

Diversity, Species Richness and Evenness of Arctiidae and Geometriidae Moth Fauna of Barpeta and Cachar District

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Abstract: Moth species were studied from some selected districts of Assam (i.e., Cachar and Barpeta district) to determine their diversity index, species richness and evenness of Arctiidae and Geometriidae family of the moth fauna. The moths were collected by applying specialized trapping methods using UV light operating during night. Collected moth species were identified up to family-genus-species level. The diversity index (Shanon-Wiener diversity index, 1949) species richness (Margalef's index, 1958) and evenness (Pielou, 1996), of moth fauna were then calculated. Based on the calculation, it was found that the diversity index, species richness and evenness of Arctiidae moth fauna in Cachar were 6.955, 0.6557, 3.104 and geometriidae moth fauna were 3.433, 7.902, and 0.8153 respectively. The diversity index, species richness and evenness of Arctiidae moth fauna were 3.027, 6.981, 0.6065 and Geometriidae moth fauna were 3.207, 7.37, and 0.7247 respectively in Barpeta district.

Keywords: Arctiidae, Geometriidae Diversity, Assam, Barpeta, Cachar.

1. Introduction

Insects comprise more than half of the world's known animal species (Wilson, 1992). Major population fluctuations in the wake of repeated forest fire and allied reasons, these communities are fast disappearing following environmental degradation. These species are, in fact, very sensitive indicators of the state of their immediate environment, or the "health" of the ecosystem that they inhabit. The great diversity of butterflies and moths could be used as a means of monitoring the health of forest ecosystems. In degraded areas, insect communities could be used to indicate which parts of the ecosystem had been degraded and the rehabilitation of such parts could be monitored by studying the concerned insect species or community. As compared to butterfly, moths are at least ten times more abundant. They can be monitored easily and are more easily enumerated. However, the problem that has to be surmounted is that there was very little up to date information. Changes in populations of moth species and in communities due to forest fires, degradation and ageing of biotypes, etc. and the alien species of plants and animals who arrive and colonize areas in response to the changing environment and climate has led to the realization that moths are sensitive to changes in their environment and that, conversely, these changes can be monitored by monitoring moth communities. In other words, a moth community can be interpreted to understand the "health" of a forest ecosystem, something that is otherwise very difficult to assess or quantify. Being highly sensitive to changes in the environment, both these groups of insects are easily affected by even relatively minor perturbations in the habitat so much

so they have been considered as indicators of environmental quality (Rosenberg *et al.*, 1986).

During the past, several studies on moth and butterflies were done in different parts of South Asia (Bingham, 1905, 1907; Bell, 1919; Bell and Scot, 1937; Talbot, 1939-47; De Niceville and Marshall, 1982-90 and Mani, 1986. Daniel (1965) and reports of such study on Sphingid moths are available from Iran and Afghanistan (Elbert 1969).

The main objective of this research study is to collect, identify and calculate diversity, species richness and evenness of Geometriidae family, because Geometrid moths have been used as a model group in a number of recent ecological studies along habitat gradients in various regions in the world (e.g. Beck *et al.*, 2002; Brehmet *et al.*, 2003a, b, 2005; Holloway & Intachat, 2003; Axmacher *et al.*, 2004), and Arctiidae family due to its large group which also responds to habitat gradients in the vegetation. The present study was carried out in the Barpeta district of Brahmaputra valley of Assam and Cachar district of Barak valley of Southern Assam.

2. Materials and Methods

i) Study area: The study was carried out in Barpeta and Cachar district of Assam. Barpeta district lies between latitude 26°5' North - 26°49' North and longitude 90°39' East - 91°17' East, covering an area of 3245 km² and Cachar district lies between 92°24' E and 93°15' E longitude and 24°22' N and 25° 8' N latitude. The total geographical area of the district is 3,786 Sq. Km.

