P: ISSN NO.: 2321-290X RNI : UPBIL/2013/55327 Shrinkhla Ek Shodhparak Vaicharik Patrika Vol-III * Issue-VI* February-2016 42 **E: ISSN NO.: 2349-980X**

Butterfly(Lepidoptera:Insecta) Diversity of Amchang Wildlife Sanctuary

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Abstract

Lepidoptera is the second largest order in the class insect that include moths and butterflies. Butterflies are important bio-indicators which should be protected to converse the bio-diversity and environment. Different plant species and habitat of Amchang Wildlife Sanctuary attracts a wide variety of butterfly fauna which play a vital role in pollination of various flowering plants besides a key component of food chain. A regular survey was conducted from March 2014 to October 2015 by visual observation. Butterflies were sampled from four habitat i.e. Disturbed habitat, Moderately disturbed habitat, less disturbed habitat and undisturbed habitat using transect method of 1x1 Sq. Km were recorded at least thrice in each season. During the study 72 species belonging to five major families were recorded of which Nymphalidae was the most common, which was followed by Pieridae, Papilionidae, Satyridae and Danidae. Evens (1932) reported 962 butterfly species belonging to 6 families from North Eastern States except Sikkim Himalayas. Out of these 303 butterflies species were recorded from Manas Biosphere Reserve in 2009 in Assam. Different plant species having commercial and aesthetic values have been studied by Kakoti (2002). Nowadays, due to excessive forest cutting for timber, fuel wood and forest products, the area

under forest are shrinking and its capacity to satisfy the need of butterfly is simultaneously diminishing (Kakoti; 2002). Many workers have done various works on insects and butterflies in Assam and North-East India, but a little work has done for study of Lepidopteran population in different Reserve Forest and Wildlife Sanctuary. Sharma *et al*., (2010) has carried out a research on diversity and distribution of mammals in Amchang Wildlife Sanctuary. However no research has been done on the insects as well as butterfly diversity of Amchang Wildlife Sanctuary. Therefore, the present study has been aimed to investigate the Lepidoptera (Butterfly) population of selected forest pockets in Amchang Wildlife Sanctuary.

Keywords: Butterfly, Diversity, Amchang Wildlife Sanctuary. **Introduction** Butterflies (Lepidoptera) are the most tantalizing beautiful creatures and one of the most plant dependent groups of insects compared to the other groups of insect. Butterflies are beneficial as they serve as pollinators and indicators of environmental quality and are appreciated for their aesthetic value (Chakravarthy *et al*., 1997). They are also good indicator in terms of anthropogenic disturbance and habitat quality as they are sensitive to changes in the environment (Sparrow *et al*.,1994; Haribal, 1998 and Kocher *et al*., 2000). Nearly 1500 butterflies (Smetacek 1992, Gay 1992) are identified from the Indian Sub continent, constituting 8.33% of the 18,000- 20,000 known species of butterflies of the World, most of the Indian butterflies are reported from the Himalayas and from the Western Ghats (Larsen 1987a; 1988). Likewise Nepal has recorded 640 species and the adjoining state of Sikkim has recorded 689 and very little is known about butterfly diversity in Bhutan despite being estimated to have 800-900 species of butterflies. North Eastern India, harbouring some of the World‟s richest biodiversity is home of more than 500 species of butterflies. Evans (1932) reported 962 species of butterflies belonging to six families from North Eastern States except Sikkim Himalayas. Out of these, 303 species of butterflies were recorded by Choudhury (2009) in Manas Biosphere Reserve in between August 2006 to July 2009.

In North East India butterflies are well studied by de Niceville (1886, 1890), Moore (1890-1903), Marshall and de Niceville (1882), Bingham (1905, 1907), Evans(1932), Talbot (1939, 1947), Wynter-Blyth (1957) and presently a little work has been worked out by Kakati *et al*., (2002) Baruah *et al*., (2004) and Choudhury *et al*., (2009). Though a little works has been done for the study of Lepidopteron population in different reserve forest and wild life sanctuary of Assam, there is no any record of study done on butterfly diversity in Amchang Wildlife Sanctuary. Therefore in the present study it has been aimed to investigate the butterfly population and the vegetation pattern in the study area Amchang Wildlife Sanctuary of Assam.

Aim and Objective of the Work

1. To find out the species diversity of butterfly by conducting an extensive survey in the selected area of Bonda Range in Amchang Wildlife Sanctuary.
2. To study the vegetation pattern in the study area.

Study Area Amchang Wildlife Sanctuary, lies between Longitude 91º 50‟‟E to 91º 58‟‟E and Latitude 26º 06‟‟ N to 26º 13′N. Its elevation varies from 50-569 meter ASL. It is bounded by River Brahmaputra in the North, National Highway and Sonapur in the South. In the West side

Guwahati city and in Eastern side Digaru Railway station. The area of the sanctuary is about 78.64sq.km.which comprises Amchang Reserve forest (53.18sq.km.), Khanapara Reserve forest (09.96sq.km.) and South Amchang Reserve forest (15.50sq.km.) is an important area of the conservation of isolated small population of *Elephas maximus.*

Map of Amchang wildlife Sanctuary

The atmospheric temperature of the study area was recorded as 31.76 ± 2⁰ C in the month of July which was come down to 3⁰ ± 2⁰ C in the month of January. The precipitation in the study area was recorded as 42.2 mm where as the mean annual rainfall was recorded 1600.00 mm during the period of study. The maximum average rainfall was recorded as 343.11mm in the month of July where as the minimum average rainfall was recorded as 9.4 mm in the month of December. The maximum relative humidity in the month of July was recorded as 85.6% and minimum in the month of January was recorded as 68.2% during the study period. (Data collected from meteorological station, Lokpriya Gopinath Bordoloi International Airport) .The main vegetation types are: -

1. Semi-evergreen and mixed deciduous forest.
2. Tropical and sub tropical deciduous and evergreen forest.
3. Secondary Moist Bamboo Brakes.
4. Open Grass lands (Das, 1973). The major sources of water in Amchang Wildlife Sanctuary is river Brahmaputra and its tributary Digaru.

Methodology Methodology has been followed by two methods that is Primary data collection and Secondary data collection.

A. (i) For Primary data collection, the survey was carried out in the parts of Bonda-Birkuchi, Panikhaty - Hatisila, Hajongbari - Tatimara, Thakurkuchi - Panbari, Ghagua-Amchang Jorabat of Amchang Wildlife Sanctuary. **(ii)** For recording butterflies "Pollard Walk" method was adopted with a few modifications based mainly on Geographical and Climate consideration 1x1 meter transect were laid in each habitat types such as-crop field, Shrub land, close canopy along the roads and wetlands/streambeds.(Pollard and Yates,1993).

B. For secondary data collection, different Books, Journals, Papers and Website was followed to identifying the butterfly species.

Result The survey was carried out in the parts of Bonda, Birkuchi, Panikhaity, Hatisila, Hajongbari, Tatimara, Chandrapur, Thakurkuchi, Panbari, Ghagua and Amchang Jorabat area of Amchang Wildlife Sanctuary. During the study, the butterflies were recorded by walking on fixed transects (Pollard and Yates, 1993) in different habitats. The butterflies were encountered in different transects of 1 KM and were recorded at least thrice in each season. Some random transects also had been made in different habitat. On the basis of Visual observation during the entire study period the status of various butterflies of the area was prepared. Collection of specimens was avoided and unidentified specimens were collected with the

help of Aerial netting and released after taking a photograph because of the conservation policy. Species which encountered a total abundance exceeding 30%,individuals were described as very common,10- 30% common in sighting , 5-10% not rare ,1-5% rare and less than1% as very rare. The study was conducted from 2014-2015 covering four different seasons:

Summer (June-August), Autumn (September-November), Winter (December-February), Spring (March-May). All surveys and sampling were limited to sunny days, under calm to light, wind conditions when mean atmospheric temperature was about 32º C and average humidity was about 80%. The following hours of the day were selected for field survey and collection of butterflies. 9.00 – 10.00Hrs, 10.30 –11.30 Hrs, 12.00 – 13.00 Hrs, 13.30 –14.30Hrs, 15.00 – 16.00Hrs and 16.30 – 17.30 Hrs. Sampling began in June 2014, when the plants were beginning to flower, and was carried out survey 13-15 days of a month until the end of sept.2015. The butterflies were identified by observing their morphology as well as their particular behaviour. Identification of butterfly had been carried out with the help of following books and website Haribal (1992) and cross checked with Evens (1932), Mani (1986), Bingham (1905), Kehimkar (2008), Winter –Blyth (1957), Kunte (2000), Talbot (1978) and Varshney (1994).

