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# Abundance and Dietary Composition of Indian Crested Porcupine in Western Part of Gir National Park and Sanctuary, Gujarat, India.

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## ABSTRACT

Ecological studies were conducted in western part of Gir National Park and Sanctuary from February to June 2013 to assess abundance and dietary composition of Indian crested porcupine (*Hystrix indica*) by sampling and analysis of pellet groups. Ten line transects, each 3 km in length, were randomly established in the study area to sample the pellet groups. Pellet groups were quantified in circular plots of 10 m radius established at regular interval of 200 m. Data were analyzed to calculate pellet group density (mean number/ha ± SD), percent frequency of occurrence and percent occurrence of different food items. The mean pellet group density was estimated to be 5.4 ± 1.4 pellet groups/ha while mean individual porcupine density was estimated to be 1.4 individuals $km^{-2}$. A total of 18 food items were identified in the diet of porcupine with an average of 3.8 food items per pellet group. Seeds contributed maximum to the diet of porcupine along with bark and roots. Seeds of 11 different plant species were found in the diet of Indian porcupine with an average of 9.5 seeds per pellet group. 487 seeds were found in the collected pellet groups with maximum seeds belonging to *Cassia fistula* (32.2%). The study showed that porcupine acts as a major seed dispersal agent of key browse plant species of different ungulate species in Gir forest ecosystem.

Key Words: Indian Crested Porcupine; Semi Arid; Pellet Group Density; Seed Dispersal; Regeneration

## INTRODUCTION

Information on abundance and food habits of a species is of paramount importance for its effective conservation and management. Data pertaining to abundance and food habit is available for large mammalian species in India (Johnsingh 1983, Karanth and Sunquist 1995, Khan 1994, Bagchi et al. 2003, Acharya 2007, Ahmad and Khan 2008, Ramesh 2010, Selvan 2013, Jhala et al. 2015). However, there is general paucity of such information on smaller mammalian species. Indian crested porcupine (*Hystrix indica,* Kerr, 1972, hereafter Indian porcupine), considered to be largest species among Indian porcupine (Menon 2014), is commonly distributed in Indian protected areas up to 2400 m in India. It is also considered to be a pest on agriculture (Prater 2005). Indian porcupine is illegally killed in some parts of India for meat consumption as well as to reduce damage to the agriculture (Kumara 2007). Much of the Information on ecological aspects of Indian porcupine is available from sub-desertic region of Israel (Gutterman 1982, Alkon and Saltz 1985, Gutterman 1987, Boeken et al. 1995) and to some extent from other regions also (Khan et al. 2000, Hafeez et al. 2011). Despite being a common and widely distributed species in India, there have been few studies on Indian porcupine so far (Sharma 2001, Chakravarthy and Girish 2007). We studied abundance and dietary composition of Indian porcupine in western part of Gir National Park and Sanctuary (Figure 1, henceforth GNPS) from February to June 2013.

