CHAPTER IV

RESULTS

4.1 Butterfly species recorded: - Obsevations were carried out in two consecutive years 2014 and 2015**.** Forty-eight species of butterfly of five families were identified during the entire study periods. Out of these, 9 species from the family Papilionidae, 25 Nymphalidae, 9 Pieridae, 3 Lycaenidae and only 2 species from the family of Satyridae. Their diagnostic characters with their scientific and common name are given below:-

Family:- Papilionidae	
1. Papilio polytes **Linnaeus, 1758 (Common Mormon)** Family:-Papilionidae Diagnostic characters: Head, thorax and abdomen is black with white spots. Upper side wings is black, forewing with marginal series of cream-coloured spots, decreasing in size towards the apex. Underside is dull coloured. Tailed species . Wing span: 75-94mm.	
2. Troides helena **Linnaeus, 1758 (Common Birdwing**) Family:-Papilionidae Diagnostic characters: Tailless and hindwing is rich silky yellow with black veins and a black marginal wing border. Forewing is black with vein stripes. Upper hindwing has no dusting of black scales . Wing span :140-162mm.	

3. *Atrophaneura dasarada* *(*Moore,1857) (Great Windmill)
Family:-Papilionidae

Diagnostic characters :- Upper surface of forewing is black. Red bodied on upper hindwing, with white and red spots. Broad tail with red-tipped on hindwing.

Wingspan:- 100-140mm

4.*Atrophaneura aristolochiae* Fabricius, 1775 (Common Rose)
Family:-Papilionidae
Diagnostic characters: Forewing is paler with black-fold stripes and well marked pale vein-stripes. Hindwing with a discal row of elongate white spots. Antennae,thorax and abdomen is black above and whole of thorax and abdomen beneath is red. Tail is black.
Wingspan: 80-110mm.

***5.Papilio demoleus* Linnaeus, 1758 (Lime Butterfly**)
Family:-Papilionidae
Diagnostic characters : Upper side of forewing is black with yellow spots. Hindwing is without a tail and with a brick-red oval spot at the inner margin. Yellow wavy markings at the base of both wings. Antennae dark reddish-brown; head, thorax and abdomen is dusky black. Wingspan : 80-100mm.

6.*Papilio memnon* Linnaeus ,1758 (Great Mormon)
Family:-Papilionidae

Diagnostic characters : Tailless, black with blue dusting on upper forewing. Bluish streaks are present between veins. Under hindwing has red crescents at tornus.

Wingspan: 120-150mm.

7. *Troides aeacus* C.& R.Felder, 1758 (Golden Birdwing) Family:-Papilionidae Diagnostic characters : Tailless and upper hindwing is golden with small areas of black dusting around cone-shaped black marginal markings. Upper forewing is black-brown with very broad grey vein stripes. Under forewing with vein stripes white and prominent. Upper side of abdomen ringed with yellow. Wingspan : 119-188mm.	
8. *Graphium sarpedon* Linnaeus,1758 (Common Bluebottle) Family:-Papilionidae Diagnostic characters : Upper side of wings are brownish-black with a short tail. Forewing with pale blue and discal band running from the inner margin narrowing anteriorly towards apex and ending in a small spot just before the apex. Hindwing with the band scaled with white continue from below the inner margin of forewing to basal part of hindwing. Wingspan : 80-90 mm.	
9. *Chilasa clytia* Linnaeus ,1758 (Common Mime) Family:-Papilionidae Diagnostic characters : Upper side of wing is rich dark brown with cream-coloured markings. Upper forewing with marginal series of spots and terminal series of small spots between veins. Upper hindwing with a series of elongated arrowhead-shaped streaks. Wingspan : 90-100mm.	
***1. Junonia lemonias* Linnaeus,1758 (Lemon Pansy)** Family :-Nymphalidae Diagnostic characters : Upper side of forewing is greyish brown with slender waved black lines near base, two waved black lines enclosed a pale yellowish-brown band beyond the middle. Hind wing is dull yellowish-brown with a large ocellus. Seasonal variation is quite well marked with the ocelli on wings prominent in wet season form and reduced in dry season form. Wingspan:- 40- 60mm	

2. *Hypolimnas bolina* Linnaeus,1758 (Great Eggfly) Family :-Nymphalidae . Diagnostic characters : Wings are very dark indigo blue. Forewing with a large elongated white spot, margined with bright bluish colour and row of small white ocelli from apex to the tornus of hindwing. Head marked with a few pale spots. Hindwing with a broad medial whitish fascia. Wingspan : 70-110mm.	
3.*Tirumala septentrionis* Butler,1874 (Dark Blue Tiger) Family :-Nymphalidae Diagnostic characters : The back ground colour of wings is dark and of a bluish-white tint. Head and thorax is blackish with white spots and streaks. Forewing is black with irregular white or pale blue spots and streaks. Hindwing with two streaks united at the base but separate distally . Wingspan : 75-95mm.	

4. *Junonia atlites* Linnaeus, 1763 (Grey Pansy) Family :-Nymphalidae Diagnostic characters : Upper side is pale grey. Forewing with two wavy black lines crossing the middle of the cell and two similar ones at the end of the cell. Hindwing with two lines crossing the end of the cell and with complete row of eyespots on both wings. Wingspan : 55-65mm.	
5. *Danaus genutia* Cramer1779 (Striped Tiger) Family :-Nymphalidae Diagnostic characters : The upper side of forewing is reddish brown with black veins and white apical spots at the end of the cell. Hindwing is paler than forewing bearing two complete series of white spots. Head and thorax is black with white spots and streaks. Wingspan : 72-100mm.	

6. *Junonia almana* Linnaeus,1758 (Peacock Pansy) Family :-Nymphalidae . Diagnostic characters : The upper side of forewing is orange-yellow, the cell and the costal area to near the apex of wing crossed by four short dark bands, a pale centred ocellus with the two black rings and two ocelli. Hindwing with three border lines as on forewing and with a very large pale yellow black ringed ocellus . Wingspan : 60-65mm.	
7.*Danaus chrysippus* Linnaeus,1758 (Plain Tiger) Family :-Nymphalidae Diagnostic characters : The upper side of wings are reddish brown. Forewing with black borders and variable numbers of white spots in the costa and apex. Apical half is black. Hindwing is paler and outer margin narrowly black with an incomplete series of white spots, with four small black spots around the cell. Head and thorax is black. Wingspan : 70-80mm.	

8. *Cethosia cyane* Drury ,1770 (Leopard Lacewing) Family :-Nymphalidae Diagnostic characters : The upper side of wings are reddish brown. Upper forewing have white band across black apical half. Upper hind wing with outer discal row of very small black spots. Along the margin on both sides of both wings with a series of white V-shaped marks. Wingspan : 80-95mm.	
9*. Junonia hierta* Fabricius,1798 (Yellow Pansy) Family :-Nymphalidae . Diagnostic characters : The upper side is black. The forewing with broad medial yellow patch, extending from the base to beyond and then narrowed and bent down ward; two short paler yellow streaks before the apex. Hindwing is black with large broad yellow patch and a large distinct blue spot. Wingspan : 45-60mm.	

***10. Athyma nefte* Cramer,1779 (Colour Sergeant**)
Family :-Nymphalidae
Diagnostic characters: The upper part is velvety black and a few orange markings. Upper forewing cell streak is yellowish broken with a prominent white detached spot at end. Upper forewing has a white discal band with blue tinged edges, a dark yellow sub marginal band from apex to downward. Similar dark yellow band and white band on upper hind wing.
Wingspan : 55-70mm.

11. *Ariadne merione* Cramer,1777 (Common Castor)
Family :-Nymphalidae .
Diagnostic characters : Upper part of both wings are rusty brown and discal line beyond cell are double and wavy. Termen is slightly concave and more rounded. Upper forewing apex is slightly square.
Wingspan : 45-60mm.

12. *Tanaecia lepidea* Butler,1868 (Grey Count)
Family :-Nymphalidae
Diagnostic characters : The upper part of wings are dark brown with pale grey border. This border is broad on hindwing and narrow on forewing and ending before the apex. Head, thorax and abdomen is black.

Wingspan : 65-80mm.

13. *Kaniska canace* Linnaeus ,1763 (Blue Admiral)
Family :-Nymphalidae .
Diagnostic characters : The upper part of wings are indigo- blue, crossed by abroad discal paler blue band with a few white dots at the anterior end and the band gradually increasing the width from the costa to anal angle and bearing a series of small black spots along its outer border in the hindwing.

Wingspan : 60-75mm.

14.*Neptis hylas* Linnaeus ,1758 (Common Sailer) Family :-Nymphalidae . Diagnostic characters: The upper side of wings is black with white markings. Forewing with white streaks, triangular spot and a sub-marginal series of five white spots towards the apex. Hindwing with a sub-basal broad white band. Wing span : 45-60mm.	
15.*Athyma opalina* Kollar ,1844 (Himalayan Sergeant) Family :-Nymphalidae . Diagnostic characters: The upper side of wing are black with creamy –white markings. Forewing with a narrow streak and two spots at its outer end in the cell, a triangular spot beyond, a sub-apical series of three spots; a discal series of four spots. Two sub-marginal wavy pale lines, the inner one is prominent towards the apex. Hindwing is brownish black with creamy markings. Wingspan : 55-70mm.	

16.*Parantica aglea* Moore,1883 (Glassy Tiger) Family :-Nymphalidae . Diagnostic characters: The upper side of wings are dark brown. Forewing with streaks and spots; cell streak divided lengthwise into two portions, and united at base , with black lines traversing throughout; most spots progressively decreasing in size. Hindwing streaks are long and broad; the cell with two broad streaks which are united at base. Wingspan : 70- 85mm.	
17. *Tanaecia jahnu* Moore,1857 (Plain Earl) Family :-Nymphalidae . Diagnostic characters: The upper side of wings are reddish brown .Tailless and discal bands are made up of connected crescents. Wing span : 65-80mm.	

***18. Ariadne ariadne* Linnaeus,1763 (Angled Castor)** Family :-Nymphalidae . Diagnostic characters: Tailless and wings are dark reddish brown with black lines regular and slender. Forewing termen is deeply concave. Upper forewing discal line is beyond the cell, single and regular. Wing span: 45-60mm.	
***19. Melanitis leda* Linnaeus ,1758 (Common Evening Brown)** Family :-Nymphalidae Diagnostic characters: Upper side of wings are brown. Forewing with two large sub-apical black spots, each with small white spots in its discal part. Costal margin is narrow. White cantered oculus in hindwing**.**	

***20. Euploea mulciber* Cramer,1778 (Striped Blue Crow)** Family :-Nymphalidae . Diagnostic characters: Upper side of forewing is glossy black, with blue spot and with terminal, marginal and discal spots. Spot in end cell present. Apical half has greyish scales and a small yellow patch . Antennae, head, thorax and abdomen are dark brown. Wing span: 90-100mm.	
***21. Cirrochroa aoris* Doubleday ,1847 (Large Yeoman)** Family :-Nymphalidae . Diagnostic characters: The upper side of wings are tawny with black narrow outer margin broadening towards upper forewing apex. An irregular discal and one or two wavy marginal black lines on upper part of both wings . Wingspan : 80-90mm.	

***22. Charaxes bharata* Felder & Felder ,1867** **(Common Nawab)** Family :-Nymphalidae . Diagnostic characters: The upper side of wings are pale greenish yellow, very wide, discal band of variable width and large pale green spot near apex on both wings and on both sides. One small yellow dot near forewing apex. Hindwing has sharp tails. Wing span : 60-70mm.	
***23. Pantoporia hordonia*,1790 Stoll** **(Common Lascar**) Family :-Nymphalidae . Diagnostic characters: The upper side of forewing has one orange line on the black marginal border. Upper part is dark brown with prominent orange bands. Upper hindwing has two orange bands, upper band broad and lower narrow. Wing span : 45-50mm.	

***24. Euploea core* Cramer ,1780 (Common Crow**) Family :-Nymphalidae . Diagnostic characters: The upper part is dark velvety brown and wings are bordered by two rows of small white spots. The inner spots are larger on both wings and elongate on hindwing. Thorax black with white spots. Wing span: 85-95mm.	
25. Junonia iphita **Cramer,1779** **(Chocolate Pansy**) Family :-Nymphalidae . Diagnostic characters: Upper part is pale to dark brown with darker brown bands. Forewing apex and hind wing tornus slightly produced. Wing span: 55-80mm.	

Family : Pieridae

1 .*Catopsilia pyranthe* Linnaeus ,1758 (Mottled Emigrant)

Family : Pieridae .

Diagnostic characters: The upper side is chalky white and markings are variable. Under side is closely mottled with fine brown or green lines.

Wing span: 50-70mm.

***2. Eurema hecabe* Linnaeus,1758 (Common Grass Yellow)**

Family : Pieridae .

Diagnostic characters: The upper side of wings are bright yellow, upper forewing apex and termen is broadly black. Upper hindwing with narrow black terminal border.

Wing span: 40-50mm.

***3. Catopsilia crocale* Cramer ,1775 (Common Emigrant)**

Family : Pieridae .

Diagnostic characters: The upper side of wings are yellowish. Forewing with Costa is narrowly black to the base; wider at the apex. Hindwing is unmarked.

Wing span: 55-65mm.

***4. Pieris canidia* Sparrman, 1768 (Indian Cabbage White)**

Family : Pieridae .

Diagnostic characters: The upper side of wings are white. The apex of forewing on the upper side is black with a few terminal black spots. Hind wing with black marginal spots and a costal spot .

Wing span : 45-60mm.

5. *Delias descombesi* Boisduval,1836 (Red-Spot Jezebel) Family: Pieridae . Diagnostic characters: The upper side is white. Upper forewing costa and termen is black but apex is more broadly black. Under hind wing is yellow with a long basal red patch along Costa Wing span: 65-85mm.	
***6.Delias eucharis* Drury,1773 (Common Jezebel)** Family : Pieridae Diagnostic characters: Forewing is whitish and the entire veins are blackened. Underside is bright yellow with black veins and marginal series of orange red spot. Wing span: 66-85mm.	

***7. Leptosia nina* Fabricius ,1793 (Psyche)** Family: Pieridae Diagnostic characters: The upper side of wings are white, the bases very slightly powdered with minute black scales. Forewing has black spot. Hindwing is uniformly white. Wing span: 35-50mm.	
***8. Catopsilia pomona* Fabricius ,1775 (Common Emigrant)** Family : Pieridae Diagnostic characters: The upper side of wings are light yellow and markings are variable. Head is black and thorax & abdomen are light yellow in the upper side . Wing span 55-80mm.	

9. Appias libythea **Fabricius ,1775** **(Striped Albatross)** Family : Pieridae Diagnostic characters: The upper side of wing are almost white and some dark apical shading and terminal markings produced inwardly. Wing span : 50-60mm.	
1. Castalius rosimon **Fabricius, 1775** **Common Pierrot** Family :Lycaenidae . Diagnostic characters: The upper side of both wings are white with a grey-blue base. The anterior margin and border is blackish-brown. Forewing with a very irregular series of square, dark spots. Hind wing with spots as on forewing but narrow and irregularly placed . Wing span: 24-32mm.	

2. Rapala pheretima **Hewitson,1863** **(Copper Flash)** Family :Lycaenidae Diagnostic characters: The upper part of wings is dark copper red, broad black apex and costa and termen is narrowly dark. Upper hind wing are all copper –red colour. Wingspan : 38-42mm.	
3. Anthene emolus (**Godart ,1824)** **(Common Ciliate Blue)** Family :Lycaenidae Diagnostic characters: The wings are light blackish and with three very short, small tufts formed by slight elongations of the fringe. Under hind wing the discal bands are more or less continuous. Wing span : 28-35mm.	

1. Lethe confuse **Aurivillus,1898** **(Banded Tree Brown)** Family :Satyridae Diagnostic characters: The upper side of wings are brown. Forewing with discal, curved, white band. Hind wing is uniform. Wing span: 50-55mm.	
2. Elymnias hypermnestra **Linnaeus, 1763** **(Common Palmfly)** Family :Satyridae . Diagnostic characters: The upper side of wings are blackish-brown with purple gloss. Forewing with a sub-marginal series of blue spots, curving strongly inwards and becoming more elongate near apex forming an oblique bar to costa. Hind wing with outer margin broadly bright. Wing span : 72-86mm.	

Butterfly Diversity and Occurrence

Species of butterflies at the site I (Ghagua):- 47 species belonging to five families of butterfly were recorded at the site I (Ghagua) during the entire study period. The percentage of contribution observed for each family with their common name and scientific name are given in Table 4.5.

