

Original Article

Food habits of indian crested porcupine (*Hystrix indica*) (Kerr 1792), in district Bagh, Azad Jammu and Kashmir

Hábitos alimentares do porco-espinho de crista indiano (*Hystrix indica*) (Kerr 1972) nos distritos de Bagh, Azad Jammu e Caxemira

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Abstract

The Indian Crested Porcupine (*Hystrix indica*) is classified as an agricultural pest species. It feeds on plants and crops; hence, it is responsible for massive financial losses worldwide. The current study was conducted to assess the diet composition of Indian Crested Porcupine in District Bagh, Azad Jammu and Kashmir (AJ&K). Thus, fecal samples were collected and examined from different sampling sites. Reference slides of the material collected from the study area were prepared for identification of dietary components in fecal pellets. A total of 80 fecal samples were collected and processed. Percent relative frequencies (P.R.F.) were calculated for each plant species recovered from pellets. Data revealed that Indian Crested Porcupine consumed 31 plant species in its diet, among them *Zea mays* (34.31±7.76) was the most frequently selected species followed by *Rumex obtusifolius* (15.32±2.57) and *Melia azedarach* (12.83±4.79). The study revealed that the greatest diversity of ($n=20$) plant species were consumed in summer season while minimum ($n=13$) species were used during winter. Among the parts of plants, stem was highly consumed in spring (57.2%) as compared to seed in fall (36.7%) while spikes and leaf were the least recovered parts from the fecal matter. The Berger-Parker diversity index showed highly diversified food (10.92) in the summer time of the year as compared to the autumn season (2.95). This study provides a baseline for the diet preference of this pest in the study area. Based on current findings, a detailed investigation on damage assessment, exploration, habitat use and management of Indian Crested Porcupine in AJ&K has been recommended.

Keywords: porcupine, *Hystrix indica*, AJ&K, diet preference, fecal analysis.

Resumo

O porco-espinho de crista indiano (*Hystrix indica*) é classificado como uma espécie de praga agrícola. Alimenta-se de plantas e colheitas; portanto, é responsável por enormes perdas financeiras em todo o mundo. O estudo atual foi realizado para avaliar a composição da dieta do porco-espinho de crista indiano nos distritos de Bagh, Azad Jammu e Caxemira (AJ&K). Assim, amostras fecais foram coletadas e examinadas em diferentes locais de amostragem. Lâminas de referência do material coletado na área de estudo foram preparadas para identificação dos componentes da dieta em pellets fecais. Um total de 80 amostras fecais foi coletado e processado. As frequências relativas percentuais (P.R.F.) foram calculadas para cada espécie de planta recuperada de pelotas. Os dados revelaram que o porco-espinho indiano consumiu 31 espécies de plantas em sua dieta, entre elas *Zea mays* (34,31 ± 7,76) foi a espécie mais selecionada, seguida por *Rumex obtusifolius* (15,32 ± 2,57) e *Melia azedarach* (12,83 ± 4,79). O estudo revelou que a maior diversidade de ($n = 20$) espécies de plantas foi consumida no verão, enquanto o mínimo ($n = 13$) espécies foi utilizado durante o inverno. Entre as partes das plantas, o caule foi muito consumido na primavera (57,2%) em relação à semente no outono (36,7%), enquanto a espiga e a folha foram as partes menos recuperadas da matéria fecal. O índice de diversidade de Berger-Parker mostrou alimentos altamente diversificados (10,92) no verão do ano em comparação com o outono (2,95). Este estudo fornece uma linha de base para a preferência alimentar dessa praga na área de estudo. Com base nas descobertas atuais, uma investigação detalhada sobre avaliação de danos, exploração, uso de habitat e gerenciamento de porco-espinho de crista indiano em AJ&K foi recomendada.

Palavras-chave: porco-espinho, *Hystrix indica*, AJ&K, preferência de dieta, análise fecal.

