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Scat Analysis of Small Indian Mongoose (*Herpestes auropunctatus*) Feeding on Fauna of Some High and Relatively Low Input Crop Fields

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ABSTRACT

This study was focused on knowing the effect of intensive agricultural practices on the feeding intensity and diversity of food items of this one of the World's worst invaders in relatively LIP and HIP crop fields of central Punjab. Total of 500 scats of small Indian mongoose (*Herpestes auropunctatus*) were collected from wheat and fodder crop fields representing low input (LIP) and those of sugarcane, vegetables and rice representing high input (HIP) fields. The mongoose was found to visit LIP fields more frequently than HIP. Contrary to this the mean size of scat samples of all the seasons was larger in HIP fields supposedly due to low rate of decomposition of residual pesticides. The diet of mongoose comprised of a variety of faunal taxa including as small as aphids and as large as bandicoot rat. The most frequent vertebrate feed items were unidentifiable birds and almost all the small mammalian pests. Among invertebrate prey taxa carabids and gomphids were frequent ones in the scats. LIP fields presented relatively more complex trophic guild of prey and predator species eaten up by the mongoose than those of HIP fields. It is concluded that the animal is beneficial in keeping the populations of almost all potential pests below economic threshold in natural and diversified ecosystems. Conversely, it would be a threat to less diverse agroecosystems as its voracious feeding may lead to elimination of some precious taxa.

Key Words: Opportunistic feeder; Pesticides; Diversity points; Bio-indicators

INTRODUCTION

Intensive agriculture has negative effects on both species and biodiversity within agricultural systems, primarily because of low crop and structural diversity and also through pesticide use and tillage (Ammann, 2003). A study on arthropod diversity in agricultural landscapes revealed higher species diversity in low tillage cultivations (Duelli *et al*., 1999; Benton *et al*., 2002) whereas, an intensive agricultural habitat harbored lowest aerial invertebrate populations at a rural Scotland. Comparable studies have found similar impacts on bird species throughout United Kingdom and European Union (Donald *et al*., 2002a,b). According to Science Assessment for Environment Canada intensive (high input) farming practices have an impact on soil microflora, plants, invertebrates, and some of the main groups of vertebrates (Mineau, 2001)

In arable crops, beneficial arthropods play an important role in controlling the population of various pests (Luff, 1983; Nyffleler & Benz, 1987). Certain arthropods especially carabids, are considered indicators of habitat quality (Kromp, 1990; Rainio & Niemela, 2003). The vertebrates such as lizards and insectivore mammals keep in balance the populations of various poisonous arthropods, harmful insects and rodents. This natural check and balance seems to be interrupted by intensive agriculture and pesticides. An integrated species approach addresses the value of each species particularly in agroecosystem thus ensuring its sustainability.

In croplands of central Punjab (Faisalabad) shrews and hedgehogs are exclusively insectivorous. Mongooses are also known to hunt insects (Roberts, 1997; Siddiqui *et al*., 2003). Several field studies have revealed the small Indian mongoose to be primarily an insectivore, though it also feeds opportunistically on small vertebrates (Cavallini & Nel, 1995). There are two species of mongoose in Pakistan, the small Indian mongoose (*Herpestes auropunctatus* (synonym: *javanicus*) and the common Indian mongoose (*Herpestes edwardsi*). The former is well adapted to live near human habitations. It is a common small carnivore in Pakistan, typically associated with better-wooded regions of river Indus plain. Its subspecies, *auropunctatus* is known to occur mainly in the southeastern part of its range in Indonesia (Corbet & Hill, 1992). As this animal feeds on whatever it affords to eat, its scats can represent whatsoever is present in its place of occurrence. Present study documents some comparisons of invertebrates and vertebrates occurring in the scats of small Indian mongoose predating on the fauna of relatively low input and high input crop fields under the changing agroclimates due to chemical inputs in the cultivated areas of Faisalabad district.

