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Short Communication

Food habits of tiger (*Panthera tigris tigris*) as shown by scat analysis in Bandhavgarh Tiger Reserve, Central India

Balasubramaniam Navaneethan[1,2]*, Kalyanasundaram Sankar[3], Manas Manjrekar[4] and Qamar Qureshi[1]

[1]*Wildlife Institute of India, P.O. Box # 18, Chandrabani, Dehra Dun – 248001, Uttarakhand, India*
[2]*Vanashree Nature Conservation, Coimbatore – 641005, India*
[3]*Salim Ali Centre for Ornithology and Natural History, Anaikatty P.O., Coimbatore, Tamil Nadu – 641108, India*
[4]*Mangrove Cell, Maharashtra Forest Department – 400051, India.*

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INTRODUCTION

Tiger (*Panthera tigris*) is a large terrestrial carnivore found in diverse habitat types showing remarkable tolerance to variation in altitude, temperature and rainfall (Schaller, 1967; Sanquist *et al.,* 1999). Being an umbrella species, its effective conservation enhances survival prospects for other forms of biodiversity (Karanth, 2003). In carnivores, the life history strategies largely depend on several factors like food, spacing pattern, habitat selection, distribution and movement pattern (Bekoff *et al.,* 1984; Sunquist & Sunquist, 1989) and among them, food is a vital resource for carnivores (Jedrezejewski *et al.,* 1989). Carnivores, especially tigers are morphologically specialized to kill large bodied prey species (Schaller, 1967). Especially tigers prey upon large to medium bodied ungulates in all the ecosystems in which they occur (Seidensticker, 1997; Karanth, 2003). They can potentially hunt prey varying from small mammals to the largest of the bovids (Biswas & Sankar, 2002). Although tigers do kill smaller prey, ranging from peafowl to prawns, they cannot survive and reproduce if a habitat does not support adequate densities of ungulates (Sunquist & Sunquist, 1989). Food habits are of basic importance when trying to understand the ecology and natural history of carnivores (Miquelle *et al.,* 1996). Studies on tiger prey selection have been scarce in tropical forests (Schaller, 1967; Griffiths, 1975; Johnsingh, 1983; Rabinowitz & Nottingham, 1986; Emmons, 1987; Rabinowitz 1989, Biswas & Sankar 2002; Ramesh *et al.,* 2009; Majumder *et al.,* 2012).

Study area

Bandhavgarh Tiger Reserve (BTR) (23°30' to 23°47' N and 80°47' to 81°11' E) lies on the extreme north-eastern border of the Madhya Pradesh State in Central India, and the northern flanks of the eastern Satpura Mountain range. BTR comprises of two conservation units, the National Park (448.842 km^2) and the Panpatha Wildlife Sanctuary (245.842 km^2). The altitude of the Park varies between 410 m and 811 m. The terrain is of rocky hills rising sharply from the swampy and densely forested valleys in the lowland. The vegetation consists of dry deciduous forest (Champion & Seth, 1968). Bandhavgarh supports a diverse assemblage of medium to large bodied prey species, such as chital (*Axis axis*), sambar (*Rusa unicolor*), gaur (*Bos gaurus gaurus*), wild pig (*Sus scrofa*), muntjac (*Muntiacus muntjak*) and nilgai (*Boselaphus tragocamelus*). In addition, several smaller prey species such as common langur (*Semnopithecus schistaceus*), rhesus macaque (*Macaca mulatta*), Indian hare (*Lepus nigricollis*), porcupine (*Hystrix indica*) also occur.

MATERIALS AND METHOD

Tiger scats were collected from roads and trails from the study area from March 2011 to February 2013. A total effort of 1110.55 km (879.30 km roads and 231.25 km trails) were walked /covered by vehicle systematically at least once every month through the study period for tiger scat collection. The length of the road/ trail varied from 1.6 Km to 14.3 Km. Tigers prefer to use roads or animal trails as travel routes and are likely to leave scats and tracks on such routes (Smith *et al.,* 1989; Karanth & Nichols, 2000). The collected scats were identified from those of other predators, particularly those of leopard, based on associated signs and tracks, size and appearance. Scats of tigers have a lower degree of coiling and relatively larger distance between two successive constrictions within a single piece of scat (Johnsingh, 1983). The collected scats were washed in order to remove the prey remains (hairs, claws and bones) and dried in sunlight for two to three days before microscopic examinations (Sunquist, 1981; Mukherjee *et al.,* 1994a & b, Karanth & Sunquist, 1995). To identify the prey species in the tiger scats a minimum of 20 hairs were randomly picked up from each scat for the preparation of slides. The hairs of the prey species were sampled following Mukerjee *et al.,* (1994a) and compared with reference slides in the laboratory collection of Wildlife Institute of India, Dehradun, India.

