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QUANTIFICATION OF PREDATION AND INCIDENCE OF PARASITIC INFESTATION IN MELGHAT TIGER RESERVE WITH SPECIAL REFERENCE TO LEOPARDS (*PANTHERA PARDUS*)

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ABSTRACT
135 scats of Leopards from Melghat Tiger Reserve were analyzed for any undigested remains. The analysis of scats of leopards revealed remains of 11 prey species with a high preponderance of small mammals including Indian hare (*Lepus nigricollis*) , sambar (*Cervus unicolor*)and wild pig (*Sus scrofa*). The prey preference on the basis of biomass was sambar > wild pig > domestic animals > chital > four horned antelope. but the order of predation on the basis of undigested remains in scats was Indian hare > sambar > wild pig > langur > domestic animals. It is found that the leopards preferred two different preys (55 scats, 40.47%) at a time. Leopards were also found to be the host of a number of gastrointestinal parasites. They got these infections from the herbivores on which they feed as well as crabs on which they preyed rarely.

INTRODUCTION

Changing environment is posing a threat to wild life by reducing the desired food availability. Most of the large mammals change their food habits according to their physiological as well as reproductive state and during scarcity of desired food the animals become susceptible to various infections. Sometimes in search of food these animals change their habitat and enter adjacent ecosystem for food and may come in contact with diseased domestic animals or they change their food habits and eat anything available to eat which may prove fatal to them. There are few reports, which supports this view (Chitampalli, 1982; Sharma, 1988; Haque, 1989; Mandal, 1989 and Digveerrendrasinh, 1994).

In the present context, the food availability has become a severe challenge before the wild animals. The challenges arise not only from changing environment but also arise from shrinkage and degradation of wilderness, the progressive marginalization of a growing population of natural resource dependent forest living people and the consequent limitation on the size of individual protected area limits. Several hypotheses have been proposed to explain prey selection by predators. These hypotheses pertain to ultimate causative factors such as energetic benefits and costs involved (Griffiths, 1975; Stephens and Krebs, 1987), as well as to proximate mechanisms of selection such as search images or prey vulnerability (Curio, 1976; Taylor, 1976; Temple, 1987).

Faeces of wild animals are the most evident and most easily recognizable signs of their presence (Liebenberg, 2000). Droppings consist of partly digested material and undigested parts of animals and plants. Fecal components may include feathers, bones, teeth, claws, scales, arthropod chitin, seeds and plant tissues, pollen grains, as well as mucus, epithelial cells and a significant amount of living and dead bacteria (Bang and Dahlstrom, 1975). In the carnivores, the secretion produced by the anal gland adheres to the faeces during defecation. The secretion of each species has a characteristic and complex odour and it supplies intra and interspecific information of an individual's territory, sex, reproductive state, and movements (Gorman and Trowbridge, 1989). The size and the amount of faeces produced by each individual vary with age, the type of ingested food, and its absorption capacity and also depending on the health of the animal. Size variation is more frequent among herbivores because of the alteration in the quality and amount of food ingested in different seasons. Size varies less among carnivores (Stuart and Stuart, 1998). Food characteristics also affect faecal consistency. Fibrous plants may be the only food found during dry periods or in arid environments, so animals produce hard and more compact faeces. During rainy periods or in tropical rainforest ecosystems, the larger consumption of green leaves, sprouts, and fruits, produce soft, large and aggregated faeces (Chame, 2003).

MATERIALS AND METHODS

Study Area: Satpuda

Satpuda range of mountain lie east west in central India

from Pench Tiger Reserve border of Seoni Madhya pradesh on east and up to Bharuch district of Gujarat on west. Central part of Satpuda hill ranges form various good protected areas spread over in two states encompassing roughly an area of 7000 sq. kms.

