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Jane Wanry Shangpliang

Department of Zoology
North Eastern Hill University,
Umshing Shillong 793022,
Meghalaya, India

S.R. Hajong

Department of Zoology
North Eastern Hill University,
Umshing Shillong 793022,
Meghalaya, India

Diversity, species richness and evenness of wild silk moths collected from Khasi hills of Meghalaya, North East India

Jane Wanry Shangpliang and S.R. Hajong

Abstract

Species richness and diversity of the wild silk moths of Khasi Hills of Meghalaya were investigated for three years (2011-2013). The study was carried out in four districts of Khasi Hills. During the study period, a total of fifteen species belonging to nine genera were recorded. *Caligula simla* was the most dominated species in all three years with seventeen specimens collected followed by *Actias selene* with fifteen number of individuals. Maximum number of individuals were recorded during the monsoon season and lesser in the pre and post monsoon seasons.

Keywords: Diversity, Wild silk moths, Khasi Hills, Meghalaya

1. Introduction

The wild silk moths belong to the family Saturniidae and Super Family Bombycoidea. The family Saturniidae is the largest family of the Superfamily Bombycoidea containing about 1861 species in 162 genera and 9 sub families^[10]. There are 1100 species of non-mulberry silk moths known in the world^[12]. The family Saturniidae comprises of about 1200-1500 species all over the world of which the Indian sub-continent, extending from the Himalayas to Sri Lanka may possess over 50 species^[11]. Jolly et al (1975) reported about 80 species of wild silk moths occurring in Asia and Africa^[9]. Singh and Chakravorty (2006) enlisted 24 species of the family Saturniidae from North East India^[15]. Arora and Gupta (1979) reported as many as 40 species of wild silk moths in India alone^[1]. Kakati (2009), during his study on wild silk moths recorded 14 species of wild silk moths belonging to eight genera from the state of Nagaland, North East India^[10]. While a few survey reports on wild sericigenous insects in the North Eastern India are available (Thangavelu and Borah, 1986; Thangavelu *et al.*, 1987; Bhattarcharya and Tiotia, 2000 and Bhattarcharya *et al.*, 2004)^[2, 3, 16, 17] information on species diversity and distribution pattern of silkmooths in the State of Meghalaya is generally lacking. Gupta (2000) recorded 20 species of wild silk moths from Meghalaya^[4].

Lepidoptera is probably one of the most suitable groups for most quantitative comparisons between insect faunas to be valid, for the many reasons elaborated by Holloway^[6, 7, 8]. Especially their abundance, species richness, response to vegetation and climate, their ease of sampling using light traps and relatively advanced taxonomy. Although light trapping of macrolepidoptera has been carried out widely in temperate and tropical regions throughout the world, but generally results are not directly comparable between areas because of different light sources, trap design, trapping periods and taxonomic coverage. A recent review by Holloway^[8] (1987) of the many light trap samples of macrolepidoptera throughout the Indo-Australian tropics gave a very useful summary of the existing information from the area and suggested some general trends in relation to altitude, isolation and disturbance.

2. Materials and Methods

2.1 Description of the collection sites

The study was carried out in different parts of Khasi Hills of Meghalaya for a period of three years (2011-2013). Meghalaya situated in the Eastern Himalayas comprises of an area of 22,549 sq. Km, and lies between 25°02' and 26°07' north latitude and 89°49' and 92°50' east longitude. The elevation ranges from 60 m to 1950m above sea level. Average maximum and minimum temperatures in the state varies from 5 °C to 32 °C and average rainfall as high as 1200 cm in some areas. It has a forest cover of 9,496 sq. km which is 42.34% of the total geographic area of the State.

Correspondence:

Jane Wanry Shangpliang
Department of Zoology
North Eastern Hill University,
Umshing Shillong 793022,
Meghalaya, India

The Meghalayan sub tropical forests have been considered among the richest botanical habits of Asia. The four districts taken for the purpose of the study are the East Khasi Hills District, West Khasi Hills District, Ri-Bhoi District and Jaintia Hills District.

2.2 Collection methods

Moths were collected by using simple light traps. These traps were set up at different sites and were operated from dusk to dawn. The wild silk moths were also collected naturally by insect collecting net. The moths were then brought to the lab and identified using available literatures [8]. During the study period a total of fifteen species of wild silk moths were collected. The diversity index, species richness and evenness of the wild silk moths were then calculated using various indices.