Quantification of the diet was based on both frequency of occurrence (proportion of total scats in which an item was found) and percent occurrence (number of times a specific item was found as a percentage of all items found) (Ackerman *et al.,* 1984). The biomass and number of individuals of the prey species consumed by tiger was estimated using Ackerman's equation (Ackerman *et al.,* 1984). The equation used was Y=1.980+0.035X, where Y = kg of prey consumed per

*Corresponding Author's E-mail: navaneeth.ooty@gmail.com

Table 1. Prey species composition in tiger scats (n=398), their relative biomass contribution in tiger diet and production of scats for each prey species in Bandhavgarh Tiger Reserve (March 2011- February 2013).

Species	Number of scats (n=398)	Percentage frequency of occurrence (%F)	Average body weight (Kg) (X)	Weight of prey eaten per scat (Kg) (Y)	Percentage of prey biomass consumed (F * Y)	Percentage relative biomass contribution
Sambar	131	32.91	134	6.67	219.54	39.38
Chital	108	27.14	45	3.56	96.47	17.31
Wild pig	45	11.31	36	3.24	36.63	6.57
Nilgai	66	16.58	180	8.28	137.31	24.63
Peafowl	1	0.25	5	2.16	0.54	0.10
Hare	5	1.26	2	2.05	2.58	0.46
Common langur	19	4.77	8	2.26	10.79	1.94
Cattle	16	4.02	180	8.28	33.29	5.97
Buffalo	7	1.76	273	11.54	20.29	3.64
					557.43	

Y= 1.980+0.035X; X =Average weight of each prey species; 557.43 Kg - Total prey weight consumed by tiger

field collectible scat; X = average weight of an individual of a particular prey type. Average weight of the each wild prey species was taken from the available literature (Schaller, 1967; Karanth & Sunquist, 1995; Khan *et al.,* 1996; Biswas & Sankar, 2002; Sankar & Johnsingh, 2002).

RESULTS

A total of 398 tiger scats were collected and analyzed during the study period. It revealed the presence of nine prey species in the tiger diet from the study area. Analysis of 50 tiger scats was found adequate to understand the food habits of tigers in Bandhavgarh Tiger Reserve (Figure 1). Ninety six percent (n= 382) of tiger scats contained single prey species and four percent (n=16) contained two prey species. No scat was found to have multiple prey species (> 2). Of the prey species identified from the tiger scats, sambar contributed 32.91 %, followed by chital 27.14 %, nilgai 16.53 %, wild pig 11.31 %, common langur 4.77 %, cattle 4.02 %, buffalo 1.76 %, hare 1.26 %, and peafowl 0.25 % in terms of percentage frequency of occurrence (Table 1).

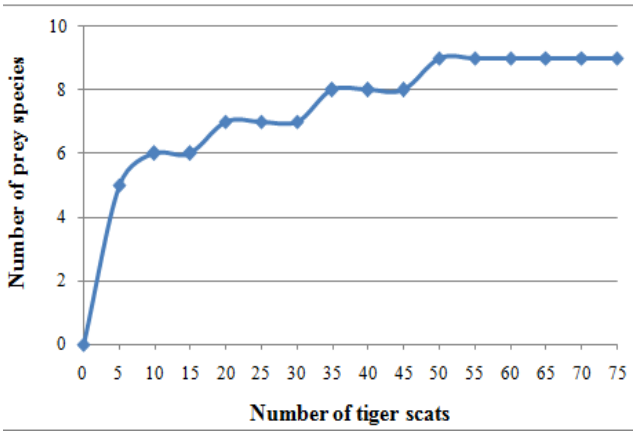

Figure 1. Diet stabilization curve of tigers in Bandhavgarh Tiger Reserve (March 2011 to February 2013).

The scat analysis revealed that the total prey biomass consumed by tigers in BTR was 557.43 kg (Table 1). In terms of species wise biomass contribution, sambar (39.38 %) was highest followed by nilgai (30.77%), chital (17.31 %), wild pig (6.57 %), cattle (5.97 %), buffalo (3.64 %), common langur (1.94%), hare (0.46 %) and peafowl (0.10 %) (Table 1).

DISCUSSION

Scat analysis showed that tigers preyed on nine different prey species in BTR. Wild ungulates (sambar, chital, nilgai and wild pig) contributed 87.89 % of the tiger diet (Table 1), which is higher as compared to other studies conducted in tropical forests in India such as Kanha - 63.4 % (Schaller, 1967), Pench - 75.5% (Biswas & Sankar, 2002) and Srisailam - 53.4 % (Reddy *et al.,* 2004).