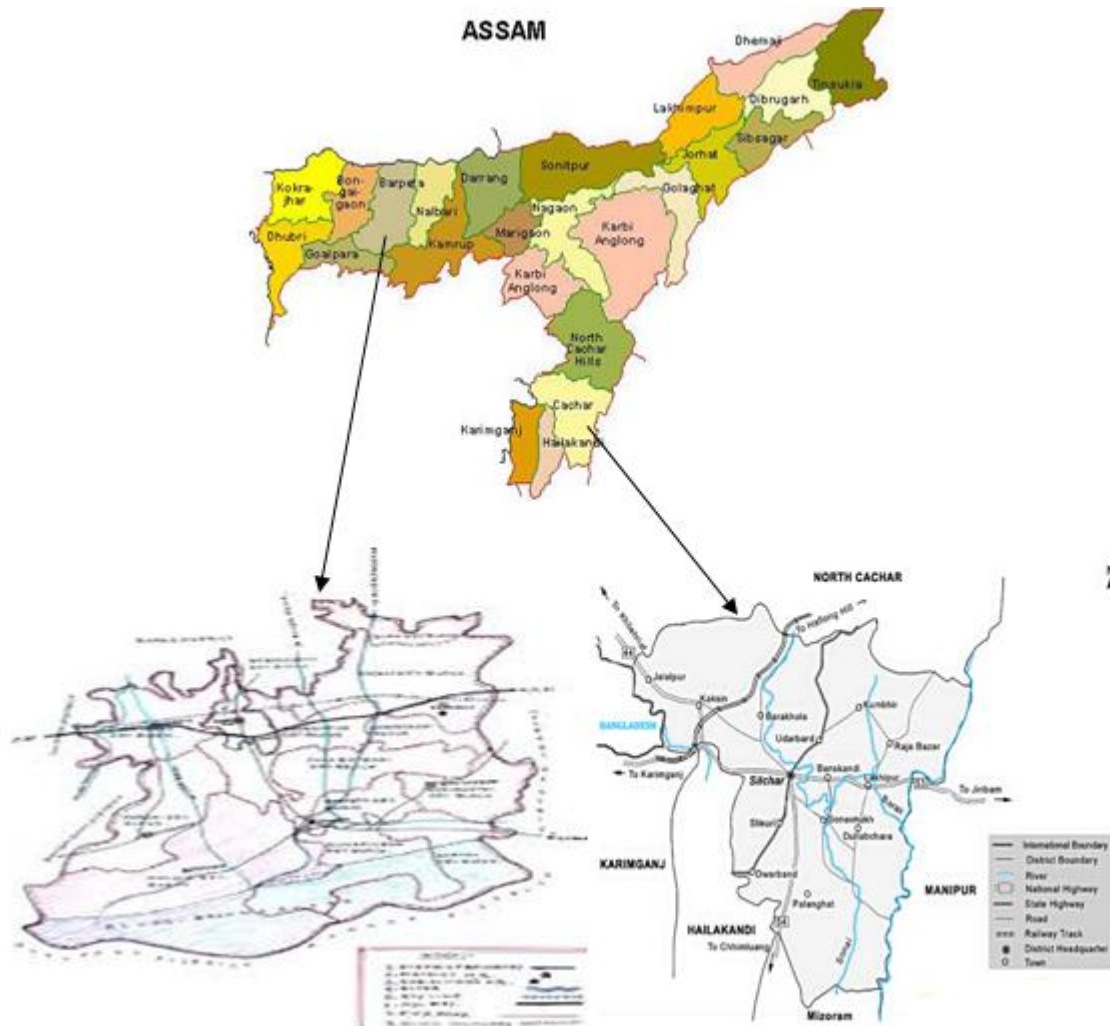


Figure 1: Map of study area (Barpeta and Cachar district, Assam)

ii) Collection of moth: Nocturnal moths were collected by using UV light of 15 watt bulb and kept the moths in a plastic jar, sprinkled with ethyl acetate. For diurnal moths collection insect net was used. These traps were set up at different sites in the study areas continuously for 45 sampling nights and days. Moths, caught in the traps were brought to the laboratory and were identified with the help of available literature based upon measurement of wing span and spreading characteristics of the wing (Hampson, 1894).

iii) Sampling method of moth species: This is a suitable method for surveying moth in a wide range of habitats. A modification of the line transects count was used to determine species richness and abundance of selected group of moth in different habitats in study areas under both the districts. Sampling count in each transect was repeated in most cases to see if any additional information is available or not.

iv) Data Analysis: Indices of diversity, species richness and evenness of moth communities were assessed for each habitat type and calculated by using Shannon-Wiener diversity index (1949), Margalef's index (1958) and evenness index (Pielou, 1966).

a) Measurement of diversity: The type of diversity used

here is α -diversity which is the diversity of species within a community or habitat. The diversity index was calculated by using the Shannon – Wiener diversity index (1949).

$$\text{Diversity index} = H = - \sum P_i \ln P_i$$

$$\text{Where } P_i = S / N$$

S = number of individuals of one species

N = total number of all individuals in the sample

\ln = logarithm to base e

b) Measurement of species richness

Margalef's index was used as a simple measure of Species richness (Margalef, 1958).

$$\text{Margalef's index} = (S - 1) / \ln N$$

S = total number of species

N = total number of individuals in the sample

\ln = natural logarithm

c) Measurement of evenness

For calculating the evenness of species, the Pielou's Evenness Index (e) was used (Pielou, 1966).

$$e = H / \ln S$$

H = Shannon – Wiener diversity index

S = total number of species in the sample.