2.3 Preservation and identification of the collected specimen

The wild silk moths collected were killed using ethyl acetate in a glass jar placed with cotton and filter paper. The insects were stretched in stretching boards, pinned with entomological pins from the dorsal of mesothorax and dried in oven at 55 °C. The dried specimens were then kept in wooden insect boxes. Few naphthol balls were placed at the bottom of the box for preventing fungal attack. Identification of the collected specimen was made using the available literatures [5].

2.4 Measurement of Diversity

To describe species diversity in natural communities Data records from each visit was combined for assessments of species diversity, richness, and dominance. The obtained data from each sampling site was calculated using the various

diversity indices such as Shannon-Wiener’s diversity index (H’) Pielou’s evenness (J’) and Berger Parker Dominance (D).

The Shannon Index (H’) was calculated by the formula

$$H' = - \sum_{i=1}^N P_i \log P_i$$

Where, H = species diversity index
 Pi = the proportion of individuals in the *i*th species
 N= total number of species
 i = species 1, 2, 3... N

Pielou’s evenness (J’) was calculated by the formula

$$J' = H' / \ln S$$

Where H’ is the Shannon index as defined above, S is the number of species observed.

Species richness was calculated by the formula;
 Total No. of individuals of the species /Total No. of occurrence

Berger Parker Dominance was calculated by the formula

$$D = N_{max} / N$$

Where, Nmax is the number of individuals in the most abundant species and N is the total number of individuals in the sample.

3. Results

Table 1: Measurement of species diversity for three years (2011-2013)

	Total No. of individuals	Species richness	Shannon (H')	Pielou Evenness (J')	Berger Parker Dominance (D')
2011					
Mean ±SD	2.583± 2.446	1.750 ±1.658	0.523± 0.593	0.473± 0.495	0.410 ±0.375
2012					
Mean ±SD	3.417 ±2.691	2.667 ±2.173	0.847 ±0.662	0.592± 0.438	0.523± 0.389
2013					
Mean ±SD	2.006± 2.216	1.417± 1.311	0.383 ±0.426	0.447± 0.476	0.553 ±0.453

2011:

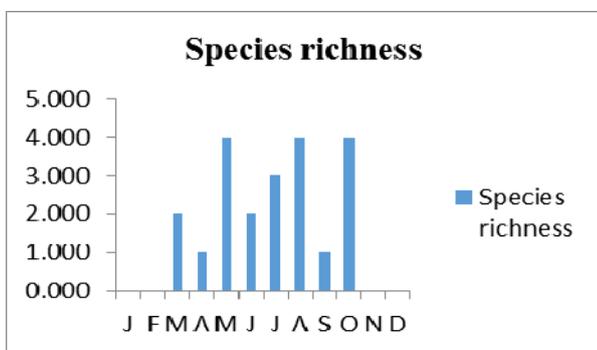


Fig 1: Monthly variation in species richness of the wild Silkmoths of Khasi Hills of Meghalaya

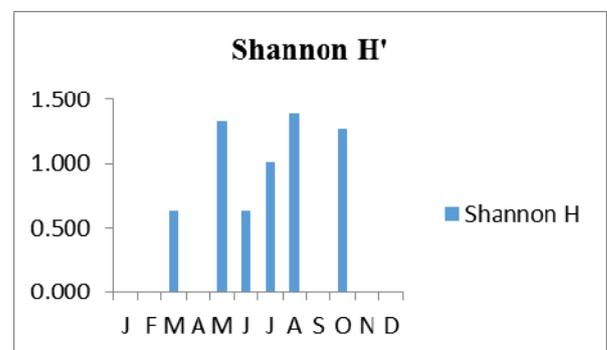


Fig 2: Monthly variation in species Diversity of the wild Silkmoths of Khasi Hills of Meghalaya

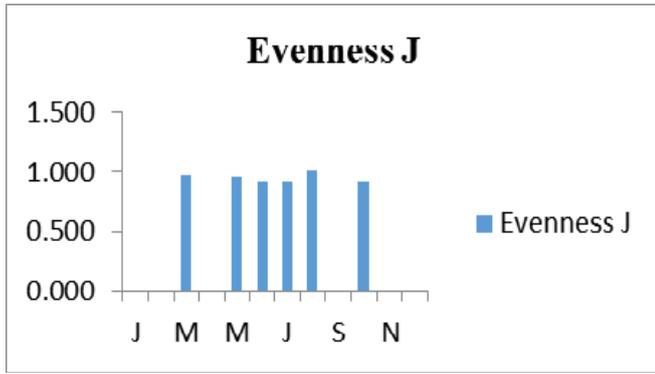


Fig 3: Monthly variation in species evenness of the wild Silkmoths of Khasi Hills of Meghalaya