Table 4.5 Family-wise list of butterflies recorded at the site I (Ghagua) in Amchang Wildlife Sanctuary and their percentage of contribution

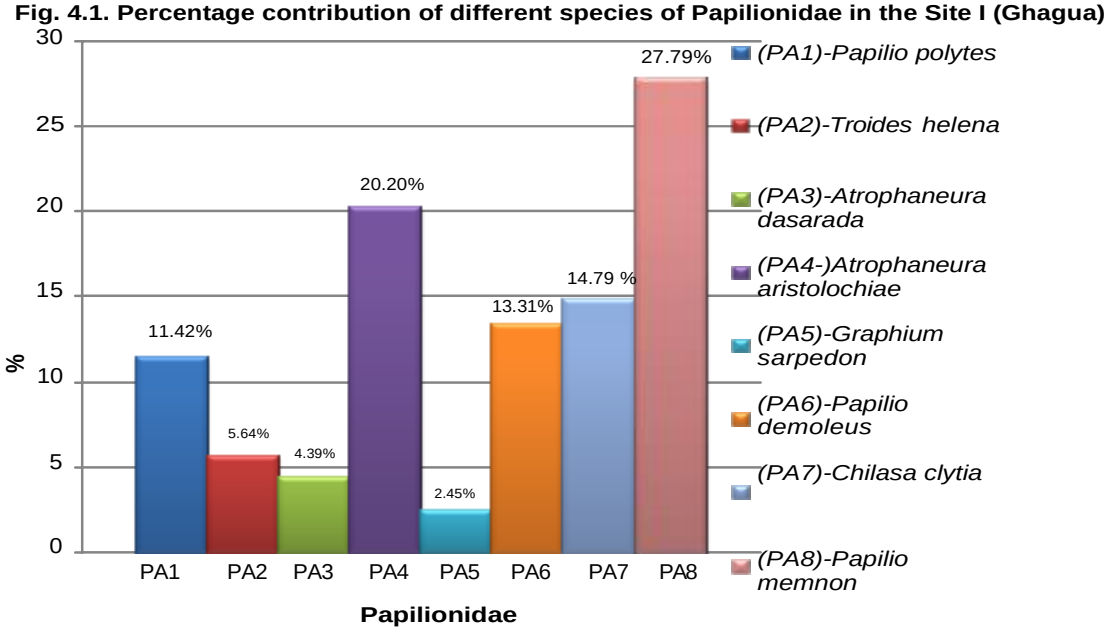
Family	S.L No	Scientific name	Abbreviation	Common name	% of contribution
Papilionidae	1	*Papilio polytes* Linnaeus ,1758	PA1	Common Mormon	11.42
	2	*Troides helena* Linnaeus ,1758	PA2	Common Birdwing	5.64
	3	*Atrophaneura dasarada* (Moore,1857)	PA3	Great Windmill	4.39
	4	*Atrophaneura aristolochiae* Fabricius,1775	PA4	Common Rose	20.2
	5	*Graphium sarpedon* Linnaeus,1758	PA5	Common Bluebottle.	2.45
	6	*Papilio demoleus* Linnaeus ,1758	PA6	Lime Butterfly	13.31
	7	*Chilasa clytia* Linnaeus ,1758	PA7	Common Mime	14.79
	8	*Papilio memnon* Linnaeus,1758	PA8	Great Mormon	27.79
Nymphalidae	1	*Junonia lemonias* Linnaeus ,1758	N1	Lemon Pansy .	6.57
	2	*Hypolimnas bolina* Linnaeus ,1758	N2	Great Eggfly	6.97
	3	*Tirumala septentrionis* Butler,1874	N3	Dark Blue Tiger	3.29
	4	*Junonia atlites* Linnaeus,1763	N4	Grey Pansy	4.4
	5	*Danaus genutia* Cramer,1779	N5	Striped Tiger	3.21
	6	*Junonia almana* Linnaeus,1758	N6	Peacock Pansy	1.75
	7	*Danaus chrysippus* Linnaeus, 1758	N7	Plain Tiger	5.47
	8	*Cethosia cyane* Drury,,1770	N8	Leopard Lacewing	1.9
	9	*Junonia hierta* Fabricius,1798	N9	Yellow Pansy	0.69
	10	*Athyma nefte* Cramer,1779	N10	Colour Sergeant	4.98
	11	*Ariadne merione* Cramer,1777	N11	Common Castor	2.74
	12	*Tanaecia lepidea* Butler ,1868	N12	Grey Count	2.11
	13	*Kaniska canace* Linnaeus, 1763	N13	Blue Admiral	0.59
	14	*Neptis hylas* Linnaeus,1758	N14	Common Sailer	3.89
	15	*Athyma opalina* Kollar,1844	N15	Himalayan Sergeant	2.07
	16	*Parantica aglea* Moore,1883	N16	Glassy Tiger	2.81
	17	*Tanaecia jahnu* Moore,1857	N17	Plain Earl	2.59
	18	*Ariadne ariadne* Linnaeus, 1763	N18	Angled Castor	4.15

	19	*Melanitis leda* Linnaeus,1758	N19	Common Evening Brown	11.69
	20	*Euploea mulciber* Cramer ,1777	N20	Striped Blue Crow	3.09
	21	*Cirrochroa aoris* Doubleday,1847	N21	Large Yeoman	0.76
	22	*Charaxes bharata* Felder & Felder,1867	N22	Common Nawab	6.16
	23	*Pantoporia hordonia* Stoll, 1790	N23	Common Lascar	2.47
	24	*Euploea core* Cramer,1780	N24	Common Crow	11.44
	25	*Junonia iphita* Cramer, 1779	N25	Chocolate Pansy	4.2
Pieridae	1	*Catopsilia pyranthe* Linnaeus,1758	P1	Mottled Emigrant	17.01
	2	*Eurema hecabe* Linnaeus ,1758	P2	Common Grass Yellow.	14.32
	3	*Catopsilia crocale* Cramer,1775	P3	Common Emigrant	7.96
	4	*Pieris canidia* Sparrman,1768	P4	Indian Cabbage White	5.54
	5	*Delias descombesi* Boisduval,1836	P5	Red-spot jezebel	5.8
	6	*Delias eucharis* Drury,1773	P6	Common jezebel	4.75
	7	*Leptosia nina* Fabricius,1793	P7	Psyche	19.76
	8	*Catopsilia pomona* Fabricius,1775	P8	Common Emigrant	6.85
	9	*Appias libythea* Fabricius,1775	P9	Striped Albatross	18.02
Lycaenidae	1	*Anthene emolus* (Godart,1824)	L1	Common Ciliate Blue	51.6
	2	*Rapala pheretima* Hewitson,1863	L2	Copper Flash	28.37
	3	*Castalius rosimon* Fabricius,1775	L3	Common Pierrot	20.04
Satyridae	1	*Lethe confusa* Aurivillius,1898	S1	Banded Tree Brown	14.927
	2	*Elymnias hypermnestra* Linnaeus, 1763	S2	Common Palmfly	85.073

Papilionidae

Eight species of Papilionidae butterflies were recorded during the entire study period (Table 4.5).

Fig. 4.1. Percentage contribution of different species of Papilionidae in the Site I (Ghagua)

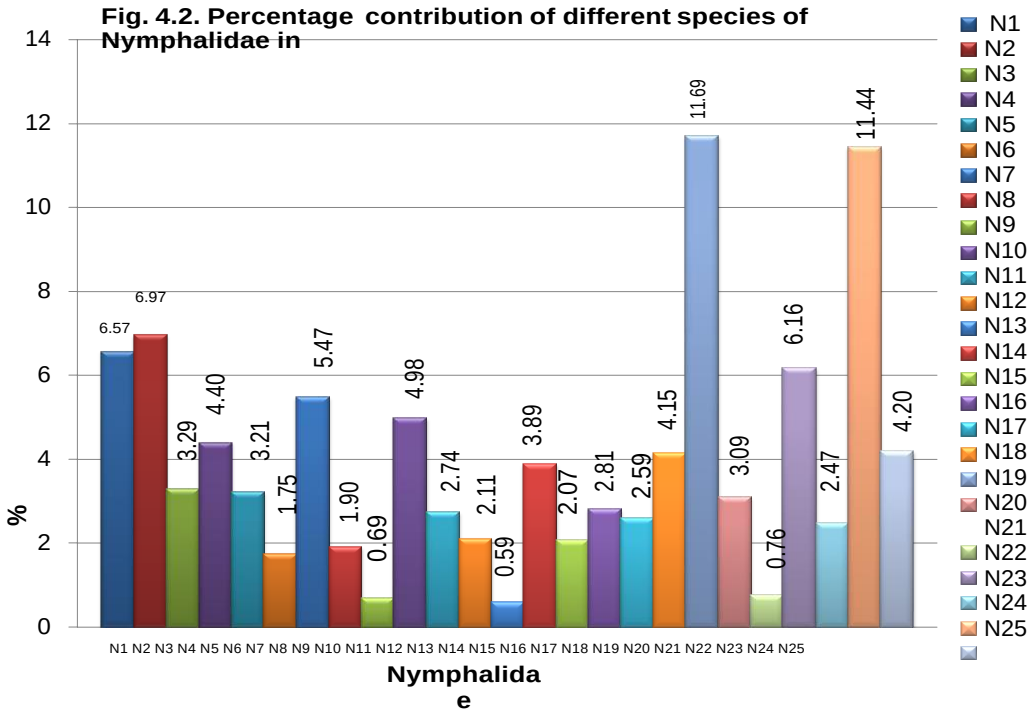


Among eight species observed the *Papilio memnon* (PA8) was the most highly distributed species with (27.79%) followed by *Papilio polytes* (PA1) with (11.42%), *Troides helena (*PA2) with (5.64%), *Atrophaneura dasarada* (PA3) with (4.39%), *Atrophaneura aristolochiae* (PA4) with (20.20%), *Graphium sarpedon* (PA5) with (2.45%), *Papilio demoleus* (PA6) with (13.31%) and *Chilasa clytia* (PA7)with (14.79 %) respectively .

Nymphalidae: - Twenty five species of butterflies were recorded during the entire study period (Table 4.5.) .

The species *Kaniska canace* (N13) was the most least distributed species with 0.59% (Fig. 4.2). Among the twenty five species observed, *Melanitis leda* (N19) (11.69%) was the highest populated and densely distributed species which was followed by *Junonia lemonias* (N1) with (6.57%), *Hypolimnas bolina* (N2) with (6.97%), *Tirumala*

septentrionis (N3) with (3.29%), *Junonia atlites* (N4) with (4.40%), *Danaus genutia* (N5) with (3.21%), *Junonia almana* (N6) with 1.75%, *Danaus chrysippus* (N7) with 5.47%, *Cethosia cyane* (N8) with 1.90%, *Junonia hierta* (N9) with 0.69%, *Athyma nefte* (N10) with 4.98%, *Ariadne merione* (N11) with 2.74%, *Tanaecia lepidea* (N12) with 2.11%, *Kaniska canace* (N13) with 0.59%, *Neptis hylas* (N14) with 3.89%, *Athyma opalina* (N15) with 2.07%, *Parantica aglea* (N16) with 2.81%, *Tanaecia jahnu* (N17) with 2.59%, *Ariadne ariadne* (N18) with 4.15%, *Melanitis leda* (N19) with 11.69%, *Euploea mulciber* (N20) with 3.09%, *Cirrochroa aoris* (N21) with 0.76%, Charaxes bharata (N22) with 6.16%, *Pantoporia hordonia (*N23) with 2.47%, *Euploea core* (N24) with 11.44% and *Junonia iphita* (N25) with 4.20% respectively.

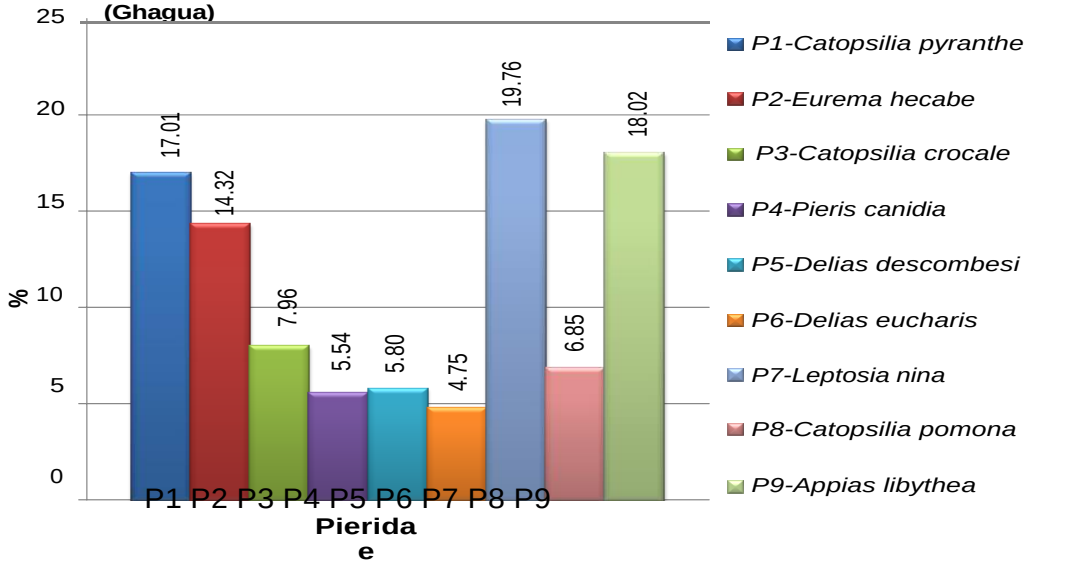


Pieridae: - Nine species of pieridae butterflies were recorded during the entire study period (Table 4.5). .

Among the nine species observed, the *Leptosia nina* (P7) was the most highly distributed species with 19.76% followed by *Catopsilia pyranthe* (P1) with 17.01%, *Eurema hecabe* (P2) with 14.32%, *Catopsilia crocale* (P3) with 7.96%, *Pieris canidia*

(P4) with 5.54%, *Delias descombesi* (P5) with 5.80%, *Delias eucharis* (P6) with 4.75%, *Catopsilia pomona* (P8) with 6.85% and *Appias libythea* (P9) with 18.02% respectively. The species *Delias eucharis* (P6) was the least distributed one (Fig. 4.3) and their contribution was only 4.75%. .

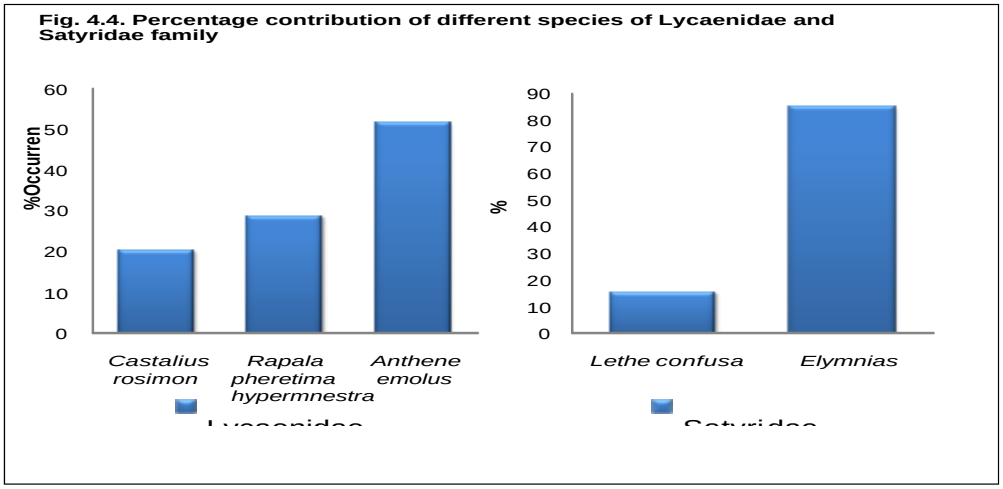
Fig. 4.3. Percentage contribution of different species of Pieridae at the site I (Ghagua)



Lycaenidae:-Three species of Lycaenidae butterflies were recorded during the entire study period (Table 4.5).

Among three species observed, the *Anthene emolus* (L1) was the most highly distributed species with 51.60% followed by *Rapala pheretima* (L2) with 28.37% and *Castalius rosimon* (L3) with 20.04% respectively (Fig. 4.4).

Fig. 4.4. Percentage contribution of different species of Lycaenidae and Satyridae family



Satyridae:-Only two species of Satyridae butterflies were recorded during the entire study period (Table 4.5). They were:-

Lethe confusa Aurivillius

Elymnias hypermnestra Linnaeus

Between them *Elymnias hypermnestra* (S2*)* was the most highly distributed species with 85.07% followed by *Lethe confuse* (S1) with 14.93% (Fig 4.4).

In the Ghagua study site, among five families recorded, most of the members belonged to the family Nymphalidae and was the most highly distributed family. This was followed by Pieridae, Papilionidae, Lycaenidae and Satyridae respectively (Table 4.5). 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. 4.5).

