

## **STUDY ON THE HETEROCERAN LEPIDOPTERA (MOTH) BIODIVERSITY OF SOME SPECIES OF FAMILY TORTRICIDAE, SPHINGIDAE & NOCTUIDAE FROM BARIYATU, RANCHI, JHARKHAND**

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### **ABSTRACT**

*Heteroceran lepidoptera* (moth) are common pests over plant groups and damage leaves, stems, flowers and fruits. A study was carried in Bariyatu, Ranchi between January 2011 and December 2011. A total 11 species belonging to three families (Tortricidae, Sphingidae and Noctuidae) were collected to get the biodiversity. The timing of collection of moths was between 6 PM to 9 PM in weekdays. The statistical interpretations were done using Shannon-Wiener diversity index, Shannon's equitability and Jaccard's coefficient. The ecological parameters taken for this work were maximum and minimum temperature, average humidity, wind speed and average rain in year 2011 at the site of work. Biodiversity of moths with their host plants was observed and finally the species richness value (Shannon, 1948) calculated was 2.35. The species richness data of Shannon-Wiener diversity index lies between 1.5 and 3.5. Therefore, this value of species richness indicates a good biodiversity of moth and interactions with their host plants in various ecological conditions and indicating the Bariyatu as a good habitat for moth biodiversity.

Key word s : *Heteroceran Lepidoptera*, Shannon-Wiener diversity index, Jaccard's coefficient, Bariyatu, Ranchi.

### **INTRODUCTION**

Insects comprise more than half of the world's known animal species (Wilson, 1992). Ranchi district is one of the rich insect biodiversity zone. But it remains merely explored especially in the area of the study of Heteroceran Lepidoptera (moths). The second largest and more diverse order is Lepidoptera of class Insecta (Benton, 1995). It includes both butterfly and moths (Hutchins, 1972; Gunathilagaraj *et al.*, 1998; Nair, 2011 and 2002) but the number of moth species is much higher than that of butterflies. Insects of this order are mainly pests particularly caterpillars on the economic important plants (Metcalf and Flint, 1939;

Mathur, 1961 and 1962). So, they have a great economical importance (Ahsan, 1991). A number of research works have been done in the field of biodiversity and commercial yielding of silk moth of family Saturnidae and Bombycidae (Grimaldi, 2005) because of the well established Central Tasar Research Institute (CTRI) at Nagari, Ranchi. But other families of heteroceran lepidoptera in newly created Jharkhand have not been listed properly till date.

Heteroceran Lepidoptera is one of the most suitable insect groups for most quantitative comparison for many reasons elaborated by Holloway (1980, 1984 and 1985) typically their abundance, species richness, response to

vegetation and climate, their sampling using light traps and relative advanced taxonomy. The usefulness of many light trap samples of macrolepidoptera through the Indo-Australian tropics gave a very useful summary for the existing information from the area and suggested some general trends in relation to altitude, isolation and distribution (Holloway, 1987).

The similar kind of works were done in the Peshawar city, Pakistan (Aslam, 2009), Karaikal region of Pondicherry, India (Adiroubane, 2010), Harmu area in Ranchi (Thakur *et. al.*, 2012) and in Morhabadi and Bariyatu areas of Ranchi (Thakur and Ghosh, 2012) in the year 2010. The moth diversity index (Shannon, 1948) of this report was 2.35 of present work is lower to the Peshawar town of Pakistan were 3.14 (Aslam, 2009) and Harmu region of Ranchi, India was about 2.37 (Thakur *et. al.*, 2012) and more than that in Morhabadi region of Ranchi, India was about 2.02 (Thakur and Ghosh, 2012) and Karaikal region of Pondicherry, India was about 1.71 (Adiroubane, 2010). Higher biodiversity confers stability (Lewin and Wilson, 1988). The status of species requires immediate attention. Many of the species may be endangered or may be on the verge of extinction.

