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Assessment of trees and crops damage caused by *Hystrix indica* in Cholistan region of Pakistan

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Abstract

Hystrix indica mainly depend on forest trees, agricultural crops including vegetables and fruits. *Hystrix indica* has an uncommonly wide, nocturnal and generally herbivorous eating behavior distributed all over the world including in Pakistan. The aim of the current research was to study Damage assessment and Eco-biology of Indian Crested Porcupine in Cholistan Districts (Bahawalpur and Bahawalnagar). For this purpose, the stomach contents of 12 *H. indica* were collected from different selected research sites that exposed 25 plants species were consumed by the porcupine as food during the four diverse seasons. It is examined that *Hystrix indica* consumed the trees stem roots and fruit. Estimate Damage of *Acacia modesta* 27.93 ± 0.3, *D. sissoo* 20.2±0.3, *M. alba* 7.9±0.4, *Prosopis juliflora* 11.13 ±0.16 and *Ziziphus jujuba* 13.2±0.3. Results showed that crops of economic importance such as *Zea mays*, *Triticum* and *Alfalfa* were found severely damaged by porcupines in irrigated plains of Cholistan. Furthermore, woody tress, herbs farm crops were badly damaged by the attack of Porcupine. However, the most serious porcupine damage occurs in agroforestry zone. In forest plantation *M. alba, Syzygium cumini, M. azedarach*, *Acacia modesta, D. sissoo* severally damaged while, among vegetables *Daucus carota, Ipomoea batatas and Solanum tuberosum* adversely affected by the attack of porcupine.

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Introduction

The rodentia order of the mammalian class includes the *Hystrix indica* (Khan *et al.*, 2014). It is found in various Middle Eastern nations and territories including Pakistan, Afghanistan, Iran, India, Nepal, Bhutan, Bangladesh, Sri Lanka, Israel, and Saudi Arabia (Hafeez *et al.*, 2011). The food of Indian porcupines is largely herbivorous and quite diverse. They utilize a variety of agricultural and organic plant products, such as tubers, fruits, cereals, roots, and bulbs (Amori *et al.*, 2008).

The Indian porcupine is a huge rodent pest that consumes both surface and subterranean vegetation at all growth stages, having a negative effect on a variety of wild and domesticated plants as well as agricultural crops (Khan, 2013). According to a survey conducted in several areas of Punjab, Pakistan Indian Porcupines destroyed wheat by 4.58% in Faisalabad, 2.03% in Quaidaabad and 1.53% in Sheikhupura causing a loss of 6.37% in Faisalabad and 5.51% in Shiekhupura (Hafeez *et al.*, 2011). An estimated 10.7% of the output of the maize crop in Azad Kashmir's hilly region was lost to severe damage (Khan *et al.*, 1997). Wheat in Pothwar, Punjab, was damaged by Indian porcupines by 0.96% (Mian *et al.*, 2007).

Groundnuts in Punjab, Pakistan, were also destroyed by Indian porcupines, and roughly 3.19-11.92% of the output was compromised (Hafeez *et al.*, 2011). However, it was estimated that groundnut damage caused by Indian porcupines ranged from 7.2% to 20.2% in Chakwal. In Bakhar, Punjab, a porcupine caused damage to 1.15–1.82% of onions, 2.28–5.51% of sugarcane, and 3.39–4.44% of melons (Hafeez *et al.* 2011). Onion damage in Bakhar was predicted to be 0.9%–5.4% earlier than in 2004, primarily at the early growth stage (Mian *et al.*, 2007). Lower Sindh, Pakistan's Indian porcupine also consumes xerophytic plant components (Ahmad *et al.*, 2003). According to reports, this species consumes 37 species of both wild and domesticated plants, including wild and domesticated palms like date palms and coconuts, as well as planted palms (Girish *et al.*, 2005).

