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Faunal Diversity and Abundance of Tenebrionidae in Rajasthan

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Abstract : Tenebrionidae was examined by means of bimonthly surveys carried out using pitfall traps. A total of 20 species were collected. Distribution and preference of habitats of most of the species were analysed. Sand dune habitat had the highest species dominance, while it was the least in the saline habitat. Relative abundance of some species decreased in the winter season.

Key words : Tenebrionid beetles, habitat, pitfall trap, relative abundance, predation.

Tenebrionids known as darkling beetles are abundantly distributed in arid and semi-arid regions of Rajasthan desert and have been poorly studied, except Pruthi and Bhatia (1952) who listed six species of these beetles, e.g., *Adesmia* sp., *Blaps*, *Pimelia indica*, *Rhytinota impolitas*, *Arthrodes* sp., *Opatroides vicinum*. The adults are mostly black, ground dwellers, detritivores, feeding mainly on dead plant materials and are conspicuous insects adapted to hot dry desert habitat.

The aim of this paper is to analyse faunal diversity, abundance and habitat preference of these insects in the desert ecosystem.

Materials and Methods

Study area and habitats

This work was undertaken under a bilateral research programme of Indo-USSR (ILTP) governments during 1989-92. Both the Indian and the USSR scientists surveyed frequently arid and semi-arid zones of the desert and collected beetles from different locations (Table 1). Four habitats-sand dune (Osia), rocky (Nava), grassland (Fatehpur), and tree species and saline depression (Sambhar) were selected. Annual precipitation of these sites ranged between 150 mm and 400 mm and vegetation cover was of natural grasses, forbs and scarcely distributed trees or shrub species. Relative abundance of beetles was studied at Jodhpur site.

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Pit-fall traps

Tenebrionid population and activities were monitored with pit-fall traps. The traps were metallic containers with 10 cm diameter opening, 12 cm deep and 600 cm^3 volume. The opening was at the soil surface. A grid of traps in each of the habitats was used. Grid rows were 4 m apart and the traps were 3 m apart within rows. The number of traps in a row and the number of rows in a grid were adjusted to the habitat geography.

The traps were left open and checked in the morning on consecutive days each month during the experimental period. Additional data on activity were recorded by direct observations during all the seasons. All the trapped beetles were released except a few taken for reference and identification. The insects were identified using the tenebrionid collection of the section and its confirmation upto species level was made with the help of the Coleoptera Section of Entomology, Zoological Survey of India, Calcutta.

Results and Discussion

Faunal diversity, species composition and activity

A total of 20 species of tenebrionid beetles (Tenebrionidae) were caught over the entire period of investigation (Table 1). Most specimens were caught from July to November, March and April and the least in May. From the different annual capture records, it appears that most activity took place between July to October, and

the least in winter (December to February) and in very hot months of May and June. Thus, on hot days, beetles were found most frequently in cooler, vegetated clumps and concentrated activity at night. In the winter, beetles burrowed in sand where temperatures were higher than that of the surface. Temperature therefore reflected thermophilic characteristics and played important role in activity of tenebrionids, as already demonstrated in species for other environments (Hamilton, 1971; Cloudsley-Thompson, 1991). The black colour of tenebrionids must be a warning to enemies, due to its unpleasant taste and smell. Burrowing was the most important behavioural adaptation to the hot dry environment and the existence of favourable microclimate within the burrows of beetles was of supreme importance to their survival (Cloudsley-Thompson, 1962). Further more, the diurnal species exhibited behavioural plasticity, which allowed them to adjust their surface activity according to temperature, and to take advantage of the ability to burrow during unfavourable periods (Abushama and Al-Salameen, 1989).

Species diversity in relation to habitat

Sand dune habitat : It is obvious from Table 2 that dune habitat exhibited highest species diversity compared to other sites. It comprised 11 species (64.7%) out of 17 species recorded from experimental sites. Absolute dominance of *Pimalia indica* and *P. inexpecta* was noticed, while other representatives were *Rasphytus fregi*, *Pachycara pleiferi*, *Tentyrina rajasthanicus*, *Oxycara tharensis*, *Zophosis deserticola*, *Blaspa* sp., *Scleron sulcatum*, *Opatroides vicinus* and *O. punctulatus*.

Rocky habitat : Eight species (47.0%) were noticed with a moderate dominance of *Adesmia delhica*. Other common species collected were *Spyrathus* sp., *Rhytinota* sp., *Rasphytus fregi*, *Sphenariopsis tristis*, *Oxycara tharensis*, *Zophosis deserticola* and *Pachycera pleifferi*.

Grassland habitat : Seven species contributing 41.1% of the total tenebrionid fauna were recorded among the species collected, two species were *Tribolium indicum* and *Latheticus orazac* found attached with dead twigs of *Acacia tortilis*

Table 1. List of tenebrionid beetles collected from Rajasthan desert

Species	Collection site	No. of collected insects per 50 x 50 m
Adesmia delhica Koch	Beawar, Nava, Jodhpur	07
Aliphitobius sp.	Jodhpur, Bilara	02
Blaps sp.	Osia, Jodhpur, Shergarh	10
Latheticus oryzae Wat	Jodhpur, Fatehpur	13
Oxycara tharensis Kulzer	Jodhpur, Sambhar, Nava, Fatehpur, Osia	05
Opatroides vicinus Frm	Jodhpur, Fatehpur, Osia	03
Opatroides punctulatus Bril	Shergarh, Osia	10
Primelia cornerer Kulz	Mathania, Osia	03
Pimelia indica Sen	Jodhpur, Sambha, Osia, Bilara, Fatehpur	06
Pimelia inexpecta Sen	Jodhpur, Sambhar	08
Pychycera pleifferi Koch	Baleser, Osia, Beriganga, Nava, Fatehpur	03
Rasphytus fregi Kulz	Jodhpur, Osia, Nava, Laxmangarh, Fatehpur	03
Rhytinota (*sphenariopsis*) *tristis* Kr	Mathania, Jodhpur, Nava, Fatehpur	02
Rhytinota sp.	Jodhpur	02
Spyrathus indica Kr	Jodhpur, Nava	03
Spyrathus sp.	Jodhpur, Nava	06
Scleron sulcatum Bd	Jodhpur, Osia	05
Tentyrina rajasthanicus Saha	Jodhpur, Osia, Baleser	02
Tribolium indicum Bl	Jodhpur, Fatehpur	08
Zophosis deserticola Kulz	Jodhpur, Osia, Nava, Fatehpur	06