MATERIALS AND METHODS

Crop fields viz., wheat, fodder, sugarcane, rice and vegetables were earmarked for the collection of scats of mongoose. The wheat and fodder fields were taken as low input (LIP) as there was relatively lesser use of synthetic fertilizers and pesticides, whereas fields of sugarcane, vegetable and rice received heavy doses of these chemicals and therefore referred as high input (HIP) crop fields. LIPs were the farms near Nishatabad; whereas, HIPs the experimental farms of University of Agriculture and Nuclear Institute of Agriculture and Biology (NIAB), Faisalabad. The second replica of low input fields could not be taken due to meager availability of these fields.

Time spent, number of sightings of mongoose and number of scats during each visit in the fields was noted to determine natural inclination of the predator toward both types of fields. Total of 500 scats were collected to determine the food menu of mongoose with reference to invertebrate and vertebrate diversity. The oven dried and stored scats were soaked in appropriate amount of warm water for 2-3 h to loosen the hair and other materials binding the scats. Each scat was examined to sort out fragments of insect bodies, bones, hairs, feathers, plant material, mollusks, and soil under a magnifying glass or low power microscope. Based on remnant bones, particularly the vertebrae, limbs, girdle and teeth it was possible to identify the vertebrate preys consumed by the mongoose. In case of mammals, prey species were determined on the basis of cuticular scale patterns of the hair, present in the scats (Mushtaq-ul-Hassan *et al*., 2003). Presence of beaks and claws of birds helped in assigning the avian preys to order level. The identification of insects was made from "Fauna of British India".

RESULTS AND DISCUSSION

Frequency of predation. Table I presents the frequency of occurrence of small Indian mongoose in different crops receiving low and high inputs (LIP & HIP respectively) of chemicals i.e., synthetic fertilizers and pesticide sprays. Accordingly, the mongoose was found to be more inclined towards relatively low input crop fields of wheat and fodder, the mongoose visited these fields more frequently than those of high input viz., rice, vegetables and sugarcane. It was interesting to note that mean scat samples of all seasons (calculated from per visit of the mongoose) were larger in all HIP crop fields than those of LIP. Conversely, the average frequency of mongoose scats was high in LIP field, which was more or less directly proportional to sightings of the animal visiting these fields (Table II).

Larger scat samples in HIP fields were assignable to slow decomposition rate of scats due to the residual effect of pesticides on the decomposer microfauna in HIP fields. Many of crop fields have been reported to be deprived of earthworms (macro-decomposers) in the cotton crop fields, receiving heavy doses of pesticides (Siddiqui, 2005, personal communication).

Diversity of Food Items. Food of mongoose was highly diversified and the animal seemed to be an opportunistic feeder (Fig. Ia). The frequency of remnants of items present in the mongoose's scats, collected from LIP crop fields was higher. Though these high frequencies of occurrence were related with larger number of scats collected from these fields, the prey fauna was more frequent and diverse scats collected from LIP fields also. (Table III).

Data revealed that certain species of birds, small mammals and insects predominated in HIP fields of sugarcane (Fig. Ia-c). Bird species could not be identified from their bone remnants but their predominating frequency in sugarcane fields could be attributed to the large number of carabid and gomphid insects in these fields. The carabid beetles had been found to constitute the major food items during the stomach analysis of little Spotted Owl, *Athene brama* (Robert, 1991). According to Mushtaq-ul-Hassan *et al*. (2003) beetles (coleoptera) were the best-utilized food items of the same bird. Ground beetles (carabidae) have been reported as useful bioindicators (Kromp, 1990; Rainio & Niemela, 2003). The adult gomphids or clubtails could have been captured by the mongoose from the irrigation ditches among the crops. Because most of the larval gomphids just as easily be called "burrowing dragonflies" conceal themselves in substrate and loose particular debris in lotic and lentic waters.