Fig. 4.5. Percentage contribution of different families of butterflies at the site I (Ghagua)

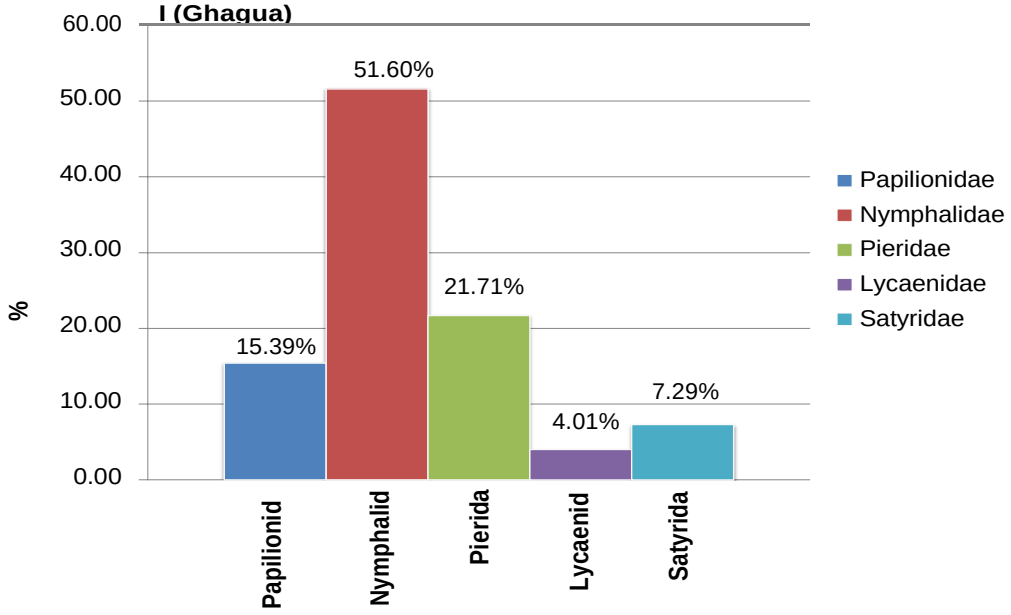


Table no:-4.6A Frequency of Occurrence, Species Density and Abundance of butterfly at the site I (Ghagua)

Family	SLNo	Scientific Name	Frequency of encounter	Species density in nos per sq. meter	Abundance	Occurance
Papilionidae	1	*Papilio polytes*	43.75	0.000247	15.44	Occasional
	2	*Troides helena*		0.000122	7.63	Occasional
	3	*Atrophaneura dasarada*	18.75	0.000095	5.94	Very Rare
	4	*Atrophaneura aristolochiae*	50	0.000437	27.31	Occasional
	5	*Graphium sarpedon*	31.25	0.000053	3.31	Rare
	6	*Papilio demoleus*	81.25	0.000288	18.00	Very Common
	7	*Chilasa clytia*	93.75	0.00032	20.00	Very Common
	8	*Papilio memnon*	81.25	0.000601	37.56	Very Common
Nymphalidae	1	*Junonia lemonias*	93.75	0.000477	29.81	Very Common
	2	*Hypolimnas bolina*	62.5	0.000506	31.63	Common
	3	*Tirumala septentrionis*	50	0.000239	14.94	Occasional
	4	*Junonia atlites*	93.75	0.000319	19.94	Very Common
	5	*Danaus genutia*	56.25	0.000233	14.56	Occasional
	6	*Junonia almana*	31.25	0.000127	7.94	Rare
	7	*Danaus chrysippus*	62.5	0.000397	24.81	Common
	8	*Cethosia cyane*	25	0.000138	8.63	Rare
	9	*Junonia hierta*	25	0.00005	3.13	Rare
	10	*Athyma nefte*	81.25	0.000361	22.56	Very Common
	11	*Ariadne merione*	75	0.000199	12.44	Common
	12	*Tanaecia lepidea*	56.25	0.000153	9.56	Occasional
	13	*Kaniska canace*	25	0.000043	2.69	Rare
	14	*Neptis hylas*	62.5	0.000282	17.63	Common
	15	*Athyma opalina*	87.5	0.00015	9.38	Very Common
	16	*Parantica aglea*	93.75	0.000204	12.75	Very Common
	17	*Tanaecia jahnu*	62.5	0.000188	11.75	Common
	18	*Ariadne ariadne*	93.75	0.000301	18.81	Very Common
	19	*Melanitis leda*	100	0.000848	53.00	Very Common
	20	*Eupolea mulciber*	50	0.000224	14.00	Occasional
	21	*Cirrochroa aoris*	18.75	0.000055	3.44	Very Rare
	22	*Charaxes bharata*	87.5	0.000447	27.94	Very Common
	23	*Pantoporia hordonia*	50	0.000179	11.19	Occasional
	24	*Eupolea core*	93.75	0.00083	51.88	Very Common
	25	*Junonia iphita*	75	0.000305	19.06	Common

Pieridae	1	*Catopsilia pyranthe*	100	0.000519	32.44	Very Common
	2	*Eurema hecabe*	87.5	0.000437	27.31	Very Common
	3	*Catopsilia crocale*	75	0.000243	15.19	Common
	4	*Pieris canidia*	62.5	0.000169	10.56	Common
	5	*Delias descombesi*	68.75	0.000177	11.06	Common
	6	*Delias eucharis*	56.25	0.000145	9.06	Occasional
	7	*Leptosia nina*	100	0.000603	37.69	ery Common
	8	*Catopsilia pomona*	62.5	0.000209	13.06	Common
	9	*Appias libythea*	100	0.00055	34.38	Very Common
Lycaenidae	1	*Anthene emolus*	12.5	0.000291	18.19	Very Rare
	2	*Rapala pheretima*	31.25	0.00016	10.00	Rare
	3	*Castalius rosimon*	25	0.000113	7.06	Rare
Satyridae	1	*Lethe confusa*	25	0.000153	9.56	Rare
	2	*Elymnias hypermnestra*	43.75	0.000872	54.50	Occasional

Table No:-4.6B Seasonal abundance of butterfly species at the site I (Ghagua)

		Seasonal abundance at the site I (Ghagua)	**Year 2014**				**Year 2015**			
Family	**SL. No**	**Scientific name**	**Winter**	**Pre monsoon**	**Monsoon**	**Ret. Monsoon**	**Winter**	**Pre monsoon**	**Monsoon**	**Ret. Monsoon**
Papilionidae	**1**	***Papilio polytes***	0.44	2.63	1.81	2.38	0.38	2.69	2.00	3.13
	2	***Troides helena***	0.38	0.81	0.94	1.69	0.38	0.81	0.94	1.69
	3	***Atrophaneura dasarada***	0.38	1.00	0.56	1.19	0.38	0.88	0.56	1.00
	4	***Atrophaneura aristolochiae***	1.63	6.75	1.63	4.94	1.44	5.00	1.63	4.31
	5	***Graphium sarpedon***	0.00	0.38	0.81	0.31	0.00	0.38	0.75	0.69
	6	***Papilio demoleus***	0.94	3.31	1.63	3.25	0.94	3.25	1.63	3.06
	7	***Chilasa clytia***	0.75	5.06	0.88	2.75	0.75	5.06	1.25	3.50
	8	***Papilio memnon***	2.50	7.13	3.38	6.81	2.50	6.50	3.38	5.38
Nym	**1**	***Junonia lemonias***	1.19	4.50	2.94	5.94	0.94	5.06	7.50	1.75
	2	***Hypolimnas bolina***	0.25	1.69	3.38	9.38	0.63	3.06	4.94	8.31

	3	***Tirumala septentrionis***	0.88	2.94	5.13	2.00	0.63	0.63	1.94	0.81
	4	***Junonoa atlites***	0.63	2.31	4.19	2.75	0.44	3.81	4.19	1.63
	5	***Danaus genutia***	0.19	3.44	3.19	2.31	0.25	1.56	3.19	0.44
	6	***Junonia almana***	0.56	1.25	1.44	1.06	0.50	1.19	1.44	0.50
	7	***Danaus chrysippus***	1.00	3.50	2.81	3.13	1.25	5.75	5.69	1.69
	8	***Cethosia cyane***	0.00	1.38	1.88	0.88	0.19	0.56	2.69	1.06
	9	***Junonia hierta***	0.00	1.13	0.81	0.38	0.00	0.19	0.56	0.06
	10	***Athyma nefte***	0.25	2.31	3.00	6.25	0.38	2.56	5.13	2.69
	11	***Ariadne merione***	0.25	2.88	2.63	0.50	0.13	2.63	2.63	0.81
	12	***Tanaecia lepidea***	0.75	2.13	1.50	1.63	0.19	1.31	1.19	0.88
	13	***Kaniska canace***	0.00	0.75	0.38	0.31	0.00	0.19	0.56	0.50
	14	***Neptis hylas***	0.00	2.13	4.63	1.38	0.00	2.75	5.25	1.50
	15	***Athyma opalina***	0.00	0.81	2.13	1.50	0.00	0.81	2.13	2.00
	16	***Parantica aglea***	0.19	1.63	2.25	3.19	0.31	2.38	2.81	0.00
	17	***Tanaecia jahnu***	0.75	3.06	0.00	3.56	1.38	0.44	0.00	2.56
	18	***Ariadne ariadne***	2.25	2.00	1.50	4.06	1.63	2.00	1.50	3.88
	19	***Melanitis leda***	3.88	9.88	8.69	8.75	3.50	7.88	7.00	3.44
	20	***Euploea mulciber***	0.31	3.50	2.19	2.31	0.44	2.31	2.19	0.75
	21	***Cirrochroa aoris***	0.25	0.75	0.38	0.38	0.19	0.75	0.38	0.38
	22	***Charaxes bharata***	0.00	5.56	2.94	3.69	1.13	3.88	5.94	4.81
	23	***Pantoporia hordonia***	0.00	2.19	2.81	0.69	0.38	2.00	2.69	0.44
	24	***Euploea core***	2.25	12.44	7.81	6.13	2.38	9.63	7.69	3.56
	25	***Junonia iphita***	2.38	2.81	1.94	2.25	2.19	2.81	1.94	2.75
Pieridae	**1**	***Catopsilia pyranthe***	2.50	7.00	5.56	5.06	0.44	4.56	3.31	4.00
	2	***Eurema hecabe***	3.31	4.38	4.88	3.81	0.81	3.31	4.50	2.31
	3	***Catopsilia crocale***	0.13	1.25	3.25	2.06	0.00	1.88	4.94	1.69
	4	***Pieris canidia***	2.25	1.00	0.75	1.50	2.13	0.75	0.00	2.19
	5	***Delias descombesi***	0.00	2.06	2.56	0.81	0.00	1.88	2.88	0.88
	6	***Delias eucharis***	0.19	1.75	2.13	0.44	0.25	1.75	2.13	0.44
	7	***Leptosia nina***	0.69	4.31	9.75	3.06	0.88	4.69	10.75	3.56
	8	***Catopsilia pomona***	0.00	1.75	2.81	0.75	0.31	3.13	3.63	0.69
	9	***Appias libythea***	2.31	6.88	3.69	5.56	2.69	2.94	5.44	4.88
Lycaenida	**1**	***Anthene emolus***	0.25	2.63	1.13	4.13	0.25	3.56	1.19	5.06
	2	***Rapala pheretima***	0.13	1.19	1.50	1.69	0.13	1.13	2.25	2.00
	3	***Castalius rosimon***	0.00	0.94	1.69	0.00	0.13	2.25	2.06	0.00
Satyrida	**1**	***Lethe confusa***	0.50	1.75	1.06	1.00	0.31	1.81	1.94	1.19
	2	***Elymnias hypermnestra***	2.94	9.88	7.50	4.75	2.19	9.69	13.06	4.50

Butterfly Abundance, Diversity and Occurrence at the site I(Ghagua)

Abundance, % of frequency occurrence and density of butterfly of the family Papilionidae at the site I (Ghagua):-

Among the eight species of the family Papilionidae, only three species were very common, three were occasional, one rare and the other one was very rare (table No 4.6). *Papilio demoleus, Chilasa clytia, Papilio memnon* were very common whose frequency of occurrence were 81.25%, 93.75%, 81.25% and they showed high abundance 18, 20 and 37.56 respectively (Table No 4.6A & 4.6B and fig 4.6, fig. 4.6A & Fig 4.6B). They were present throughout the year (January–December). Rare species like *Graphium sarpedon* was totally absent during the months of November, December and January of both the study year. Increasing species abundance from the beginning of the monsoon till the early part of ret. monsoon (August–September) and then declined in species abundance from ret. monsoon to the end of winter.

While analysing the seasonal abundance *Papilio polytes, Atrophaneura aristolochiae ,Papilio demoleus ,Chilasa clytia* and *Papilio memnon* had represented high abundance during the pre monsoon or ret.monsoon period (Fig 4.6A&4.6B). During the monsoon period, their abundance decreased as compared to pre monsoon and ret. monsoon season. At the end of ret. monsoon period, their population were gradually decreasing. But in case of *Atrophaneura aristolochiae* and *Papilio memnon* their presence through out the year indicated that they were totally susceptible to any environmental changes as well as seasonal variation. On the other hand, species like *Troides helena, Atrophanura dasarada* and *Papilio demoleus* had shown high abundance during ret. monsoon period of both the study year. Increasing species abundance started from the beginning of the pre monsoon till the early part of ret. monsoon in most of the species and then declined in species abundance and finally reached least abundance during winter season. The butterfly abundance was also varied in this site but the pattern of variation as well as frequency of occurrence was different.

Fig No 4.6 :- Abundance and % of frequency occurrence of the family Papilionidae at the site I (Ghagua) during the entire study period (2014 & 2015)

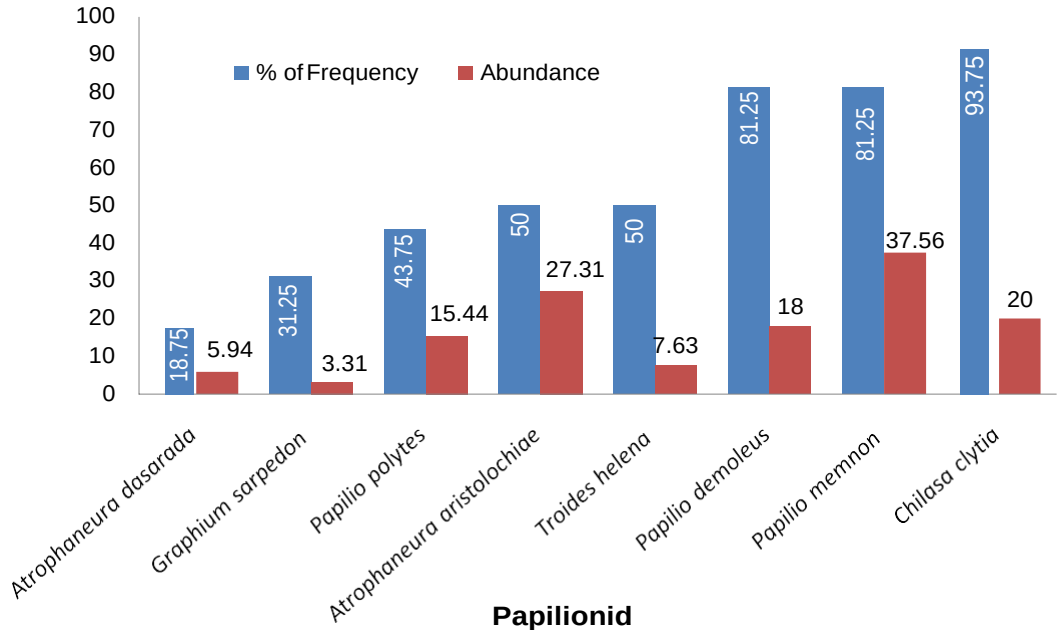


Fig. 4.6A :- Seasonal abundance of the family Papilionidae at the site I (Ghagua) during the year 2014

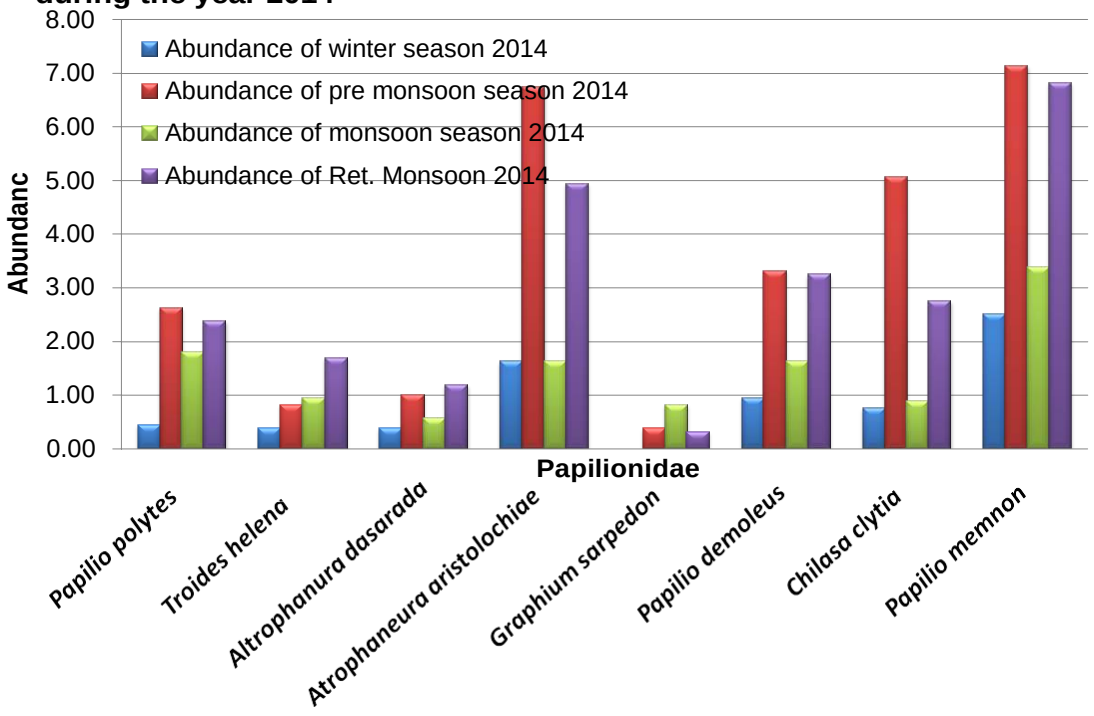
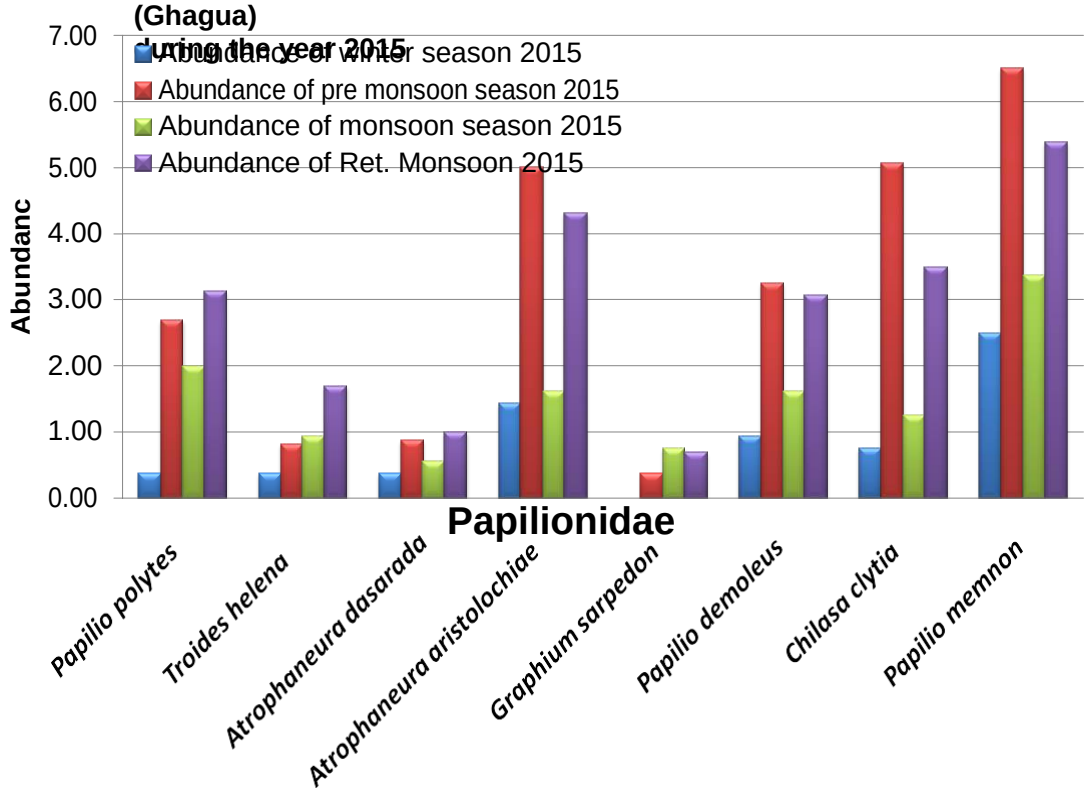