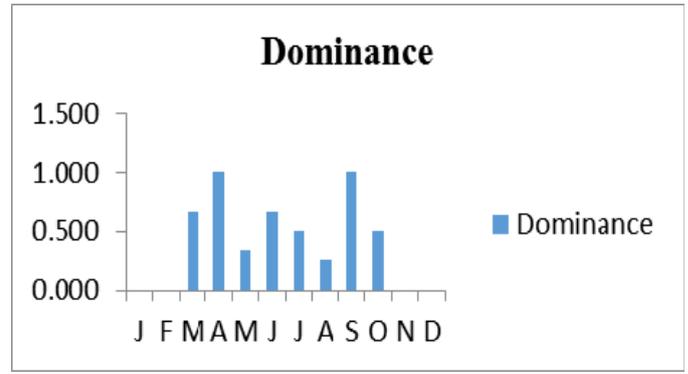


Fig 4: Monthly variation in species dominance of the wild Silkmoths of Khasi Hills of Meghalaya

2012:

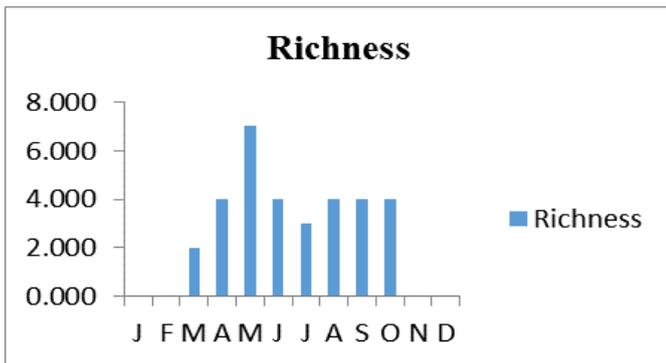


Fig 5: Monthly variation in species richness of the wild Silkmoths of Khasi Hills of Meghalaya

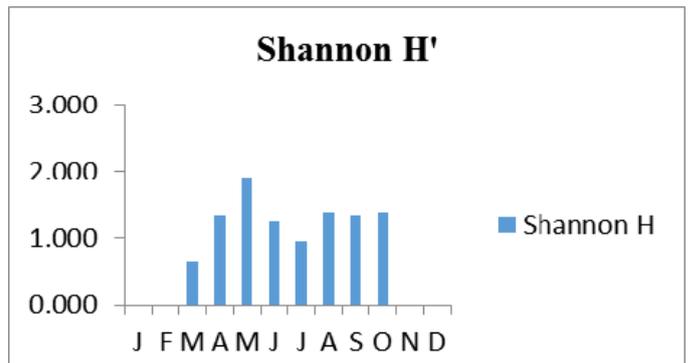


Fig 6: Monthly variation in species Diversity of the wild Silkmoths of Khasi Hills of Meghalaya

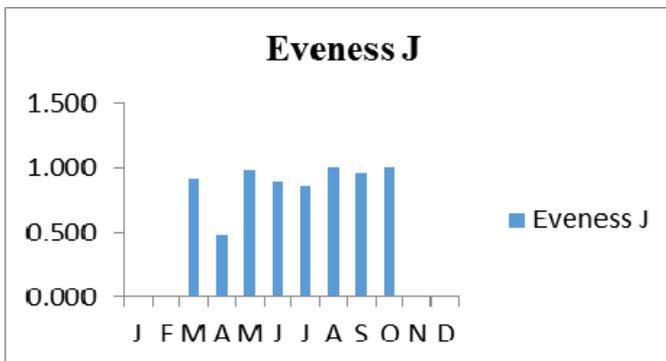


Fig 7: Monthly variation in species evenness of the wild Silkmoths of Khasi Hills of Meghalaya

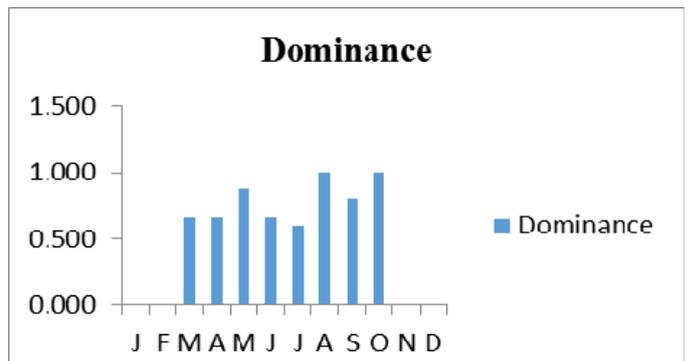


Fig 8: Monthly variation in species dominance of the wild Silkmoths of Khasi Hills of Meghalaya