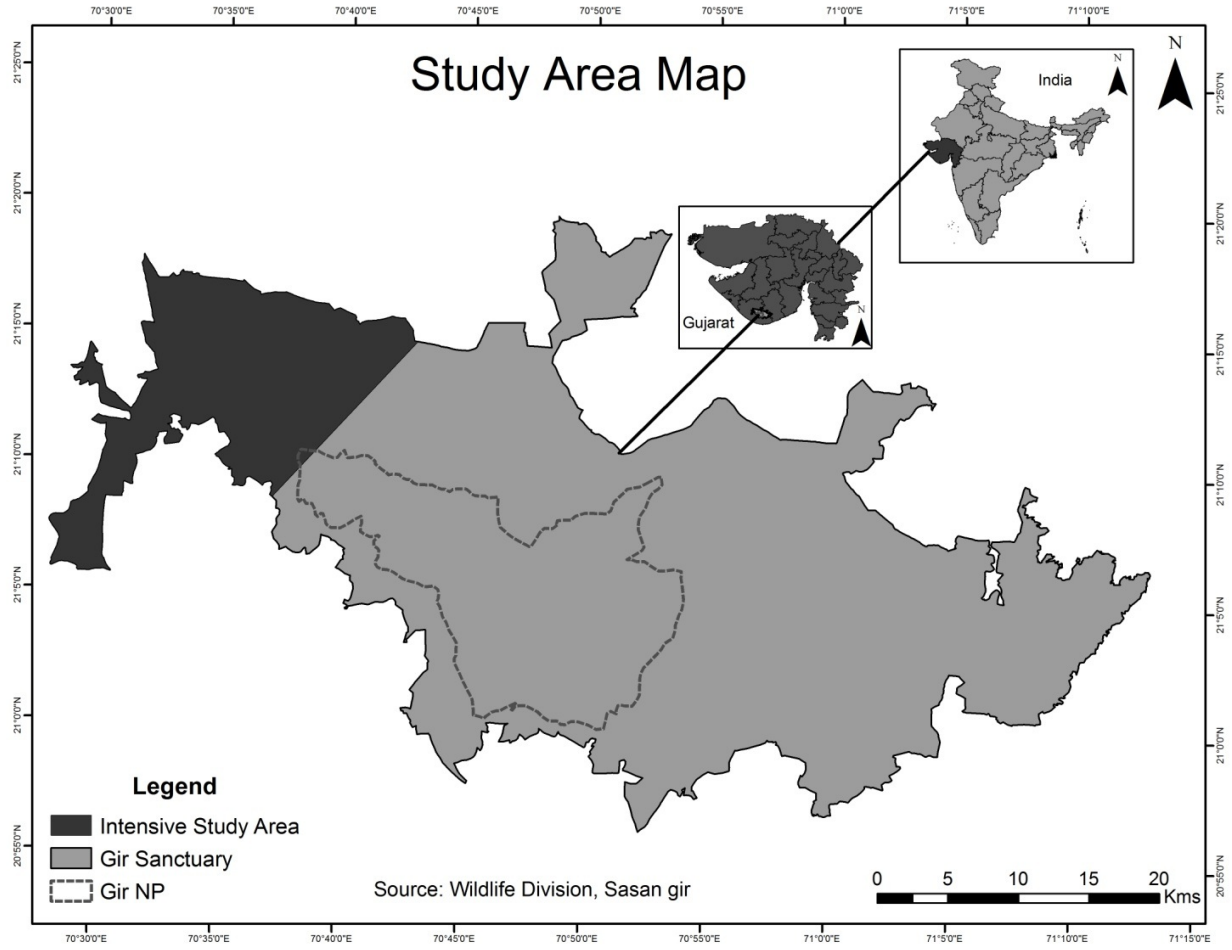


Figure. 1. Map of Gir National Park and Sanctuary with location of Intensive study area

## STUDY AREA

The GNPS (20°57′ to 21°20′ N latitude and 70°27′ to 71°13′ longitude) lies 40 km from the coast in the Kathiawar peninsula of Gujarat, India. GNPS lies within the 4B Gujarat Rajputana Biotic Province of bio-geographic Classification of India (Rodgers and Panwar 1988). It is home for the last surviving population of Asiatic lion (*Pathera leo persica*). The area has dry deciduous forest 5A/C1b of Champion and Seth (1968) classification, with west Gir dominated by *Tectona grandis* and east Gir dominated by *Anogeissus latifoia*, together with *Acacia* and *Zizyphus* species (Khan 1993).

## MATERIAL AND METHODS

Pellets or dung provide vital information on population distribution, size and diet that is otherwise difficult to obtain for elusive and nocturnal species (Putman 1984). Considering nocturnal behavior of Indian porcupine, we assessed its abundance using pellet group density as a measure of abundance. The basic requirement for estimating animal abundance from pellet group is the identification of pellet group. Indian porcupine pellets are spindle shaped pellets of about 1-1.5 cm in diameter and 3-5 cm in length (Sharma 2001) and are easy to identify in forests. Ten line transects , three km each in length, were established randomly in the study area to estimate pellet group density. Circular plots of 10 m radius were established on each line transect at regular interval of 200 m to sample porcupine pellet groups. Each plot was intensively searched for pellet groups by two observers. The plots were segregated in three different habitats namely Teak-*Acacia-Zizyphus* Wood-land (TAZW), Thorn Woodland (TW) and Mixed Forest (MF) following Khan (1993). A total of 138 plots were established out of which 38, 59, and 41 plots were in

TAZW, MF and TW habitat respectively. Pellet group density was estimated by dividing number of pellet groups in a plot by the area of plot. Individual densities of porcupine were estimated following Sharma (2001). Environmental conditions in Gir and Sariska are almost same since both are located in Semi-arid bio-geographic zone of India. Therefore decay rate of porcupine pellet groups estimated by Sharma (2002) and defecation rate available from the Vadodara Zoo were used to convert pellet group densities into individual densities using the equation:

$$N = Y.r / D$$

where,
Y = mean pellet group density,
r = mean decay rate per day,
D = mean defecation rate per day.