Fig. 4.6B :- Seasonal abundance of the family Papilionidae at the site I (Ghagua) during the year 2015



Abundance, % of frequency occurrence and density of butterfly of the family Nymphalidae at the site I (Ghagua)

Percentage of frequency occurance, density and abundance of the family Nymphalidae were *Junonia lemonias (*93.75, 0.00048, 29.81,very common); *Hypolimnas bolina* (62.5, 0.00051, 31.63, common); *Tirumala septentrionis(*50, 0.00024, 14.94, occasional); *Junonia atlites(*93.75, 0.00032, 19.94, very common); *Danaus genutia(*56.25, 0.00023, 14.56, occasional); *Junonia almana (*31.25, 0.00013, 7.94, rare); *Danaus chrysippus (*62.5, 0.0004, 24.81, common); *Cethosia cyane* (25, 0.00014, 8.63, rare); *Junonia hierta* (25, 0.00005, 3.13, rare); *Athyma nefte* (81.25, 0.00036, 22.56, very common); *Ariadne merione* (75, 0.0002, 12.44, common); *Tanaecia lepidea*(56.25, 0.00015, 9.56, occasional); *Kaniska canace (*25, 4.3E-05, 2.69, rare); *Neptis hylas*(62.5, 0.00028, 17.63, common); *Athyma opalina (*87.5, 0.00015, 9.38, very common); *Parantica aglea(*93.75, 0.0002, 12.75, very common); *Tanaecia jahnu (*62.5, 0.00019, 11.75, common) ; *Ariadne ariadne (*93.75, 0.0003, 18.81, very common); *Melanitis leda (*100, 0.00085, 53, very common); *Euploea*

*mulciber (*50, 0.00022, 14, occasional); *Cirrochroa aoris (*18.75, 5.5E-05 , 3.44, very rare); *Charaxes bharata (*87.5, 0.00045, 27.94, very common); *Pantoporia hordonia (*50, 0.00018, 11.19, occasional); *Euploea core (*93.75, 0.00083, 51.88, very common); *Junonia iphita* (75, 0.00031, 19.06 ,common) (Fig. No 4.7 and Table No.4.6). Out of 25 species recorded in Ghagua study site, nine species were categorized as very common, six as common, five as occasional, four as rare and only one was recorded as very rare species. The species *Cirrochroa aoris* was the only very rare species whose frequency of occurrence 18.75%, density 55 per sq.kilometer and abundance only 3.44 although it had been observed throughout the year in the selected area near forest edge. Their seasonal abundance did not vary much. Only a little bit variation in their abundance during pre monsoon period had been observed. Very common species were *Junonia lemonias, Junonia atlites, Athyma nefte, Athyma opalina, Parantica aglea, Ariadne ariadne, Melanitis leda, Polyura athamas* and *Euploea core.* During the month of November, December, January and February some of abundant species were totally absent (Fig.4.7A & Fig 4.7B). In case of species *Polyura athamas, Parantica aglea* and *Athyma opalina* were totally silent during these periods. There were six numbers of common species in Ghagua site recorded and they were *Hypolimnas bolina, Danaus chrysippus, Ariadne merione, Neptis hylas* and *Tanaecia jahnu*. The species *Tanaecia jahnu* was also totally silent during the winter season of both the study year. The density of *Neptis hylas* was low during monsoon period which indicated that they were less tolerant of environmental parameter like temperature, high humidity and heavy rainfall. Five occasional species were *Tirumala septentrionis, Danaus genutia, Tanaecia lepidea, Euploea mulciber* and *Pantoporia hordonia.* Increase in abundance started from the early part of pre monsoon and reached peak during the monsoon or early part of ret. monsoon and then faced the declining trend gradually. Out of four rare species (*Junonia almana, Cethosia cyane, Junonia hierta* and *Kaniska canace*) *Junonia hierta* was observed totally silent during the monsoon periods. High humidity, high rainfall and high atmospheric temperature may be the reasons for their absent or migration.

Fig. 4.7 :-Abundance and % of frequency occurrence of the family Nymphalidae at the site I (Ghagua) during the entire study period (2014 & 2015)

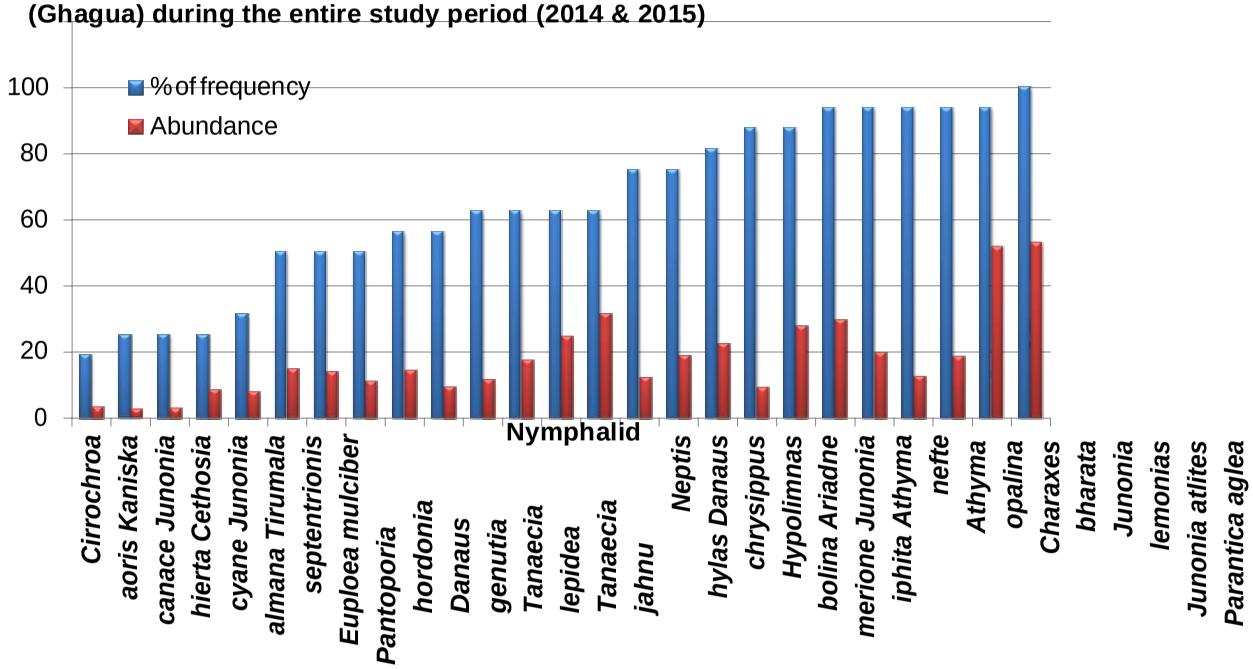
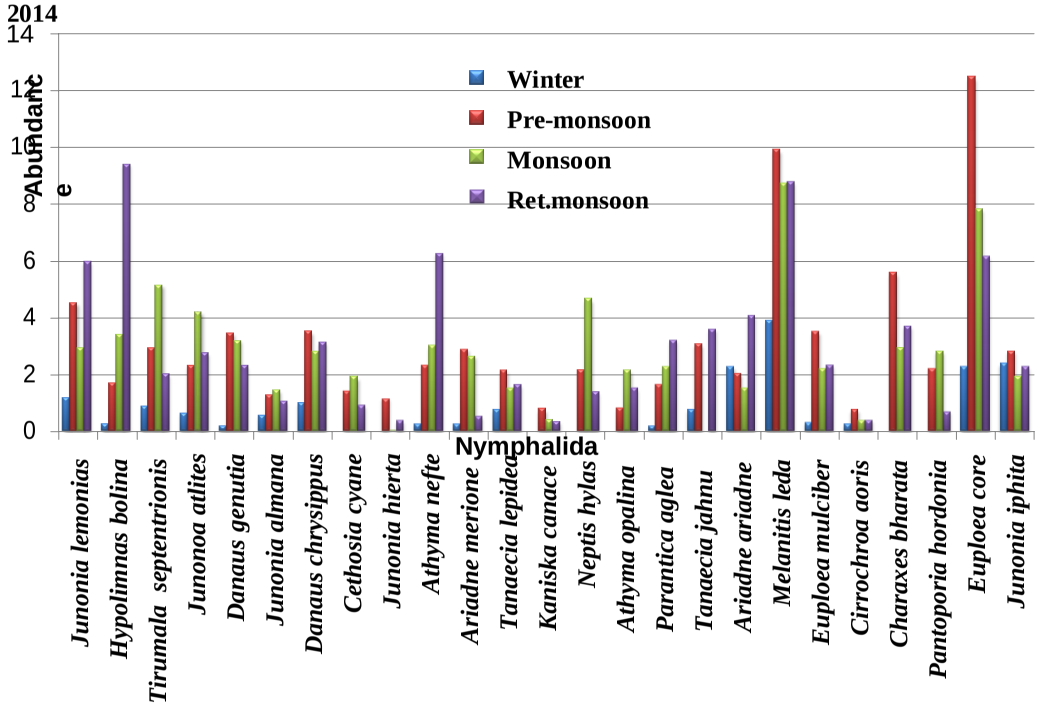


Fig. 4.7A:- Seasonal abundance of the family Nymphalidae at the site I (Ghagua) during 2014



A r i a d n e

a r i a d n e

E u p l o e a

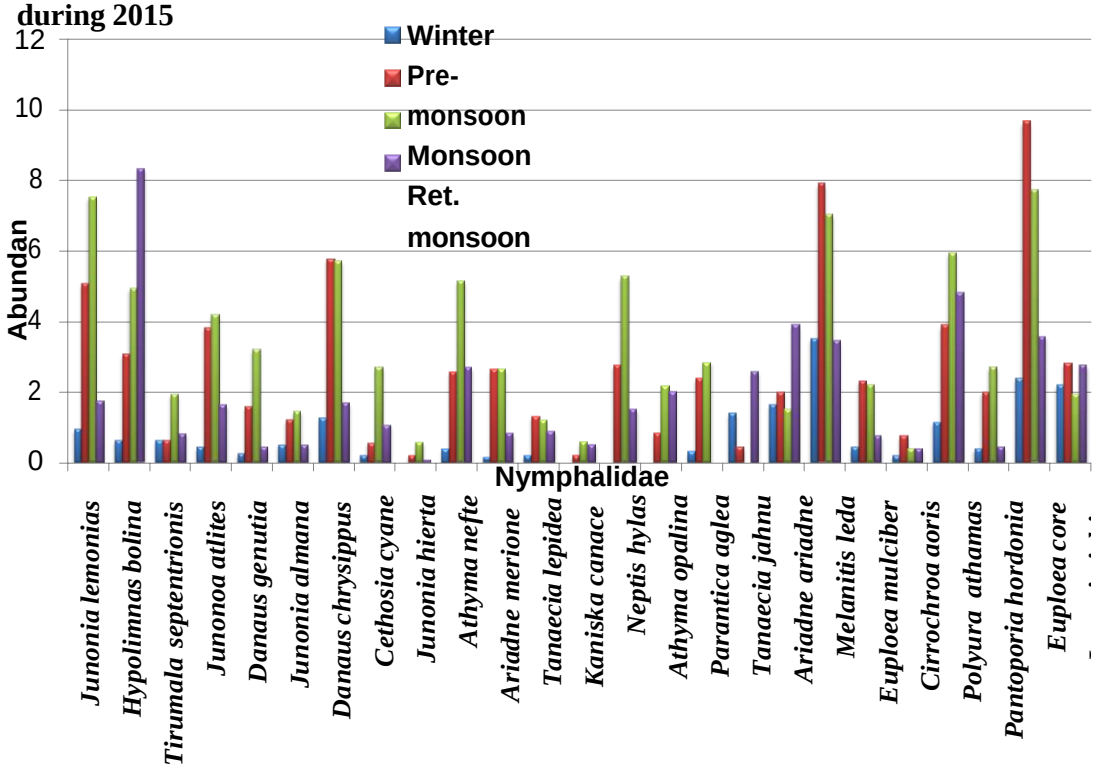
c o r e

M e l a n i t

i s

l e d a

Fig. 4.7B :- Seasonal abundance of the family Nymphalidae at the site I (Ghagua) during 2015



Abundance, % of frequency occurrence and density of butterfly of the family Pieridae at the site I(Ghagua)

Total nos of nine species had been recorded at the Ghagua site whose percentage of frequency occurrence, density in per sq.meter and abundance were *Catopsilia pyranthe(*100, 0.00052, 32.44, very common); *Eurema hecabe(*87.5, 0.00044, 27.31, very common); *Catopsilia crocale(*75, 0.00024, 15.19, common); *Pieris canidia (*62.5, 0.00017, 10.56, common); *Delias descombesi (*68.75, 0.00018, 11.06, common); *Delias eucharis (*56.25, 0.00015, 9.06, occasional); *Leptosia nina (*100, 0.0006, 37.69, very common); *Catopsilia pomona (*62.5, 0.00021, 13.06, common); *Appias libythea (* 100, 0.00055, 34.38, very common) (Table No 4.6 and Fig. No 4.8).

While analysizing Seasonal abundance of the family Pieridae at the site I (Ghagua), it was observed that out of nine species of Pieridae butterfly, four were very common; four common and only one was occasional. Very common species were *Catopsilia pyranthe, Eurema hecabe, Leptosia nina* and *Appias libythea*. Common species were

Catopsilia crocale, *Pieris canidia*, *Delias descombesi* and *Catopsilia pomona* and only one occasional species was *Delias eucharis*. *Leptosia nina* was the highly abundant species (abundance 37.69, frequency of occurance 100% and density 630 per Sq. kilometre) (Fig. 4.8, 4.8A & 4.8B). All of them were seen throughout the study period although their variation of density were observed season wise except the two common species *Delias descombesi* and *Catopsilia pomona* which were totally absent during the winter seasons of both the study periods. *Leptosia nina* had shown highest abundance (9.6) during monsoon period of both the study year (Fig. 4.8A & 4.8B).

Fig. 4.8.:- Abundance and % of frequency occurrence of the family Pieridae at the site I(Ghagua) during the entire study period.

