Habitat Association And Diversity Of Acridids (Orthoptera: Acrididae) In A Dry Deciduous Forest Of West Bengal

Hiroj Kumar Saha[1]* and Parimalendu Haldar[2]

[1] *Assistant Professor, PG Department of Zoology, Bethune College, Kolkata- 700006, West Bengal, India*

[2] *Department of Zoology, Visva-Bharati University, Santiniketan-731235, West Bengal, India*

Abstract

Acridids are most dominant group of herbivorous insects throughout the world, and play an important role in the functioning of forest ecosystem. Acridid assemblages of five different habitats i.e. weed dominant sites (WDS), *Oriza* species dominant sites (ODS), sal dominant sites (SDS), road sites (ROS) and rock sites (RS) in Chipkuthi forest, West Bengal, India were studied. Acridid diversity, abundance and species richness were observed to undisturbed and disturbed habitats. The number of different species found in each habitat (species richness) was followed in descending order as WDS (17), ODS (13), SDS (10), ROS (8) and RS (6). Weedy field habitat had higher diversity whereas rock habitat had lower diversity of acridids. In general, habitats with fewer plant species have a relatively lower diversity of insects. Higher species richness contains more tropic levels and maintains inter-specific interactions. Species richness can affect both the size and stability of a population.

Key words: Acridids; dry deciduous forest; species richness; habitat type.

Introduction

Acridids also play an important role in the functioning of forest ecosystems as they contribute to the diet of many birds and spider species (Belovsky & Slade 1993; Oedekoven & Joern 1998). They are dominant group of herbivorous insects throughout the world. Although grasshoppers are commonly perceived as important components of grassland, their role in forest ecosystems is largely uninvestigated. The high diversity, functional importance and sensitivity of grasshoppers, combined with the ease with which they can be sampled, had led to the suggestion that grasshoppers make excellent bioindicators for use in assessments of ecological changes associated with land use (Armstrong and Van Hensbergen 1997).

Grasshopper diversity was studied by Wysieck *et al.* (2000) in Argentina and habitat association of grasshoppers was studied by Squiter *et al.* (2002) and Capinera et al. (1997). Grasshoppers bioindicators was suggested by Andersen *et al.* (2001) and Baldi and Kisbenedek (1997). In India, there was only a preliminary study on the Orthopteran fauna of a deciduous forest (Vats and Mittal, 1991 and Joshi *et al.,* 1999). The aim of the present study is to identify the different habitats of dry deciduous forest in West Bengal and to study the variation in the distribution of acridids in the ecosystem.

Materials and methods

The study was carried out in the Chipkuthi forest (area 3 sq km), located at three km away from Santiniketan at approximately 23°29´N and 87°42´E with an average altitude of 58.9 m. Five habitat types based on difference in vegetation and degree of human disturbance could be identified. Selected habitats included five terrestrial weed dominant sites (WDS), five *Oriza ruphipogon* Griff. dominant sites (ODS), five sal dominant sites (SDS), five road sites (ROS) and five rock sites (RS).

Sampling of acridids was conducted at fifteen day intervals from Oct. 2004 to Sept. 2005. Each selected habitat was divided into five sites of $10m^2$ area. From each sampling site the acridids were collected by sweep net sampling method which is an accurate method for estimating grasshopper species composition (Evans *et al.* 1983). In each site 20 sweeps of a 30 cm diameter sweep net were taken from 7.30 am to 10.30 am. All vegetation within a site was swept including tall grasses, herbs, shrubs, bushes and trees up to a height of 2 meter. The acridids were collected and counted and brought to the laboratory for identification. All identifications were confirmed from Zoological Survey of India, Kolkata. Data were subjected to two way analysis of variance (ANOVA) and MATLAB programme (6.0 versions); Shannon-Weaner index (H') (Shannon-Weaner, 1949) was also worked out to determine the species diversity index.