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1. Introduction

Indian Crested Porcupine (*Hystrix indica*) (Kerr 1792), is a commonly found rodent throughout the Pakistan (Mushtaq et al., 2010). It inhabits different types of habitats like plantations, canal sides, and embankments of water bodies. It also prefers to live in subtropical broadleaf hill forests in Asia. Indian Crested Porcupine are herbivorous in diet, feeding upon a variety of plants and crops (Talukdar et al., 2019) and often cause massive losses to orchard owners and farmers by damaging fruits, vegetables and other flowering plants (Khan et al., 2007; Pervez, 2006; Hafeez et al., 2011). The economically important varieties of maize, potato and groundnut were damaged by this species (Khan et al., 2000; Hafeez et al., 2011). Besides, the pumpkin (*Cucurbita moschata*), okra (*Abelmoschus esculentus*), onion (*Allium cepa*) carrot (*Daucus carota*) and bitter gourd (*Momordica charantia*) were also reported to be eaten by Indian Crested Porcupine (Pervez, 2006; Hafeez et al., 2011). Some grasses such as Johnson grass (*Sorghum halepense*), buffelgrass (*Cenchrus ciliaris*), Sewan grass (*Elionurus hirsutus*) and oilgrass (*Cymbopogon jwarancusa*) were also trampled by it (Khan et al., 2000; Hafeez et al., 2011). Despite the significant loss caused by the species, no scientific data are available regarding damage assessment of Indian Crested Porcupine in AJ&K. Therefore, this is the first study of the foraging behavior and effect of Porcupine as a pest in district Bagh, AJ&K.

2. Materials and methods

2.1. Study Area

The area under study is comprised of 1368 km² and lies at 33° 53'-34° 07' N, 73° 29'- 74° 00' E with an altitude of 1500 m to 2500 m above sea level (Figure 1). Topographically, it is a hilly area covered by the Pir- Panjal range that is sparsely covered with coniferous forests. Generally, the climate of the area change with elevation having a temperature range between 2 °C to 40 °C. The annual rainfall of the study is about 1500 mm (Alif, 2016).

2.2. Method

The study area was divided into three study sites: Dheerkot (site I), Bagh (site II) and Hari Gehal (site III) (Figure 1). The ten potential sub sites were selected from each site to collect fecal material during a period of one year (November 2015 to October 2016). It covered all four seasons of the year including winter (November-January) spring (February–April); summer (May–August), and autumn (September–October).

2.3. Sampling

Food and feeding habits were investigated by analyzing almost 80 fecal samples collected from 30 study sites of the study area. The collected fecal samples were identified through their characteristic size and shape, labeled and stored in refrigerator at -4°C.

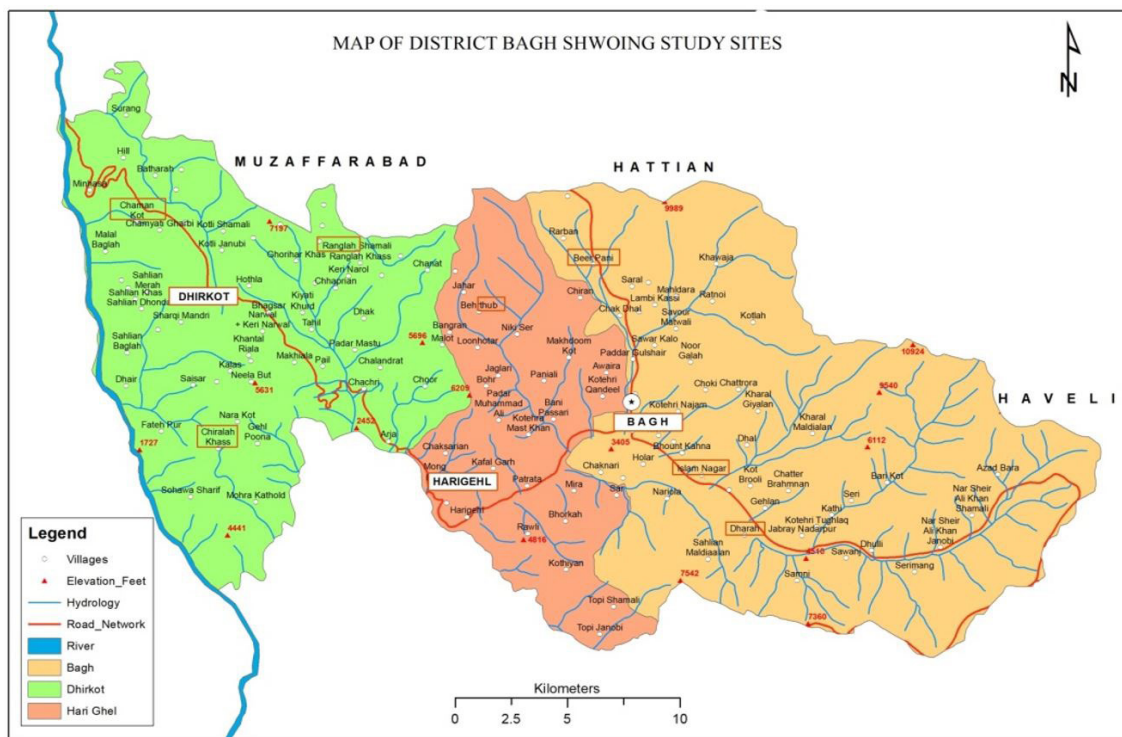


Figure 1. Location map of study area showing different study sites during study period.