3. Results and Discussion

During the study period a total of 223 no of specimens from Cachar district and a total of 201 no of specimens from Barpeta district belonging to family Arctiidae and Geometriidae were found (Table 1 a & b). Among those specimens 22 genera of arctiidae (amongst which 3 genera are unidentified) and 37 genera of geometriidae family (amongst which 5 genera are unidentified) were found from Cachar and 24 genera of Arctiidae (amongst which 3 genera are unidentified) and 30 genera of Geometriidae (amongst which 3 genera are unidentified) were found from Barpeta district. This study indicated that the diversity index, species richness and evenness of Arctiidae moth fauna were 3.104, 6.955 and 0.6557 and Geometriidae moth fauna were 3.433, 7.902, 0.8153 respectively in Cachar district (Table 2). The diversity index, species richness and evenness of Arctiidae moth fauna were 3.027, 6.981, 0.6065 and Geometriidae moth fauna were 3.207, 7.37, and 0.7247 respectively in Barpeta district. The Fig.1, Fig2 and Fig3 shows the comparative diversity index, evenness and species richness of Arctiidae and Geometriidae moth family of Cachar and Barpeta district respectively.

The biodiversity (diversity index, species richness and evenness) of moth fauna in Cachar district is more than Barpeta district as Barpeta is a flood plain area so Cachar has rich vegetation than Barpeta district as vegetation plays an important role for the existence of insect fauna in a community as it provides the main source of food etc.

4. Acknowledgement

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References

[1] Axmacher, J.C., Holtmann, G., Scheuermann, L., Brehm, G., Müller-Hohenstein, K. & Fiedler, K. (2004) Diversity of geometrid moths (Lepidoptera: Geometridae) along an Afrotropical elevational rainforest transect. *Diversity and Distributions*, **10**, 293–302.

[2] Beck, J., Schulze, C.H., Linsenmair, K.E. & Fiedler, K. (2002) From forest to farmland: diversity of geometrid moths along two habitat gradients on Borneo. *Journal of Tropical Ecology*, **17**, 33–51.

[3] Bell, T. R. D. and F. B. Scot, 1937. Fauna of British India including Ceylon and Burma. Moths. Vol. V. Sphingidae. Taylor and Francis Ltd. London. Bell, T. R. D., 1919. The common butterflies of the plains of India (including those met within the hill stations of the Bombay Presidency). *J. Bomb. Nat. Hist. Soc.*, 26(2): 438-487; 26(3): 750-764; 26(4): 941-954.

[4] Bingham, C. T., 1905. The Fauna of British-India

including Ceylon and Burma. Butterflies. Vols. I and II. Taylor and Francis Ltd. London. Bingham, C. T., 1907. The Fauna of British-India including Ceylon and Burma. Butterflies. Vols. I and II. Taylor and Francis Ltd. London. *Biogeography* 33: 108-120.

[5] Brehm, G., Homeier, J. & Fiedler, K. (2003a) Beta diversity of geometrid moths (Lepidoptera: Geometridae) in an Andean montane rainforest. *Diversity and Distributions*, **9**, 351–366.

[6] Brehm, G., Süssenbach, D. & Fiedler, K. (2003b) Unique elevational diversity patterns of geometrid moths in an Andean montane rainforest. *Ecography*, **26**, 356–366.

[7] Daniel, F., 1965. Österreichische Entomologische Iran-Afghanistan-Expeditionen Beiträge zur Lepidopteren fauna. *Zeits. Wein. Ent. Ges.*, 50 (9-10): 121-145.

[8] De Niceville, L. and G. F. L. Marshall, 1886. The Butterflies of India, Burma and Ceylon. Vol. II. Calcutta Central Press Co. Ltd., Calcutta India.

