0.07	6.07
Total	280		

wider range of habitats (Stuart 1976).

Golden Jackal is one of the meso-carnivores which is an omnivorous and opportunistic forager. The diet of Golden Jackal varies according to season and habitat (Jethva & Jhala 2003). This study demonstrates the broad range of prey items in the Golden Jackal diet. The winter food habits of Golden Jackal shows 16 prey items in its diet. In similar studies 12 food items were investigated in Golden Jackal diet (Alam et al. 2015).

The diet spectrum of the Golden Jackal shows a multiple number of prey items (Jethva & Jhala 2004; Nadeem et al. 2012; Alam et al. 2015). A study in Africa indicates that its diet comprises invertebrates and fruits, however 60% of their diet comprises lizards, snakes, birds, rodents, hares, and Thomson's Gazelle *Gazella thomsoni* (Wyman 1967; Moehlman 1983, 1986). The birds (Egrets, Garganey, Babbler, Yellow-footed Green Pigeon, Common Teal and Grey Francolin) encompass a major part (38.92%) in the diet of Golden Jackal as observed in the present study. A similar study in Keoladeo National Park (KNP), Bharatpur indicate that the Golden Jackal's diet is dominated by rodents (26.5%) followed by birds (24.1%) (Sankar 1988). The content of rodents found in Jackal scats in KNP confirmed the significance of rodents as a prey item throughout the year. Several other studies conducted in different protected areas of the Indian subcontinent indicate that vegetative matter

(grasses, pods of *Prosopis juliflora* and *Cassia fistula*, fruits of *Ziziphus* spp. and *Syzgium cumini*), are another important component of Golden Jackal diet's (Schaller 1967; Mukherjee 1989; Gupta 2006; Majumder et al. 2011; Nadeem et al. 2012; Alam et al. 2015).

Feeding on small mammals by jackal is reported in a number of studies in Asian (Demeter & Spassov 1993; Mukherjee et al. 2004; Jaeger et al. 2007) and the African continents (Lamprecht 1978; Goldenberg et al. 2010) and European agricultural areas (Lanszki et al. 2006; Lanszki & Heltai 2010). The presence of cattle, Nilgai and civet in the scat of Golden Jackal in the present study indicate scavenging on carcasses. The presence of insect remains in the scat confirms that those insects that were capable of attracting the attention of the jackal and had hard exoskeletons would appear in the scats of Golden Jackal (Giannatos et al. 2010). Jackals are known to feed on insect larvae as well, but their remnants do not appear in the scat (Kaunda & Skinner 2003). The presence of plastic remains also reveals the tendency of jackals to frequent human settlements in search of food reflecting dependency of these animals on human leftovers (Alam et al. 2015).

PBS is a popular bird sanctuary and thousands of migratory as well as residential birds congregate in winter. So it is easier to predate on birds rather than searching for other prey items. The time and energy costs needed to search and successfully hunt a certain prey species have to be compensated by the resulting energy intake. Therefore, Golden Jackal choose birds as they require less searching time and have more nutrient value than the rodents. A long term ecological study is required to know the food habits of all meso-carnivores found in PBS and assess their impact on migratory birds.

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