2.4. Reference Slides

The main seasonal plants and damage plant of the area under study were used in making reference slides by following the method of Williams (1962) and Ward (1970). The dried vegetation fragments were soaked for a night in a mixture of distilled water, ethyl alcohol, and glycerin (1:1:1) and afterward passed through water for 10-20 minutes. A homogenizer was used to grind the plant tissue (Virtis, Model 302968) in a medium of distilled water. To clear the specimen, the ground tissues were put in a cotton cloth and placed in 1% sodium hypochlorite. Then it was soaked in 5% Chlorox (chlorine bleach) and distilled water (1:4) for half an hour. Dilute acetic acid was added to the contents to neutralize the basic effect of sodium hypochlorite. The contents were treated with a mordant solution for 15-30 minutes, and basic residues were removed by dripping the distilled water. For staining, the contents were treated with hematoxylin for 10-15 minutes and then washed with water. A drop of Canada balsam was placed on a clear glass slide. Stained plant material was transferred in mounting medium on a glass slide with the help of a camel hair brush and spread uniformly. Again a couple of drops of Canada balsam were placed on the stained plant material and secured with a coverslip of 22 x 40 mm.

2.5. Diet analysis

During laboratory analysis, the fecal material was washed with water and soaked in distilled water in a cotton cloth. The distilled water was filtered and remains were passed through 70% alcohol for 10 minutes. To achieve differentiation, the fragments were treated with light green stain. Alcohol gradients (30%, 40%, 50%, 70%, 90% and 100%) were used to prepare permanent mounts. The different slides prepared were observed under light microscope (60 X) and compared with reference slides. The percent relative frequency of fragments of various species of plants was calculated as:

$$\text{Percent Relative Frequency (\%)} = \frac{\text{Total No. offragments of a sp.}}{\text{Total No. offragments analysed}} \times 100$$

For the diversification of food in dissimilar seasons Berger-Parker index was used as:

$$\text{Berger-Parker index } d = \frac{N_{\max}}{N}$$

Where N_{\max} showed the maximum numeral figure of fragments of a plant species in a season and N were the overall parts of plants recovered in that season respectively. To calculate the overlap among different study sites, Sorensen's similarity index was implied as:

$$\text{Sorensen's similarity index} = \frac{2(C)}{A+B} \times 100$$

Where C was the number of plant species found commonly from both localities A and B. While A and B represent the plant species recovered from locality A and B respectively.

Kruskal-Wallis test was performed to investigate level of significance ($P < 0.05$) among the diet variation in different study localities and seasons.

3. Results

The analysis of fecal samples showed following spatio-temporal diversity in the nutrition of Indian Crested Porcupine in study area:

3.1. Spatial Food Analysis

The following diversity of plant species were recovered from three study sites: site I (30), site II (30) and site III (26). Of consumed plants, *Zea mays* (R.F=16.49%), *Melia azedarach* (R.F=8.21%), *Rumex obtusifolius* (R.F=6.32%) and *Pinus roxburghii* (R.F=5.26%) were found to be highly used in site I. In site II, *Zea mays* (R.F=9.26%), *Arisaema jacquemontii* (R.F=5.65%), *Pinus wallichiana* (R.F=7.28%), *Rumex obtusifolius* (R.F=7.69%) and *Diospyros lotus* (R.F=5.11%) were more often selected. While the most used plant species by Indian Crested Porcupine in site III, were *Zea mays* (R.F=7.47%), *Sorghum halepense* (R.F=6.41%), *Melia azedarach* (R.F=6.41%), *Brassica campestris* (R.F=6.05%) and *Pinus roxburghii* (R.F=6.05%) (Table 1). Sorensen's similarity index depicted a high resemblance amongst the study sites I&II, I&III (91.80% each) and II and III (91.22%).