The main objective of this project was to collect, identify and calculate diversity, species richness and evenness of moths in the context of different ecological factors like maximum and minimum temperature, average humidity, wind speed and average rain in the year 2011 at Bariyatu. Therefore, an effort was made to get the moth diversity index (Shannon, 1948) during the period of one year of 2011 of families Tortricidae, Sphingidae and Noctuidae. Diversity can be defined as the number of different items and their relative frequency at a given level.

## MATERIALS AND METHODS

The present study was conducted in Bariyatu municipal areas, Ranchi nearly at 23°22'52" N latitude to 85°18'05" E longitude covering an area of twelve km<sup>2</sup> respectively. Bariyatu was dotted with several man made constructions,

fields and green land areas. This is divided into many localities by a network of roads.

### Vegetation profile of Bariyatu, Ranchi:

The area selected was measured about 150 meter<sup>2</sup>. This area has also a good number of both exotic and endogenous plants including Mango (*Mangifera indica*), Litchi (*Litchi chinensis*), Amaltas (*Cassia fistula*), Citrus (*C. limon*), Fig, Guava (*Pasidium guajava*), Papaya (*Carica papaya*), Rose (*Rosa damascena*), Sesum (*Delbergia latifolia*), China rose (*Hibiscus rosa-sinensis*) *Nerium oleander* and other crop land plants like Potato (*Solanum tuberosum*), tomato (*Lycopersicum esculantum*), Rice (*Oryza sativa*), wheat (*Triticum aestivum*), Brinjal (*Solanum melongena*), Sugarcane (*Saccharum officinarum*), Banana (*Musa acuminata*) and other shrubs.

### Ecological factors were taken:

The parameters of ecological factors were taken properly to observe impact of variations in the biodiversity of moths. The annual mean temperature value of Bariyatu area was maximum 29.24 °C and minimum 18.08 °C. The maximum monthly mean temperature was 36.9 °C (May) and minimum monthly mean temperature was 9.9 °C (January).

The annual mean rain fall was 121.05 mm. The annual mean value of average relative humidity was 68.17%. The annual mean speed of wind was 7.76 km/h. The data of maximum and minimum temperature along with humidity was taken by using thermo-hygrometer. The date of rain, wind speed and precipitation was taken from the authentic government website. Regular visits were made during January 2011 to December 2011 at different parts of Bariyatu especially around the fields, housing colonies and green land areas.

Specimens were collected using photophilic trap method between 6pm to 9pm by quadrat method (With a caution not to disturb the dispersal and movement of species in order to observe the ethics and movement of species). The specimens were identified up to species

level with the help of keys from the Druce, H. (1881-1900); Bell and Scott (1937); Metcalf and Flint (1973); and also consulted Pradhan (1969); Richard and Davies (1934).

Specimens have been deposited in the Department of Zoology, Ranchi Women's College, Ranchi. The following statistical tools were applied for the biodiversity measurement of the areas:

To calculate the diversity of the moth, Shannon-Weiner diversity index (1948) was used.

#### Diversity Index:

Diversity index was calculated by

$$H' = -\sum p_i \ln p_i$$

Here,  $p_i = n_i/N$

$n_i$  = number of individuals of a species

$N$  = total number of individuals of all species

$\ln$  = natural logarithm (to base e)

$H'$  = diversity index

The maximum possible diversity consisting  $X$  categories (no. of species here) was calculated by using the formula

$$H'_{\max} = \ln X$$

**Table 1: Taxonomy of collected moths of family Tortricidae, Sphingidae and Noctuidae from Bariyatu Ranchi (January 2011 - December 2011)**