[9] Dennis, R. L. H. 1993. Butterflies and Climate Change. Manchester: Manchester University Press. *Ecological assembly rules: perspectives, advances, retreats*. Cambridge University Press, London, UK *Ecology* 22: 155-166.

[10] Elbert, G., 1969. Afghanistan bombyces and sphinges. (Sphingidae: Lepidoptera). *Lich. Mus. Tierh. Dresden*, 12(5): 37-63. Entomological Society. London: Academic Press.

[11] Hampson, G. F., 1894. The fauna of British India including Ceylon and Burma. Moths. Vols. I-V, London.

[12] Harrington, R. and Stork, N. E. (Eds) 1995. Insects in a Changing Environment. 17th Symposium of the Royal Entomological Society.

[13] Heppner, J.B. 1991. Faunal regions and the diversity of Lepidoptera. *Tropical Lepidoptera* 2: 1-85.

[14] Holloway, J.D. & Intachat, J. (2003) Aspects of the diversity of Geometridae (Lepidoptera) in Pasoh Forest Reserve. *Pasoh: ecology of a lowland rain forest in Southeast Asia* (ed. by T. Okuda, N. Manokaran, Y. Matsumoto, K. Niyama, S.C. Thomas and P.S. Ashton), pp. 292–313. Springer, Tokyo.

[15] Holloway, J.D. 2001. The moths of Borneo: family Arctiidae, subfamily Lithosiinae. *Malayan Nat. J.* 55: 279-486.

[16] Mani, M. S., 1986. Butterflies of the Himalaya. Oxford and IBH Co., New Delhi, India, 181 p.

[17] Margalef, R., 1958. Temporal succession and spatial heterogeneity in phytoplankton. In: *Perspectives in Marine biology*, Buzzati-Traverso (ed.), Univ. Calif. Press, Berkeley, pp. 323-347.

[18] Pielou, E. C., 1966. The measurement of diversity in different types of biological collections. *J. Theoret. Biol.*, 13: 131-144.

[19] Rosenberg, David, Danks, H.V. and Lehmkuhi, Dennis. M.C. (1986) importance of insects in Environmental Impact Assessment. *Environmental Management*, 10 (5) pp. 773-783.

[20] Shannon, C. E. and W. Wiener, 1949. The mathematical theory of communication. Urbana, University of Illinois Press, 177 p.

- [20] Talbot, G., 1939-1947. Fauna of British-India including Ceylon and Burma. Butterflies, Vols. I and II. Today and Tomorrow's Printers and Publishers, New Delhi, India.
 [21] Wilson, E. O., 1992. Fluctuations in abundance of tropical insects. Amer. Nat., 112: 1017-1045.

Table 1/a: Number of individuals of Arctiidae moth of Cachar district, Assam India during the present study.

Family	Subfamily	species	No of individual				
			Cachar	Barpeta			
Arctiidae	Arctiinae	<i>Aemiliapagana</i>	2	0			
		<i>Amerilaastrea</i>	2	1			
		<i>Cretonotosgangis</i>	3	15			
		<i>Cretonotostransiens</i>	9	8			
			<i>Eugoabipunctata</i>	6	4		
			<i>Acronictarumicis</i>	0	1		
			<i>Halysidotatelessa</i>	3	2		
			<i>Bertholdiaalmeidai</i>	2	0		
			<i>Ecpontheriascriborea</i>	6	3		
			<i>Hypercompe sp.2</i>	1	0		
			<i>Idalussp</i>	1	1		
			<i>Manginaargus</i>	1	0		
			<i>Syntomoidesimaon</i>	16	17		
			<i>Syntomoideseressa</i>	7	11		
			Lithosiinae		<i>Agyla sp.</i>	1	1
					<i>Cyanadivakara</i>	2	1
					<i>Cyanainterogationis</i>	12	8
					<i>Cyanasigna</i>	2	8
	Lymantriinae		<i>Arctornis sp.</i>	11	13		
			<i>Euproctissimilis</i>	0	1		
			<i>Euproctis sp.1</i>	7	4		
			<i>Euproctis sp.2</i>	1	1		
			<i>Hypoprepiafucosa</i>	2	1		
			<i>Lycomorhapholus</i>	1	3		
	Erebiinae		<i>Catacolapatala</i>	1	0		
			<i>Erebus sp1</i>	1	0		
			<i>Erebus sp2.</i>	2	1		
			<i>Nyctemaraadversata</i>	2	1		
			<i>Arctepolygrapha</i>	0	1		
			<i>Nyctemaraarctata</i>	1	1		
	Aganainae		<i>Astoacaracae</i>	3	2		
	Unidentified		N1	2	0		
			N2	3	1		
			N3	0	1		
			N4	1	1		
			Total nos of individual	115	113		