List of Vegetation of Amchang Wildlife Sancturay

Common Name	**Scientific Name**
Mango	*Mangifera indica*,Linn.
Coconut	*Cocos nucifera*,Linn.
Drum Stick	*Moringa oleifera*,Lamk.
Indian Goose Berry	*Emblicaofficinalis*,
Indian Rubber	*Ficus elastica* var,decora Roxb.
Segun	*Tectona grandis*,Linn f.
Satiana	*Alstonia scholaris*(Linn)R.Br.
Bogori	*Zyzyphus jujuba*,Lamk.
Silikha	*Terminalia chebula*,Retz.
Giant Banana	*Muse gigantac,Duthie*
Mango	*Mangifera indica*,Linn.
Coconut	*Cocos nucifera*,Linn.
Wood apple	Aegle mamelos ,corr
Bulld wood	*Mimusops clengi* , Linn.
Tamarind tree	*Tamarindus indica*
Tea	*Thea sinensis var assanicca*
Purging cassia	*Cassia fistula* ,L.
Pomelo	*Citrus decumane* , Linn.
Sweet Orange	*Citrus sinensis*, osbeck
Indian Coral tree	*Erythrina indica*, Linn.
Beetle Palm	*Areca catechu*, Linn.
Date Palm	*Phoenix sylvestris* , Roxb.
Carambola	*Averrhoea carambola* ,Linn.

List of Nectaring Plants of Amchang Wildlife Sanctuary

Common Name	**Scientific Name**
Rose (red)	*Rosa damascene*, mill L.
Rose (white)	*Rosa alba*,L.
Lantana	*Lantana camera*,L.
Touch-me-not	*Mimosa pudica*,L.
Ixora	*Ixora macrophylla*,Linn.
Hibiscus	*Hibiscus rosa-sinensis*,L.
Mussaenda	*Mussaenda froudosa*, Linn.
Yellow oleander	*Thevetia peruviana*,(Pers Schum)
Pea flower	*Clitoria ternatea*, L.

Gold mohur flower	*Caesalpinia pulcherrima*,(L.)Sw
Datura flower	*Daturastramonium*,Linn.
Papaya flower	*Carica papaya L.*
Lemon	*Citrus paradisi*,Macfad
Magnolia	*Magnolia granndiflora* ,L.
Jasmine	*Jasminum sambac*(L.)Aiton
Pomegranate	*Punica granatum*,Linn.
Common Name	**Scientific Name**

List of Butterfly diversity in Amchang Wildlife Sanctuary

Sl.No	Common Name	Scientific Name	Family
1	Common Mormon	*Papilio polytes*	Papilionidae
2	Common Birdwing	*Triodes helena*	Papilionidae
3	Great Windmill	*Atrophaneura dasarada*	Papilionidae
4	Common Rose	*Atrophaneura aristolochiae*	Papilionidae
5	Common Blue Bottle	*Graphium sarpedon*	Papilionidae
6	Lime Butterfly	*Papilio demoleus*	Papilionidae
7	Common Mime	*Chilasa clytia*	Papilionidae
8	Great Mormon	*Papilio memnon*	Papilionidae
9	Common Jay	*Graphium agammemnon*	Papilionidae
10	Red Helen	*Papilio helenus*	Papilionidae
11	Fivebar Swordtail	*Panthysa antiphates*	Papilionidae
12	Lemon Pansy	*Precis lemonias*	Nymphalidae
13	Great eggfly	*Hypolimnas bolina*	Nymphalidae
14	Dark Blue Tiger	*Tirumala septentrionis*	Nymphalidae
15	Grey Pansy	*Precis atlites*	Nymphalidae
16	Striped Tiger	*Danaus genutia*	Nymphalidae
17	Peacock Pansy	*Junonia almana*	Nymphalidae
18	Plain Tiger	*Danaus chrysippus*	Nymphalidae
19	Leopard Lacewing	*Cethosia cyane*	Nymphalidae
20	Yellow Pansy	*Junonia hierta*	Nymphalidae
21	Common Baron	*Euthalia aconthea*	Nymphalidae
22	Common Lascar	*Pantoporia hordonia*	Nymphalidae
23	Blue Striped Palmfly	*Elymnias patna*	Nymphalidae
24	Whitebar Brushbrown	*Mycalesis anaxias*	Nymphalidae
25	Common Brushbrown	*Mycalesis perseus*	Nymphalidae
26	Common Fiverring	*Ypthima baldus*	Nymphalidae
27	Common Jester	*Symbrenthia hypselis*	Nymphalidae
28	Yellow Rajah	*Charaxes marmax*	Nymphalidae

29	Tawny Rajah	*Charaxes polyxena*	Nymphalidae
30	Pallid Nawab	*Polyura arja*	Nymphalidae
31	Red Lacewing	*Cethosia bibles*	Nymphalidae
32	Large Yeomen	*Cirrochroa aoris*	Nymphalidae
33	Common Sergeant	*Parathyma perius*	Nymphalidae
34	Staff Sergeant	*Athyma selenophora*	Nymphalidae
35	Blue Tiger	*Tirumala limniace*	Nymphalidae
36	Common Lascar	*Pantoporia hordonia*	Nymphalidae
37	Nigger	*Orsotrioena medus*	Nymphalidae
38	Yellow Coster	*Acraea issoria*	Nymphalidae
39	Punchinello	*Zemeros flegyas*	Nymphalidae
40	Orange Oakleaf	*Kallima inachus*	Nymphalidae
41	Sullied Sailor	*Neptis soma*	Nymphalidae
42	Common Map	*Cyrestis thyodamas*	Nymphalidae
43	Mottled Emigrant	*Catopsilia pyranthe*	Pieridae
44	Common Grass Yellow	*Eurema hecabe*	Pieridae
45	Common Emigrant	*Catopsilia crocale*	Pieridae
46	African Emigrant	*Catopsilia florella*	Pieridae
47	Red based Jezebel	*Delias aglaia*	Pieridae
48	Painted Jezebel	*Delias hyperate indica*	Pieridae
49	Broad Boardered Grass yellow	*Eurema brigitta*	Pieridae
50	Spotless Grass Yellow	*Eurema lacta lacta*	Pieridae
51	3-Spot Grass Yellow	*Eurema blanda silhetana*	Pieridae
52	Small White	*Pieris canidia*	Pieridae
53	Small White	*Pieris rapae*	Pieridae
54	Large White	*Pieris brassica*	Pieridae
55	Striped Albatross	*Appias libythea olferna*	Pieridae
56	Plain Puffin	*Appias indra narendra*	Pieridae
57	Chocolate Albatross	*Appias lyncida*	Pieridae
58	Spot Puffin	*Appias lalage lalage*	Pieridae
59	Albatross	*Appias libythea libythea*	Pieridae
60	Dark Clouded Yellow	*Colias electo fieldi*	Pieridae
61	Brown Veined White	*Anaphaeis aurola*	Pieridae
62	Bath White	*Pontia daplidice*	Pieridae
63	Lesser Bath White	*Pontia chloridice*	Pieridae
64	Yellow Orange Tip	*Ixias pyrene pirenassa*	Pieridae
65	Great Orange Tip	*Hebomoia glaucippe*	Pieridae
66	Common Gull	*Cepora nerissa*	Pieridae
67	Tailed Sulphur	*Dercas verhuelli*	Pieridae
68	Common Palmfly	*Elymnias hypermnestra*	Satyridae
69	Common Evening Brown	*Melanitis leda*	Satyridae
70	Banded Tree Brown	*Lethe confuse*	Satyridae
71	Common Indian Crow	*Eupolea core*	Danaidae
72	Striped Blue Crow	*Eupolea mulciber*	Danaidae

Conclusion Study was carried out only for one year revealed 251 individuals and 72 species of five major families. The stated area had rich butterfly diversity. The development of industrial area within this area having chemical zone can affect to the biodiversity. It is very important to understand in relation between host plant and the butterflies to protect them as they have co-evolved. Further systematic research is essential for getting a detailed periodic estimate and comparisons of the faunal diversity of butterflies in different seasons.