Different parts (via stems, roots, leaves, seeds spikes, tubers, rhizomes and fruits) of plants were recovered from the fecal material of species. Percent relative frequency showed that the stem and seeds were the most consumed parts while leaves and spikes were the least consumed parts in all sites (Figure 2).

3.2. Temporal Food Analysis

Analysis of fecal samples collected in different seasons showed the following diversity in the food of Porcupine.

3.2.1. Winter

During winter the 13 plant species were found to be eaten by Indian Crested Porcupine collected in winter season. Among them, *Rumex obtusifolius* (15.32±2.57) was the most abundant species. *Melia azedarach* (12.83±4.79), *Arisaema jacquemontii* (11.46±1.79), and *Pinus wallichiana* (9.42±1.86) were recovered in sufficient proportion. While *Allium cepa* (2.38±0.82), *Asphodelus tenuifolius* (2.72±0.98) and *Brassica campestris* (1.82±1.41) were least selected species. A quantifiable amount of polythene bags and pieces of clothes (5.45±0.94) were also recovered from

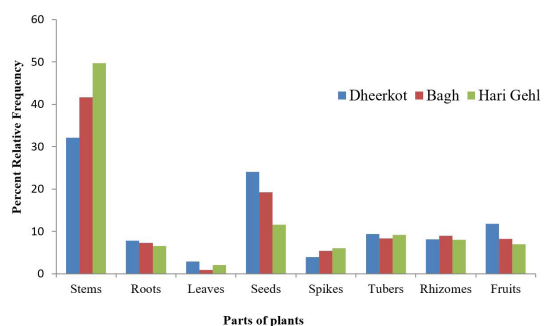


Figure 2. Percent relative frequency of different parts of plants recovered from the fecal samples collected from the study area.

the fecal pellets. A small proportion (4.77 ± 0.63) could not be identified (Table 2). Among the different parts of plants being consumed the stem was used up mostly accounting about 41.3% of the total, followed by fruit (17.8%), rhizome (15.5%), seed (13.8%) and tuber (0.73%). While in winter season leaf and spike were not consumed by species (Figure 3).

3.2.2. Spring

During spring 16 plant species were extracted. Amongst these *Triticum aestivum* (13.28 ± 1.90), *Melia azedarach* (11.83 ± 1.84), and *Brassica campestris* (11.05 ± 1.10) were

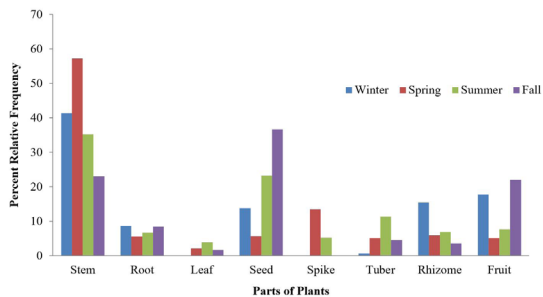


Figure 3. Seasonal variation in the percentage of different parts of plant recovered from fecal samples in the study area.

Table 1. Percent relative frequency of plant species recovered from the fecal sample of Indian Crested Porcupine collected from the three study sites of study area.