Melghat Tiger Reserve

The Melghat Tiger Reserve extends for about 65 km. between 21° 46′ and 20° 11′ and 95 km. Between 77° 34′ and 76° 38′.The altitude of the Reserve varies from 380 m. in the east to 950 m. in the west above M.S.L. Minimum and maximum temperature are 4° C to 46° C respectively. The total area of MTR is 1676.93 Sq. km. which includes the core area (Sanctum sanctorum), Gugamal National Park with an area of 361.28 Sq. km. , which is undisturbed and is totally villageless.Melghat Sanctuary (buffer and tourism zone)is an area of about 788.75 Sq. km. Multiple use area includes 39 villages with an area about 526.90 Sq. km.The neighbouring protected area of Melghat in Satpuda is Wan Wild life Sanctuary (211.00Sq. km.), Narnala Wildlife Santcuary (12.35Sq. km.) and Ambabarva Wildlife Sanctuary (127.11Sq. km.) under Akot division. The Tiger Reserve supports a diverse fauna includes Carnivores, Herbivores and Primates.

Materials for study

The material for this study comprises the faecal samples (Scats) of leopards (*Panthera pardus*) from Melghat Tiger Reserve. The periods of collection of material extends October 2003 to January 2006. A total 135 faecal samples were screened for the study of undigested remains and also for parasitic infections. The faecal samples were collected in the polythene bags, fresh faecal samples were preferred for analysis. The polythene bags containing the faecal samples were labelled with date, time, and locality. The bags were properly sealed and were brought to the laboratory.

Methodology

In nature it is very difficult to keep track of all animals killed by the tiger and the important method of knowing the food habit is through the collection of faeces containing hairs, which will reveal the animals prayed upon by the tiger. The need for studying food habits of carnivores in general and the tiger in particular prompted in the present investigation to undertake a study of mammalian hair structure that could be used for investigating food habits on the basis of hair remains in the faecal sample.

Procedure for taking hair impressions

Procedure as described by Koppikar and Sabnis (1976 and 1979). The method was slightly modified in the present investigation.

Initially all the hair specimens were carefully washed in warm water, they were thoroughly passed through ether or xylol. The clean slides were smeared with colourless nail polish / ethyl lactate (having refractive index close to glass slides) and the sorted hairs (one or two) were pressed and kept straight on the smeared slide with the help of forceps. After 8 to 10 minutes the hair was pilled out from the smear and then the hair impressions on the slide was observed under the compound microscope. Gross appearance, length of the hair, diameter, colouration were noted and the actual photographs were taken in three different regions of the hair impression on high power (400X) of the microscope, which were used as a key for the identification of a carnivores diet and eating habits.

The hairs that are coming along with the faecal matter of the leopard were matched with standard hair impressions to determine the diet and eating habits.

Laboratory analysis of the samples for presence of any parasitic infection

Every time half of the faecal sample was used for observation of any parasitic infection. It was washed in warm mammalian saline and then sieved through a fine mesh. The contents were centrifuged. The supernatant was discarded and the matter settled down was observed carefully under dissecting microscope and then through compound microscope.

Identification of the parasite

The parasitic infections (whole mounts, eggs, cysts) in the faecal sample were identified, separated with needle and slides (whole mounts) were prepared by using standard methods. Identification was carried out using standard keys.

Incidence

The incidence of gastrointestinal parasite was studied mainly based on the microscopical examination of faecal samples collected from the study area, so as to assess the intensity of parasitic infections of *Panthera pardus*.

Evaluation of incidence

During screening the different samples were examined as per their habitat and incidence of parasitic infections and their percentage were noted.

Calculation of biomass

The biomass consumed per animal / day was calculated (Sabnis, 2004) by using the formula –

$$C = \frac{T}{N.n}$$

Where,

C = Biomass consumption

T = Total biomass in kg (determined from hair or epidermal remains in each scat. Observation of one type of hair indicates one animal consumed/killed. Two different types of hairs indicate two different types of animal consumed/