References

- Baruah, K.K., D. Kakati and J. Kalita. (2004). Present status of Swallowtail Butterflies in Garbhanga Reserve Forest, Assam, India. Zoo‟s Print Journal 19(4):1439-1441.
- Bingham, C.L. (1905).The fauna of British India including Ceylon and Burma, Butterfly-Vol.I, Taylor and Francis Ltd., London. 511pp.
- Bingham, C.L. (1907). The fauna of British India including Ceylon and Burma, Butterfly- Vol-II. Taylor and Francis Ltd., London.453pp.
- Chakravarthy, A.K.D. Rajagopal and R. Jagannatha; Insects as bio-indicators of conservation in the tropics. Zoo‟s Print J., 12, 21-25 (1997).
- 5. Choudhury, K., S. Ghosh and H. Singha. (2009). Conservation status of butterflies in Ripu-Chirang Reserve Forest, Western Assam, India. (In press).
- 6. Das, P.C. (1973). Working plan for the South Kamrup forest division, Assam, Office of the D.F.O., East Kamrup, 1-58.
- 7. de Niceville, L.(1886). The butterflies of India, Burma and Ceylon. Vol-II. Nymphalidae, Lemoniidae, Libythaeinae, Nemeobinae. The Calcutta Central press Co.Ltd. 332 pp.
- 8. De Niceville, L. (1890). The butterflies of India, Burma and Ceylon.Vol-III (Lycaenidae).The Calcutta Central press co.Ltd.503pp.
- 9. Evans, W.H (1932). The identification of Indian Butterflies. (2nd Edition). The Bombay Natural History Society, Mumbai, India. 454pp.
- 10. Gay (1992) Common Butterflies of India.WWF India and Oxford University Press Mumbai India.
- 11. Haribal, M.(1998). The Butterfly of Sikkim Himalaya and their natural history. Sikkim Natural Conservation Foundation, Gangtok, India. 217pp.
- 12. Kakati, D. and J. Kalita. (2002). Deforestation and its impact on swallowtail butterflies of Garhbhanga Reserve Forest, Kamrup paper presentation in National Seminar on Environmental degradation and its impact on North East India, Guwahati College (Assam).
- 13. Kocher SD, Williams EH, 2000. The diversity and abundance of North American butterflies, vary with habitat disturbance and geography. *Journal of Biogeography* 27:785-794.
- 14. Larsen.TB.The butterflies of the Nilgiri mountains of South India Lepidoptera Rhopalocera. J. Bombay Nat.hist.soc. 1987a: (84):26-43.
- 15. Larsen TB.The butterflies of Nilgiri Mountains of South India Lepidoptera

Rhopalocera. J.Bombay Nat.hist.soc.1988:(86):39-46.

- 16. Marshall, G.F.L. and L. De Niceville. (1882). Butterflies of India, Burma and Ceylon. Vol-I. Nymphalidae (Danainae, Satyrinae, Elymniinae, Morphinae, Acraeinae). The Calcutta Central pressCo.Ltd.327pp.
- 17. Moore, F. (1890-1892). Lepidoptera Indica. Vol. I.Rhopalocera.FamilyNymphalidae. Lovell Reeve andCo.Ltd., London.317pp.
- 18. Moore, F.(1893-1896). LepidopteraIndica, Vol. II. Rhopalocera. Family Nymphalidae. Lovell Reeve and Co. Ltd., London. 274pp.
- 19. Moore, F. (1896-1899). Lepidoptera Indica. Vol. III. Rhopalocera. Family Nymphalidae. Lovell Reeve and Co. Ltd., London.253pp.
- 20. Moore, F. (1899-1900). Lepidoptera Indica. Vol. IV. Rhopalocera. Family Papilionidae, Family Pieridae. Lovell Reeve and Co. Ltd., London.
- 21. Moore, F. (1901-1903) Lepidoptera Indica. Vol. V. Rhopalocera. Family Nymphalidae, Family Riodinidae, Family Papilionidae. Lovell Reeve and Co. Ltd., London.
- 22. Pollard, E., Yates, T.J. (1993). Monitoring butterflies for ecology and conservation. The British Butterfly Monitoring Scheme. Chapman and Hall, London. 274pp.
- 23. Smetacek P. Record of Plebejus eversmanni (Stgr.) from India. J. Bombay Nat, hist. soc. 1992; (89) :385- 386.
- 24. Sparrow, H.P.,T.D. Sisk, P.R. Ehrlich and D.D. Muray.(1994).Techniques and guidelines for monitoring Neotropical Butterflies. Conservation Biology, 8:800-809.
- 25. Talbot, G. (1939). The fauna of British India including Ceylon and Burma, Butterfly-Vol-I. Taylor and Francis Ltd., London. 600pp.
- 26. Talbot, G.(1947).The fauna of British India including Ceylon and Burma, Butterfly-Vol-II. Taylor and Francis Ltd., London. 506pp.
- 27. Wynter- Blyth, M.A. (1957). Butterflies of the Indian region. Bombay Natural History Society, Bombay 523 pp

Global Research Methodology Journal , Vol- V,
19th issue, Nov, 2016- www.grmgrlaranye.com
ISSM 2249-300X

Butterfly (Lepidoptera: Insecta) diversity and correlation with environmental factors in Ghagua of Amchang Wildlife Sanctuary, Kamrup, ASSAM

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ABSTRACT

Insects, including the species-rich Lepidoptera, play a central role in all terrestrial ecosystems. They have relatively the largest number of species in the animal kingdom and constitute the majority of all described species in the biosphere. Different plant species and habitat of Amchang Wildlife Sanctuary attracts a wide variety of butterfly fauna which play a vital role in pollination of various plants besides a key component of food chain. A regular survey was conducted from March 2014 to October 2015 by visual observation. Butterflies were sampled from Ghagua study site using line transect method of 1Km were recorded at least thrice in each month. During the study 47 species belonging to five major families were recorded of which Nymphalidae was the most common and followed by Papilionidae, Pieridae, Lycaenidae and Satyridae .
Evans (1932) reported 962 butterfly species belonging to 6 families from North-Eastern States except Sikkim Himalayas. Out of these 303 butterfly species were recorded from Manas Biosphere Reserve in 2009. Butterfly, which varies from place to place and season to season and even from one minute to the next is because of the biotic and abiotic environments which reasonably affect and influence in the distribution, diversity and abundance of butterflies. The present study was undertaken to assess the diversity, richness and abundance of butterfly species correlated with environmental parameters observed in Ghagua of Amchang Wildlife Sanctuary, Kamrup district, Assam, India.

Keywords: Butterfly, Richness, Abundance, correlation ,

Introduction

Butterflies are mainly day-flying group of the order Lepidoptera, which includes moths. Lepidopteran (order Lepidoptera), include more than 155,000 species of butterflies, moths and skippers. The name Lepidoptera is derived from the Greek, meaning “Scaly Winged” and refers to the

characteristic covering of microscopic dust like scales on the wing. Lepidopteron lives on every continent except Antarctica. Though they are far more numerous and diversified in the tropics, some species survive at the limits of polar vegetation. There are many species in nearby every environment from arid desert and high mountain tops to marshes and tropical rainforest. Insects, including the species-rich Lepidoptera, play a central role in all terrestrial ecosystems. They have relatively the largest number of species in the animal kingdom and constitute the majority of all described species in the biosphere. Their short generation times produce rapid population responses to a wide range of biotic and abiotic environment making them vitally important for ecological study (Lewis *et al.,* 1998). The rapid growth of population of insect is mainly because of their short life cycle and the production of hundreds of eggs at a time by the female. It takes generally a short period to develop from egg to larva and pupa to adult. All insect species have a limited distribution range and characteristically, insect numbers fluctuate to a greater or lesser extent both in time and in space. In many places, the rate of change of insect number is fluctuated by the influences of seasonal, cyclical, and other variations of weather. When the season is favourable for development, two or more generation of a species may occur at each year. Successive generations often show different patterns of numerical change.