Dietary composition of Indian porcupine was studied from analysis of pellet groups. Pellet groups were crushed and broken into identifiable pieces. Pellets of porcupine consisted of semi-digested food material and therefore it was easy to distinguish different food items using the reference material on seeds and leaves collected during the study (Figure 2). Seeds and leaves could be identified up to species level but roots and bark material could not be identified up to species level and therefore these items were treated as two different categories under root and bark. Dietary composition of porcupine was estimated in terms of Frequency of Occurrence (FO %; i.e. proportion of total number of pellet groups in which food item was found) of each food item and Percent Occurrence (PO i.e. number of times a particular food item occurred in the pellet group relative

Figure 2. Porcupine pellet groups in study area (upper left), *Zizyphus auritiana* and *Zizyphus nummularia* seeds in a pellet group (upper right), *Cassia fistula* seeds in a pellet group (lower left), and *Dalbergia sisso* leaves in a pellet group of porcupine (lower right)

Table. 1. Food items in the diet of Indian porcupine in western part of Gir National Park and Sanctuary.

| Food Items | Family | Life form | Count of occurrence | Frequency (%) of occurrence | Percent occurrence |
|---|---|---|---|---|---|
| Bark | - | - | 29 | 56.86 | 15.34 |
| Root | - | - | 29 | 56.86 | 15.34 |
| *Zizyphus mauritiana* (S) | Rhamnaceae | S | 24 | 47.06 | 12.70 |
| *Cassia fistula* (S) | Fabaceae | T | 21 | 41.18 | 11.11 |
| *Dalbergia sissoo* (L) | Fabaceae | T | 15 | 29.41 | 7.94 |
| *Capparis Sepiaria* (S) | Capparaceae | S | 12 | 23.53 | 6.35 |
| *Combretum decandrum* (L) | Combretaceae | C | 12 | 23.53 | 6.35 |
| *Bauhinia racemosa* (S) | Fabaceae | T | 9 | 17.65 | 4.76 |
| *Zizyphus nummularia* (S) | Rhamnaceae | S | 8 | 15.69 | 4.23 |
| *Syzygium cumini* (L) | Myrtaceae | T | 7 | 13.73 | 3.70 |
| *Acacia senegal* (S) | Mimosaceae | T | 6 | 11.76 | 3.17 |
| *Acacia catechu* (S) | Mimosaceae | T | 5 | 9.80 | 2.65 |
| *Carrisa conjesta* (S) | Apocynaceae | S | 3 | 5.88 | 1.59 |
| *Tamarindus indica* (L) | Caesalpiniaceae | T | 3 | 5.88 | 1.59 |
| *Cocculus hirsutus* (L) | *Menispermaceae* | | 3 | 5.88 | 1.59 |
| Unidentified (S) | - | - | 1 | 1.96 | 0.53 |
| *Dalbergia sisso* (S) | Fabaceae | T | 1 | 1.96 | 0.53 |
| *Lantana camara* (S) | Verbenaceae | S | 1 | 1.96 | 0.53 |
| Total | | | 189 | 3.71 | 100 |

to total number of food items). Total number of seeds of different plant species were counted to estimate relative number of seeds of different species being dispersed by porcupine. Seed dispersed in terms of number of seeds of a particular species dispersed per hectare was estimated by multiplying average number of seeds of a particular species per pellet group with pellet group density. The nomenclature of plants follow Patel (1984).

## RESULTS

The estimated pellet group density (mean ± S.D.) of the Indian porcupine was 5.4 ± 1.4 Pellet group $ha^{-1}$. It was lowest in TW (2.3 ± 1.3 pg $ha^{-1}$), followed by TAZW (5.7 ± 2.1 pg $ha^{-1}$), and highest in MF (6.4 ± 2.5 pg $ha^{-1}$). However these differences were not significant (Kruskall Wallis One Way Anova, P> 0.05). The mean Individual density of Indian porcupine was estimated to be 1.4 individuals/$km^2$ and it was highest in MF (1.6 individuals $km^{-2}$) followed by TAZW (1.4 individuals $km^{-2}$) and lowest in TW (0.5 individual $km^{-2}$).