Results and discussion

A total of 1843 number of adult acridid individuals were collected from the study area of which 18 acridid species i.e., *Acrida exaltata* (Walker) (0.81%), *Aulacobothrus luteipes* (Walker) (1.19%), *Aiolopus thalassinus tamulus* (Fabricius) (2.33%), *Catantops pinguis innotabilis* (Walker) (0.43%), *Dittopternis venusta* (Walker) (19.04%), *Epistaurus sinetyi* Bolivar (3.852%), *Gastrimargus africanus africanus* (Saussure) (0.59%), *Gastrimargus africanus orientalis* Sjist. (1.356%), *Gesonula punctifrons* (Stal.) (2.55%), *Hieroglyphus banian* (Fabricius) (7.27%), *Leva cruciata* Bolivar (3.03%), *Oedaleus abruptus* (Thunberg) (14.18%), *Oxya fuscovittata* (Marschall) (16.11%), *Oxya hyla hyla* Servile (11.39%), *Phlaeoba infumata* Brunner (2.278%), *Spathosternum prasiniferum prasiniferum* (Walker) (9.96%), *Truxalis indica* (Walker) (2.875%), and *Tylotropidius varicornis* (Walker) (0.43%) were observed in all the habitats (**Table1**).

In the WDS habitat the species like *O. fuscovittata* and *O. hyla hyla* were dominant (F=37.01; df = 17,72; P<0.0001) and least abundant is *C. pinguis innotabilis* whereas *G. africanus africanus* was absent in this site. In the ODS habitat. *H. banian* was dominant (F= 27.68; df = 17,72; P<0.0001) whereas *A. luteipes*, *T. indica*, and *T. varicornis* were least abundant but *C. pinguis innotabilis, E. sinetyi*, *G. africanus africanus, G. africanus orientalis*, and *L. cruciata* were totally absent in this site. *D. venusta* was dominant (F= 41.51; df = 17,72; P<0.0001) in the SDS habitat while *A. exaltata*, *G. africanus orientalis*, *G. africanus africanus*, *G. punctifrons, H. banian*, *O. fuscovittata*, *O. hyla hyla*, and *T. varicornis* were not found during study period. In the ROS habitat *D. venusta* was dominant (F= 22.12; df = 17,72; P<0.0001) among all the species while *A. thalassinus tamulus, G. africanus orientalis, S. prasiniferum prasiniferum,* were least dominant. In RS habitat only 6 acridid species were found where *O. abruptus* was dominant (F= 9.92; df = 17,72; P<0.0001) and *T. indica* was least dominant.

Species diversity varied from habitat to habitat. A diversity index was a mathematical measure of species diversity in a community. Diversity was a function of disturbances with the undisturbed habitat WDS (0.9159) having the highest value followed by the ODS (0.8375), SDS (0.7267), ROS (0.7012) and RS (0.6677). Species abundance followed same order as the species diversity.

Species richness was quantified as the total number of species present at each site. It was also highest in WDS (17) followed by the ODS (13), SDS (10), ROS (8) and RS (6). Higher species richness contains more tropic levels and maintains inter-specific interactions. It may also affect both the size and stability of a population.

From MATLAB programme it was evident that different species showed different distribution in the five habitats ($F_1 > F_{á;17,68}$) and different habitats had different effects on a particular species ($F_2 > F_{â;4,68}$).

Several studies have been done on the potential of grasshoppers as indicators of forest ecosystem disturbance (Joshi *et al.* 1999). In India, the dynamics of grasshopper assemblages are extremely poorly understood and unaware of any Indian study document the responses of grasshoppers assemblages to disturbance. Acridids are not simply or passively tracking plant community structure rather, these insects appear to be sensitive to a more complex array of ecological conditions. In general, vegetation has a direct effect on acridid diversity and abundance (Kemp *et al.* 1990 a, 1990b). But disturbance also has a direct effect of acridid population. Fielding and Brusven (1993) reported that grasshopper species richness and diversity were lowest in disturbed site. In the present study it was demonstrated that both vegetation and disturbance has direct effect on grasshopper populations in a dry deciduous forest in India. It was found that species richness and abundance were maximum in WDS, which is similar to the finding of Capinera et al. (1997) and minimum in RS habitat. This may be due to abundant plant species and no anthropogenic disturbance or grazing by cattle in WDS habitat. However, in RS habitat regular human disturbance was observed and abundance of plant species were minimum due to rocky nature of soil. The observation was similar to those of Parmenter *et al.* (1991) and Anderson (1964).