There are about18,000 species of butterflies in the world. India has 1,501species, of which 321 are skippers,107 swallowtails,109 whites and yellows and 521 Brush footed butterflies and 443 Blues, which constitute 65% of total Indian fauna. According to ZSI report,1989; there are 10families, 55 genera and 104 species of butterfly already had been established from N .E. Region of India. However, the state of Assam in North Eastern India, harboring some of the world‟s richest biodiversity is home to more than 500 species of butterflies. Large scale habitat deforestation and fragmentation has led to the decline of several butterfly population in the state and many species believed to be common during the early part of the 20th century have now declined rapidly. Many workers have been done various works on insects and butterflies in Assam and North East India. However a little works has been done for study of Lepidopteran population in different reserve forest and wildlife sanctuary. Sharma *et al*. ,(2010) had carried out a research on Diversity and Distribution of Mammals in Amchang Wild life Sanctuary. However, no research has been done on the insects as well as butterfly diversity of Amchang Wildlife Sanctuary. Therefore in the present study it has been aimed to investigate the Lepidoptera (Butterfly) population density of selected area in Ghagua studysite in Amchang Wildlife Sanctuary .

Objective:- 1) To find out the species diversity, richness and abundance of butterfly by conducting a survey in the selected area of Ghagua in Amchang Wildlife Sanctuary

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2) To study the vegetation pattern in the study area.

Study Area:- Amchang Wildlife Sanctuary is situated on the eastern part of the capital city Guwahati, Assam. The area of the sanctuary is about 78.64sq.km. It is located at the lower foothills of Shillong plateau which is the adjoined part of Raja Mayang hill Reserve Forest and Pabitora Reserve Forest. Amchang is declared as a Wildlife Sanctuary on 19th June 2004 by the Government of Assam. It comprises of three reserve forests – Amchang, South

Amchang, and Khanapara. The central coordinates of Amchang Hill is 91º.45′.00‟ East and 26 .6′.20″North. The altitude of this area is about 50-569m. The Khamranga beel,which is the lowest area and the Parahopa peak is the highest point of 569 m. The northern part of the study area is guarded by mighty Brahmaputra River, the southern part is bordered by the 37 National Highway, the western side is covered by Guwahati Metro City and the eastern part is attached to the Marigaon district.

Ghagua site is located on the North eastern vicinity area of the Amchang Wildlife Sanctuary. It is located on 26°20′96″ E longitude and 92°27′81″ N latitude

It is a vast stretch (500 acres) of agricultural land along the forest edge, well managed agricultural, horticultural and fruit cultivating practices are going on in full swing. The various sectors considered for the study are shown in fig. below

Because of its geographical location, climate, rainfall and good soil conditions, hills and hillocks, numerous marshy lands and wetlands, it supports a variety of rich forest ecosystem. Climate is the major factor which affects floral and faunal composition of the region

Methodology:- Methodology has been followed by two methods i.e. Primary data collection and Secondary data collection. For primary data collection, the survey was carried out in the parts of Ghagua study sites of Amchang Wildlife Sanctuary. To study the magnitude of diversity and the level of population distribution of butterflies, the three selected sites were painstakingly censused during four different seasons (Pre monsoon, Monsoon, Ret Monsoon and Winter) in 2014 & 2015. The survey was carried out by steadily walking along the survey routes and recording butterflies observed within a 20 m width along the routes, using the line transect method (Yamamoto 1975; Pollard and Yates 1993).This method has been extensively used to survey and monitor butterfly populations and communities (Honda and Kato 2005; Clark *et al*., 2007; Lee *et al*., 2014). For Secondary data collection different Books , Journals, Papers and web site were followed for identifying the butterfly species. The butterflies were encountered in different transects of 1 KM and were recorded at least thrice in each month. Some random transects also had been made in different habitat. On the basis of Visual observation during the entire study period the status of various butterflies of the area was

prepared. As a conservation policy, collection was avoided and unidentified specimens were collected with the help of Aerial netting and released after taking a photograph.

Statisticalanalyses:-

The statistical analyses were computed based on the recommendations of Michael (1986), Ludwig and Reynolds (1988) and Southwood and Henderson(2000).The data, giving particulars on the total number of families, species and individuals of butterflies collected were pooled together and processed. The following indices were computed for the present study.

Richness indices:- The richness indices such as R1 (Margalef‟s index) and R2 (Menhinick‟s index) were calculated relating to number of species and total number of individuals using the following formulae.

$R1=(S-1)/Log_e(n)$,$R2 =S/\sqrt{n}$ Where **S** is the total number of species and **n** the total number of individuals.

Diversity indices:-The Simpson‟s (λ) and Shannon-Weiner (H‟) indices of diversity were calculated relating to the number of families of butterflies and the total number of species collected using the following formulae.

Simpson's index(λ)= $\sum_{i=2}^{s} Pi^2$ *Where* pi = ni/N , i = 1, 2, 3 . . . S i.e., the proportional abundance of the ith species and N is the known total number for all S species.

Shannon-Weiner index (H')= $\sum_{j=1}^{s}(pi \ln pi)$ Where pi is the proportion of individuals in the ith species. S is the total number of species and ln is the log with base e logarithms. Hill"s diversity number 1, the number of abundant species (N1) = e^H *Where* H‟ is the Shannon-Weiner index and Hill‟s diversity number 2, the number of very abundant species (N2) =1/λ where λ is the Simpson‟s index.

Evenness indices:- The evenness indices E1,E2 and E3 were calculated using the following formulae

E1 = H'/ $Log_e(S)$= $\ln(N_1)/\ln(N_0)$ E2= e^H/S= N_1/N_0

$E3 = (e^H-1)/(S-1) = (N_1-1)/(N_0-1)$

$E4 = (1/\lambda)/e^H = N_2/N_1$

$E5 = (1/\lambda-1)/((e^{II}-1) = (N_2-1)/(N_1-1)$ *Where* H" is the Shannon-Weiner index, N_0 is the number of all species and N_1 is the number of abundant species.

Correlation coefficient and regression analyses :-

Correlation coefficient and regression analyses were computed using standard formulae:-

Correlation coefficient (r) = $\frac{\Sigma(x-\bar{x})(y-\bar{y})}{\sqrt{\Sigma(x-\bar{x})^2}\sqrt{\Sigma(y-\bar{y})^2}}$

Regression coefficient (b) = $\frac{\Sigma(x-\bar{x})(y-\bar{y})}{\Sigma(x-\bar{x})^2}$

The statistical treatments were given to analyse the interaction between different abiotic factors (temperature, humidity, rainfall and wind velocity) and the density of butterfly population. The analyses made between monthly butterfly population in the site studied and the role of abiotic factors on the population density, richness were analysed for the entire period of the research work.

Results:- 1) Plant phenology in Ghagua

In the Ghagua study site totally 51 plant species belonging to nectering and vegetation plant includes shrubs, herbs, small trees, trees,flowering plants and some ornamental plants. Most of the permanent trees are fruiting trees, which includes the Papaya (*Carica papaya*), Jackfruit (*Artocarpus heterophyllus)*, Mango(*Mangifera indica*), Pomegranate(*Punica granatum*), Pomelo(*Citrus maxima*), Lemon (*Citrus lemon*), Curry leaf (*Murraya*

koenigii),Coconut (*Cocos nucifera*), Carambola (*Averrhoa carambola)* and so on. Seasonal farm crop such as maize (*Zea mays*) and paddy (*Oryza sativa*) are also planted here. Flowering plants such as, Thorn apple (*Datura* metel), Bahak (*Adhatoda vasica),* Touch-me-not (*Mimosa pudica),* Jasmine (*Jasminum sambac*) and China rose (*Hibiscus rosa-sinensis*), Yellow oleander *(Thevetia peruviana),* Lantana (*Lantana camera)* are also available here .