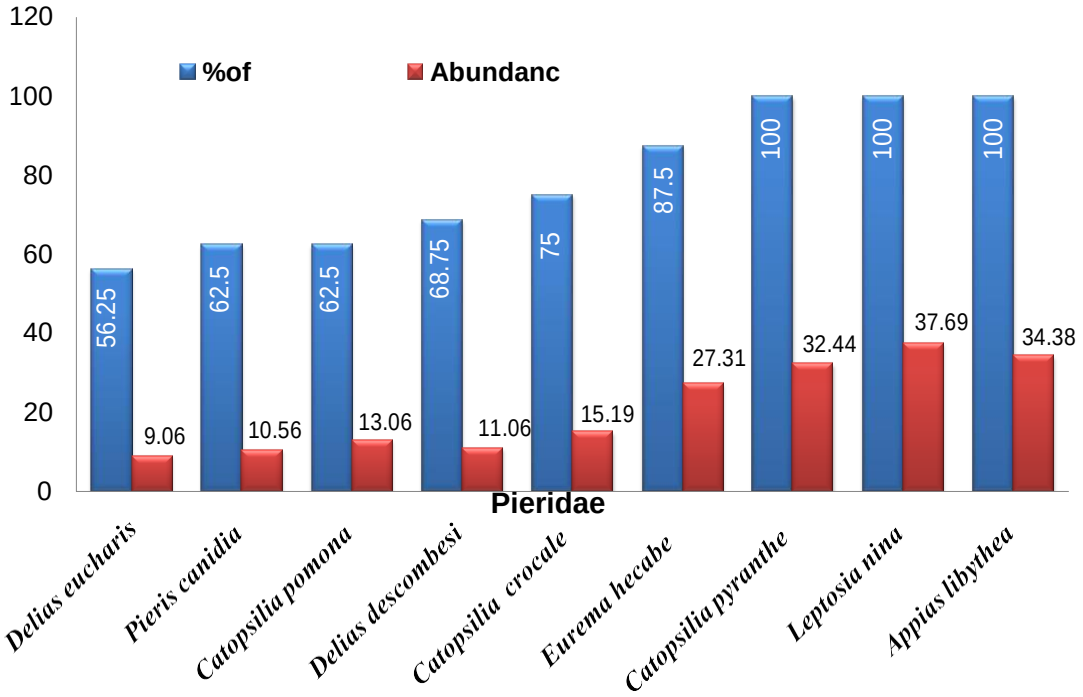


Fig. 4.8A:-Seasonal abundance of the family Pieridae at the site I (Ghagua) during 2014

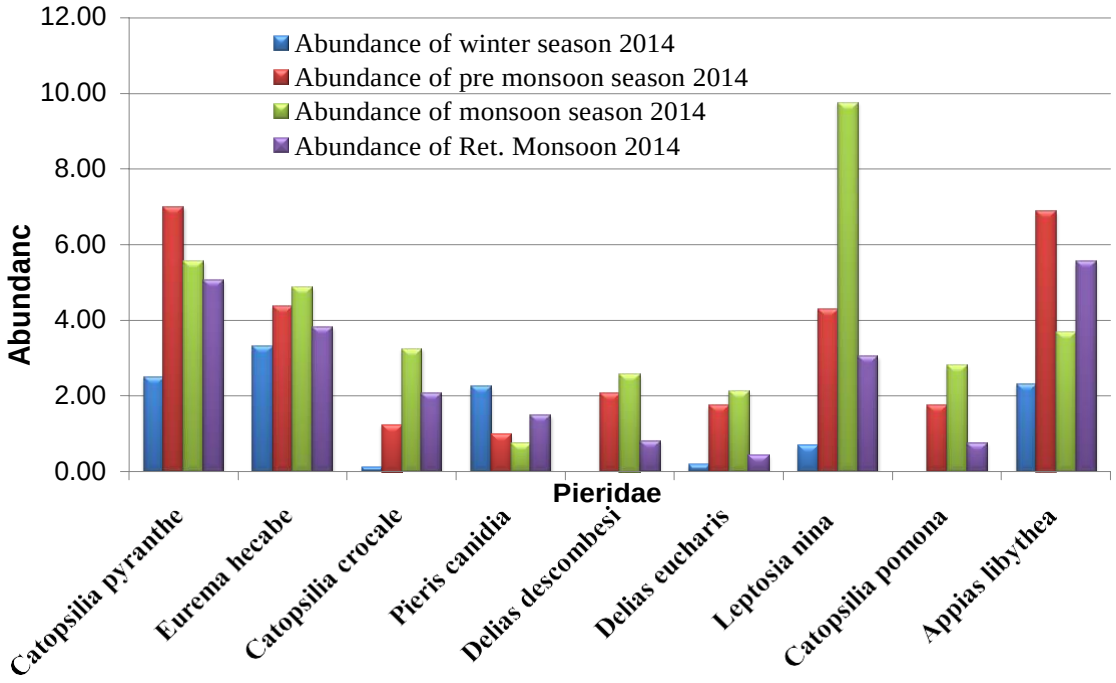
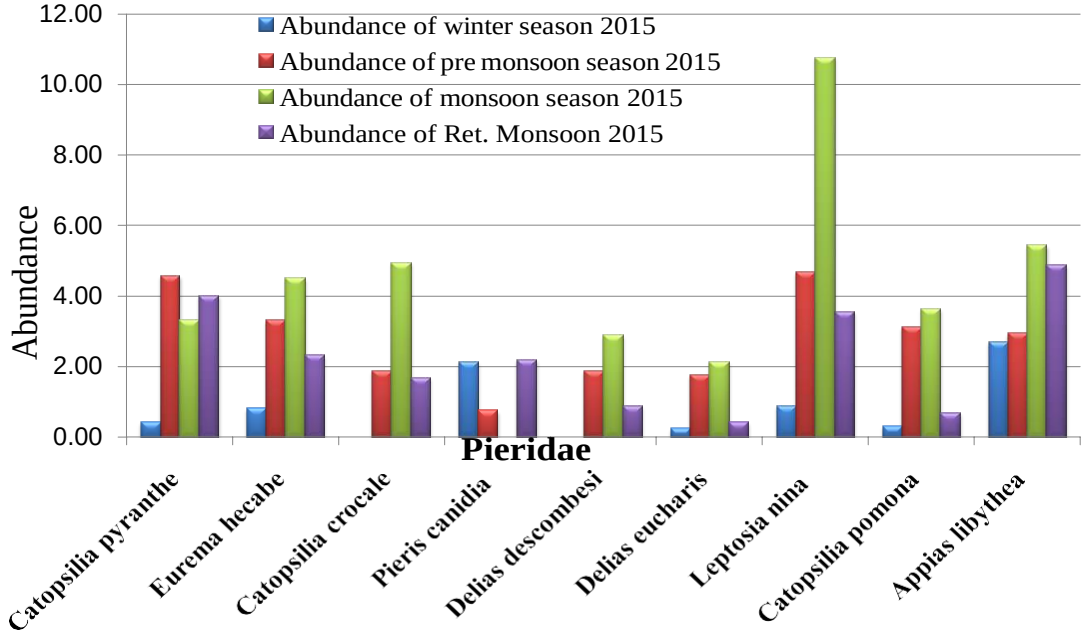


Fig. 4.8B. :-Seasonal abundance of the family Pieridae at the site I (Ghagua) during 2015



Abundance, % of frequency occurrence and density of butterfly of the family Lycaenidae at the site I (Ghagua)

Present diversity and population studies on butterflies carried out at Ghagua site in the Amchang wildlife Sanctuary and its vicinity area during different seasons of the years revealed the presence of only three species of Lycaenidae family. These were *Anthene emolus, Rapala pheretima* and *Castalius rosimon.* Out of these, two were categorised as rare species and one was in very rare species. Frequency of occurrence, density and abundance of both the rare species were *Rapala pheretima* (31.25, 0.00016, 10, Rare) and *Castalius rosimon (*25, 0.00011, 7.06, Rare) (Fig.4.9). Similarly the very rare species *Anthene emolus (*12.5, 0.00029, and 18.19, very rare) had shown higher abundance comparing with the other two Lycaenidae butterflies although its percentage of frequency occurrence was less which indicated that density was strictly limited in particular areas. .

Two rare species *Rapala pheretima* and *Castalius rosimon* whose abundance were (10) and (7.06) had shown high abundance during ret. monsoon and monsoon season and very rare species *Anthene emolus* had shown poor abundance during winter season (Fig.4.9A and 4.9B). This indicated that they could not accept any environmental changes.

Fig. 4.9. :-Abundance and % of frequency occurrence of family Lycaenidae and Satyridae at the site I (Ghagua) during the entire study Period

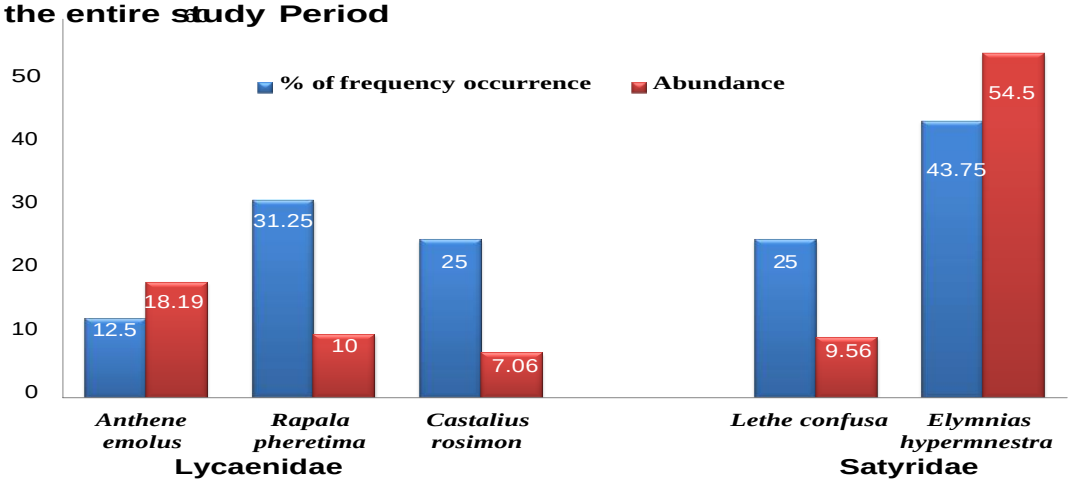


Fig. 4.9.A. :-Seasonal abundance of the family Lycaenidae and Satyridae at the site I (Ghagua) during the year 2014

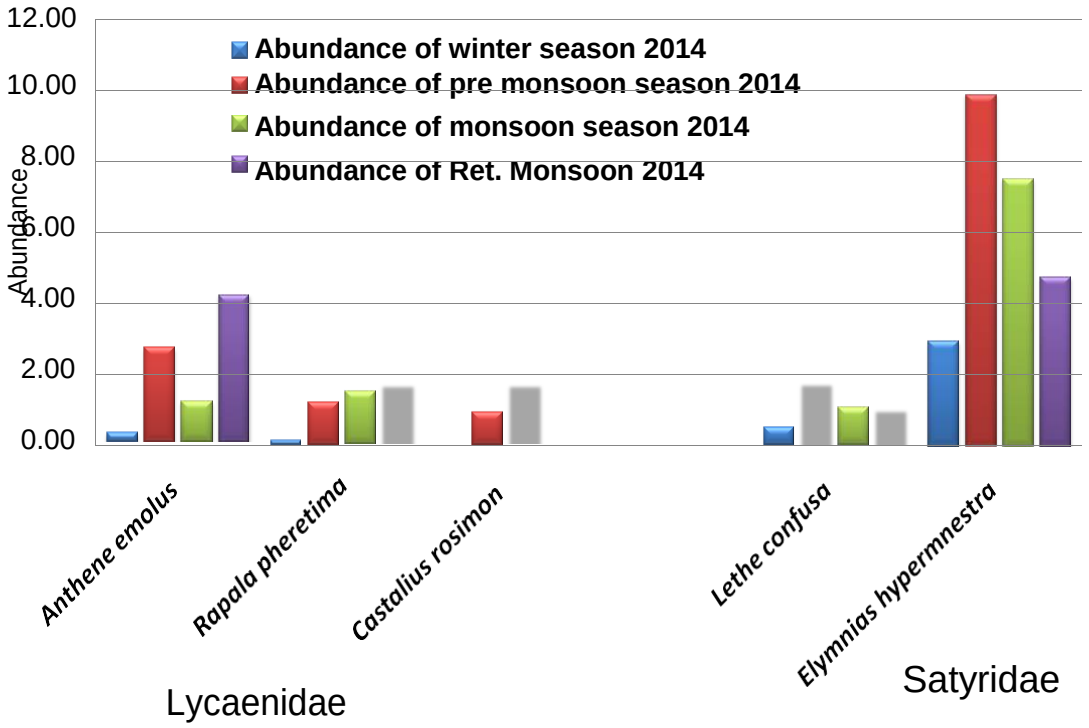
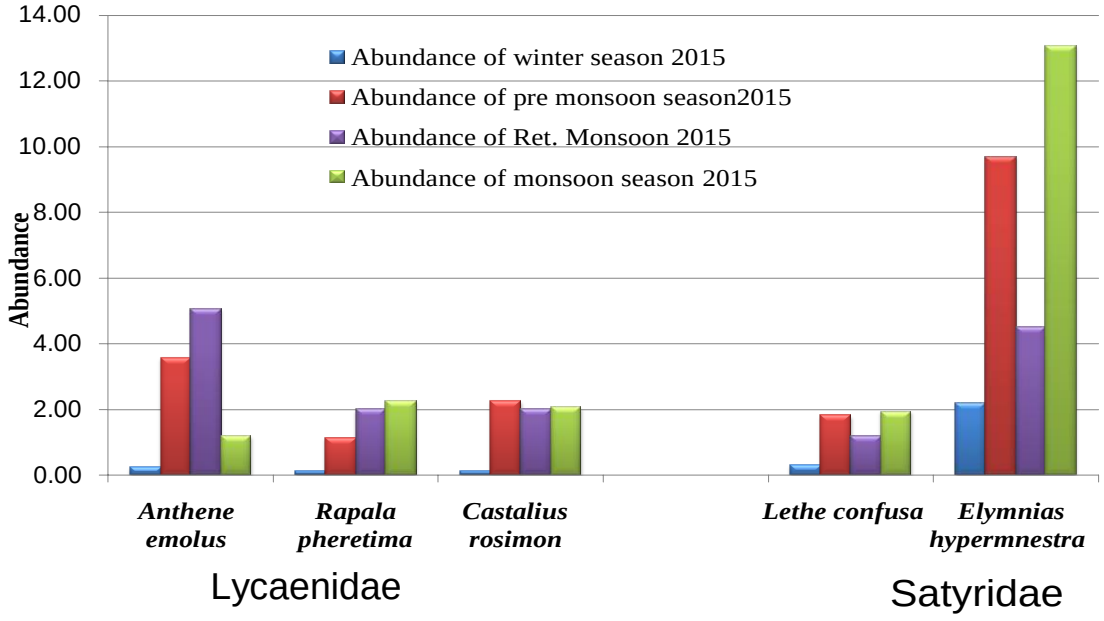


Fig. 4.9.B. :-Seasonal abundance of the family Lycaenidae and Satyridae in the site I (Ghagua) during the year 2015



Abundance, % of frequency occurrence and density of butterfly of the family Satyridae at the site I (Ghagua)

Only two species were observed, they were *Lethe confusa and Elymnias hypermnestra. Elymnias hypermnestra* was occasional and other one was rare. Seasonal abundance of *Lethe confusa (*0.50, 1.75, 1.06, 1.00) and *Elymnias hypermnestra (*2.94, 9.88, 7.50, 4.75,) (Fig.4.9, 4.9A & 4.9B) indicated that they occured throughout the year but their density varied significantly season to season. Both of them reached peak during monsoon season and after that abundance decreaseed upto winter season.

4.2.3. Diversity and Richness at the site I (Ghagua)

The result of the family-wise diversity indices analysis indicated (Table 4.7) 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 Number N1=6.4756; N2=5.6693; Evenness index E =0.8755. 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 E =0.9028.

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 E=0.8364. Lycaenidae recorded the following value–Simpson‟s index 0.3868; Shannon-Weiner index=1.0209; Hill‟s Diversity NumberN1= 2.7755; N2 =2.5851; Evenness index E= 0.9314. 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 E=0.8795.

From this observed results, it was concluded that at the Ghagua site the family Nymphalidae was highly represented and densely distributed with more number of individual.

Table 4.7. Family-wise diversity indices of butterflies at the Ghagua Site					
	Papilionidae	Nymphalidae	Pieridae	Lycaenidae	Satyridae
	Richness				
S	8	25	9	3	2
n	2163	7255	3052	564	1025
R1	0.91155	2.6998	0.9971	0.3157	0.1442
R2	0.172	0.2935	0.1629	0.1263	0.0625
	Diversity				
ƛ	0.1764	0.0597	0.14065	0.3868	0.746
H´	1.8682	2.9973	2.064	1.0209	0.4214
N1	6.4756	20.0242	7.8756	2.7755	1.5241
N2	5.6693	16.7475	7.11	2.5851	1.3404
	Evenness				
E	0.8755	0.8364	0.9028	0.9314	0.8795

The Shannon-Weiner diversity index for Ghagua site was well documented month-wise in Table 4.8. 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 indices were 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). In the family Pieridae, the least diversified months were February 2014 and December 2015 (1.4555, 1.3814). The highest diversity index was observed during the month of May 2014 and September 2015 (2.1153, 2.0518, 2.0562) while the moderate index was observed during the months of March and April (1.6096, 1.7164, 1.9122, 1.8721) of both the study years.

The family Nymphalidae showed its high diversity index almost all the months studied except the month of August 2014 & 2015 during which the index was very high

(2.9774, 2.9224). The lowest diversity index was observed during the months of December and January (2.1360, 2.1960, 2.5025, and 2.1918).

The family Lycaenidae showed its highest diversity index during the month of August 2014 and 2015 (1.0438, 1.0790). The least diversity index was observed during the months of January and December (0, 0, 0, 0) for both the year studied.