The agro-chemicals can change the chemical composition of plants, which are in turn taken up by phytophagous animals. These animals, when dead, are decomposed, can change the soil nutrient status thereby

Table I. Number of mongoose sightings and collection of scats taken from high and relatively low input crop fields of Faisalabad (Relative mean sample size is given in parentheses)

			No. of mongoose sightings / No. of scats				
Inputs	**Research Areas**	**Crops**	**Spring**	**Summer**	**Fall**	**Winter**	**Total**
High	Nuclear Instituteof Agriculture & Biology, Faisalabad	Rice + Vegetables	2/13 (6.50)	2/10 (5.00)	10/73 (7.30)	8/70 (8.75)	22/166 (7.55)
Low	Nishatabad, Faisalabad	Wheat + Fodder	6/34 (5.67)	4/23 (5.75)	19/110 (5.79)	9/50 (5.55)	38/217 (5.71)
High	University of Agriculture, Faisalabad	Sugarcane	2/23 (11.5)	3/27 (9.00)	4/30 (7.50)	6/37 (6.17)	15/117 (7.80)
Total		-	10/70 (7.00)	9/60 (6.67)	33/213 (6.45)	23/157 (6.83)	75/500 (6.67)

Table II. Mean occurrence of scats of small Indian mongoose (calculated from collection of no. of scats/hour) in high and relatively low input crop fields of Faisalabad round the year

Seasons	Localities (Crops)		
	HIP (Rice +Vegetables)	LIP (Wheat + Fodder)	HIP (Sugarcane)
Spring	2	5	4
Summer	3	5	4
Fall	7	8	4
Winter	7	7	7
Average	5	6	5

Table III. Diversity points counted as variation in the relative frequency of food items in the scats collected from HIP and LIP cropfields (Highest=3 points, high=2 points, Low=1 point)

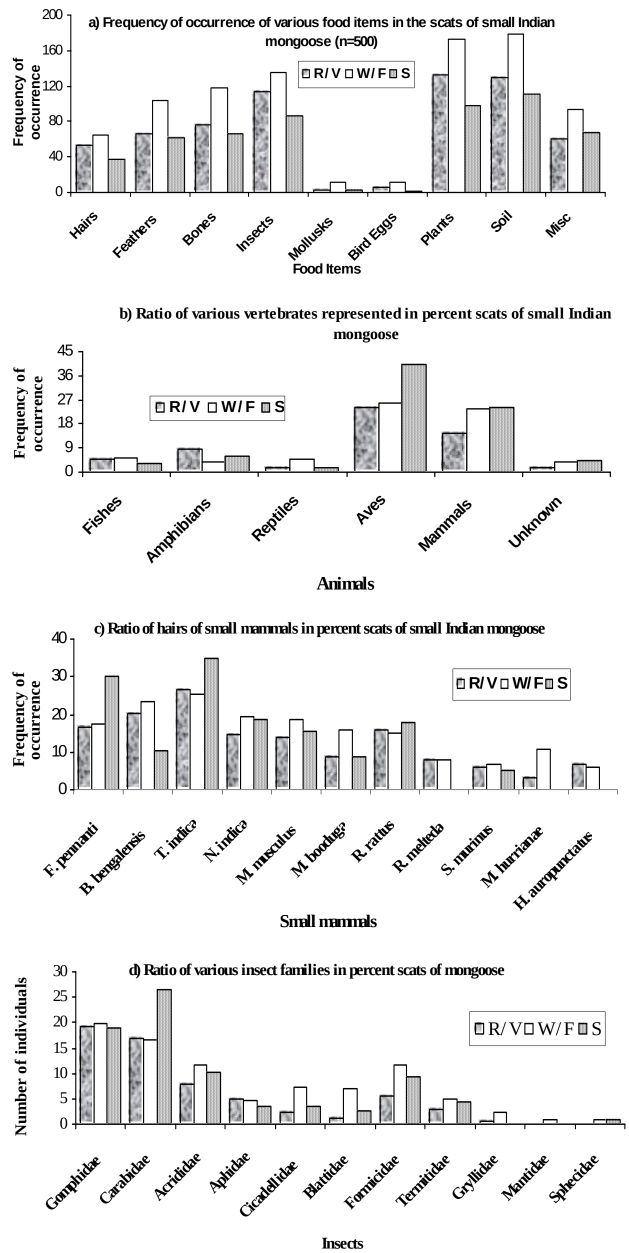
Vertebrates	R/V HIP	W/F LIP	S HIP
Fishes	2	3	1
Amphibians	3	1	2
Reptiles	1	3	1
Aves	1	2	3
Mammals	1	2	2
Diversity points	8(5) = 40	11(5) = 55	9(5) = 45
Per cent Ratio	29	39	32
Small Mammals			
F. pennanti	1	2	3
B. bengalensis	2	3	1
T. indica	2	1	3
N. indica	1	3	2
M. musculus	1	3	2
M. booduga	2	3	1
R. rattus	2	1	3
R. meltada	1	1	-
S. murinus	2	2	1
M. hurrianae	1	2	-
Diversity points	15(10)=150	21(10)=210	16(8)=128
Per cent Ratio	31	43	26
Insect Families			
Gomphidae	2	3	1
Carabidae	2	1	3
Acrididae	1	3	2
Aphididae	3	2	1
Cicadellidae	1	3	2
Blattidae	1	3	2
Formicidae	1	3	2
Termitidae	1	3	2
Gryllidae	1	2	-
Mantidae	-	1	-
Sphecidae	-	1	1
Diversity points	13(9)=117	25(11)=275	16(9)=144
Per cent Ratio	22	51	27