Scientific Name	Common Name	Percent Relative Frequency		
		Site 1 (Dheerkot)	Site 11 (Bagh)	Site 111 (Hari Gehal)
<i>Allium cepa</i>	Onion	0.63	0.82	0.00
<i>Amaranthus viridis</i>	Green amaranth	2.32	1.16	2.49
<i>Arisaema jacquemontii</i>	Blume	5.12	5.65	5.34
<i>Asphodelus tenuifolius</i>	Onion weed	0.84	0.82	0.00
<i>Brassica campestris</i>	Mustard	2.74	4.63	6.05
<i>Capsicum annum</i>	Pepper	1.54	0.14	0.00
<i>Cucumis melo</i>	Musk melon	1.68	4.22	3.56
<i>Cyperus rotundus</i>	Nut grass	3.16	1.91	3.02
<i>Diospyros lotus</i>	Date Plum	1.75	5.11	0.71
<i>Eucalyptus camaldulensis</i>	Red gum	4.14	3.74	3.20
<i>Ficus carica</i>	Common fig	0.91	1.43	3.20
<i>Gladiolus dalenii</i>	Sword lily	3.79	2.79	2.67
<i>Hordeum vulgare</i>	Barley	1.19	1.09	1.78
<i>Lagenaria siceraria</i>	calabash	2.04	1.36	2.85
<i>Lycopersicum esculentum</i>	Tomato	2.88	2.04	2.85
<i>Melia azedarach</i>	Chinaberry tree	8.21	7.49	6.41
<i>Morus alba</i>	Mulberry	1.12	0.48	1.07
<i>Olea cuspidata</i>	Wild olive	0.98	1.36	0.00
<i>Pinus roxburghii</i>	Indian pine	5.26	6.33	6.05
<i>Pinus wallichiana</i>	Blue pine	4.98	7.28	5.34
<i>Pisum sativum</i>	Garden pea	0.98	0.14	2.85
<i>Prosopis juliflora</i>	Mesquite	0.28	1.09	0.00
<i>Prunus padus</i>	Bird cherry	1.82	1.02	1.60
<i>Rumex obtusifolius</i>	Broad-leaved dock	6.32	7.69	6.05
<i>Solanum melongena</i>	Brinjal	0.21	0.88	0.71
<i>Solanum tuberosum</i>	Potato	2.32	1.16	3.91
<i>Sorghum halepense</i>	Johnson grass	4.56	4.70	6.41
<i>Triticum aestivum</i>	Common wheat	3.02	4.22	2.49
<i>Tulipa humilis</i>	Tulip	0.00	0.00	2.21
<i>Vitex negundo</i>	Chinese chaste tree	0.28	0.61	0.36
<i>Zea mays</i>	Maize	16.49	9.26	7.47
Others		3.72	3.95	5.69
Unidentified Material		4.14	4.83	3.56

the most consumed species. *Pinus roxburghii* (7.59±1.77), *Rumex obtusifolius* (5.80±1.72) and *Solanum tuberosum* (5.80±1.60) were recovered in sufficient proportion. While other plants like *Prosopis juliflora* (2.23±1.83), *Vitex negundo* (1.67±1.26), *Arisaema jacquemontii* (1.23±0.96) were least noted in this season (Table 2). Among different parts of plant stems were more utilized (57.2%), part over spike (13.4%) while rhizome (5.95) and leaves were detected in small (2.09%) proportions (Figure 3).

3.2.3. Summer

During summer almost 20 plant species were found to be present in feces. The plants of *Zea mays* (9.16±1.86), *Cucumis melo* (9.16±1.76) and *Gladiolus dalenii*, (8.40±1.90) were the most widely consumed species. *Ficus carica* (7.94±1.30), *Lycopersicum esculentum* (7.33±1.44), *Cyperus rotundus* (5.04±0.75) and *Solanum tuberosum* (4.89±0.78) were recovered in sufficient proportion. *Pinus wallichiana* (2.14±0.52), *Melia azedarach* (1.37±0.50) and

Table 2. Percent relative frequency of different plant species recovered from fecal samples of Indian Crested Porcupine in different seasons.