The family Satyridae, very few months alone showed moderate diversity index. The moderate diversity index was observed during the month of June, July and August (0.4344, 0.3830, 0.2911 in the year 2014 and 0.4127, 0.3463, 0.3951 in the year 2015) 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 of both the years.

Table 4.8. Month-wise Shannon-Weiner Index computed for the five families of butterfly

	year 2014												Year 2015										
	Jan	Feb	Mar	April	May	June	July	August	Sept	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	August	Sept	Oct	Nov
Papilionidae	1.6171	1.6253	1.7215	1.7605	1.8236	1.8898	1.8597	1.9412	1.8246	1.8801	1.6689	1.5833	1.6171	1.6164	1.7447	1.8060	1.8236	1.8775	1.8924	1.9291	1.9582	1.9311	1.6689
Nymphalidae	2.1360	2.4185	2.7979	2.9151	2.8741	2.4662	2.9063	2.9774	2.9296	2.8242	2.4933	2.1960	2.5025	2.7131	2.7934	2.7523	2.8498	2.8493	2.8431	2.9224	2.8703	2.7226	2.6190
Pieridae	1.6417	1.4555	1.6096	1.7164	2.1153	2.0606	1.9401	1.8670	1.9597	1.8005	1.5495	1.5156	1.5464	1.7047	1.9122	1.8721	2.0518	1.9907	1.8465	1.8544	2.0502	1.8637	1.6838
Lycaenidae	0	0.6365	0.9949	0.9433	0.9123	1.0130	0.9949	1.0438	0.5983	0.6070	0.5983	0	0	1.0397	1.0239	0.9973	0.9399	0.9812	1.0529	1.0790	0.5297	0.61086	0.6870
Satyridae	0.2500	0.4195	0.4741	0.4227	0.3622	0.4344	0.3830	0.2911	0.5297	0.4869	0.2954	0.2712	0	0.3576	0.2749	0.4418	0.5156	0.4127	0.3463	0.3951	0.5511	0.5147	0.4692

Table 4.9 season-wise observation of Shannon Index at the Site I (Ghaggar)

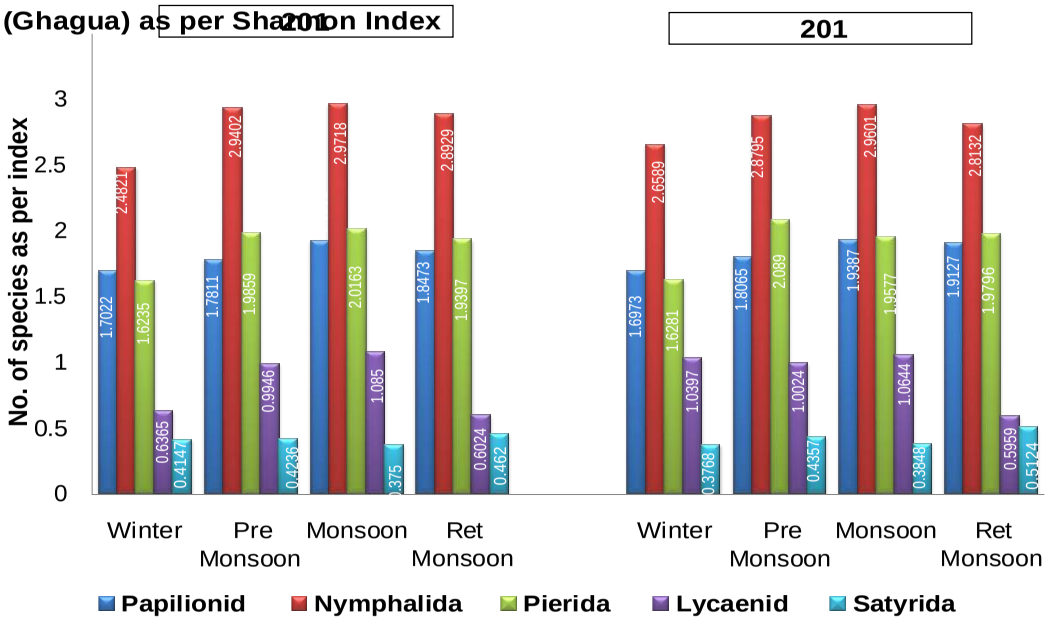
	Year 2014				Year 2015			
Family	Winter	Pre monsoon	Monsoon	Ret monsoon	Winter	Pre monsoon	Monsoon	Ret monsoon
Papilionidae	1.7022	1.7811	1.9292	1.8473	1.6973	1.8065	1.9387	1.9127
Nymphalidae	2.4821	2.9402	2.9718	2.8929	2.6589	2.8795	2.9601	2.8132
Pieridae	1.6235	1.9859	2.0163	1.9397	1.6281	2.089	1.9577	1.9796
Lycaenidae	0.6365	0.9946	1.085	0.6024	1.0397	1.0024	1.0644	0.5959
Satyridae	0.4147	0.4236	0.375	0.462	0.3868	0.4357	0.3848	0.5124

Season-wise Shannon-Weiner Index (Table 4.9, Fig. 4.10) of Ghagua site indicated that the diversity of butterfly was very high during monsoon (Papilionidae=1.9292 & 1.9387, Pieridae=2.0163 &1.9577, Nymphalidae=2.9718 & 2.9601, Lycaenidae= 1.0850 & 1.0644) but in case of Satyridae, population density was very high during ret. monsoon period (0.4620 & 0.5124). Ret.monsoon period indecies were such as (Papilionidae=1.8473 in the year 2014 & 1.9127 in the year 2015, Pieridae=1.9397 &1.9796, Nymphalidae =2.8929 & 2.8132, Lycaenidae=0.6024 & 0.5959 and Satyridae=0.4620 & 0.5124) while it showed moderate level during pre-monsoon:- Papilionidae =1.7811 & 1.8065, Pieridae=1.9859 during the year 2015, Nymphalidae= 2.9402 & 2.8795, Lycaenidae =1.0850 & 1.0024, and Satyridae=0.4236 & 0.4357 and very poor diversity during the winter season such as Papilionidae=1.7022 & 1.6973, Pieridae=1.6235 & 1.6281, Nymphalidae=2.4821 & 2.6589. But in case of Lycaenidae, diversity was poor in ret. monsoon season which was 0.6024.

Gradually the 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 ret.monsoon onwards. The trend was very clearly expressed in the Fig. 4.10.

Among the five families studied, the family Nymphalidae showed the best representation in almost all seasons than other families. It showed best richness R1= 2.6998, R2=0.2935, highest diversity =0.0597, H=2.9973, highest abundance N1=20.0242, N2=16.7475 and evenness E=0.8278 (Table 4.8), while the family Satyridae showed least representation during all the seasons.

Fig. 4.10.:-Season-wise distribution of butterfly of different families at the site (Ghagua) as per Shannon Index



Butterfly diversity and occurrence at the site II (South Amchang)

Species of butterflies at the site II (South Amchang)

47 species of butterflies belonging to five families were recorded at the site II (South Amchang) during the entire study period. The percentage of contribution observed for each family with their common name and scientific name are given in Table 4.10

Table 4.10.:- Family-wise list of butterflies recorded at the site II (South Amchang) in Amchang Wildlife Sanctuary and their percentage of contribution

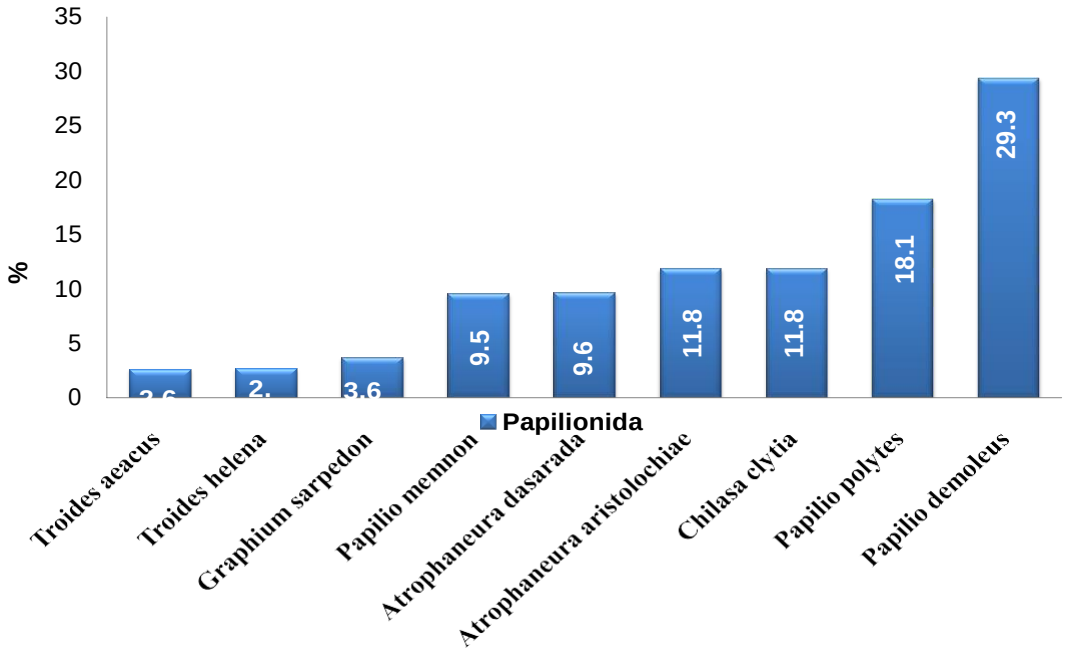
Family	S.L No	Scientific name	Abbreviation	Common name	% of contribution
Papilionidae	1	*Papilio polytes* Linnaeus,1758	PA1	Common Mormon	18.17
	2	*Troides helena* Linnaeus,1758	PA2	Common Birdwing	2.7
	3	*Atrophaneura dasarada* (Moore,1857)	PA3	Great Windmill	9.68
	4	*Atrophaneura aristolochiae* Fabricius,1775	PA4	Common Rose	11.85
	5	*Graphium sarpedon* Linnaeus,1758	PA5	Common Bluebottle.	3.69
	6	*Papilio demoleus* Linnaeus,1758	PA6	Lime Butterfly	29.36
	7	*Chilasa clytia* Linnaeus,1758	PA7	Common Mime	11.85
	8	*Papilio memnon* Linnaeus,1758	PA8	Great Mormon	9.55
	9	*Troides aeacus* C.&R.Felder	PA9	Golden Birdwing	2.63
Nymphalidae	1	*Junonia lemonias* Linnaeus ,1758	N1	Lemon Pansy .	10.02
	2	*Hypolimnas bolina* Linnaeus ,1758	N2	Great Eggfly	9.17
	3	*Tirumala septentrionis* Butler,1874	N3	Dark Blue Tiger	1.39
	4	*Junonia atlites* Linnaeus,1763	N4	Grey Pansy	5.02
	5	*Danaus genutia* Cramer ,1779	N5	Striped Tiger	2.84
	6	*Junonia almana* Linnaeus ,1758	N6	Peacock Pansy	1.12
	7	*Danaus chrysippus* Linnaeus,1758	N7	Plain Tiger	6.6
	8	*Cethosia cyane* Drury,1770	N8	Leopard Lacewing	2.1
	9	*Junonia hierta* Fabricius ,1798	N9	Yellow Pansy	0.25
	10	*Athyma nefte* Cramer ,1779	N10	Colour Sergent	6.84
	11	*Ariadne merione* Cramer ,1777	N11	Common Castor	3.31

	12	*Tanaecia lepidea* Butler ,1868	N12	Grey Count	1.09
	13	*Kaniska canace* Linnaeus,1763	N13	Blue Admiral	0.26
	14	*Neptis hylas* Linnaeus,1758	N14	Common Sailer	3.47
	15	*Athyma opalina* Kollar,1844	N15	Himalayan Sergeant	2.35
	16	*Parantica aglea* Moore,1883	N16	Glassy Tiger	2.5
	17	*Tanaecia jahnu* Moore,1857	N17	Plain Earl	1.24
	18	*Ariadne ariadne* Linnaeus,1763	N18	Angled Castor	5.19
	19	*Melanitis leda* Linnaeus,1758	N19	Common Evening Brown	12.53
	20	*Euploea mulciber* Cramer,1778	N20	Striped Blue Crow	2.68
	21	*Cirrochroa aoris* Doubleday,1847	N21	Large Yeoman	0.93
	22	*Charaxes bharata* Felder & Felder,1867	N22	Common Nawab	7.44
	23	*Pantoporia hordonia* Stoll,1790	N23	Common Lascar	2.74
	24	*Euploea core* Cramer,1780	N24	Common Crow	8.93
Pieridae	1	*Catopsilia pyranthe* Linnaeus,1758	P1	Mottled Emigrant	16.19
	2	*Eurema hecabe* Linnaeus,1758	P2	Common Grass Yellow.	11.41
	3	*Catopsilia crocale* Cramer,1775	P3	Common Emigrant	9.83
	4	*Pieris canidia* Sparrman ,1768	P4	Indian Cabbage White	4.52
	5	*Delias descombesi* Boisduval,1836	P5	Red-spot jezebel	6.25
	6	*Delias eucharis* Drury,1773	P6	Common jezebel	5.17
	7	*Leptosia nina* Fabricius,1793	P7	Psyche	20.75
	8	*Catopsilia pomona* Fabricius,1775	P8	Common Emigrant	6.1
	9	*Appias libythea* Fabricius ,1775	P9	Atriped Albatross	19.78
Lycaenidae	1	*Rapala pheretima* Hewitson,1863	L1	Copper Flash	23.11
	2	*Anthene emolus (*Godart,1824)	L2	Common Ciliate Blue	27.89
	3	*Castalius rosimon* Fabricius,1775	L3	Common Pierrot	49
Satyridae	1	*Lethe confusa* Aurivillius,1898	S1	Banded Tree Brown	13.15
	2	*Elymnias hypermnestra* Linnaeus, 1763	S2	Common Palmfly	86.85

Papilionidae:- Nine species of Papilionidae butterflies were recorded during the entire study period(Table 4.10). Among the 9 species observed, the *Papilio demoleus* (PA6) was the most highly distributed species with 29.36% of contribution, followed by *Papilio polytes (*PA1) with 18.17%, *Chilasa clytia* (PA7) with 11.85%,

Atrophaneura aristolochiae (PA4) with 11.85%, *Atrophaneura dasarada* (PA3) with 9.68%, *Papilio memnon* (PA8) with 9.55%, *Troides helena (*PA2) with 2.70%, *Graphium sarpedon* (PA5) with 3.69% and *Troides aeacus*(PA9) with 2.63% respectively (Fig.4.11).

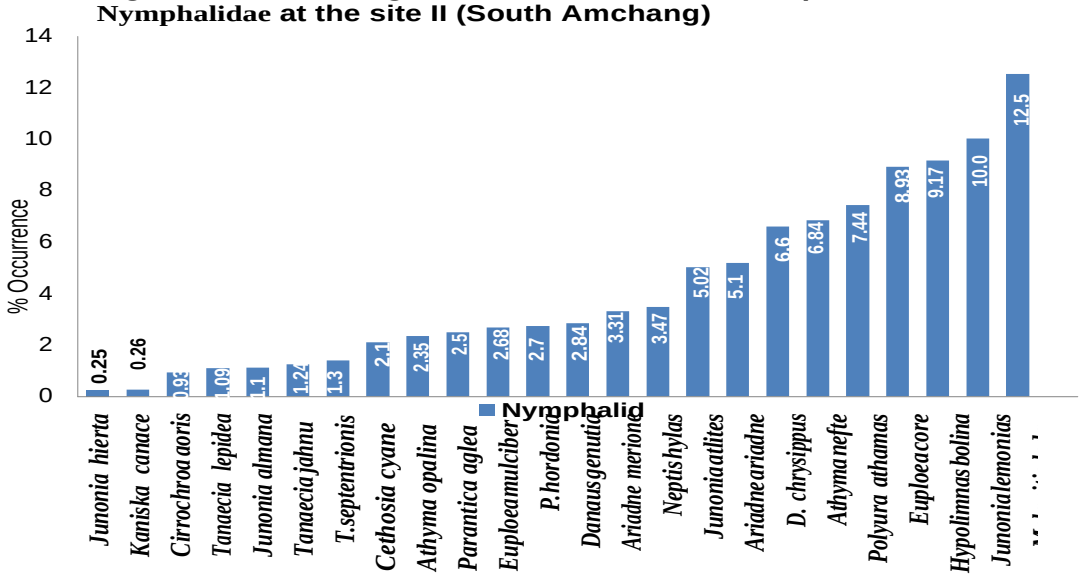
Fig. 4.11. Percentage contribution of different species of the family Papilionidae at the site II (South Amchang)



Nymphalidae:-Twenty four species of butterflies were recorded during the entire study period (Table 4.10). Among the 24 species recorded *Melanitis leda* (N19) was the most highly distributed species with percentage of contribution 12.53% followed by *Junonia lemonias*(N1) with 10.02%, *Hypolimnas bolina* (N2) with 9.17%, *Tirumala septentrionis(*N3) with 1.39%, *Junonia atlites(*N4) with 5.02%, *Danaus genutia* (N5) with 2.84%, *Junonia almana* (N6) with 1.12%, *Danaus chrysippus* (N7) with 6.60%, *Cethosia cyane*(N8) with 2.10%, *Junonia hierta* (N9) with 0.25%, *Athyma nefte* (N10) with 6.84%, *Ariadne merione* (N11) with 3.31%, *Tanaecia lepidea* (N12) with 1.09%, *Kaniska canace* (N13) with 0.26%, *Neptis hylas* (N14) with 3.47%, *Athyma opalina* (N15) with 2.35%, *Parantica aglea* (N16) with 2.50%, *Tanaecia jahnu* (N17) with 1.24%, *Ariadne ariadne* (N18) with 5.19%, *Euploea mulciber (*N20)

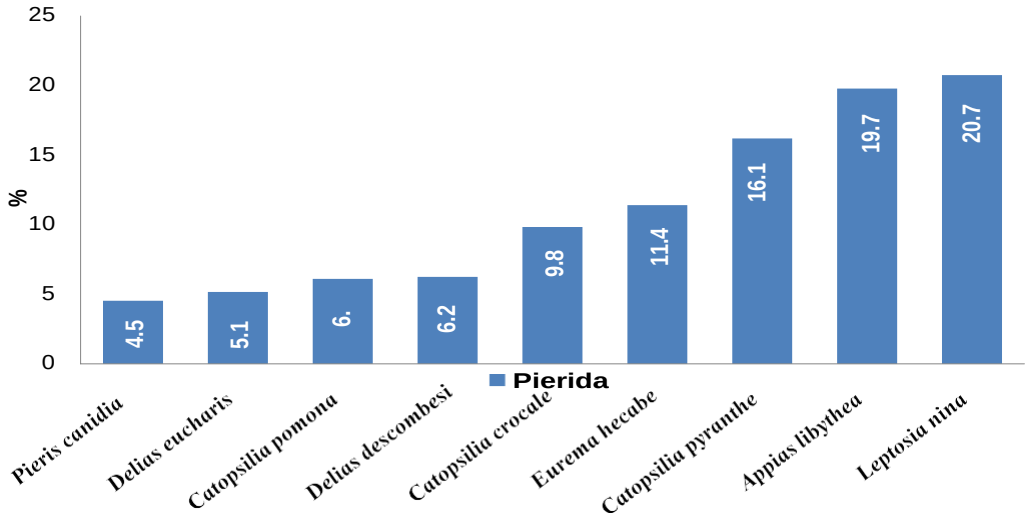
with 2.68%, *Cirrochroa aoris (*N21) with 0.93%, *Polyura athamas (*N22) with 7.44%, *Pantoporia hordonia (*N23) with 2.74% and *Euploea core* (N24) with 8.93%. The species *Junonia hierta* (N9) was the least distributed species with 0.25% (Fig. 4.12).