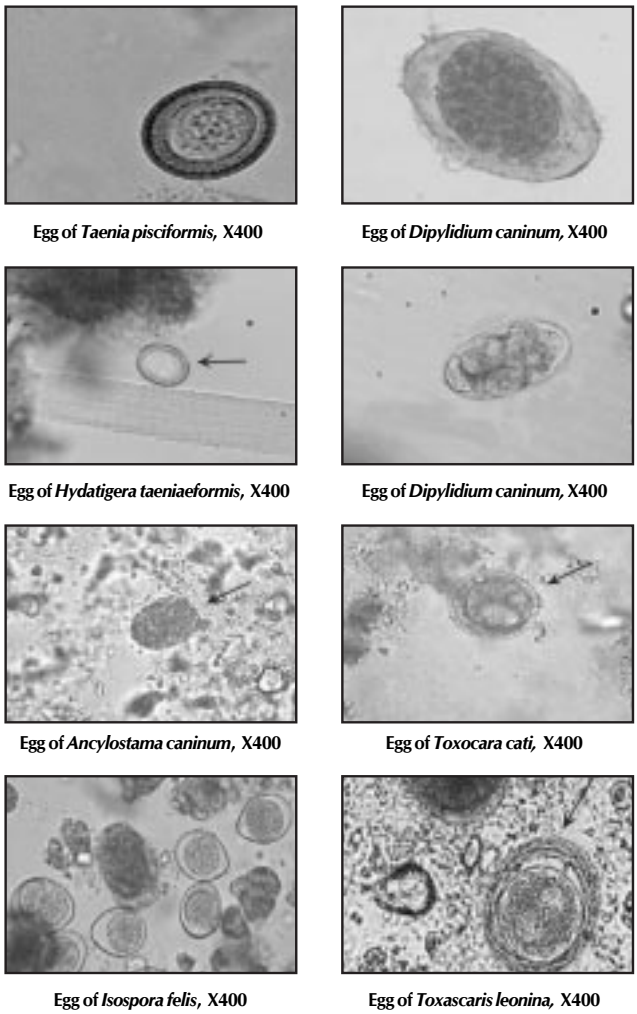
killed. The ideal weights of these animals are considered for biomass calculations).

N = Number of scats collected

n = Number of animals consumed/killed.

RESULTS

135 scats of leopards from Melghat Tiger Reserve were analyzed for any undigested remains. The results of scat analyses of leopards are summarized in Tables 1, 2, 3 and 4. The analysis of scats of leopards revealed remains of 11 prey species with a high preponderance of small mammals including Indian hare (*Lepus nigricollis*), sambar (*Cervus unicolor*)and wild pig (*Sus scrofa*). The prey preference on the basis of biomass was sambar > wild pig > domestic animals > chital > four horned antelope. But the order of predation on the basis of undigested remains in scats was Indian hare > sambar > wild pig > langur > domestic animals. In the present study 50.37 % of leopard scats contained single prey species and 49.62 % contained two prey species. No scat was found to contain 3 or 4 prey species simultaneously. Daily comsumption of each leopard was found to be 1.3037 kg /day /leopard and annual consumption was 475.8505 kg / annum /leopard. Leopards were also found to be the host of a number of gastrointestinal parasites as shown in Plate 1a, 1b 1c; Fig.1 and Table 4. 65.18% samples were seen infected with the various parasitic infections.



Egg of *Taenia pisciformis*, X400 | Egg of *Dipylidium caninum*, X400

Egg of *Hydatigera taeniaeformis*, X400 | Egg of *Dipylidium caninum*, X400

Egg of *Ancylostama caninum*, X400 | Egg of *Toxocara cati*, X400

Egg of *Isospora felis*, X400 | Egg of *Toxascaris leonina*, X400

Figure1(a) : Parasitic infections in *Panthera pardus* (leopard).