Scientific Name	Common Names	Winter (PRF)	Spring (PRF)	Summer (PRF)	Fall (PRF)
<i>Allium cepa</i>	Onion	2.38±0.82	0.00±0.00	0.00±0.00	0.00±0.00
<i>Amaranthus viridis</i>	Green amaranth	0.00±0.00	0.00±0.00	3.05±0.67	4.23±1.32
<i>Arisaema jacquemontii</i>	Blume	11.46±1.79	1.23±0.96	4.58±1.50	4.02±1.51
<i>Asphodelus tenuifolius</i>	Onion weed	2.72±0.98	0.00±0.00	0.00±0.00	0.00±0.00
<i>Brassica campestris</i>	Mustard	1.82±1.41	11.05±1.10	3.97±0.78	0.00±0.00
<i>Capsicum annum</i>	Pepper	0.00±0.00	0.00±0.00	0.00±0.00	2.41±1.07
<i>Cucumis melo</i>	Musk melon	0.00±0.00	2.68±0.98	9.16±1.76	2.62±1.86
<i>Cyperus rotundus</i>	Nut grass	2.95±1.38	0.00±0.00	5.04±0.75	3.02±1.80
<i>Diospyros lotus</i>	Date Plum	8.97±2.94	2.79±0.83	0.00±0.00	0.00±0.00
<i>Eucalyptus camaldulensis</i>	Red gum	3.75±0.95	3.79±0.94	1.07±0.50	1.91±1.60
<i>Ficus carica</i>	Common fig	0.00±0.00	0.00±0.00	7.94±1.30	0.00±0.00
<i>Gladiolus dalenii</i>	Sword lily	2.84±1.13	0.00±0.00	8.40±1.90	2.82±1.73
<i>Hordeum vulgare</i>	Barley	0.00±0.00	4.80±1.60	0.00±0.00	0.00±0.00
<i>Lagenaria siceraria</i>	Calabash	0.00±0.00	0.00±0.00	4.58±1.22	2.92±1.06
<i>Lycopersicum esculentum</i>	Tomato	0.00±0.00	0.00±0.00	7.33±1.44	2.72±1.06
<i>Melia azedarach</i>	Chinaberry tree	12.83±4.79	11.83±1.84	1.37±0.50	5.13±2.01
<i>Morus alba</i>	Mulberry	0.00±0.00	0.00±0.00	3.36±0.71	2.31±1.47
<i>Olea cuspidata</i>	Wild olive	0.00±0.00	0.00±0.00	0.00±0.00	4.02±2.00
<i>Pinus roxburghii</i>	Indian pine	9.19±2.15	7.59±1.77	2.60±0.60	3.82±0.94
<i>Pinus wallichiana</i>	Blue pine	9.42±1.86	8.26±2.40	2.14±0.52	3.82±0.72
<i>Pisum sativum</i>	Garden pea	0.00±0.00	0.00±0.00	4.89±1.31	0.00±0.00
<i>Prosopis juliflora</i>	Mesquite	0.00±0.00	2.23±1.83	0.00±0.00	0.00±0.00
<i>Prunus padus</i>	Bird cherry	0.00±0.00	0.00±0.00	0.00±0.00	4.63±2.71
<i>Rumex obtusifolius</i>	Broad-leaved dock	15.32±2.57	5.80±1.72	2.90±0.76	3.82±1.57
<i>Solanum melongena</i>	Brinjal	0.00±0.00	0.00±0.00	3.05±0.82	0.00±0.00
<i>Solanum tuberosum</i>	Potato	0.00±0.00	5.80±1.60	4.89±0.78	0.00±0.00
<i>Sorghum halepense</i>	Johnson grass	6.13±0.94	3.46±1.96	4.43±0.99	5.73±1.76
<i>Triticum aestivum</i>	Common wheat	0.00±0.00	13.28±1.90	0.00±0.00	0.00±0.00
<i>Tulipa humilis</i>	Tulip	0.00±0.00	3.35±1.80	0.00±0.00	0.00±0.00
<i>Vitex negundo</i>	Chinese chaste tree	0.00±0.00	1.67±1.26	0.00±0.00	0.00±0.00
<i>Zea mays</i>	Maize	0.00±0.00	0.00±0.00	9.16±1.86	34.31±7.76
Others		5.45±0.94	4.91±0.94	3.21±0.74	2.92±0.99
Unidentified Material		4.77±0.63	5.47±0.51	2.90±0.74	4.02±1.37

Eucalyptus camaldulensis (1.07±0.50) were present in least proportions. A significant amount of unidentified materials (2.90±0.74) were also found (Table 2). Moreover, the stem parts (35.2%), seeds (23.2%) and tubers (11.3%) constituted a higher percentage of diet than spikes (5.22%) and leaves of the plants (3.85) (Figure 3).

3.2.4. Fall

Among the 18 plant species consumed by the Indian Crested Porcupine during fall season, *Zea mays* (34.31±7.76) was the most preferred plant species. The other plant species like *Sorghum halepense* (5.73±1.76), *Melia azedarach* (5.13±2.01), and *Prunus padus* (4.63±2.71) were also recovered in sufficient amounts. The least consumed plants species were *Capsicum annuum* (2.41±1.07), *Morus alba* (2.31±1.47) and *Eucalyptus camaldulensis* (1.91±1.60). The occurrence of other and unidentified material found from the fecal sample collected in autumn season were 2.92±0.99 and 4.02±1.37 respectively (Table 2). The most preferred parts of the plant in fall season were seed (36.7%) followed by stem (23%), fruit (22%) and leaf (1.72%) (Figure 3).

The variation in diet of species during different seasons was evaluated by Berger-Parker diversity index which revealed that the diet of Indian Crested Porcupine varied mostly (10.92) in summer, followed by spring (7.53), winter (6.53) and fall (2.95) (Table 3). There was a non-significant difference in the relative frequencies of plant species consumed by the porcupines during different seasons (Kruskal-Wallis test: $X^2 = 0.40$, $p = 0.750$, $df = 3$) and among different localities (Kruskal-Wallis test: $X^2 = 0.08$, $p = 0.922$, $df = 2$) (Table 4).