Fig. 4.12.:- Percentage contribution of different species of Nymphalidae at the site II (South Amchang)



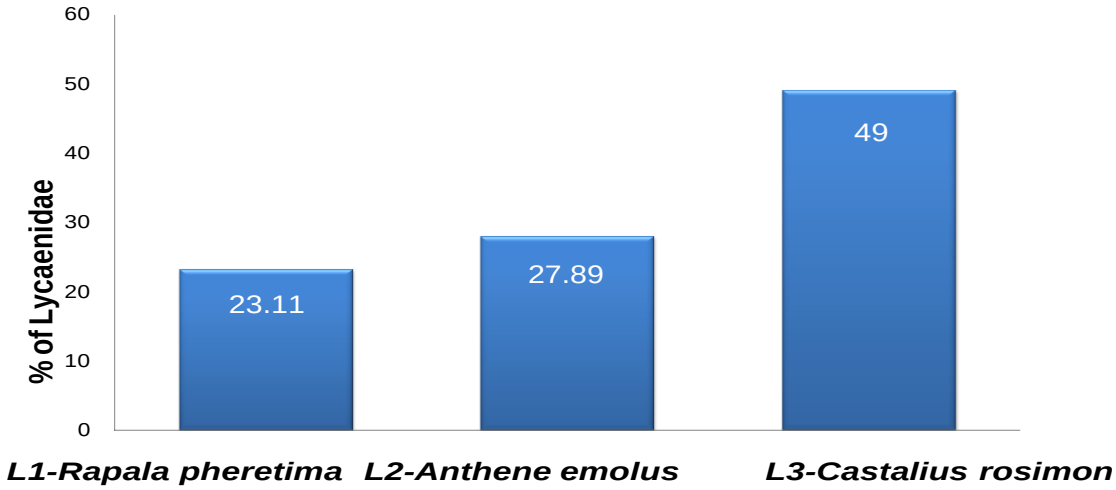
Pieridae:-Nine species of Pieridae butterflies were recorded during the entire study period (Table 4.10). Among the nine species observed, the *Leptosia nina* (P7) was the most highly distributed species with 20.75% followed by *Appias libythea* (P9) with 19.78%, *Catopsilia pyranthe* (P1) with 16.19%, *Eurema hecabe* (P2) with 11.41%, *Catopsilia crocale* (P3) with 9.83%, *Delias descombesi* (P5) with 6.25%, *Catopsilia pomona* (P8) with 6.10%, *Delias eucharis* (P6) with 5.17% and *Pieris canidia (*P4) with 4.52% was the least distributed species (Fig. 4.13).

Fig. 4.13. Percentage contribution of different species of the family Pieridae at the site II (South Amchang)



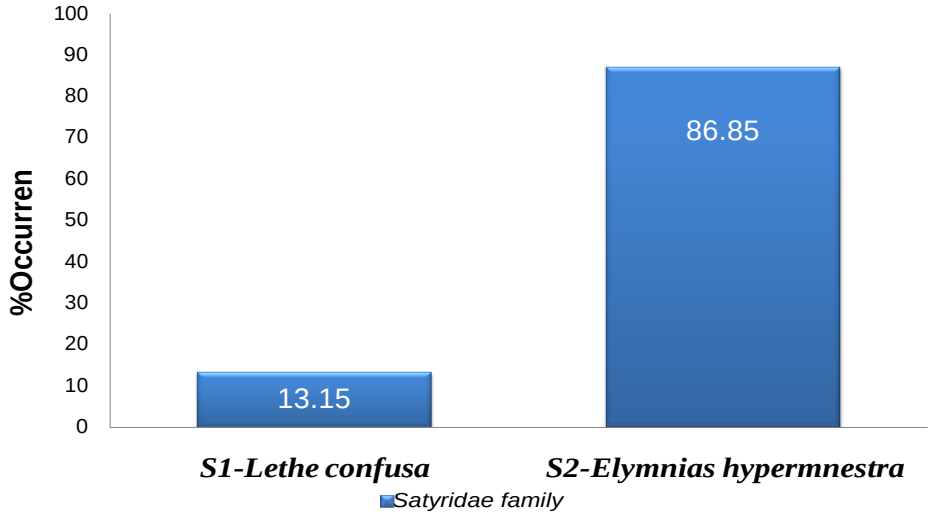
Lycaenidae: - Three species of Lycaenidae butterflies were recorded during the entire study period (Table 4.10). Among them *Castalius rosimon* (L3) was the most highly distributed species with 49% followed by *Rapala pheretima* (L1) with 23.11% and *Anthene emolus* (L2) with 27.89% (Fig.4.14).

Fig. 4.14. Percentage contribution of different species of the family Lycaenidae at the site II (South Amchang)



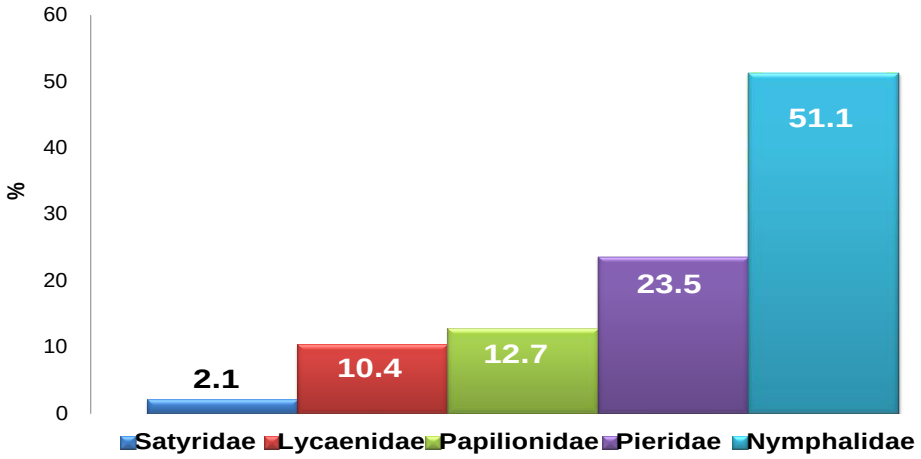
4.3.1.5 Satyridae: - Only two species of Satyridae butterflies were recorded during the entire study period (Table 4.10). *Elymnias hypermnestra* (S2) was the most highly distributed species with 86.85% followed by *Lethe confusa* (S1) with 13.15% only in this site (Fig. 4.15).

Fig. 4.15. Percentage contribution of different species of the family Satyridae at the site II (South Amchang)



In the South Amchang study site, totally 47 species belong to five families were recorded and counted. Among these the family Nymphalidae was found to be the most highly distributed. This was followed by Pieridae, Papilionidae, Lycaenidae and Satyridae respectively. Percentage contribution of the family Papilionidae was 12.77%, family Pieridae was 23.55%, family Nymphalidae was 51.14%, family Lycaenidae was 10.41% and finally the contribution of Satyridae was 2.36% respectively (Fig. 4.13).

Fig. 4.16. Percentage contribution of different families of butterfly at the site II (South Amchang)



From this observed results, it was concluded that the family Nymphalidae was highly distributed with large number of individuals in this site II (South Amchang).

Butterfly density, abundance and occurrence at the site II (South Amchang).

A total 47 numbers of butterfly species had been identified in this area during the entire study period, out of these, 9 species belonged to the family of Papilionidae, 24 belonged to the family Nymphalidae, 9 belonged to the family Pieridae, 3 in the family Lycaenidae and only two belonged to Satyridae family. On the basis of frequency of occurrence, these species had been categorized into five different classes i.e. very common (80-100%), common (60-80%), occasional (40-60%), rare (20-40%) and very rare (0- 20%). 10 species represented very common, 11 common, 10 occasional, 13 rare and only 3 nos represented very rare species.

Table no - 4.11 Frequency of occurrence, Species Density and Abundance of butterfly at the site II (South Amchang)

Family	SL. No	Scientific name	% of frequency	Density (Nos per sq. meter)	Abundance	Occurance
Papilionidae	1	*Papilio polytes*	50	0.000277	17.31	Occasional
	2	*Troides helena*	31.25	0.000041	2.56	Rare
	3	*Atrophaneura dasarada*	18.75	0.000147	9.19	Very Rare
	4	*Atrophaneura aristolochiae*	43.75	0.000188	11.75	Occasional
	5	*Graphium sarpedon*	31.25	0.000056	3.50	Rare
	6	*Papilio demoleus*	75	0.000444	27.75	Common
	7	*Chilasa clytia*	87.5	0.00018	11.25	Very Common
	8	*Papilio memnon*	68.75	0.000145	9.06	Common
	9	*Troides aeacus*	18.75	0.00004	2.50	Very Rare
Nymphalidae	1	*Junonia lemonias*	62.5	0.000606	37.88	Common
	2	*Hypolimnas bolina*	81.25	0.000555	34.69	Very Common
	3	*Tirumala septentrionis*	12.5	0.000084	5.25	Very Rare
	4	*Junonia atlites*	56.25	0.000304	19.00	Common
	5	*Danaus genutia*	31.25	0.000172	10.75	Rare
	6	*Junonia almana*	25	0.000068	4.25	Rare
	7	*Danaus chrysippus*	43.75	0.000399	24.94	Occasional
	8	*Cethosia cyane*	25	0.000127	7.94	Rare
	9	*Junonia hierta*	25	0.000015	0.94	Rare
	10	*Athyma nefte*	75	0.000414	25.88	Common
	11	*Ariadne merione*	56.25	0.0002	12.50	Occasional
	12	*Tanaecia lepidea*	25	0.000066	4.13	Rare
	13	*Kaniska canace*	56.25	0.000016	1.00	Occasional
	14	*Neptis hylas*	87.5	0.00021	13.13	Very Common
	15	*Athyma opalina*	93.75	0.000142	8.88	Very Common
	16	*Parantica aglea*	62.5	0.000151	9.44	Common
	17	*Tanaecia jahnu*	37.5	0.000075	4.69	Rare
	18	*Ariadne ariadne*	100	0.000314	19.63	Very Common
	19	*Melanitis leda*	93.75	0.000758	47.38	Very Common
	20	*Euploea mulciber*	25	0.000162	10.13	Rare
	21	*Cirrochroa aoris*	31.25	0.000056	3.50	Rare
	22	*Charaxes bharata*	50	0.00045	28.13	Occasional
	23	*Pantoporia hordonia*	56.25	0.000166	10.38	Occasional
	24	*Euploea core*	75	0.00054	33.75	Common
Pieri	1	*Catopsilia pyranthe*	87.5	0.000451	28.19	Very Common
	2	*Eurema hecabe*	75	0.000318	19.88	Common

	3	*Catopsilia crocale*	75	0.000274	17.13	Common
	4	*Pieris canidia*	68.75	0.000126	7.88	Common
	5	*Delias descombesi*	56.25	0.000174	10.88	Occasional
	6	*Delias eucharis*	100	0.000144	9.00	Very Common
	7	*Leptosia nina*	93.75	0.000579	36.19	Very Common
	8	*Catopsilia pomona*	43.75	0.00017	10.63	Occasional
	9	*Appias libythea*	62.5	0.000551	34.44	Common
Lycaenidae	1	*Anthene emolus*	31.25	0.000058	3.63	Rare
	2	*Rapala pheretima*	25	0.00007	4.38	Rare
	3	*Castalius rosimon*	25	0.000123	7.69	Rare
Satyrid	1	*Lethe confuse*	43.75	0.000162	10.13	Occasional
	2	*Elymnias hypermnestra*	93.75	0.00107	66.88	Very Common

Table No:-4.11B. Seasonal Abundance of butterfly species at the site II (South Amchang)

Seasonal abundance at the site II (South Amchang)			**Year 2014**				**Year 2015**			
Family	**SL. No**	**Scientific Name**	**winter**	**Pre monsoon**	**Monsoon**	**Ret. monsoon**	**Winter**	**Pre monsoon**	**Monsoon**	**Ret. mons**
Papilionidae	**1**	*Papilio polytes*	0.44	2.38	4.94	1.13	0.31	2.75	4.44	0.94
	2	*Troides helena*	0.00	0.13	1.13	0.00	0.00	0.25	1.00	0.06
	3	*Atrophaneura dasarada*	0.00	1.88	3.00	0.06	0.00	1.38	2.81	0.06
	4	*Atrophaneura aristolochiae*	0.38	1.94	2.94	0.75	0.38	1.81	2.94	0.63
	5	*Graphium sarpedon*	0.00	0.38	0.94	0.06	0.00	0.38	1.69	0.06
	6	*Papilio demoleus*	0.50	2.44	8.31	1.69	0.50	3.69	8.94	1.69
	7	*Chilasa clytia*	0.06	3.00	2.13	0.19	0.06	2.94	2.75	0.13
	8	*Papilio memnon*	0.06	1.50	2.00	0.94	0.06	2.00	1.56	0.94
	9	*Troides aeacus*	0.00	0.31	0.75	0.00	0.00	0.31	1.06	0.06
Nymphalidae	**1**	*Junonia lemonias*	1.00	6.38	11.00	3.13	1.00	5.19	8.25	1.94
	2	*Hypolimnas bolina*	0.25	1.69	5.63	9.38	0.25	3.06	5.56	8.88
	3	*Tirumala septentrionis*	0.06	0.50	1.69	0.19	0.31	0.63	1.69	0.19
	4	*Junonia atlites*	0.63	2.31	4.19	1.63	0.63	3.81	4.19	1.63