DISCUSSION

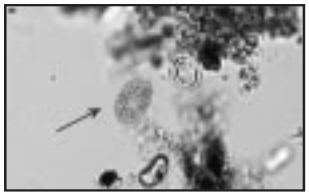
In the present study the major diet of leopard in Melghat comprises of Indian hare (62 samples out of 135) and sambar (45 samples out of 135). Most of the studies on food habits in Africa and Asia have represented ungulates to be the main prey species of the leopard (Bailey, 1993). One study (Edgaonkar and Chellam, 1998) in Sanjay Gandhi National Park, Maharashtra indicated that the bulk of the diet of leopards SGNP is domestic dogs. However, the present study seems to be the exception as reasonable number of hares are preyed by the leopards in Melghat, though

Table 1: Percentage occurrence of undigested remains recorded in the scats of the leopard (*Panthera pardus*) from Melghat Tiger reserve.

Sr. no.	Prey species	No.of animals	%Occurrence	Animal wt. considered*(kg)	Biomass(kg)	% Biomass
1	***Cervus unicolor*** (Samber) **	45	23.68	225	10125	42.61
2	***Semnopithecus entellus*** (Langur)	14	7.37	21	294	1.24
3	***Lepus nigricollis*** (Indian hare)	62	32.63	02	124	0.52
4	***Axis axis*** **(Chital)	01	0.53	85	85	0.36
5	***Tetracerus quadricornis*** **	10	5.26	30	300	1.26
6	***Sus scrofa*** ** (Wild boar)	41	21.58	230	9430	39.69
7	***Macaca mulatta***	01	0.53	12	12	0.05
8	Cattle ***(Cow)	11	5.79	300	3300	13.89
9	Goat***	02	1.05	45	90	0.38
10	Bat	02	2.05	300 gm	0.600	0.0025
11	Bird(Jungle fowl)	01	0.53	01	01	0.0042
Total		**190**			**23761.6**	

*According to Prater (Book of Indian animals) and Vivek Menon (A field guide to Indian mammals)., ** Major ungulates (*Cervus unicolor and Sus scrofa*) = 83.92 %., *** Domestic animals = 14.27 %, Average biomass consumed = 125.06 Kg., Total scats analyzed = 135.

Egg of *Capillaria hepatica* X400

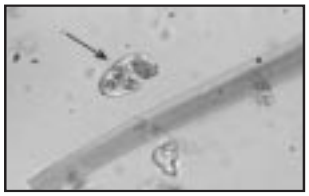


Egg of *Diphyllobothrium latum* X400

Egg of *Fasciola hepatica* X400

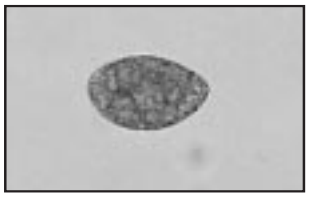
Egg of *Hymenolepis diminuta* X400

Egg of *Metagonimus sp.* X400



Egg of *Paragonimus kellicotti* X400

Egg of *Paragonimus westermani* X400



Egg of *Spirometra erinacei* X400

Figure 1(b) : Parasitic infections in *Panthera pardus* (leopard).

Egg of *Trichuris trichuria* X400

Egg of *Trichuris vulpis* X400

Figure 1(c) : Parasitic infections in *Panthera pardus* (leopard).

biomass wise it is very less. Many studies have documented the opportunistic nature of the leopards' hunting pattern (Bothma and Le Riche, 1984; Eisenberg, 1986; Bailey, 1993). Because of the occurrence of a good population of Indian hare in Melghat and declining population trend of medium sized ungulates, the leopard seems to be largely surviving on small prey (Less than 20Kg in weight) and big ungulates like Sambar and wild pig. Schaller (1972) found that the leopard was mostly taking prey in the 20-70 Kg class. Thirty six percent of leopard prey in Chitwan was less than 25 Kg (Seidensticker *et al.*, 1990) while 60% of

Table 2: Monthly total biomass consumed by the leopard (*Panthera pardus*).