Sl. No.	Name of moth species	Sample Code	Common Name	Family	Host Plant
1	<i>Cydia pomonella</i> , Linn.	TOR001	Codling moth	Tortricidae	Tree fruits
2	<i>Cirrhochrista pulchellalis</i> , Lederer	TOR002	Rice borer	Tortricidae	Grass family (poaceae)
3	<i>Parotis marginata</i> , Hampson	TOR001		Tortricidae	Indian devil tree ( <i>Astonia scholaris</i> ), capa jasmine ( <i>Gardenia jasminoides</i> )
4	<i>Alabama argillacea</i> , Hubner	NOC001	Cotton bollworm moth	Noctuidae	Cotton
5	<i>Heliothis zea</i> , Boddie	NOC002	Cotton bollworm moth	Noctuidae	Cotton, corn, tomato
6	<i>Catocala fraxini</i> , Schrank	NOC003	cutworm moth	Noctuidae	Leaves of herbs & shrubs
7	<i>Trigonodes hyppasia</i> , Cramer	NOC004	----	Noctuidae	Leaves of <i>Indigofera</i>
8	<i>Acherontia atropos</i> , Linn.	SPH001	Death's head Hawk moth	Sphingidae	Solanaceae, Lantana
9	<i>Acherontia styx</i> , Westwood	SPH002	Death's head Hawk moth	Sphingidae	Sesamum indicum, Solnaceae (Potato)
10	<i>Deilephila nerii</i> , Linn.	SHP003	Sphinx moth or oleander hawk worm moth	Sphingidae	Nerium oleander
11	<i>Deilephila lineate</i> , Linn.	SHP004	Melonworm moth	Sphingidae	Poaceae family

This was a measure of number of species in a community.

Another parameter evenness (J) was calculated by

$$J' = H' / H'_{\max}$$

$$D = (S-1) / \ln(N)$$

Here, D = Margalef index (1968)

S = No. of species

N = Total number of species.

## RESULT AND DISCUSSION

Species richness is the simplest diversity measure to count the number of species in an area. Species diversity, on the other hand takes into account the relative abundance of a species and not just its occurrence. The first index used in the present study is Shannon-Weiner diversity index (1948), which comes from information-statistics. Information statistics indices are based on the rationale that diversity in a natural system can be measured in a way that is similar to the way information contained in a code or message is measured.

The graphical representation of month wise change in the ecological factors (Figure-2) like maximum and minimum temperature, humidity, average rain and wind speed taken from the site of collection. The relationship between the ecological factors and the species richness of moths indicate their reproduction and abundance

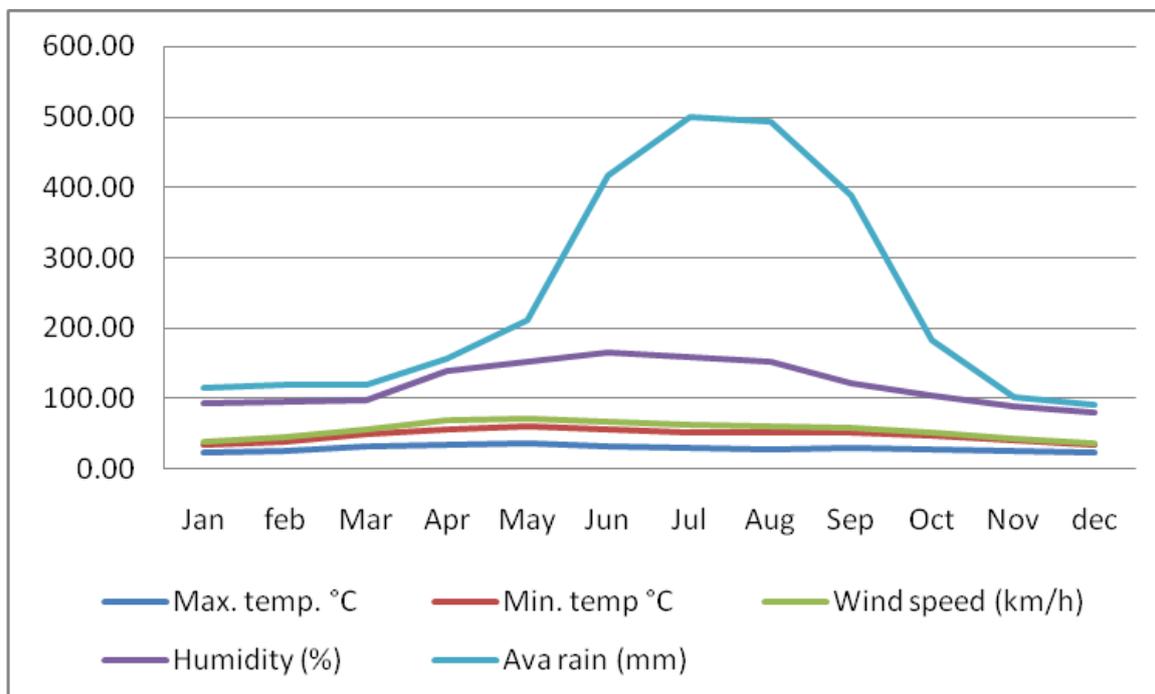
in Bariyatu, Ranchi. The months of April to August is showing significant increase in the population of moths as 72-73% of the annual collection was made in these months. The climatic factors changed from summer to rainy seasons during these months as mean temperature, humidity and rainfall increased.