The *H indica* is classified as Least Concern by the IUCN because to its tolerance to a wide range of environments and diet kinds. While population size varies depending on range, this species has steady populations and is not as fragmented, in some areas; it is common enough to be considered a pest. However, suitable habitat for porcupines is presently becoming less common in some locations as a result of human habitation, urbanization and the use of pesticides. Indian porcupines are extensively targeted because they harm farmland, forest trees and nursery plants. Porcupines are heavily traded primarily for bush meat and their therapeutic properties (Amori *et al.*, 2008). Indian porcupines which are common in the research area are a severe agricultural pest. So yet no research has been done in the area. Since this is the first study on agricultural damage by Indian porcupines in Cholistan, it will give important information about the kind and extent of damage done to crops by these animals. The study will also highlight current deadly and non-lethal farming control techniques. All of this information is crucial for managing porcupines, protecting crops, and training future researchers.

Material and Methods

Study area

The current study was carried out in 2021 at the Islamia University of Bahawalpur, Pakistan, in the Department of Forestry, Range and Wildlife Management. Cholistan, also known as Rohi, is a vast desert in the southern region of Punjab, Pakistan, and was chosen as the research site (Fig. 1). In the districts of Bahawalpur, Bahawalnagar, and Rahim Yar Khan, Cholistan occupies a region of 25,800 km^2. It is located between 69°57'30" and 72°52'30" east and 27°42'00" to 29°45'00" north. Sand makes up 81% of the desert, while the remaining 19% is made up of alluvial pads and small sandy rises (Riaz *et al.*, 2021).

Study period

The study period was divided into four seasons: spring (February to April), summer (May to August), fall (September to October), and winter (November to January) from February 2020 to January 2021.

In total, 12 porcupine stomachs were examined over the period of the four seasons.

Fig. 1. Map of Punjab with indicate study areas of Bahawalpur and Bahawalnagar (Cholistan)

Trapping material

Bamboo mat, steel pegs and bait material i.e., (carrots, sweet potato, potato and corn).

Trapping methods

The live trap was made of bamboo mat and was put late at night at the mouths of active burrows with proper bait. Each trap was fixed in place with steel pegs so that a caught animal could not tilt it. The traps were examined early in the target morning to catch any captured animals according to (Hafeez *et al.*, 2014).

Slides preparation

Reference slides of the study area's plant species were prepared. For the leaves, roots, stems and bark of several plant species, separate slides were prepared. The reference plant's vegetative parts were dried, soaked in a solution of distilled water, glycerin and ethanol (1:1) and then washed with running water. The mixture was ground in distilled water before being placed in a micro-sieve. The 6 cm long hollow cylinder with 0.05 mm pore size and rubber stopper at one end makes up the micro sieve. After that, specimens were submerged for 20 to 30 minutes in a sodium hypochloride solution of 5% chlorox and 4 parts distilled water. It was then placed in the mordant solution for 16–40 minutes with to offset its basic effects, diluted acetic acid was added. The contents were stained with hematoxylin and kept on for 10 to 15 minutes. On a slide (22 x 40 mm), a drop of mounting media (100c distilled water and 100 garabic gum) was added. The total relative frequency was determined as follows:

Percentage damages= No. of damaged plants/no of total plants ×100

Comparing the relative frequency of various food components found in the stomach contents seasonally allowed researchers to determine the species' preferred diet. Level of significance of results was analyzed with the help of analysis of variance (ANOVA) using SPSS software at 95% confidence limit X ± 2 S.D. (SPSS, 1996).

Results and Discussion

Seasonal eating behavior

Bahawalpur

Spring: *T. aestivum* (17%) and *citrus fruits* (17%) are the most severely consumed species in the spring. *A. cepa* (8%), *B. campestris* (7%), *P. juliflora* (6%), *Syzygium cumini* (6%), *S. melongena* (6%), *M. alba* (5%), *D. sissoo* (4%), *M. indica* (3%), *M. azedarach* (3%) and *Z. jujuba* (2%) were ate to a lesser extent. Among the different issues (2%) were hair, spine and stone fragments, which formed a small fraction of depleted matter, unknown nutrients (5%), and dark plant parts (8%) (Fig. 2). The presence of *citrus* seed affirmed the consequences of Arshad *et al.* (1990). Higher utilization of *T. aestivum* and changing utilization of other plant species affirm the consequence of Hafeez *et al.* (2014).