2013:

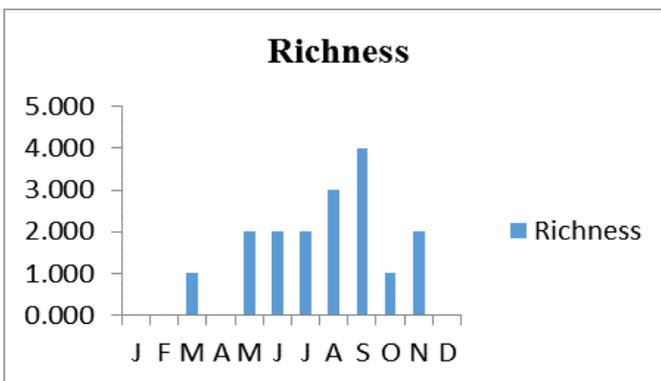


Fig 9: Monthly variation in species richness of the wild Silkmoths of Khasi Hills of Meghalaya

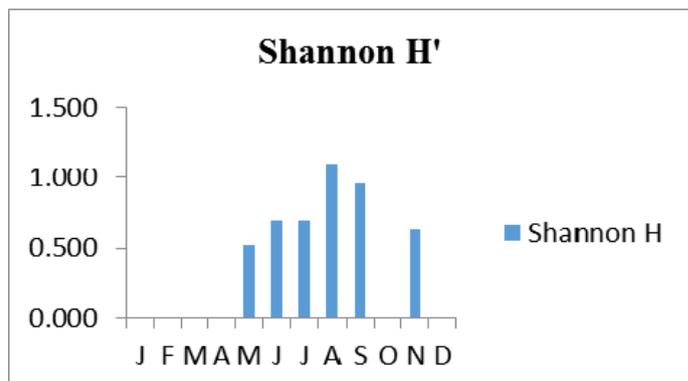


Fig 10: Monthly variation in species Diversity of the wild Silkmoths of Khasi Hills of Meghalaya

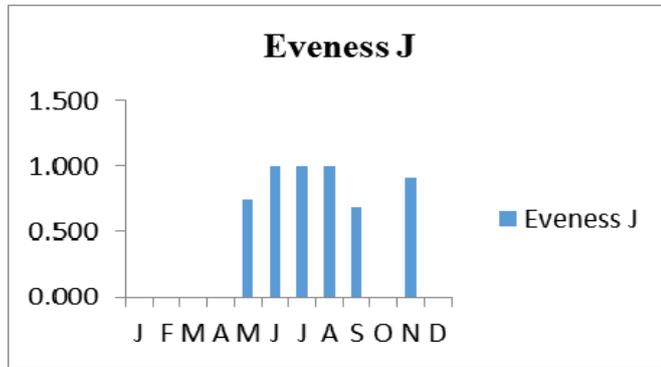


Fig 11: Monthly variation in species evenness of the wild Silkmoths of Khasi Hills of Meghalaya

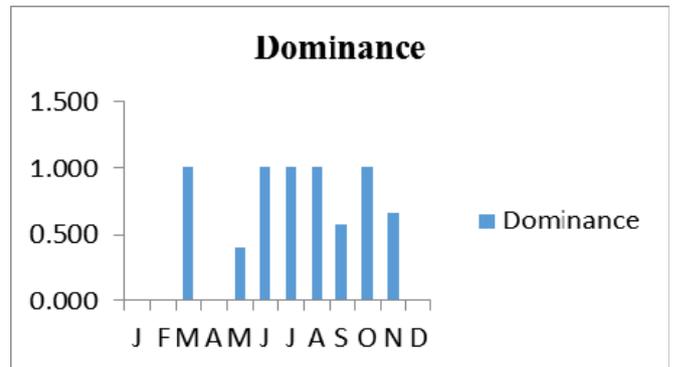


Fig 12: Monthly variation in species dominance of the wild Silkmoths of Khasi Hills of Meghalaya

Table 2: Year wise distribution of the wild silk moths of Khasi Hills of Meghalaya for three years (n=15), values are represented as Mean ±SD