A total of 51 pellet groups of Indian porcupine were analyzed which yielded a total of 18 food items (Table 1) with an average of 3.8 food items per pellet group. The diet of Indian porcupine comprised of bark (15.3%), roots (15.3%) and leaves and seeds (69.3%). The porcupine utilized seeds of *Cassia fistula*, *Capparis sepiaria*, *Bauhinia racemosa*, *Zizyphus nummularia*, *Acacia senegal*, *Acacia catechu*, *Carissa conjesta*, *Dalbergia sissoo*, *Lantana camara,* an unidentified seed and leaves of *Dalbergia sissoo*, *Combretum decandrum, Syzygium cumini, Tamarindus indica* and *Cocculus hirsutus*.

Indian porcupine utilized seeds of 11 plant species which contributed a total of 48.4% in comparison to other food items with an average of 9.7 seed $pg^{-1}$. A total of 487 seeds were found in the analyzed pellet groups (Table 2). Maximum number of seeds belonged to *Cassia fistula* (32.2%) followed by *Zizyphus mauritiana* (20.5%), *Zizyphus nummularia* (16%), *Capparis sepiaria* (10.6%), *Bauhinia racemosa* (7.5%), *Dalbergia sissoo* (4.1%), *Acacia catechu* (4.1%), *Acacia senegal* (2 %), *Lantana camara* (1.4%), *Carissa conjesta* (1%) and an unidentified seed (0.2%). Average number of seed per pellet group was highest for *Cassia fistula* (3.1) and lowest for an unidentified seed species (0.02). The average number of seeds dispersed by porcupines was estimated to be 52.6 ± 13.7 seeds dispersed $ha^{-1}$.

Table. 2. Number of seeds in pellet groups, percent occurrence and seeds dispersed per ha

| Seed species | Total no.of seed in pellet groups | Seed $pg^{-1}$ | Percent occurrence | seeds dispersed per ha |
|---|---|---|---|---|
| *Cassia fistula* | 157 | 3.08 | 32.24 | 16.62 ± 4.34 |
| *Zizyphus mauritiana* | 100 | 1.96 | 20.53 | 10.59 ± 2.76 |
| *Zizyphus nummularia* | 78 | 1.53 | 16.02 | 8.26 ± 2.16 |
| *Capparis sepiaria* | 52 | 1.02 | 10.68 | 5.51 ± 1.44 |
| *Bauhinia racemosa* | 37 | 0.73 | 7.60 | 3.92 ± 1.02 |
| *Dalbergia sissoo* | 20 | 0.39 | 4.11 | 2.12 ± 0.55 |
| *Acacia catechu* | 20 | 0.39 | 4.11 | 2.12 ± 0.55 |
| *Acacia Senegal* | 10 | 0.20 | 2.05 | 1.06 ± 0.28 |
| *Lantana camara* | 7 | 0.14 | 1.44 | 0.74 ± 0.19 |
| *Carissa conjesta* | 5 | 0.10 | 1.03 | 0.53 ± 0.14 |
| Unidentified seed | 1 | 0.02 | 0.21 | 0.11 ± 0.03 |
| Total | 487 | 9.54 | 100 | 51.56 ± 13.46 |

## DISCUSSION

The findings of present study are comparable with that of Sharma (2001) who studied Indian porcupine in dry deciduous forest of the Sariska Tiger Reserve. The estimated individual density in Gir was lower than Sariska, coastal plains of Nagev desert (2.1 individuals $km^{-2}$, Alkon 1999) and coastal plains of Israel (4 individuals $km^{-2}$, Server and Mendelssohn 1991). The study in Sariska was carried out after three consecutive droughts which increased not only the detection probability of pellet groups but also slowed down the decay rate of pellet groups resulting in overestimation of abundance of porcupine in Sariska. It seems that densities of porcupines are dependent upon the resources. Densities were higher where there was higher availability of resources. For example, Alkon (1999) estimated a density of 7.5 animals $km^{-2}$ where porcupines fed upon potatoes. Shrub densities play an important role in governing spatial distribution of porcupine (Prater 2005). Shamshad (2011) found shrub density to be highest in MF of western Gir. Sharma (2001) found that pellet group density was highest in habitats which porcupine utilized for feeding purposes. It could be possible that MF in Gir has higher availability of preferred forage for porcupines responsible for highest pellet group density in MF under present study.