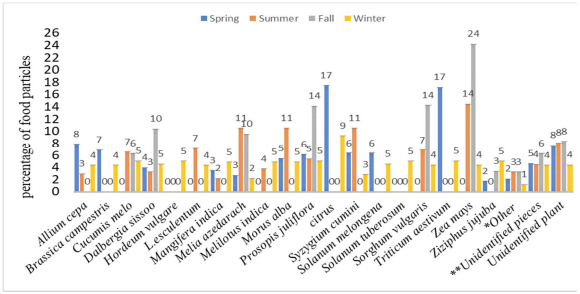

Fig. 2. Percentage of food particles obtained from abdominal contents of *H. indica* trapped from Bahawalpur

Summer: Fig. 2 showed the level of the food things of various plants species consumed throughout the mid-year season plants specie. *Zea mays* (14%) were the

most seriously eaten specie as it had the higher extent. *Syzygium cumini* (11%), *M. alba* (11%), *M. azedarach* (11%), *L. esculentum* (7%), *Sorghum vulgaris* (7%), *P. juliflora* (5%), *A. cepa* (3%), *D. sissoo*(3%) and *M. indica* (2%) were consumed-through in moderately less extents, different tissues (3%) involved hair, spine and bits of stone which established a tiny piece of absolute stomach substance, while unidentified food matter comprised (4%) and Unknown plant materials made up 8% of the stomach contents.

Fall: Fig. 2 showed the level of the food things of various plants species consumed throughout the Fall season plants specie. *Zea mays* (24%) was the generally burned-through specie. *Sorghum vulgaris* (14%), *P. juliflora* (14%), *D. sissoo* (10%), *M. azedarach* (10%), *Cucumis melo* (6%) and *Ziziphus jujuba* (3%) were eaten in moderately little amount, different issues (3%) included hair, spine and bits of stone which comprised a tiny piece of all out-stomach substance, while unidentified food matter established (6%) and obscure plant parts (8%) of the stomach content. Intensified utilization of *Z. mays* supported the perception of (Ahmed *et al*., 1987) who depicted that damage led in maize fields in Faisalabad place was unlimited.

Winter: The level of the food things of the stomach substance during winter seasons, recorded Fig. 2. *Citrus* (9%) was most seriously consumed species. *T. aestivum* (5%) and *P. juliflora* (5%) *Cucumis melo* (5%), *H. vulgare* (5%), *M. indica* (5%), *A. cepa* (4%), *B. campestris* (4%), *M. alba* (5%), *Z. jujuba* (5%), *D. sissoo* (5%), *S. tuberosum* (5%), *Solanum melongena* (5%), *M. azedarach* (2%) were used less seriously. Unidentified food things (4%), obscure plant parts were (4%) and other food things (1%) of winter diet involved hair, spine and string particles.

The presence of *citrus* seed affirmed the consequences of Arshad *et al.* (1990). Higher utilization of *T. aestivum* and changing utilization of other plant species affirm the consequence of Hafeez *et al.* (2014).

Bahawalnagar

Spring: The stomach substance (Table 1) showed appearance of 7 plant species consumed by the porcupine throughout the spring season. *Melia azedarach* (31±0.2) was the most widely consumed species. *Triticum aestivum* (15.3±0.2), *Cynodom dactylon* (14±0.3) and *Morus alba* showed up in high recurrence. *Prosopis juliflora* (11.1±0.2), *Dalbergia sissoo* (6.2±0.1), *Ziziphus jujuba* (5.1±0.2) contributed critical extents. Other (1.9±0.1) Unidentified (8.1±0.1) Unknown plant (12±0.3) were likewise present in adequate extent. The presence of different plant specimens consumed by the porcupine affirmed the findings of Arshad *et al.* (1990).

Summer: The investigation of the stomach substance of porcupines caught throughout the summer showed that 7 plant species were eaten (Table 1). *Zea mays* 15±0.2 was the most seriously consumed species. *Cucumis melo* (3.1±0.1), *Cynodom dactylon* (9±0.1), *Dalbergia sissoo* (12.1±0.2), *Morus alba* (13±0.2), *Prosopis juliflora* (6.3±0.4) and *Sorghum vulgaris* (11.1±0.2) were additionally consumed in critical extents. Other (2.0±0.2), Unidentified (7.9±0.1) Unknown plant (11.1±0.4) were additionally found in huge extent. Presence of various food particles affirms the discoveries of Roberts (1997), Arshad *et al.* (1990) and Brooks *et al.* (1988).