4. Discussion

Porcupine management and diet preference has been well studied in Pakistan (Ahmad et al., 2003; Awan et al., 2004; Pervez, 2006; Khan et al., 2007; Mian et al., 2007; Hafeez et al., 2011; Hafeez et al., 2014; Khan et al., 2014; Hafeez et al., 2015; Pervez et al., 2015). However, the current analysis is the first case study of damage imparted by Indian Crested Porcupine on plants and crops in least studied region of AJK (district Bagh).

During investigation 31 important plant species were documented from feces of Indian Crested Porcupine. These are categorized as vegetables (8), fruits (6), trees (5), cereal grains (3), herbs (3) shrubs (2) grasses (2) and flowering plants (2). Among vegetables, onion (*Allium cepa*), chili pepper (*Capsicum annuum*), brinjal (*Solanum melongena*), calabash (*Lagenaria siceraria*), potato (*Solanum tuberosum*), pea (*Pisum sativum*), tomato (*Lycopersicon esculentum*) and mustard plant (*Brassica campestris*) were consumed. Whereas the fruits included date plum (*Diospyros lotus*), wild olive (*Olea cuspidata*), mulberry (*Morus alba*), common fig (*Ficus carica*) and musk melon (*Cucumis melo*). The cereal grains wheat (*Triticum aestivum*), maize (*Zea mays*) and barley (*Hordeum vulgare*) were also fed upon by Indian Crested Porcupine. The cereal grains are a vital source of food worldwide. The current study region is a rural area of a developing country, where people's livelihood is mainly dependent on agriculture, therefore, the crops and livestock are being considered as major household income sources. Hence, human-Porcupine conflict is an increasingly important issue.

On average, consumption of plants species at three different sites of study area was similar with *Zea mays*, *Melia azedarach*, *Pinus roxburghii* and *Rumex obtusifolius*

Table 3. Berger-Parker diversity index of diversity in seasonal sample of the fecal pellets of the Indian Crested Porcupine in Bagh, AJ&K.

Season	Number of food particles (N)	Maximum number of food particles (N_{max})	Berger-Parker index ($\frac{N_{max}}{N}$)	1/d
Winter	881	135	0.15323	6.53
Spring	896	119	0.13281	7.53
Summer	655	60	0.09160	10.92
Fall	1006	341	0.33897	2.95

Table 4. Kruskal-Wallis test for spatial and seasonal diet variation of Indian Crested Porcupine in the study area during study period.

Localities	DF	SS	MS	F	P
Between	2	136.2	68.114	0.08	0.9222
Within	96	80672.8	840.341		
Total	98	80809.0			
Seasons					
Between	3	1654	551.31	0.40	0.7502
Within	128	174563	1363.77		
Total	131	176217			

found to be highly consumed by Indian Crested Porcupine. The area is sparsely covered with coniferous forests and has similar types of hilly habitats and vegetation. Besides, Indian Crested Porcupine is strictly herbivore in diet (Talukdar et al., 2019), therefore a high overlap (Sorensen's similarity index) in food items was noted in the diet of animal species among different study sites. However, seasonal variation in the diet of Indian Crested Porcupine has been noted in present study. *Triticum aestivum* (13.28±1.90), *Melia azedarach* (11.83±1.84), and *Brassica campestris* (11.05±1.10) were recorded as most abundant species in fecal samples collected during spring season. This is in accordance of findings of Hafeez et al. (2014), who found that the *Triticum aestivum* (20.45±1.20) as major consumed crop along with some other plants like *Prosopis juliflora*, (10.80±1.32) and *Sorghum halepense* (13.65±0.84) in the diet of Indian Crested Porcupine consumed in spring in rain bestowed Pothwar Plateau, Punjab, Pakistan.

Zea mays (9.16±1.86), *Cucumis melo* (9.16±1.76) and *Gladiolus dalenii* (8.40±1.90) were the most extensively consumed items in summer season. Hafeez et al. (2014) reported *Zea mays* (16.98±1.58), *Prosopis juliflora* (13.40±0.98) and *Morus alba* (11.63±1.69) as highly used dietary species of Indian Crested Porcupine during summer season from Thal Desert of Pakistan. The present study revealed the least consumption of *Eucalyptus camaldulensis*, *Solanum sp.* and *Cyperus rotundus* in summer diet of Indian Crested Porcupine, similar to the results of Hafeez et al. (2014). Brooks et al. (1988) reported the crops like maize and potato in food of the species in irrigated plains and mountainous areas. Khan et al. (2000) found the species feeding on the grasses like *Cenchrus ciliaris* and *Sorghum halepense* at Karluwala (Bhakkar) Pakistan.