Porcupine is a generalist forager (Alkon 1999) substantially feeding on a variety of food plants as documented in Gir and elsewhere. Studies in Nagev desert (Gutterman and Herr 1981, Gutterman 1982, 1987) showed that porcupines fed upon 18 species of genotypes and hemi cryptophytes. Chakravarthy and Girish (2007) documented 16 plant species in Western Ghats while Hafeez et al. (2011) also reported 27 plant species in the diet of Indian porcupine in Pakistan. Porcupines probably increased their survival rate and fitness by foraging on wide array of plant species (Chakravarthy and Girish 2007). Seeds were the most dominant items in the diet of Indian porcupine in GNPS which has also been found in the diet of other porcupine species (Lekagul and McNeely 1977, Roberts 1977, Payne et al. 1985). However Chakravarthy and Girish (2007) and Hafeez et al. (2011) documented bark as a major food item in the diet of Indian porcupine. According to McIntyre (1972) bark is consumed during low availability of high quality forage. GNPS seems to have higher availability of fallen fruits and leaves leading to porcupines feeding less frequently on barks of tress. Sharma and Prashad (1992) documented debarking on eight plant species by Indian porcupine in Sariska Tiger Reserve, with low tree mortality. Chakravarthy and Girish (2007) also reported maximum debarking in the coconut plantations of Western Ghats in areas which were closer to the forest tracts.

Rodents are reported as seed predators in the oriental region (Corlett 1998). Velho et al. (2009) found that Indian porcupine acted as a dominant seed predator in Pakke Wildlife Sanctuary, India. Seed dispersal by mammals has also been documented by some of the studies in India. Balasubramanian and Bole (1993) studied the seed dispersal by Bonnet macaque (*Macaca radiata*), jackal (*Canis aureus*) and chital (*Axis axis*) in Point Calimere Wildlife Sanctuary. Baskaran et al. (1997) studied food habits of sloth bear (*Melursus ursinus*) in Mudhumalai Wildlife Sanctuary and found four species of fruits in the diet of sloth bear. Johnsingh (1981) documented presence of seeds in the diet of chital while Sankar and Vijayan (1992) documented presence of seeds in diet of nilgai (*Boselaphus tragocamelus*). These studies have not quantified number of seeds dispersed by a species. Brush tailed porcupine (*Atherusus africanus*) played a clear role in seed dispersal in Gabon (Hion et al. 1985) and seed dispersal was affected by characteristics of fruits such as seed color, protection coat, type of edible tissue, seed number, seed size and seed weight (Hion et al. 1985). Large sized rodent species chose larger well protected seeds with fibrous flesh. Their strong jaws allowed them to open well protected seeds (Hion et al. 1985). The results in Gir follow the same pattern where Indian porcupine

consumed fruits with larger seeds in greater proportion then others (combined PO of *Zizyphus mauritiana* and *Zizyphus nummularia* =17.93%). The Indian porcupine in Gir also utilized seeds of *Cassia fistula* in greater proportion which are enclosed in hard pods as compared to small seeds of plant species such as *Acacia spp. Lantana camara* and *Carissa conjesta*. The dispersal of seeds of plant species such as *Acacia*, *Zizyphus*, *Carrisa* by porcupine have ecological significance for Gir ecosystem. All these plant species dominate the shrub story with *Tectona grandis* in tree layer in western Gir and are major browse plants on which ungulate species thrive in Gir (Khan 1994, Dave 2008). Fruits also act as a supplement for high nutritional demand of lactating females of ungulates in Gir (Khan 1993).

Apart from documenting role of Indian porcupine in seed dispersal, the study also provides methodological insight. Assessing diet of Indian porcupine merely from debarking site may provide biased result in areas where there is an availability of alternative resources. Use of both debarking site and pellet group analysis should be taken into consideration for assessment of food habits of Indian Porcupine.

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