In BTR, sambar was found to be the principal prey species of tigers as it was inferred from the percentage frequency of occurrence and relative biomass consumed (Table 1). The occurrence of sambar as the main prey species in tiger diet may be attributed to the larger body weight and wide distribution of sambar across the study area (Johnsingh, 1983; Karanth & Sunquist, 1995; Avinandan *et al.,* 2008). Preference of large bodied prey species by tiger has been reported from different Tiger Reserves, such as Nagarahole, Pench, Ranthambhore, Satpura, Mudumalai, Sariska and Pakke (Karanth & Sunquist 1995; Biswas & Sankar 2002; Bagchi *et al.,* 2003 Edgaongar, 2008; Ramesh *et al.,* 2009; Sankar *et al.,* 2010; Selvan *et al.,* 2013).

Chital was the second most utilized prey species by tigers in BTR (27% frequency of occurrence), which is less as compared to other studies conducted in Kanha (52.2 %), Bandipur (38.0 %), Pench (53.0 %), Nagarhole (33.6 %) and Mudumalai (41.9 %) (Schaller, 1967;

Johnsingh, 1983; Biswas & Sankar, 2002; Karanth & Sunquist, 1995; Ramesh *et al.,* 2009) and higher than as reported from Srisailam, Satpura and Sariska and (Reddy *et al.,* 2004; Edgaongar, 2008; Sankar *et al.,* 2010).

In the present study, frequency of occurrence of nilgai (16.58 %) in tiger scat was higher as compared to reported studies in India such as Sariska (13.7 %), Srisailam (3.6 %) and Ranthambore (3.2 %) (Sankar & Johnsingh, 2002; Reddy *et al.,* 2004; Bagchi *et al.,* 2003). The frequency of occurrence of wild pig (11.31 %) in tiger scat in BTR was similar as reported from Bandipur (10.5%) and Nagarhole (10.1%) (Johnsingh, 1983; Karanth & Sunquist, 1992) and higher as compared to Pench (8.8 %), Mudumalai (3.6 %), Rajaji (6.8 %) Ranthambore (2.8 %), Sariska (1.1 %) and Kanha (0.8 %) (Biswas & Sankar, 2002; Ramesh *et al.,* 2009; Harihar, 2005; Bagchi *et al.,* 2003; Sankar & Johnsing, 2002; Schaller 1967) and lower than Srisailam (33.1 %) and Sunderban East (16 %) (Reddy *et al.,* 2004; Khan, 2008). The frequency of occurrence of common langur (4.77 %) in tiger diet was similar to studies as reported from Ranthambore (4.8 %), Sariska (4.5 %) and Nagarhole (4.2%) (Bagchi *et al.,* 2003; Sankar & Johnsing, 2002; Karanth & Sunquist, 1992). The percentage frequency occurrence of livestock (cattle and buffalo) in tiger diet in the present study (5.78 %) was similar to as reported from Kanha (5.9 %), Bandipur (5.5 %), Satpura (5.3 %) and Srisailam (5.8 %) (Schaller, 1967; Johnsingh, 1983; Reddy *et al.,* 2004, Edgaongar, 2008) and lower than as reported from Rajaji (25 %) and Sariska (19.4 %) (Harihar, 2005; Sankar *et al.,* 2010). Thus it can be inferred that the contribution of wild prey to the tiger's diet in BTR was much higher (94.22 %) as compared to that of livestock (5.78 %). Tigers may not prefer livestock if wild ungulate prey is abundant (Biswas & Sankar, 2002; Reddy *et al.,* 2004).

The low occurrence of rodent and peafowl remains in tiger diet (1.51 %) is similar to findings as reported from Mudumalai (0.9 %), Nagarhole (1.3 %), Srisailam (2.4 %) and Pakke (2.7 %) (Ramesh *et al*., 2009; Karanth & Sunquist, 1992; Reddy *et al.,* 2004; Selvan *et al.,* 2013).

During the study period 50 gaur were reintroduced in BTR (Sankar *et al.,* 2013). Although gaur constitute a major prey species in the tiger diet in Bandipur Tiger Reserve (23.87 %) and Nagarhole Tiger Reserve (17.4 %) (Andheri *et al.,* 2007; Karanth & Sunquist, 1995), no gaur remains were found in the tiger scats in the present study. However tiger predated on three sub-adult gaur during the study period, but their remains were not found in tiger scats. The contribution of gaur to the diet of tiger in other protected areas of India varies from 23.87 % in Bandipur Tiger Reserve to 0.62% in Pench Tiger Reserve, Madhya Pradesh (Andheria *et al.,* 2007; Majumder *et al.,* 2012).

The present study showed that the tiger diet in BTR constitutes mainly of medium and large bodied ungulates, hence regular monitoring of ungulate populations is very essential. BTR is among the few protected areas in India that harbors high densities of tigers 16.25 ± 3.45 km^2 (Jhala *et al.,* 2011). Hence it is imperative to carry out a long term study on prey availability and prey preference of tigers in Bandhavgarh.

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