	<i>Attacus atlas</i>	<i>Archaeoattacus malayanus</i>	<i>Actias selene</i>	<i>Actias maenas</i>	<i>Antheraea assamensis (wild)</i>	
2011						
Mean±SD	0.167±0.389	0.083± 0.289	0.417± 0.793	0.083 ±0.289	0.083 ±0.289	
2012						
Mean±SD	0.250± 0.452	0	0.667 ±0.888	0.083± 0.289	0.083± 0.289	
2013						
Mean±SD	0.083± 0.289	0	0.167 ±0.577	0.167± 0.389	0	
	<i>A. assamensis (semi-Dom)</i>	<i>Antheraea roylei</i>	<i>Antheraea helferi</i>	<i>Caligula simla</i>	<i>Caligula thibeta</i>	
2011						
Mean±SD	0.083 ±0.289	0.250± 0.622	0	0.083± 0.289	0	
2012						
Mean±SD	0.083± 0.289	0.167± 0.389	0.167 ±0.389	0.583± 0.996	0.167± 0.389	
2013						
Mean±SD	0	0.167 ±0.389	0.167 ±0.577	0.583± 0.289	0.083± 0.289	
	<i>Caligula zuleika</i>	<i>Cricula trifenestrata</i>	<i>Samia ricini</i>	<i>Samia canningi</i>	<i>Rhodinia newara</i>	<i>Loepa katinka</i>
2011						
Mean±SD	0.250± 0.866	0.250± 0.622	0.417± 0.996	0.333± 0.651	0	0.083± 0.289
2012						
Mean±SD	0.083± 0.289	0.417± 0.996	0.083± 0.289	0.333± 0.492	0.083± 0.289	0.083± 0.289
2013						
Mean±SD	0	0	0.167± 0.389	0	0.083± 0.289	0.333 ±0.888

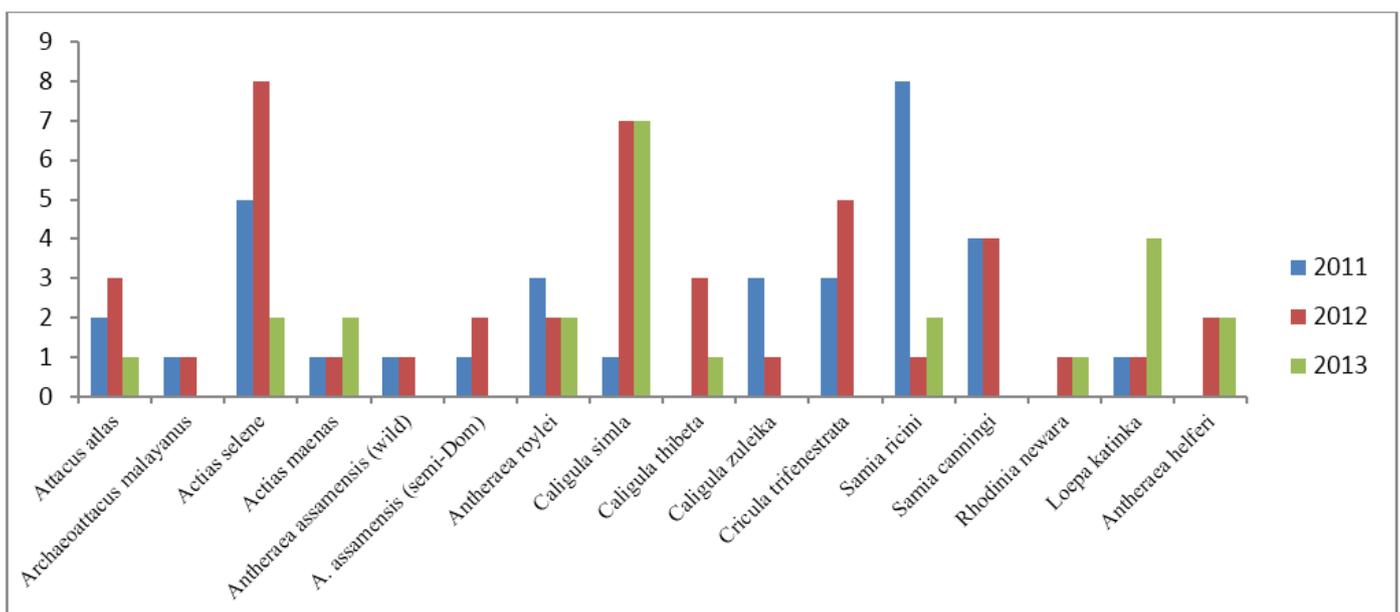


Fig 13: Graph showing number of individuals of wild silk moths of Khasi Hills of Meghalaya collected during the study period.