Table No- 1 Nectering plants and vegetation in (Ghagua)

Botanical name	English /Vernacular name	Habit
Mesua ferrea L.	Iron wood (Nahor)	Tree
***Mimusopsclengi* L.**	**Buld wood (Bakul)**	**Tree**
***Adhatodavasica* Nees**	**Bahak (White)**	**Shrub**
Butea monospearma	**Palash**	**Tree**
***Clerodendroncolebookianum*walp**	**Nefafu**	**Shrub**
***Erythrina indica* Linn.**	**Indian Coral tree**	**Tree**
***Datura* metel Linn**	**Thorn apple (Datura)**	**Shrub**
***Bauhiniapurpurae* Linn.**	**Maintain ebony (Kanchan)**	**Tree**
***Clerodendruminfortunatum*Linn.**	**Vetetita**	**Shrub**
***Thevetia peruviana*(Pers Schum)**	**Yellow oleander**	**Shrub**
***Amaranthusviridis* Linn.**	**Green calalu (Khutora)**	**Herb**
***Hibiscus rosa-sinensis* L.**	**China rose**	**Shrub**
***Lantanacamera* Linn.**	**Lantana**	**Shrub**
***Mimosa pudica* Linn.**	**Touch-me- not**	**Herb**
***Cymbidium aloifolium* Swartz.**	**Kapauphul**	**Orchid**
***Leacus aspera* Spreng**	**Dron**	**Herb**
***Brassicacampestris* Linn.**	**Mustard (Sariah)**	**Herb**
***Ageratum conyzoides* Linn.**	**Goat weed (Gondhowa bon)**	**Herb**
***Solanum indicum* Linn.**	**Indian night shade (Titbhaguri)**	**Shrub**
***Tagetes erecta* Linn.**	**Marigold (Gendha)**	**Shrub**
***Bauhinia purpurea* Linn.**	**Ranga kanchan**	**Shrub**
***Catharanthusroseus* G.Don(L.)**	**Periwinkle (Nayantara)**	**Shrub**
***Calotropis gigantea*(L.)R.Br**	**Madar (Akon)**	**Shrub**
***Anthocephalluscadamba* Miq**	**Kadam**	**Small tree**
***Tectona grandis* Linn.f.**	**Teak**	**Tree**
***Terminalia chebula* Retz.**	**Shilikha**	**Tree**
***Cedrus deodara* Land**	**Deodar**	**Tree**
***Bombax celba* L.**	**Red silk cotton (Simolu)**	**Tree**
***Albizia lebbeck* Benth**	**Siris tree**	**Tree**
***Gmelina orborea* Linn.**	**Candahar (Gomari)**	**Tree**
***Cassia fistula* L.**	**Purging cassia (sonaru)**	**Tree**
***Ricinus communis* Linn.**	**Castor oil plant (Aragach)**	**Shrub**
***Mangifera indica* Linn**	**Mango (Aam)**	**Tree**
***Zizyphus jujuba* Lamk.**	**Bogori**	**Small tree**
***Psidium guajava* Linn.**	**Guava (Madhuri)**	**Small tree**
***Chenopodium album* Linn.**	**Jilmil**	**Herb**
***Hibiscus sabdariffa* Linn.**	**Roselle (Mesta)**	**Shrub**
***Moringa oleifera* Lam.**	**Drum stick (Sagina)**	**Small tree**
***Elaeocarpus floribundus* Blume**	**Olive (Jalpai)**	**Small tree**
***Emblica officinalis* Gaertn.**	**Indian goose berry (Amlakhi)**	**Tree**
***Melia azedarach* Linn.**	**Margosa (Ghoranim)**	**Tree**
***Camellia sinensis*(L.)**	**Tea plant**	**Shrub**
***Artocarpus heterophyllus* Linn.**	**Jack fruit (Kathal)**	**Tree**
***Tamarindus indica* Linn.**	**Tamarind (Teteli)**	**Tree**
***Citrus maxima* Meer.**	**Pomelo (Rabab tenga)**	**Small tree**
***Murrya koenigii*(L.) Spreng**	**Curry leaf plant (Narsing**	**Shrub**
***Cocos nucifera* Linn**	**Coconut (Narikal)**	**Tree**
***Borassus flabellifer* Linn.**	**Tal**	**Tree**
***Syzygium cumini* (L) Skeels**	**Black berry (Kolajam)**	**Tree**
***Ficus cunia* Ham**	**Dumaru**	**Small tree**
***Averrhoa carambola* Linn.**	**Carambola (Kardoi)**	**Small tree**

Vegetation

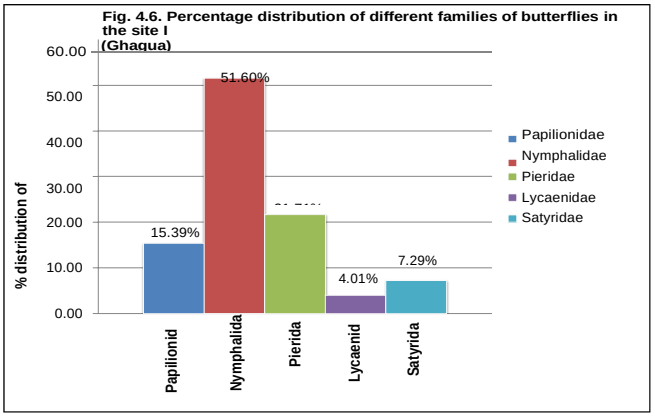
Diversity and distribution of butterfly (Ghagua) :-A total number of 14059 butterflies belong to five families were recorded during the entire study period. The number of individuals observed for each family with their common name and scientific name inTable2 .

Table 2 Family-wise list of butterflies

Family	S.L No	Scientific name	Common name	Total No. observed	Percentage
Papilionidae	1	*Papilio polytes* Linnaeus	Common Mormon	247	11.42
	2	*Troides helena* Linnaeus	Common Birdwing	122	5.64
	3	*Atrophaneura dasarada* Moore	Great Windmill	95	4.39
	4	*Atrophaneura aristolochiae* Fabricius	Common Rose	437	20.20
	5	*Graphium sarpedon* Linnaeus	Common Bluebottle.	53	2.45
	6	*Papilio demoleus* Linnaeus	Lime Butterfly	288	13.31
	7	*Chilasa clytia* Linnaeus	Common Mime	320	14.79
	8	*Papilio memnon* Linnaeus	Great Mormon	601	27.79
Nymphalidae	1	*Junonia lemonias* Linnaeus	Lemon Pansy .	477	6.57
	2	*Hypolimnas bolina* Linnaeus	Great Eggfly	506	6.97
	3	*Tirumala septentrionis* Butler	Dark Blue Tiger	239	3.29
	4	*Junonia atlites* Linnaeus	Grey Pansy	319	4.40
	5	*Danaus genutia* Cramer	Striped Tiger	233	3.21
	6	*Junonia almana* Linnaeus	Peacock Pansy	127	1.75

In the Ghagua study site, among the 14059 individuals recorded, most of the members belong to the family Nymphalidae and was the most highly distributed family with a total number of 7255 individuals. This was followed by Pieridae with 3052 individuals, Papilionidae with 2163 individuals, Lycaenidae with 564 individuals and Satyridae with only 1025 individuals respectively.The percentage contribution of the family Papilionidae was 15.39%; Pieridae was 21.71%; Nymphalidae was 51.60%;Lycaenidae was 4.01% and the contribution of Satyridae was 7.29% respectively (Fig. 4.6)

Family	S.L No	Scientific Name	Common Name	Total observation	Percentage
Nymphalidae	7	*Danaus chrysippus* (Linnaeus)	Plain Tiger	397	5.47
	8	*Cethosia cyane* Drury	Leopard Lacewing	138	1.90
	9	*Junonia hierta* Fabricius	Yellow Pansy	50	0.69
	10	*Athyma nefte* Cramer	Colour Sergeant	361	4.98
	11	*Ariadne merione* Cramer	Common Castor	199	2.74
	12	*Tanaecia lepidea* (Butler)	Grey Count	153	2.11
	13	*Kaniska canace* Linnaeus	Blue Admiral	43	0.59
	14	*Neptis hylas* Linnaeus	Common Sailer	282	3.89
	15	*Athyma opalina* Kollar	Himalayan Sergeant	150	2.07
	16	*Parantica aglea* Moore	Glassy Tiger	204	2.81
	17	*Tanaecia jahnu* Moore	Plain Earl	188	2.59
	18	*Ariadne ariadne* Linnaeus	Angled Castor	301	4.15
	19	*Melanitis leda* Linnaeus	CommonEveningBrown	848	11.69
	20	*Euploea mulciber* Cramer	Striped Blue Crow	224	3.09
	21	*Cirrochroa aoris* Doubleday	Large Yeoman	55	0.76
	22	*Polyura athamas* Drury	Common Nawab	447	6.16
Nymphalidae	23	*Pantoporia hordonia* Stoll	Common Lascar	179	2.47
	24	*Euploea core* Cramer	Common Crow	830	11.44
	25	*Junonia iphita* Cramer	Chocolate Pansy	305	4.20
Pieridae	1	*Catopsilia pyranthe* Linnaeus	Mottled Emigrant	519	17.01
	2	*Eurema hecabe* Linnaeus	Common Grass Yellow.	437	14.32
	3	*Catopsilia crocale* Cramer	Common Emigrant	243	7.96
	4	*Pieris canidia* Sparrman	Indian Cabbage White	169	5.54
	5	*Delias descombesi* (Boisduval)	Red-spot jezebel	177	5.80
	6	*Delias eucharis* Drury	Common jezebel	145	4.75
	7	*Leptosia nina* Fabricius	Psyche	603	19.76
	8	*Catopsilia pomona* Fabricius	Common Emigrant	209	6.85
	9	*Appias libythea* Fabricius	Striped Albatross	550	18.02
Lycaenidae	1	*Anthene emolus* Godart	Common Ciliate Blue	291	51.60
	2	*Rapala pheretima* Hewitson	Copper Flash	160	28.37
	3	*Castalius rosimon* (Fabricius)	Common Pierrot	113	20.04
Satyridae	1	*Lethe confusa* Aurivillius	Banded Tree Brown	153	14.927
	2	*Elymnias hypermnestra* Linnaeus	Common Palmfly	872	85.073