Table 1/b: Number of individuals of Geometriidae moth of Cachar district, Assam India during the present study

Geometriidae	Geometriinae	species	Cachar	Barpeta		
		<i>Agathiahilarata</i>	1	0		
		<i>Chlorissagelida</i>	0	1		
		<i>ComostolaSubtiliaria</i>	0	4		
		<i>Dysphaniasagana</i>	2	1		
		<i>Dyspterisarbovaria</i>	1	0		
		<i>Eumela sp.</i>	1	2		
		<i>Gelasmathelydaria</i>	6	2		
		<i>Hemitheagraminea</i>	2	1		
		<i>Pelagodesantiquadraraia</i>	7	5		
		<i>Pigasa sp.</i>	2	2		
		<i>Tanorhinusdimissa</i>	1	2		
			Ennominae	<i>Abraxas (Abraxas)conferta</i>	4	1
				<i>Abraxas (Calospilos) martaria</i>	7	7
				<i>Alcisarisema</i>	2	3
				<i>Aplochloravivilaca</i>	1	0
<i>Arichanna maculate</i>	2			1		

		<i>Ascotisselenaria</i>	3	2
		<i>Chiasmaemersaria</i>	2	3
		<i>Chorodnavulpinaria</i>	2	0
		<i>Cleora sp.</i>	2	2
		<i>Dalimaschistacearia</i>	4	3
		<i>Elphoshymenaria</i>	2	1
		<i>Hypochrosisrefescens</i>	0	1
		<i>Hypochrosisquadraria</i>	2	1
		<i>Hypomecis sp.</i>	1	0
		<i>Modasina contaminata</i>	1	0
		<i>Odontoperasimilaria</i>	1	0
		<i>Plutodescostatus</i>	2	1
	Larentiinae	<i>Hydreliaornata</i>	3	2
		<i>Psyrangulifera</i>	2	1
		<i>Xandramesletiferaria</i>	1	0
	Sterhiinae	<i>Scopula sp1.</i>	3	4
		<i>Scopula sp2.</i>	8	7
		<i>Scopula sp3.</i>	7	9
		<i>Problepsis vulgaris</i>	6	2
		<i>Problepsisapollinaria</i>	4	6
	Unidentified	N1	5	4
		N2	4	0
		N3	3	1
		N4	0	2
		N4	1	0
Total nos of individual			108	88

Table 2: Diversity index, Evennes, Species richness of Arctiidae and Geometriidae moth of Cachar and Barpeta district, Assam

Study site	Family	Diversity index (H)	Evennes (e)	Species richness
Cachar	Arctiidae	3.104	0.6557	6.955
	Geometriidae	3.433	0.8153	7.902
Barpeta	Arctiidae	3.027	0.6065	6.981
	Geometriidae	3.204	0.7247	7.37

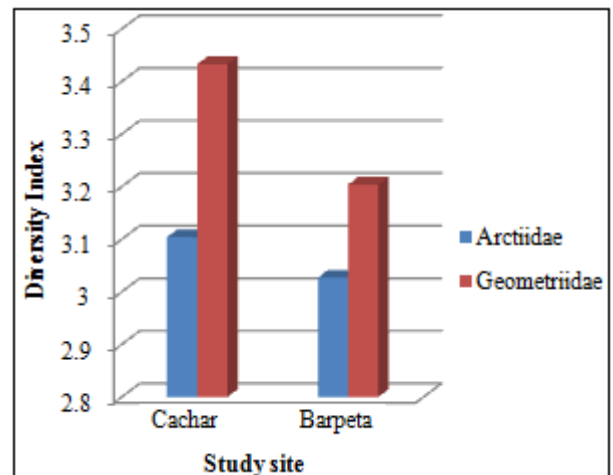


Figure 1: Graph showing diversity index of Arctiidae and Geometriidae moth fauna of Cachar and Barpeta district.