Fall: The porcupines (n=2) were caught in the long stretches of October 2020. 9 plant species consumed by the porcupine throughout in this season (Table 1). *Zea mays* (16±0.2) was recovered at most noteworthy amount. *Morus alba* (14.9±0.1), *Melia azedarach* (13±0.2), *Dalbergia sissoo* (12±0.1), *Cynodom dactylon* (11.2±0.2), *Sorghum vulgaris* (10.1±0.2), *Prosopis juliflora* (9.1±0.1), *Ziziphus jujuba* (4.1±0.1) and *Melilotus indica* (3.2±0.1) were consumed in critical extents. In fall diet, the porcupines burned-through other (2.2±0.3) matter like hair and spine Unidentified (9±0.1) and Unknown plants (13.2±0.1) were likewise comprised in less amount.

Winter: All the (n=3) tests gathered in winter taken in the space of Bahawalnagar. The stomachs of

porcupines yielded 9 different types of plant-based foods. *Dalbergia sissoo* (17±0.2) and *Morus alba* (14.8±0.1) were discovered seriously consumed species. *Melia azedarach* (14±0.2), *Cynodom dactylon* (13±0.20), *Triticum aestivum* (11.2±0.1), *Sorghum vulgaris* (9.9±0.3), *Ziziphus jujuba* (9±0.2), *Cucumis melo* (6±0.2), *Prosopis juliflora* (7.2±0.1), were less often burned-through. Other (3.1±0.1) Unidentified (6.2±0.1) Unknown plants (12.2±0.3) were in low amount in the total stomach substance. Presence of the greater utilization of *T. aestivum* confirms the result of Hafeez *et al.,* 2014.

Table 1. Shows the relative frequency of food particles obtained from abdominal contents of *H. indica* trapped from Bahawalnagar

Food particles	Summer		Spring		Fall		Winter	
Cucumis melo	3.1	±0.1	0.0	±0.0	0.0	±0.0	6.0	±0.2
Cynodom dactylon	9.0	±0.1	14.0	±0.3	11.2	±0.2	13.0	±0.2
Dalbergia sissoo	12.1	±0.2	6.2	±0.1	12.0	±0.1	17.0	±0.2
Melia azedarach	0.0	±0.0	31.0	±0.2	13.0	±0.2	14.0	±0.2
Melilotus indica	0.0	±0.0	0.0	±0.0	3.2	±0.1	0.0	±0.0
Morus alba	13.0	±0.2	12.1	±0.3	14.9	±0.1	14.8	±0.1
Prosopis juliflora	6.3	±0.4	11.1	±0.2	9.1	±0.1	7.2	±0.1
Sorghum vulgaris	11.1	±0.2	0.0	±0.0	10.1	±0.2	9.9	±0.3
Triticum aestivum	0.0	±0.0	15.3	±0.2	0.0	±0.0	11.2	±0.1
Zea mays	15.0	±0.2	0.0	±0.0	16.0	±0.2	0.0	±0.0
Ziziphus jujuba	0.0	±0.0	5.1	±0.2	4.1	±0.1	9.0	±0.2
*Other	2.0	±0.1	1.9	±0.1	2.2	±0.3	3.1	±0.1
**Unidentified pieces	7.9	±0.1	8.1	±0.1	9.0	±0.1	6.2	±0.1
Unidentified plant	11.1	±0.4	12.0	±0.3	13.2	±0.1	12.2	±0.3

*Other= Quill, Hair and Thread. **Unidentified= Unidentified material. Values are (Means ± S.D.)

Conclusion

It was determined that porcupines consumed twelve distinct plant species in the spring, as well as seven in the fall and nineteen in the winter. Of these, *Acacia modesta* and *P. juliflora* were consumed in the greatest amounts in the winter, while motives in the spring, the most *triticum aestivum* were eaten. *Morus alba*, which is comparable to *Acacia modesta*, was enjoyed at its finest in the fall and winter. *H. indica*'s diet clearly changed with seasonal and geographic variation, which can be mostly related to the accessibility of food species or their components.

It was observed that mechanical control of *H. indica* was very much difficult and time consuming because of its nocturnal behavior so chemical control is recommended to control the *H. indica* population to minimize its economical loses.

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