The result of the family-wise diversity indices analysis indicated that, in the Ghagua site, the family Nymphalidae was recorded as the rich family with 25 species (R_1 =2.6998; R_2 =0.2935) followed by the families Pieridae with nine species(R_1 =0.9971; R_2 =0.1629),Papilionidae with eight species (R_1 =0.91155; R_2 =0.1720),Lycaenidae with three species(R_1 =0.3157; R_2 =0.1263) and Satyridae with only two species (R_1 =0.1442; R_2 =0.0625). Family Papilionidae recorded the following values – Simpson‟s index 0.1764; Shannon- Weiner index 1.8682,Hill‟s Diversity NumberN1=6.4756; N2 = 5.6693;Evenness

index: E1=0.8984; E2=1.2630; E3= 0.7822; E4 =0.8755 and E5=0.8527.

Family Pieridae recorded the following values – Simpson‟s index=0.14065; Shannon-Weiner index =2.0640; Hill‟s Diversity Number N1=7.8756; N2= 7.1100; Evenness index E1=0.9394;E2=1.2577; E3 = 0.8595; E4 =0.9028 and E5=0.7758. Family Nymphalidae recorded the following values – Simpson‟s index =0.0597; Shannon-Weiner index =2.9973; Hill‟s Diversity NumberN1=20.0242 ; N2 =16.7475; Evenness index E1=0.9311; E2 = 1.1274; E3=0.7927; E4 =0.8364 and E5=0.8278.Lycaenidae recorded the following value – Simpson‟s index 0.3868; Shannon-Weiner index = 1.0209; Hill‟s Diversity Number N1 = 2.7755; N2 =2.5851; Evenness index E1=0.9293; E2=1.4053; E3=0.8878; E4= 0.9314 and E5= 0.8928.Family Satyridae recorded the following values – Simpsons‟ index = 0.7460; Shannon-Weiner index =0.4214; Hill‟s Diversity Number N1=1.5241; N2 = 1.3404; Evenness index E1=0.6080; E2=1.2345; E3 = 0.5241; E4=0.8795 and E5=0.6495.

From this observed results, it was concluded that in Ghagua Site the family Nymphalidae was highly represented and densely distributed one with more number of individuals. The Shannon-Weiner diversity index for Ghagua site is well documented month-wise. The family Papilionidae showed moderate diversity index almost all the months studied except the month of November, December and January 2014 and 2015 during which the index was very least (1.6689,1.5833, 1.6171, 1.6689,1.5833, 1.6171). The highest diversity index was observed during the month of October 2014 and September 2015 (1.8801, 1.9582). The family Satyridae very few months showed moderate diversity index. The moderate diversity index was observed during the month of June, July and August (0.4344, 0.3830, 0.2911, 0.4127, 0.3463, 0.3951) while among the remaining months of the study period several month showed the least index such as (0,2712 to 0.3622). During the month of January 2014 the index showed only „0‟. This indicated that among the five families studied, the members of the Satyridae showed the poorest diversity and similarly in case of Lycaenidae also poorest diversity index was seen during the month of January and December both the year. Gradually the population diversity picked up from pre-monsoon onwards in almost all families studied and it reached its peak during monsoon and then faces the declining trend from post-monsoon onwards.

Population Dynamics of butterflies in(Ghagua)

Month-wise population distributions of 47 species of butterflies belonging to five families were recorded. The five families studied were Papilionidae, Pieridae, Nymphalidae, Lycaenidae and Satyridae. Total population observed was 14049 during the entire study period. The results of correlation and linear regression analyses between butterfly population of chosen families and abiotic factors such as temperature, relative, humidity, rainfall and wind velocity are also calculated.The population density of Nymphalidae were reported high (Fig. 4.24 and 4.27) 473 to 550 during April to September 2014 and 2015 because of moderate rainfall (188 to 377 mm),high relative humidity (84% and 92%),low average wind speed (1 to 2 km/hr) and maximum temperature (33 to 34°C). Again low population density was observed during the period from October to March. Environmental temperature and relative

humidity recorded was gradually falling down (22°C,to12°C) and (90% to 75%).

Papilionidae density was high (166, 159) during August 2014 & 2015 due to moderate rainfall (277 mm and 250mm) and the conducive relative humidity(91%,90%).Low population density was observed during December and January (<15). The environmental parameters were differed greatly during the entire study period. During the month of June to August of both the years temperature was moderate between (28 – 32C), humidity between 80% –92%, wind speed also moderate (1 – 3 km/h) and the rainfall was high (277– 377mm). This favourable situation resulted in the greater explosion (<150) of the Papilionidae individuals during these months. While during the months of November, December, January and February 2014 – 2015 the environmental condition was greatly changed, the temperature falls (12 – 9C)and very scanty rainfall (nil – 5 mm) resulted in the steep fall of the butterfly population.

In Ghagua Site most of the families showed their peak of diversity as well as population density during April to September of both the years of study (Fig. 4.27). This was mainly because of the reason that all the environmental parameters were favourable to the butterflies during these months (Table 4.16). It is the period of monsoon and post monsoon resulted in growth of rich flora with required flowers.

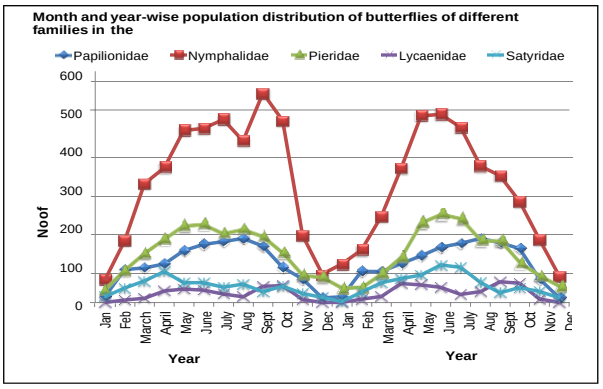
Correlation with environmental parameters

The relationship between the availability of the butterflies and the various environmental factors were statistically analysed. The regression analysis indicated that the various abiotic factors such as the temperature, humidity, wind speed and rainfall had an influential impact on the availability, distribution and diversity of population in the study site. The regression equation and regression line are well marked.

Table 4.17. Record of environmental parameters in Ghagua of Amchang wild life sanctuary studied from 2014 to 2015

	Min. Temp °C	Max. Temp °C	Relative Humidity %	Rainfall In mm	Average wind speed km/hr
2014 Jan	13	26	79	8	2
Feb	12	23	88	21	0
March	16	30	81	47	1
April	22	34	71	181	3
May	22	32	84	226	2
June	26	33	91	308.7	2
July	27	33	90	377	1
Aug	25	32	91	227	1
Sept	24	33	92	199	1
Oct	22	31	89	92	0
Nov	15	27	90	25	1
Dec	12	21	94	10	1
2015 Jan	12	21	92	7	1
Feb	12	24	84	21	3
March	21	27	80	50	3
April	19	31	86	176	4
May	22	32	89	225	3
June	24	33	89	310	3
July	26	34	88	375	2
Aug	25	32	90	250	1
Sept	25	33	91	188	0
Oct	22	31	91	90	1
Nov	18	28	87	22	2
Dec	12	23	94	10	0

In Site (Ghaua), the density of the butterflies of the families showed an overall positive correlation to maximum temperature (Pieridae:r=0.8717, b=0.0586,a=21.8796;Nymphalidae:r=0.8900,b= 0.0243,a=21.9738; Papilionidae:r=0.5132, b=0.0394, a=25.7801 and Lycaenidae: r =0.7512, b=0.1726, a= 25.2337) the values mere statistically significant.