The result of Table 2 indicates the value of  $pi$  In  $pi$  is 2.356. The Shannon diversity index for real communities are often found to fall between 1.5 and 3.5. It indicates that the diversity richness of collected moths from Bariyatu was 2.35 while in the year 2010 it was 1.86 (Thakur, 2012) which was much less than the present data. The ecological factors like rain, wind speed, cloud, precipitation, temperature and sunlight may affected this jump even the rate of urbanization in Bariyatu is rapid. The species richness was 2.37 in Harmu region (Thakur *et al*, 2012) and 2.02 in Morhabadi (Thakur, 2012) in year 2010 which indicates that the present species richness value ( $Pi \log Pi$ ) 2.35 is an average value in Ranchi town regarding the moths biodiversity index. It is also notable that the moth diversity index (Shannon. 1948) of Peshawar town of Pakistan was 3.14 (Aslam, 2009) which is certainly much higher than the value obtained from Ranchi while the Shannon index of Karaikal region of Pondicherry, India was about 1.71 (Adiroubane, 2010), which is lower than Ranchi.

**Table 2: Shannon-Weiner diversity index (1948) of the collected data from Bariyatu, Ranchi (January 2011- December 2011)**

Code	ni	R.A. = ni/100	Pi=ni/N	Log Pi	Pi Log Pi
TOR001	58	0.58	0.102292769	-2.27992	-0.23322
TOR002	34	0.34	0.059964727	-2.814	-0.16874
TOR003	38	0.38	0.0670194	-2.70277	-0.18114
NOC001	54	0.54	0.095238095	-2.35138	-0.22394
NOC002	47	0.47	0.082892416	-2.49021	-0.20642
NOC003	53	0.53	0.093474427	-2.37007	-0.22154
NOC004	23	0.23	0.040564374	-3.20487	-0.13
SPH001	58	0.58	0.102292769	-2.27992	-0.23322
SPH002	69	0.69	0.121693122	-2.10625	-0.25632
SHP003	61	0.61	0.107583774	-2.22949	-0.23986
SHP004	72	0.72	0.126984127	-2.06369	-0.26206
	<b>567</b>	<b>5.67</b>	<b>1</b>	<b>-26.8926</b>	<b>2.35645</b>

**Figure-1. Graph of ecological factors taken as parameter to check the species richness of moths of family Tortricidae, Sphingidae and Noctuidae at Bariyatu, Ranchi in year 2011**



The total number of individuals caught in a light trap is an indication of biomass although more care has to be taken in its interpretation than for diversity as the size of a light trap catch can be influenced significantly by the setting of the trap, interference from other lights and lunar cycles (Barlow and Woiwod, 1989).

### CONCLUSION

This work was an attempt to describe some aspects of biodiversity of moth fauna of Bariyatu, Ranchi. A lot of further work is necessary in the regard and further collections are essential for getting a detailed periodic estimate of the faunal diversity of moths in this area. Finally it is hoped that such work may lead to the development of standard monitoring procedure which could be of value in assessing the environmental stability of areas under cultivation of plants and the prediction of the effect on the structure of moth populations of tropical forest destruction (Barlow and Woiwod, 1989).

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### Limitation:

The field studies were not done in midsummer days. The following data is merely a rough sketch. A detailed landscape survey might throw more on the available niche distribution of the species.

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