Months	Years			
	2003	2004	2005	2006
Jan.	-	-	272	326
Feb.	-	2173	1437	-
Mar.	-	572	1715	-
Apr.	-	02	986	-
May.	-	-	487	-
Jun.	-	-	-	-
July.	-	-	-	-
Aug.	-	-	634.3	-
Sep.	-	227	-	-
Oct.	-	227	2017.3	-
Nov.	502	227	3953	-
Dec.	242	248	3743	-
Total consumption	774	3676	14945.2	4167
Grand total	23761.6 kg			
No. of Leopards	05	18	84	28

Table 3: Daily consumption by leopard in Melghat Tiger Reserve

Formula	Total biomass of faecal contents in kg. (T)	Year and number of pellets	Number of animals	Daily Consumption in kg.
$C = \frac{T}{N(n)}$	23761.6	(2003-2006) 135	135	1.3037 kg /day

Daily consumption (C)

$$C = \frac{T}{N(n)} = \frac{23761.6}{18225} = 1.3037 \text{ kg /day /leopard}$$

Annual consumption: 1.3037 x 365 = 475.8505 kg / annum /leopard

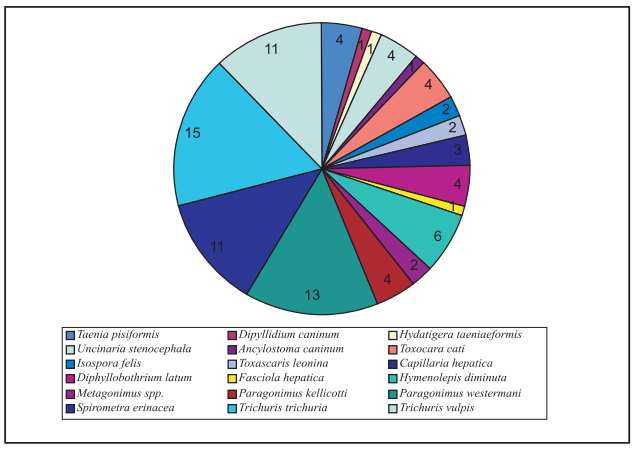


Figure 1: Parasitic infection (egg/ ova / cysts) observed in scats of leopard (*Panthera pardus*) from Melghat Tiger Reserve (2003 – 2006).

scats analyzed in the present study contained prey species, langur, hare, macaca and bats, that could be considered as small (< 20 Kg). However, Seidensticker (1983) found that an abundant and diverse prey base in Chitwan meant that leopards took macaques, while Schaller (1967) observed leopards feeding on langurs frequently in Kanha Tiger Reserve, Shrivastava *et al.,* (1994) studied food habits of mammalian predators in Periyar Tiger Reserve, Thekkady (Kerala). The leopards in the Periyar Reserve preyed mostly on the Nilgiri Langur (81.44%). Other prey species of leopards consisted of the sambar (14.43%) the large flying squirrel and rodents. However, in Mundanthurai plateau, Tamilnadu sambar formed the major prey (50%) of the leopards followed by *Lepus* (16.2%) and *Chital* (9.3%) (Sathyakumar, 1989).

Prey selection by leopards in Melghat indicates that they have balanced feeding habits with respect to their prey and it must be because they are getting enough prey to feed on, particularly the large mammals in Melghat. However, it is observed that leopards in Melghat often kill more than one prey in a day. They got these parasitic infections from the herbivores on which they feed as well as crabs on which they preyed rarely.

Table 4: Parasitic infection (egg/ ova / cysts) observed in scats of leopard (*Panthera pardus*) from Melghat Tiger Reserve (2003 – 2006).

Wild carnivore	S.no.	Species
Leopard (*Panthera pardus*)	1	Taenia pisiformis
	2	*Dipyllidium caninum*
	3	*Hydatigera taeniaeformis*
	4	*Uncinaria stenocephala*
	5	*Ancylostoma caninum*
	6	*Toxocara cati*
	7	*Isospora felis*
	8	*Toxascaris leonina*
	9	*Capillaria hepatica*
	10	*Diphyllobothrium latum*
	11	*Fasciola hepatica*
	12	*Hymenolepis diminuta*
	13	*Metagonimus spp.*
	14	*Paragonimus kellicotti*
	15	*Paragonimus westermani*
	16	*Spirometra erinacea*
	17	*Trichuris trichuria*
	18	*Trichuris vulpis*

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