Among crops, *Zea mays* (34.31±7.76) was the most used plant species in fall season. In a research conducted in Pothwar Plateau of district Punjab, Pakistan, Hafeez et al. (2015) testified the occurrence of *Zea mays* (13.91%), *Sorghum vulgare* (13.28%) and *Cynodon dactylon* (12.38%) in the autumn diet of the animal. Moreover, Mian et al. (2007) also expressed in his findings the existence of *Zea mays*, *Hordeum vulgare* and *Triticum aestivum* in the diet of this species in central Punjab, Pakistan. In a study conducted in the Thal Desert, different species of plants like *Morus alba* (12.32 ± 0.67), *Prosopis juliflora* (12.20 ± 1.30), *Melia azedarach* (12.19 ± 0.99), *Eucalyptus camaldulensis* (8.98 ± 0.90), *Zea mays* (8.60 ± 2.02), *Sorghum halepense* (5.54 ± 0.64), *Cyperus rotundus* (4.44 ± 1.36), *Cucumis melo* (3.95 ± 0.50), *Dalbergia sissoo* (3.70 ± 0.78), and *Solanum nigrum* (2.93 ± 0.30) were reported by Hafeez et al. (2014) in the fall diets of this species.

The cultivated plants are noted as major diet components in Punjab (Mian et al., 2007; Hafeez et al., 2011; Khan et al., 2014; Hafeez et al., 2015), in contrast to the present study that has a mixture of wild (15) and cultivated species (16). This could be due to reduced extent of agriculture near our study area compared with the Punjab area. Moreover, similar plants were found to be consumed by Indian Crested Porcupine in district Bagh as reported in existing literature of its feeding habits in Pakistan. But the ranks of consumed plants varied according to season and locality.

The difference of general habitat and abundance of plant species in both areas likely accounts for this variation.

Our work revealed that the stem was the most highly part of the plant eaten by Indian Crested Porcupine. Maximum consumption of stem (29.0%) was also reported by Hafeez et al. (2011) from fecal pellets of Indian Crested Porcupine from Faisalabad, Pakistan. The greater use of stem could be a gnawing strategy, which was used to sharpen incisors and keep them fit for cutting (Downs et al., 2015). Further stem selection could also lower the effort of the animal required in exploring, digging out and extracting the concealed parts of plants lying beneath the ground surface. (Lovari et al., 2017). The seed was the second frequent plant part found in fecal material. Seed could be a good source of energy, as they have clumped distribution and persistence in autumn, making them a good choice to be eaten by a herbivore. Underground parts of plants are noted as dietary items during different seasons in the current analysis. Even Indian Crested Porcupine can consume them in a food deficient period. Moreover, roots, rhizomes and tubers are high carbohydrate sources (Alkon and Saltz, 1985; Lovari et al., 2017). Mori et al. (2017) explained the presence of roots and tuber in the dietary components of the Indian Crested Porcupine throughout the year in Turkey and central Italy respectively. Leaves were least recovered, perhaps their high digestibility is the reason for such rarity. Akram et al. (2017) reported bark as the major (34.89%) dietary components of the species in the winter season, followed by twigs (17.18%), seeds (17.06%); roots (2.59%) were a minor part of diet in Madhya Pradesh, India. Wild fruits were noted as the main food source during the winter season in Italy (Mori et al., 2017). Overall diet of Indian Crested Porcupine consists of mainly woody parts of plants in the winter season (Talukdar et al., 2019). Food selection of this species is based on palatability, digestibility, crude contents and availability of food items. This selection is a significant influence that explains how this animal adapts itself in a wide range of habitat (Alkon and Saltz, 1988; Refinetti, 2008; Fattorini and Pokheral, 2012).

Indian Crested Porcupine were noted to feed on 31 wild and cultivated plants in our area, *Zea mays* the chief crop is most selected diet item of this species. There is an increasing risk of Indian Crested Porcupine as an agricultural pest in this area due to a lack of baseline data regarding feeding habits. A detailed study is required to evaluate the damage of this pest species in cultivated lands of the country.

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