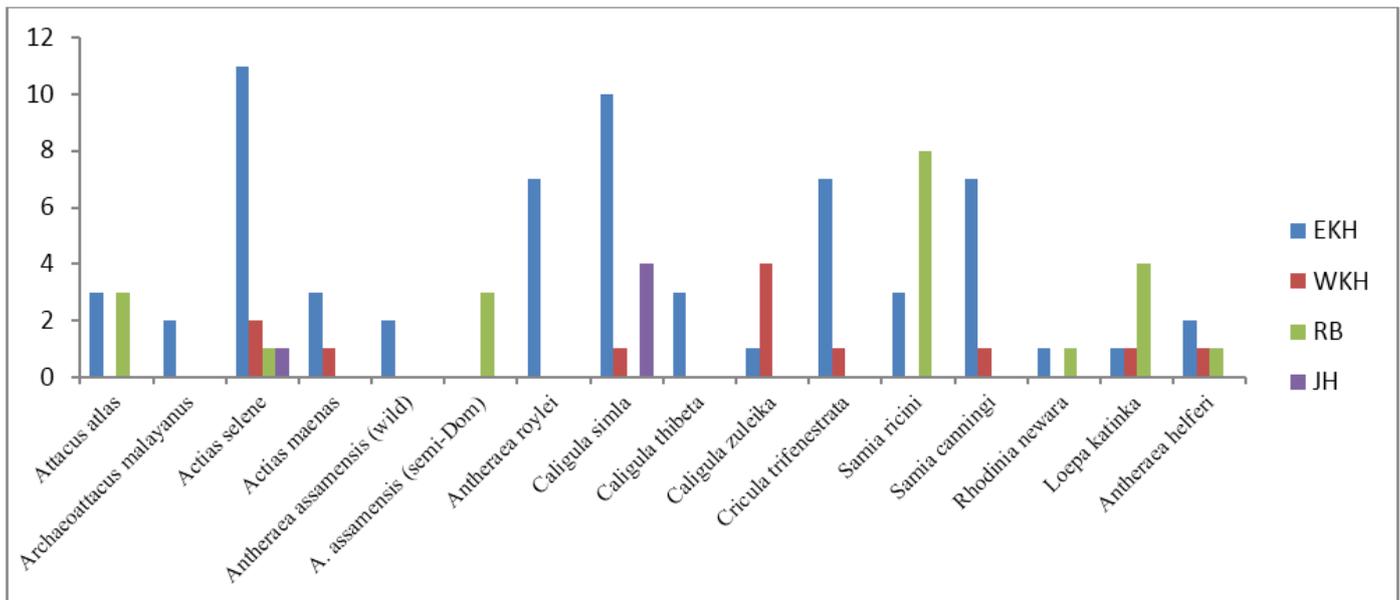


Fig 14: Graph showing the distribution of wild silk moths in the four districts of Meghalaya (EKH-East Khasi Hills, WKH-West Khasi Hills, RB-Ri Bhoi, JH-Jaintia Hills district)

4. Discussion

During the study period a total of 101 individuals were collected belonging to fifteen species and nine genera. Shannon Wiener diversity index is highest for the year 2012 (0.847 ± 0.662) and lowest in the year 2013 (0.383 ± 0.426). Pielou evenness is highest for the year 2012 (0.592 ± 0.662) followed by 2011 (0.473 ± 0.095) and 2013 (0.447 ± 0.426). East Khasi Hills District is the most diverse among the four districts with 11 species followed by Ri-Bhoi District and West Khasi Hills District with 5 species each and then Jaintia Hills with only 2 species collected from the area. Maximum number of wild silk moths was recorded during the monsoon season. This might be due to the presence of sufficient host plants and favourable climatic conditions for the development and growth of the wild silk moths. The least number of silkmoths were observed during the winter season when the adequacy of host plants and unfavourable climatic conditions were observed. Although the study area suggests a good number of wild silk moths, but much has still to be explored for the study of wild silk moths from the Khasi Hills of Meghalaya. Meghalaya is very rich in biodiversity but most of the areas is yet to be explored for the study of the wild silk moths. Out of the fifteen number of species collected *Antheraea assamensis* is found in the wild and is also semi domesticated. East Khasi Hills is the most diverse as compared to the other three districts and Jaintia Hills showing the least number of species (Fig. 13).

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