Table 2. Faunal distribution of tenebrionid beetles in the experimental sites

Species	Habitat			Saline depression
	Sand dune	Rocky	Open grass-land with trees	
Spyrathus sp.	–	+	–	–
Rasphytus fregi	+	+	+	–
Pachycera pleifferi	+	+	+	–
Phytinota (Sphenariopsis tristis)	–	+	+	–
Tentyrina rajasthanicus	+	–	–	–
Oxycara tharensis	+	+	+	–
Zophosis deserticola	+	+	+	–
Pimelia indica	+ + +	–	–	+
Pimelia inexpacta	+ + +	–	–	+
Blasps sp.	+	–	–	–
Scleron sulcatum	+	–	–	–
Opatroides vicinus	+	–	–	–
Opatroides punctulatus	+	–	–	–
Adesmia delhica	–	+	–	–
Rhytinota sp.	–	+	–	–
Latheticus oryzae	–	–	+	–
Tribolium indicum	–	–	+	–
Species 17	11(64.7%)	8(47%)	7(41.2%)	2(11.8%)

– Absence of species; + Presence of species; + + Moderate dominance; + + + Absolute dominance

tree on the ground, while remaining five species were *Rasphytus fregi*, *Pachycera pleifferi*, *Rhytinota (Sphenariopsis) tristis*, *Oxycara tharensis* and *Zophosis deserticola*.

Saline depression habitat : Species diversity was the lowest as compared to those of the other habitats. Only two species, *Pimelia indcia* and *P. inexpecta* were recorded. The species contribution to fauna was only 11.8%.

Most of the species had their preference to a particular habitat. However, habitats within a land type exhibited a remarkable similarity in species composition. The different habitats had, sometimes, the same species and differed in species relative abundance, in spite of the differences in their plant communities. Plant density of the habitat had strong influence on species composition and abundance. The existing low species number in saline depression habitat might be due to sparse vegetation and high compact saline soil type, while comparatively high number of species in sand dune or grassland habitats may be due to loose sandy soil and adequate vegetation cover.

Adult tenebrionids were mainly scavengers of plant materials, but they also occasionally consumed remains of dead animals with no apparent specificity between species. Competition for food related to classical niche partitioning does not seem to play an important role in shaping tenebrionid community structure in habitats within the same soil type (Holm and Edney, 1973). Like other beetles in desert, tenebrionid exhibited several morphological and behavioural adaptations to avoid inter specific interactions for reducing the hazards of heat stress and predation (Hamilton, 1971).

Lizards and birds were found to consume the beetles in their diet at all the experimental sites resulting is decrease in their population. Rathore (1969) reported feeding of 15 to 40% Coleopterous beetles (tenebrinids) by Indian sand skink (*Ophiomorus tridactylus*), while Sharma and Vajirani (1977) observed that tenebrionids were most commonly eaten by desert lizards. Spotted owlet (*Athene brama indica*) consumed 15 to 19% of the beetles of tenebrionidae, particularly in the winter season (Advani and Jain, 1983).

Table 3. Relative abundance of tenebrionid beetles in open grassland at CAZRI Farm, Jodhpur

Species	Mean (%) of tenebrionids captured, trap/24 h		
	Nov.	Dec.	Jan.
Rasphytus fregi	6.0	0.9	–
Oxycara tharensis	65.2	45.4	19.2
Pachycera pleifferi	9.6	8.2	7.3
Zophosis deserticola	18.5	45.5	73.5
Rhytinota tristis	0.7	–	–

Relative abundance : It was estimated during three months (November 1990 to January 1991). It was revealed that all the five species exhibited their predominance in November (Table 3). The most abundant species was *Oxycara tharensis* (65.2%), followed by *Zophosis deserticola* (18.5%) and to a lesser extent, *Pachycera pleifferi* (9.6%), *Rasphytus fregi* (6.0%), and *Rhytinota tristis* (0.7%). Species abundance decreased considerably, except in *Zophosis deserticola* which showed increasing trend in December and January. However, disappearance of *Rhytinota tristis* and *Rasphytus fregi* might be due their burrowing habit in the winter. Thus, the present study points to the urgency of the work to be undertaken on the species diversity of tenebrionidae family which happens to possess highly adaptive nature in the hot dry habitats. Indira Gandhi Nahar Pariyojana (IGNP), in the western border of Rajasthan, has drastically changed the scenario of soil ecosystem. Flooding of canal water for irrigation in sand habitat has resulted into breakdown of soil strata, consequently, breeding grounds of beetles in the area have largely been affected. Egg laying and larval development took place in the soils around the root clumps of grasses and shrubs. Secondly, the population has suffered adversely due to continuous agricultural management practices (deep tillage, inputs of fertilizers, pesticides in the soil). The fauna has decreased gradually as a result of degradation of natural environment and has become smaller from year to year. More critical observations are required on the status of insects and faunal diversity.

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