In the Ghagua-ecosystem the density of butterfly families showed negative significant

difference to relative humidity (Papilionidae**:**r=-0.4386, b=-0.04258, a=91.37988 ; Nymphalidae**: r=**-0.0873, b=-0.00301 , a=88.45423; Pieridae**: r=**0.0507, b=0.00431, a=86.99339; Lycaenidae**: r=**0.0647, b=0.01879, a=87.09537; Satyridae**: r=**-0.3528, b=-0.07639, a=90.80455) .

Discussion and findings

The importance and abundance of butterflies in any system mean that they are particularly studied for the use as indicators of biodiversity, ecosystem health and landscape degradation (Ambrose, 2005). The butterfly distribution is expected to cover with the distribution of the host plants even at small scales and type of vegetation may reflect difference in the composition of butterfly communities among habitats at the generic and family level (Beccaloni,1997).

Butterflies of site (Ghagua) are found to be habitat specific to some extent. Diversity and population distribution of butterfly depend on the potential role of crops under cultivation. This study reveals the relationship between vegetation and butterfly species richness, species diversity and population density. So it is important to understand the basic process causing changes in distribution patterns and composition of butterflies. The present study emphasizes the role of diversified vegetation and various nectarine plants, associated with various environmental parameters such as temperature, humidity, rainfall and wind velocity on species richness of butterflies.

Fruiting trees, vegetables, flowering plants and other leafy crops serve to attract many butterflies. Their availability throughout the year was another advantage to the butterflies. Danks (1993) indicated that characteristics features of host plants along with climate influence the distribution and the diversity of butterflies and other insects. The climatic conditions that were observed in the study area were one of the major and suitable factors throughout the period and had influence on the distribution and diversity of population. It was observed that some species of butterfly were present throughout the year. So their presence during all season suggested that they are either susceptible to minor environmental changes or the environment is effectively non-seasonal. The rich number of species availability was mainly because of the availability of varieties of crop plants and vegetation. Rich marginal vegetation, which includes milk weed plants and shrubs, were large in size around the Site. These vegetations provide a protected safe breeding ground and good habitation to the butterflies largely found to harbour many larvae of butterflies. These observations were support by Hammond and Miller(1998) who observed that shrubs, herbs and grasses supported high level of species richness to butterflies. Presence of fresh water pond inside the Ghagua study site was also found to influence colonisation of some butterflies. Saxena (1996) explained the relationship of water and moist air for butterfly diversity and stressed the importance of a water body to increase immediate survival value. In addition to the pond, number of permanent trees also provided the rooster places for many adult butterflies. During survey, a large number of butterflies were found to use shrubs and herbs as roosting places, especially the *T. septentrionis* preferred tamarind trees. Papilionids such as *Papilio demoleus, P. polytes, Atrophaneura aristolochiae, and Papilio memnon* and Pierids like *C. pyranthe, Leptosia nina* and a few others were observed as predominant species in Ghagua. Even though

butterfly exhibited seasonal or periodical peaks, they occurred almost all the months. This view was substantiated by Owen (1969) that Lepidoptera is relatively high for most of the year in tropical region because of the relatively large number of plant species present. Seasonal distribution of many butterfly species was found related to temperatures fluctuations. Temperature is probably the single most important environmental factor influencing insect behaviour, distribution, population size, development, survival and reproduction (Petzoldt and Seaman, 1992; Ward, 1992). Temperature within the favourable range will speed up the metabolism of an insect and consequently increase its rate of development. Each species and each stage in the life history may develop at its own rate in relation to temperature (Gullan and Cranston, 2000). Muralirangan *et al.*,(1993) observed that high humidity stimulates fungal attack and high temperature causes a decrease in insect population. However, butterflies are highly sensible to predict cyclic seasonal changes and the quality of air. The ability to recognize the slightest difference in humidity enables them to move to favourable areas (Saxena, 1996). In the present study also almost all observed members of butterflies belong to different families were very high during high temperature (Max 34°C) and humidity (90%) such as June , July and August and this indicated that the condition that prevailed during these period may be suitable. Hammond and Miller (1998) indicated that grasses and herbs largely support butterfly distribution. Stephens (1989) insisted the presence of grasslands to cater butterflies. In the present study also the area covered under Ghagua there are several varieties of plants such as herbs and grasses and their presence might have enhanced the population in this area. Most of the species were found to inhabit this site because of rich floral distribution and an ever-cool interior climate. This view coincides with the opinion of Mathew and Rahamathulla (1993), that the lepidopterans show a positive tendency towards area with floristic richness and moderate climate.

The forest cover, flower abundance, field size and optimum nutrient levels were other factors identified as influencing ones on butterfly species diversity as well as composition. During the entire study period, *Junonia iphita* (N25) was observed during the month of June, July, August and September of the study period and this indicated that the condition that prevailed during these period may be suitable for this variety. Relative humidity and rainfall influenced the population density positively. Several studies reported that rainfall and humidity exert positive effect, while the temperature and wind exerts negative correlation to population density of butterflies (Tanaka and Tanaka, 1982; Bosque and Estala, 1994; Edwin, 1997; Jainulabdeen Shaik and Prasad, 2004). But Garraway and Freeman (1990) reported that there is no negative response of butterflies to rainfall. In the present study also they showed their presence in abundance during the rainy months of June, July and August 2014 and 2015. The species such as *D. chrysippus* , *C. pyranthe* were dominant during this period. On the contrary, most of the butterflies were almost absent during extreme winter months except *D. cyrysippus* which was found to be present throughout the year and this indicated that this species is highly adoptable for all kinds of environmental conditions. Their population was at its peak during June to September and declined slowly towards the end of December. The combined effects of biotic

and abiotic factors that are prevailed in the Ghagua Site may be the main reason of slow down population. Setamou *et al.,* (2000) suggested that the host plant richness increases butterfly population density, and high rainfall and humidity were recorded to be positive to butterfly dynamics. Berryman (1986) reported an increase in lepidopteron population directly to low temperature and high rainfall and indirectly to natural enemies. Singh *et al.,* (1992) reported inverse status of population of butterflies to high temperature and low humidity. Most of the species are sun-loving and open habitat dwellers belonging to the Family Nymphalidae. Butterflies like *Papilio polytes and Graphium sarpedon* begins to fly early in the morning and start feeding at the flowers. Thus, the butterflies under this cluster are those associated with the forest edge.

In a managed ecosystem, the pesticide applications may also have some indirect effects on distribution of butterfly species though normally it causes only temporary changes in the relative abundance of them. Widespread use of organic pesticides has been considered as a major factor responsible for loss of butterfly population, but it has rarely resulted in the extinction of the species.

Findings

Butterflies contribute one of the best studied groups of animals among the invertebrate fauna. Adult butterflies are popular with people because of their bright coloured wings and their observable daily activities that include feeding on nectar as they visit garden.

More specifically, the findings indicate the following:

Among the five different families observed the family Nymphalidae was represented by several numbers of individuals. The family Satyridae had the least number of representatives in the entire ecosystem studied. The butterfly species viz., *D. chrysippus,* belonging tothe family Nymphalidae ,*C. pyranthe* belonging to the family Pieridae occured throughout the study period.

Fruiting trees, vegetables, flowering plants and other leafy crops served to attract many families of butterflies. Moreover, their availability throughout the year was another added advantage to the butterflies.

This base line bio-diversity information is highly imperative for better conservation, long term sustainability of natural resources and the human community.

Despite its limitations, this study attempts the bio-diversity assessment, perhaps for the first time in Amchang wildlife sanctuary.