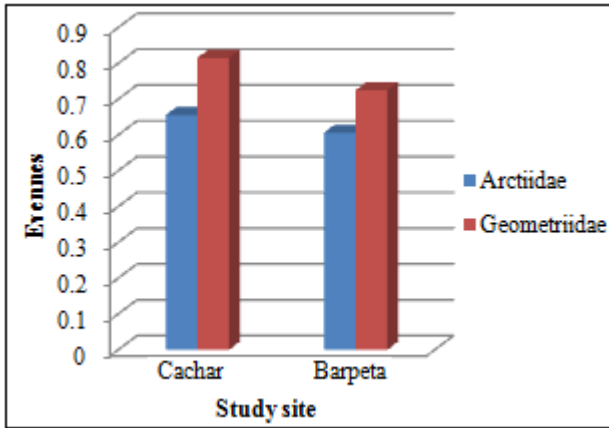


Figure 2: Graph showing Evenness of Arctiidae and Geometriidae moth fauna of Cachar and Barpeta district.

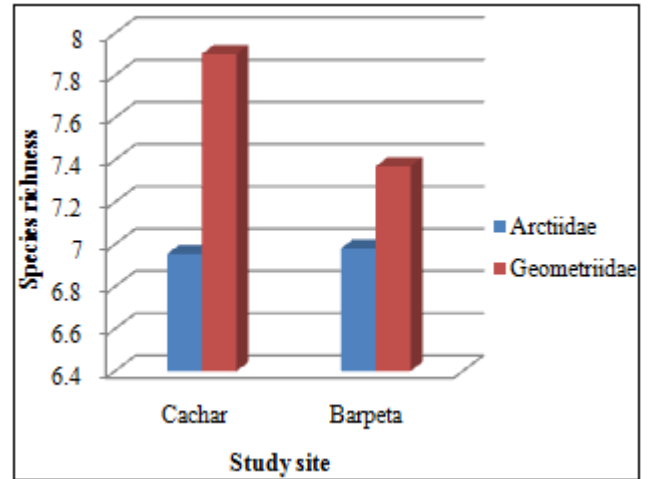
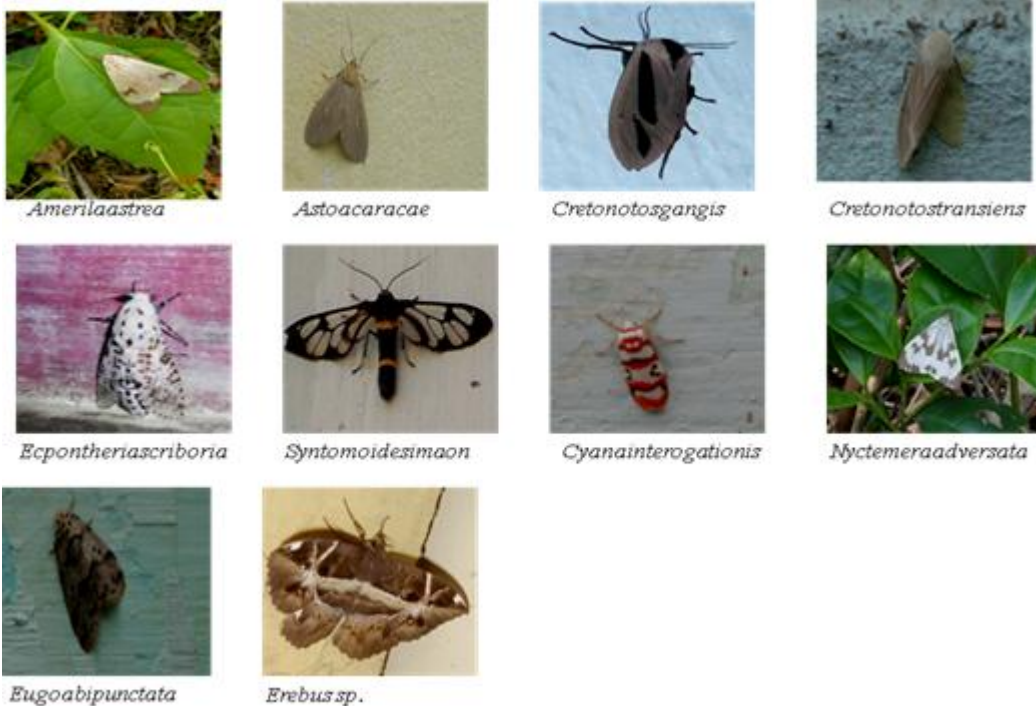


Figure 3: Graph showing Species richness of Arctiidae and Geometriidae moth fauna of Cachar and Barpeta district.

Arctiidae moths



Geometrid moth





Dyspteris arbovaria



Emerald sp.