D.P = R.F.P x S.R
D.P = Diversity points
R.F.P = Relative frequency (abundance) points
S.R = Species richness or number
R / V = Rice/Vegetables
W / F = Wheat/Fodder
S = Sugarcane

altering the dynamics of the agroecosystem. This may appear in the resurgence of target or non-target species of plants and animals. In the present study, predominance of carabid insects in HIP fields especially in sugarcane indicates the changed chemical composition of soil in these fields. There might have other abiotic or biotic links also. Nonetheless, we feel that studies on the bioindicator species in the cropland and impact of various chemicals on chemical constituents of recipient crops are imperative.

Frequency of small mammalian pests (of the area) such as *Tatera indica* was highest in the scats collected from

Fig. 1. (a-d). Representation of some invertebrates and vertebrates in the scats of small Indian mongoose visiting low input and high input cropfields of Faisalabad



sugarcane fields (Fig. Ib). The occurrence of other pest species viz., *Funumbulus pennanti, Nesokia indica* and *Rattus rattus* was also fairly good in both LIP and HIP fields. The occurrence of particular prey taxa in scats could be attributed to their availability in the cropland and nearby orchard in the study area. Wheat had been reported to be the most preferred crop which attracted many of the rodent pests like *Tatera indica, Bandicota bengalensis, Nesokia indica, Rattus meltada, Rattus rattus, Mus musculus* and *Mus booduga*, whereas sugarcane crop provide best refuge and shelter to most of these rodent pests in off-wheat season, as this crop stayed in the fields almost round the year in this region (Beg & Rana, 1978; Beg *et al*., 1979; 1980; Khan & Beg, 1984, 1986; Rana *et al*., 1998).

Diversity points (DP) in LIP and HIP fields. The DP also represents the mongoose's inclination towards LIP fields due to relatively more heterogeneity and abundance of prey taxa (Table III). It ranges from the small insects such as aphids to birds and mammals of up to the size of 160 mm of bandicoot rat (Robert, 1997).

LIP fields presented relatively more complex trophic guild of prey and predator species, which were eaten up by the mongoose. This suggested that this non specific mammalian predator was not responsible for disturbing the ratio of the mutually interacting species of its prey rather it seemed to keep balanced specific ratio of prey and predators in relatively more diverse crop fields. Specific ratio of prey and predator species abundance ensures the survival of the two, and thus helps sustainability of the agro-ecosystem. Contrary to this HIP fields offer-reduced chances of herbivore feeding. Additionally, sublethal levels of pesticides may continue to exert subtle effects, reducing the ability of the non-target organisms to reproduce, predate or avoid their predators (Morley, 2004).

In crux, the above study provides evidence of changed agroclimate due to the use of pesticides. The mongoose which is one of the top 100 world's worst invaders (DiFiore, 2001) could be beneficial in keeping the populations of nearly all the pests and potential pests below economic threshold in natural and diversified ecosystems. Conversely, it would be a threat in less diversified agroecosystem as its voracious feeding may lead to elimination of some important taxa.

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