REFERENCES

- Ambrose, D.P. 2005. The Insects: Structure, Function and Biodiversity, Kalyani Publishers, New Delhi. 820.
- Beccaloni, G.W. 1997. Vertical stratification of the ithomiine butterfly (Nymphalidae: Ithomiinae) mimicry complexes: The relationship between adult flight height and larval host plant higher. *Biol. J. Lin. Soc.* **62:** 313-341.
- Berryman, A.A. 1986. On the dynamics of black headed budworm populations. *Can. Entomol* **118(8):** 775-779.
- Bosque, L.A.A.D. and A.M. Estala. 1994. Seasonal abundance of *Diabrotica balteata* and other *Diabroticina beetles* (Coleoptera : Chrysomeliade) in Northeastern. *Mexico,Environ. Entomol.* **23(6):** 1409-1415.
- Bowers, M.D., I.L. Brown and D.D. Wheye. 1985. Bird predation as a selective agent in a butterfly population. *Evolution.* **39:** 93-103.

- Danks, H.V. 1993. Patterns of diversity in the Canadian insect fauna. Mem. *Ent. Soc. Can* **165:** 51-74.
- Evans, W.H (1932). The identification of Indian Butterflies. (2nd Edition). The Bombay Natural History Society, Mumbai, India. 454pp.
- Edwin, J. 1997. Distribution, diversity and population dynamics of chosen insects in the Courtallam tropical evergreen forest. Ph.D. Thesis, Madurai Kamaraj University,Madurai. 287.
- Garraway, E. and B.E. Freeman. 1990. The population dynamics of Ipsgrandicollis (Eichhoff) (Coleoptera : Scolytidae) in Jamaica *Can. Entomol.* **122:** 217-227.
- Gullan, P.J. and P.S. Cranston. 2000. The insect: An outline of Entomology. (Second edition) *Blackwell Science,* USA. 470.
- Hammond, P.C. and J.C. Miller. 1998. Comparison of the biodiversity of Lepidoptera within three forested ecosystems. *Ann. Entomol. Soc. Am.* **91(3):** 323-328.
- Hellmann, J.J. 2002.The effect of an environmental change on mobile butterfly larvae and the nutritional quality of their hosts. *The Journal of Animal Ecology.* **71:** 925-936.
- Jainulabdeen Shaik and Prasad, S.K. 2004. Severe infestation of cabbage butterfly, *Pieris brassicae* (Linnaeus) on six species of Brassica effect of abiotic factors on its population dynamics *Journal of Entomological Research*, **28:** 193-197.
- Lewis, O.T., R.J. Wilson and M.C. Harper. 1998. Endemic butterflies on Grande comore:habitat Preferences and conservation priorities. *Biological conservation.* **85:** 113–121.
- Ludwig, J.A. and J.F. Reynolds. 1988. Statistical ecology: a primer on methods and computing. John Wiley and Sons, Inc USA. 337.
- Michael, P. 1986. Ecological methods for field and laboratory investigations. Tata McGraw –Hill Pub. Comp. Ltd., New Delhi. 404.
- Pollard,E.,Yates,T.J.(1993).Monitoring butterflies for ecology and conservation. The British Butterfly Monitoring Scheme. Chapman and Hall, London. 274pp.
- Sharma Bidyut.B.Saugat Choudhury, Dipankar Lahkar,Biswajit Baruah and Arup Barua . 2010. Diversity and Distribution of Mammals in Amchang Wild life Sanctuary. NeBio. Vol. 2, No.2.June 2011.I.
- Rodgers, W.A. 1986. The role of fire in the management of wildlife habitats. A review; *Indian forester.* **112:** 848.
- Roy, D., P. Rothery, D. Moss, E. Pollard and J. Thomas. 2001. Butterfly numbers and weather: predicting historical trends in abundance and the future effects of climate change. *The Journal of Animal Ecology.* **70:** 201-207.
- Saxena, A.B. 1996. Ecology of Insects. *Anmol. Pub. Pvt. Ltd.*, New Delhi. 391.
- Setamou, M., F. Schulthess, H. Poehling and C. Borgemeister. 2000. Spatial distribution of and sampling plans for *Mussidia nigrivenella* (Lepidoptera : Phyralidae) on cultivated and wild host plants in Benin. *Environ. Entomol.* **29(6):** 1216-1225.

- Singh, G.P., R.P. Sinha, S.P. Singh and S.F. Hameed. 1992. Population dynamics and biology of sesamum shoot and leaf webber. *Antigastra catalaunalis* Dub. (Lepidoptera :Pyralidae) *J. Ent. Res.* **16(4):** 305-310.
- South Wood, T.R.E. and P.A. Henderson. 2000. Ecological methods. Blackwell Science Ltd. 462.
- Srygley, R.B. and P. Chai. 1990. Flight morphology of neotropical butterflies : Palatability and distribution of mass to the thorax and abdomen. *Oecologia.* **84:** 491 – 499. How many species are there? *Biodiversity and Conservation.* **2:** 215-232.
- Tanaka, L.K. and S.K. Tanaka. 1982. Rainfall and seasonal changes in arthropod abundance on tropical oceanic, Island. *Biolropica.* **14:** 114-123.
- Yamamoto, N., J. Yokoyama and M. Kawata. 2007. Relative resource abundance explains butterfly biodiversity in island communities. *Proceedings of the National Academyof Sciences of the United States of America.* **104:** 10524-10529.

List Paper published and seminar attended

Name of the Author	Year of publication	Title of the paper	Name of the Journal: Volume: Year & Page No.
1) Maitrayee Chakravarty (Guided by Dr.Rezina Ahmed. Associate professor of Cotton College, Zoology Department, Guwahati, ASSAM)	2016 February	Butterfly (Lepidoptera:Insecta) Diversity of Amchang Wildlife Sanctuary	Shrinkhala: Volume III, Issue VI , February - 2016 , Page No-42-46
2 Maitrayee Chakravarty	2015 October	Butterflies – The Natural Treasure of North East India	IJRSI (International Journal of Research and Scientific Innovation . Vol II, Issue X, October 2015, Page No- 159-160.
3 Maitrayee Chakravarty (Guided by Dr.Rezina Ahmed. Associate professor of Cotton College, Zoology Department, Guwahati, ASSAM)	2016 January	Butterfly (Lepidoptera: Insecta) Diversity of Amchang Wildlife Sanctuary	61th Annual Technical Session of Assam Science Society 2016, Voll-I (Abstract), January, Page No- 78
4 Maitrayee Chakravarty and Bipul Kr. Nath	2015, August	Pesticide Toxicity :- A Study	Global Research Methodology Journal, Vol-V , 18th Issue , August 2015, Page No-20-23 Published by Aranya Suraksha Somiti.Assam and BCLSC
5) Maitrayee Chakravarty (Guided by Dr.Rezina Ahmed. Associate professor of Cotton College, Zoology Department, Guwahati, ASSAM)	2016, March	Climate change and Butterfly diversity in Amchang Wildlife Sanctuary , Assam	Souvenir Cum Book of Abstracts, 1st International Conference on Climate Science. 2016, Page No-103
6) Maitrayee Chakravarty (Guided by Dr.Rezina Ahmed. Associate professor of Cotton College, Zoology Department, Guwahati, ASSAM)	14th and 15th March /2016	Seasonal Abundance of butterfly in Amchang Wildlife Sanctuary	National seminar on New Horizon in Zoological Research with special reference to Aquaculture & Biodiversity sponsored by UGC, New Delhi and organized by Department of Zoology, Guwahati University
7)) Maitrayee Chakravarty	M.Phil (Zoology)	Vertebrate diversity of Hakama beel ,	Vinayaka Missions University Salem , Tamilnadu , India

	Session Dec 2009	(Bilashipara dist. Dhubri, Assam) and its surrounding area	
	23rd July 2015	National Conference on IPR in Bio Sciences for Scientists from North – East Indian State	Amity University organized by University of Science and Technology, Meghalaya.
	20th to 22nd November 2015	International Conference on Molecular Signaling Recent Trends in Biosciences	Department of Zoology, North Eastern Hill University, Shillong, Meghalaya
	4th, 5th and 6th February 2015	ICSSR Sponsored International Seminar on "Women Empowerment : Issues and Challenges"	Department of Economics Gossaigaon College,Assam in collaboration with Internal Quality Assurance cell (IQAC)
	18th and 19th February	Application of Basic Statistical Tools in Life Science	Internal Quality Assurance Cell, Cotton College, Guwahati, Assam
		Life time membership of (CEEED)	The Centre of Environment, Education and Economic Development. Organized by NGO partnership system, Planning Commission, Govt. of India