Both RS and ROS were highly disturbed sites; however in ROS site species abundance was slightly more than rock site may be due to greater plant abundance. Only two subspecies i.e. *G. africanus africanus* and *G. africanus orientalis* were dominant in the rock site, which was according to the finding of Anderson et al. (2001) in Australian Tropical Savannas. In SDS, which is in the midst of the forest and with little anthropogenic disturbance, the species richness and abundance were more or less moderate. However, *D. venusta* is the dominant species in this habitat may be due to their food preference on Sal leaves (*Shorea robusta* Gaertn f.). *H. banian* was dominant in ODS habitat as it was very close to paddy field. The species richness and abundance were highest in SDS habitat in comparison to ODS habitat field with water in most of the time. The species like *G. punctifrons*, *H. banian* and *Oxya sp*ecies were abundant

in both ODS and WDS habitats which were partly boarded by agricultural land. These species are indicated as pest of paddy plants. The similar pattern by Sanjayan and Muralirangan (1997) reported that *Oxya species* and *H. banian* are pest of rice (*Oryza sativa* L.). The majority of the collected species are pest according to the Pictorial Handbook on Indian Short-Horned Grasshopper Pests (Acridoidea: Orthoptera) (Mandal *et al.* 2007).

Out of the 18 collected species five (*D. venusta, O. abruptus*, *O. fuscovittata,* O. *hyla hyla*, *S. prasiniferum prasiniferum*) contributes 70.68% of acridid assemblages while the nine least abundant species (*A. luteipes, A. thalassinus tamulus*, *E. sinetyi*, *G. africanus orientalis*, *G. punctiforns*, *H. banian*, *L. cruciata*, *P. infumata* and *T. indica*) together made up 26.74% and four species (*A. exaltata*, *C. pinguis innotabilis, G. africanus africanus* and *T. varicornis*) were rare and represented only 2.27% of the assemblage. The least abundant species i.e. *A. exaltata*, *C. pinguis innotabilis* and *T. varicornis* were restricted only to undisturbed areas. The study area showed that certain acridid species were restricted to specific undisturbed or healthier habitats. Therefore, the acridids considered in this study could be successfully used for bioindication of different habitats and also may be used as effective "tools" in monitoring ecological condition in the forest ecosystems.

Table 1. Distribution of abundance & community parameters of Acridids at Chipkuthi forest.

Species name	WDS	ODS	SDS	ROS	RS
A. exaltata	12	3	0	0	0
A. luteipes	8	2	12	9	0
A. thalassinus tamulus	21	8	12	2	0
C. pinguis innotabilis	2	0	6	0	0
D. venusta	81	21	179	59	11
E. sinetyi	5	0	14	23	29
G. africanus africanus	0	0	0	0	11
G. africanus orientalis	3	0	0	5	17
G. punctifrons	10	37	0	0	0
H. banian	3	131	0	0	0
L. cruciata	14	0	42	0	0
O. abruptus	127	18	78	15	35
O. fuscovittata	187	102	0	8	0
O. hyla hyla	139	71	0	0	0
P. infumata	23	8	11	0	0
S. prasiniferum prasiniferum	54	110	7	6	0
T. indica	15	2	26	9	1
T. varicornis	6	2	0	0	0
Total (N):	710	515	387	127	104

WDS: Terrestrial Weed dominant sites; ODS: *Oriza* species dominant sites; SDS: Sal dominant sites; ROS: Road sites; and RS: Rock sites.

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