	5	*Danaus genutia*	0.19	1.56	3.19	0.44	0.19	1.56	3.19	0.44
	6	*Junonia almana*	0.00	0.50	1.44	0.19	0.00	0.50	1.44	0.19
	7	*Danaus chrysippus*	0.44	4.69	4.63	1.19	0.44	5.88	6.00	1.69
	8	*Cethosia cyane*	0.00	0.31	2.69	0.88	0.00	0.31	2.69	1.06
	9	*Junonia hierta*	0.00	0.00	0.31	0.06	0.00	0.00	0.50	0.06
	10	*Athyma nefte*	0.25	2.31	8.38	3.13	0.25	2.56	5.88	3.13
	11	*Ariadne merione*	0.25	2.88	2.63	0.50	0.25	2.88	2.63	0.50
	12	*Tanaecia lepidea*	0.19	0.56	0.94	0.38	0.19	0.56	0.94	0.38
	13	*Kaniska canace*	0.00	0.06	0.38	0.06	0.00	0.06	0.38	0.06
	14	*Neptis hylas*	0.00	0.19	4.63	1.38	0.00	0.31	5.25	1.38
	15	*Athyma opalina*	0.00	0.81	2.13	1.50	0.00	0.81	2.13	1.50
	16	*Parantica aglea*	0.19	1.63	2.25	0.00	0.19	2.38	2.81	0.00
	17	*Tanaecia jahnu*	0.75	0.44	0.00	0.94	0.75	0.44	0.00	1.38
	18	*Ariadne ariadne*	2.25	2.00	1.50	4.06	2.25	2.00	1.50	4.06
	19	*Melanitis leda*	2.81	8.44	8.69	3.88	2.81	8.19	8.69	3.88
	20	*Euploea mulciber*	0.31	2.44	2.19	0.13	0.31	2.44	2.19	0.13
	21	*Cirrochroa aoris*	0.25	0.75	0.38	0.38	0.25	0.75	0.38	0.38
	22	*Charaxes bharata*	0.00	4.44	5.94	3.69	0.00	4.44	5.94	3.69
	23	*Pantoporia hordonia*	0.00	2.19	2.81	0.19	0.00	2.19	2.81	0.19
	24	*Euploea core*	0.88	5.31	7.81	2.88	0.88	5.31	7.81	2.88
	25	*Junonia iphita*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pieridae	**1**	*Catopsilia pyranthe*	0.75	4.88	4.31	5.00	0.75	4.88	3.38	4.25
	2	*Eurema hecabe*	1.13	2.06	4.31	2.13	1.13	2.06	4.94	2.13
	3	*Catopsilia crocale*	0.13	2.00	5.38	1.06	0.13	2.00	5.38	1.06
	4	*Pieris canidia*	2.25	0.31	0.00	1.38	2.25	0.31	0.00	1.38
	5	*Delias descombesi*	0.00	2.06	2.56	0.81	0.00	2.06	2.56	0.81
	6	*Delias eucharis*	0.19	1.75	2.13	0.44	0.19	1.75	2.13	0.44
	7	*Leptosia nina*	0.69	4.31	9.75	3.06	0.69	4.31	10.31	3.06
	8	*Catopsilia pomona*	0.00	1.75	2.81	0.75	0.00	1.75	2.81	0.75
	9	*Appias libythea*	2.31	3.63	6.13	5.56	2.19	2.94	6.13	5.56
Lycaenida	**1**	*Anthene emolus*	0.00	0.56	1.00	1.88	2.56	1.13	3.50	1.00
	2	*Rapala pheretima*	0.00	1.38	0.81	2.44	1.38	1.69	2.75	1.19
	3	*Castalius rosimon*	0.00	0.94	1.69	0.00	0.00	1.75	3.31	0.00
Satyridae	**1**	*Lethe confusa*	0.50	1.75	1.81	1.00	0.50	1.75	1.81	1.00
	2	*Elymnias hypermnestra*	2.94	11.56	13.50	4.75	2.94	11.56	14.88	4.75

Abundance, % of frequency occurrence and density of butterfly of the family Papilionidae at the site II (South Amchang)

Among nine species of butterflies of the family Papilionidae, only one species was categorized to very common, two common, two occasional, two rare and two were very rare. *Chilasa clytia* was the very common species whose frequency of occurrence, abundance and density in per sq.kilometre were 87.5%, 11.25, and 180 respectively (Table No:-4.11). This species was seen throughout the year except winter season. *Papilio memnon* and *Papilio demoleus* were common species whose frequency of occurrence, density and abundance were 68.75%, 145, 9.2 and 75%, 444, 27.29 respectivly (Fig: 4.17).

Seasonal changes had effected in abundance but in case of *Papilio memnon,* it had been observed that they were totally silent during winter season.

Out of the two occasional species, *Papilio polytes* represented higher abundance than *Atrophaneura aristolochiae*. While analysing the seasonal abundance *Papilio polytes, Atrophaneura aristolochiae, Papilio demoleus, Chilasa clytia* and *Papilio memnon* (Fig.4.18A & 4.18B) had represented high abundance during the monsoon period. At the end of monsoon, their density and abundance were gradually decreasing. But in case of *Atrophaneura aristolochiae* and *Papilio memnon,* their presence throughout the year indicated that they were totally susceptible to any environmental conditions as well as seasonal variation. On the other hand, species like *Troides helena, Atrophaneura dasarada* and *Papilio demoleus* had shown high abundance during ret. monsoon of both the study year.

Increasing species abundance started from the beginning of the pre monsoon till the early part of ret. monsoon in most of the species and then declined and finally reached least abundance during winter season. The butterfly abundance was also varied in this site but the pattern of variation as well as the frequency of occurrence was different. *Tirumala septentrionis, Danaus genutia, Tanaecia lepidea, Euploea mulciber* and *Pantoporia hordonia* were occasional species.

Fig. 4.17. :-Abundance and % of frequency occurrence of the family Papilionidae at the site II(South Amchang)

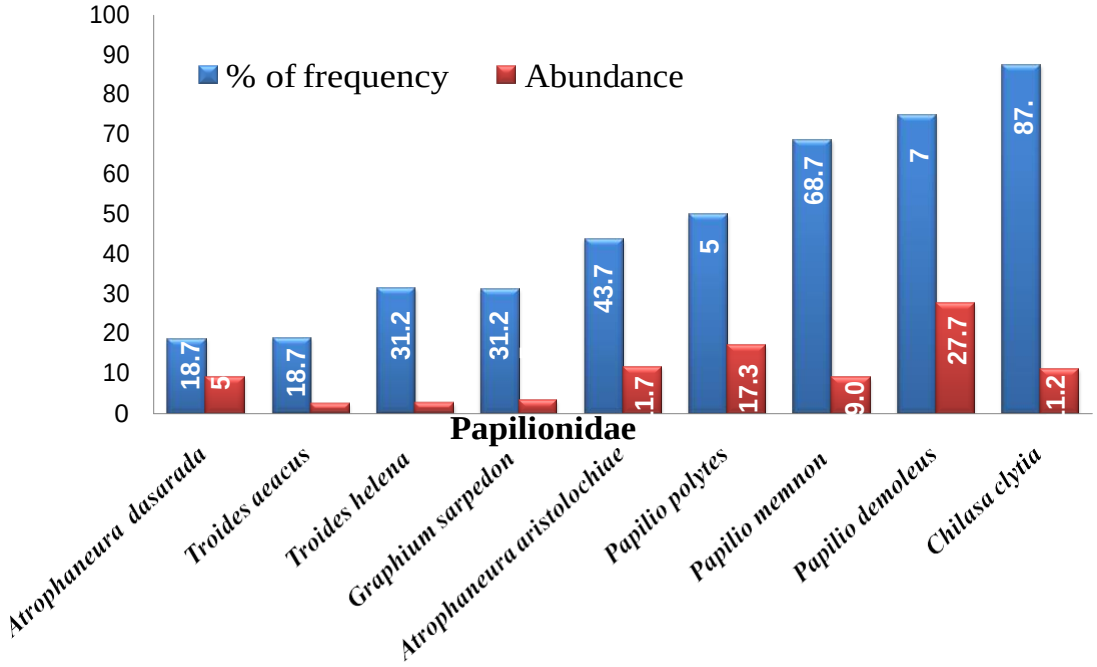


Fig. 4.18 A. :-Seasonal Abundance of the family Papilionidae at the site II (South Amchang) during 2014

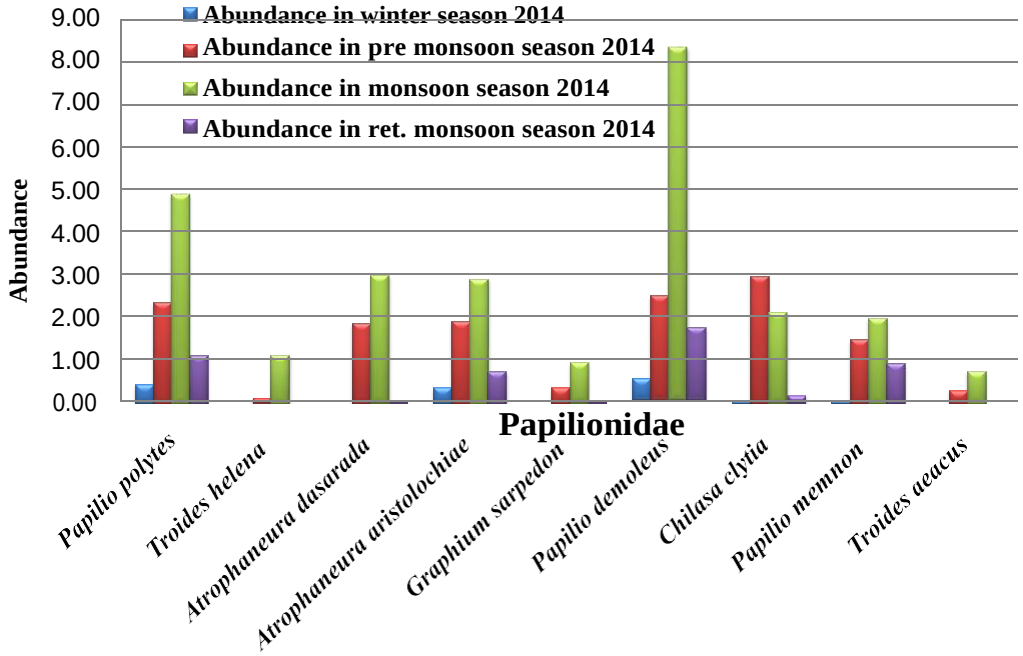
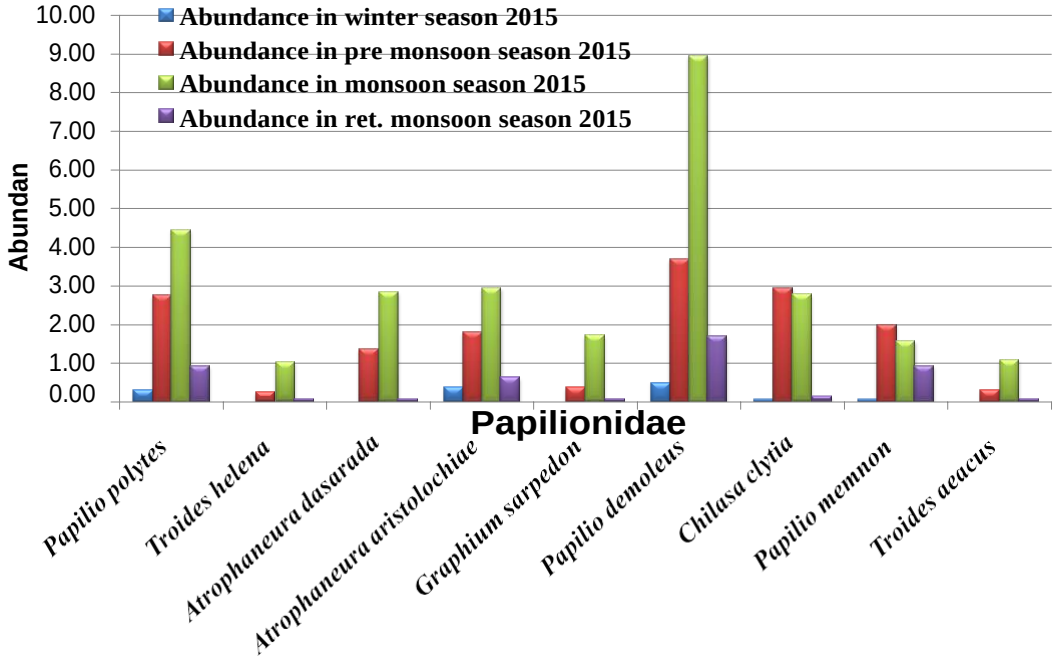


Fig. 4.18B. :-Seasonal abundance of the family Papilionidae at the site II (South Amchang) during the year 2015



Abundance, % of frequency occurrence and density of butterfly of the family Nymphalidae at the site II (South Amchang)

Out of 24 species of butterfly, five species were categorized as very common and they were *Hypolimnas bolina, Neptis hylas, Athyma opalina, Ariadne ariadne* and *Melanitis leda*. Their percentage of frequency occurrence, density and abundance mentioned in the table 4.11 and Fig.4.19. Their population started increasing during the month of February & March and reached peak in the month of June, July and August and then started decreasing up to December but exceptational case was that species *Neptis hylas* and *Athyma opalina* (Fig:4.19*)* were totally absent during the month of November, December and January. While comparing seasonwise abundance of very common species, it had been observed that *Melanitis leda* represented highest abundance (8.69) during monsoon season whereas *Hypolimnas bolina* and *Ariadne ariadne* had shown high abundance during ret. monsoon period (Fig.4.20A & 4.20B). *Neptis hylas* and *Athyma opalina* were totally absent during winter season of both the study year.

Percentage of frequency occurrence and abundance of common species in the study site were *Junonia atlites* (62.5%, 37.88); *Junonia lemonias* (56.25%, 19.00); *Athyma nefte* (75%, 25.88); *Parantica aglea* (62.5%, 9.44) and *Euploea core* (75%, 33.75) (Fig: 4.19). *Junonia atlites* had shown highest abundance. All of them were seen throughout the year in spite of individual variation in abundance except *Athyma nefte* and *Parantica aglea* which were totally absent during the months of November, December, January and February. It had been observed that *Junonia atlites* had shown highest abundance (11.00, 8.25) (Fig. 4.19) during the monsoon season of both the study years. Seasonal abundance of other common species were such as *Athyma nefte* (0.25, 2.31, 8.38, 3.13); *Parantica aglea* (0.19, 1.63, 2.25, 0.00); *Euploea core* (0.88, 5.31, 7.81, 2.88) during the year 2014 and *Athyma nefte* (0.25, 2.56, 5.88, 3.13); *Parantica aglea* (0.19, 2.38, 2.81, 0.00); *Euploea core* (0.88, 5.31, 7.81, 2.88) during the year 2015 (Fig.4.20B). All species were represented throughout the year but their abundance varied seasonwise. Increase in density started from the early part of pre monsoon and reached peak during monsoon season and gradually decreasing trend started from ret. monsoon onward. In case of *Parantica aglea,* it was observed that they were totally absent during winter season. The declination of species diversity and abundance were associated with habitat dryness and differences in microhabitat conditions with monsoon, pre monsoon and ret.reating monsoon season as shown in the fig. 4.20A & 4.20B. This variation indicated that the abiotic factors of rainfall, temperature and humidity played a vital role in influencing the distribution and abundance (Hill *et al.*, 2003; Shubhalakshmi & Chaturvedi, 1999).

Almost 75% butterfly species sampled in the South Amchang site were seasonal rather than distributed equally throughout the year. Ranging from the latter half of the ret.reating monsoon through winter up to early pre monsoon season, the vegetation pattern of study area had greatly changed and these changes were influencing majority of butterfly communities to utilize the seasons or to avoid it. This emphasizes the need for biodiversity assessments to cover sufficiently long period to account for seasonal variation in species abundance in different habitats. Differences in phonology across the seasons and among the species could be a mechanism to reduce competition

(Clench 1967; Wolda & Fisk 1981). The differences in diversity between seasons and seasonality of butterflies could be possible due to monthly collection of data for a longer period of two years or more. This emphasizes the need for biodiversity assessments to cover sufficiently long period to account for seasonal variation in species abundance in different habitats.

Density per sq.kilometre, Percentage of frequency occurrence and abundance of Occasional species of the family Nymphalidae were *Danaus chrysippus* (399, 43.75%, 24.94); *Ariadne merione* (200, 56.25%, 12.50); *Kaniska canace* (16, 56.25%, 1.00); *Polyura athamas (*450, 50%, 28.13) and *Pantoporia hordonia* (166, 56.25%, 10.38) (Fig.4.19). All these species were not seen from the month November, December and January. Although abundance of the species *Kaniska canace* was poor, they can be observed from May to September only. They were less tolerant about seasonal changes.

Seasonwise abundance of rare species during the year 2014 were *Danaus genutia*(0.19,1.56, 3.19, 0.44); *Junonia almana* (0.00, 0.50, 1.44, 0.19); *Cethosia cyane* (0.00, 0.31, 2.69, 0.88); *Junonia hierta* (0.00, 0.00, 0.31, 0.06,); *Tanaecia lepidea*(0.19, 0.56, 0.94, 0.38); *Tanaecia jahnu* (0.75, 0.44, 0.00, 0.94); *Euploea mulciber (*0.31, 2.44, 2.19, 0.13); *Cirrochroa aoris* (0.25, 0.75, 0.38, 0.38) (Fig.4.20A). Similarly during the year 2015 *Danaus genutia* (0.19, 1.56, 3.19 ,0.44); *Junonia almana* (0.00, 0.50, 1.44, 0.19); *Cethosia cyane* (0.00, 0.31, 2.69, 1.06); *Junonia hierta* (0.00, 0.00, 0.50, 0.06); *Tanaecia lepidea* (0.19, 0.56, 0.94, 0.38); *Tanaecia jahnu* (0.75, 0.44, 0.00, 1.38); *Euploea mulciber (*0.31, 2.44, 2.19, 0.13); *Cirrochroa aoris* (0.25, 0.75, 0.38, 0.38) (Fig. 4.20B). All of them showed highest abundance either in pre monsoon or monsoon period as this was the season of growing flowering plants and leafy crops. But in case of *Junonia hierta* it had been observed that their presence in only during monsoon and ret. monsoon period indicated that they couldnot accept high seasonal variation. *Junonia almana* and *Cethosia cyane* couldnot be found during winter season also. This showed that they might migrate from the area due to change in climate or habitat. .

Only one very rare species had been identified in the family Nymphalidae during the entire study period. This species was *Tirumala septentrionis* which had high abundance during monsoon and lowest abundance during winter season. Although they were present throughout the year but their frequency of occurrence was very less.

Fig. 4.19. :-Abundance and % of frequency occurrence of the familyNymphalidae at the site II (South Amchang)

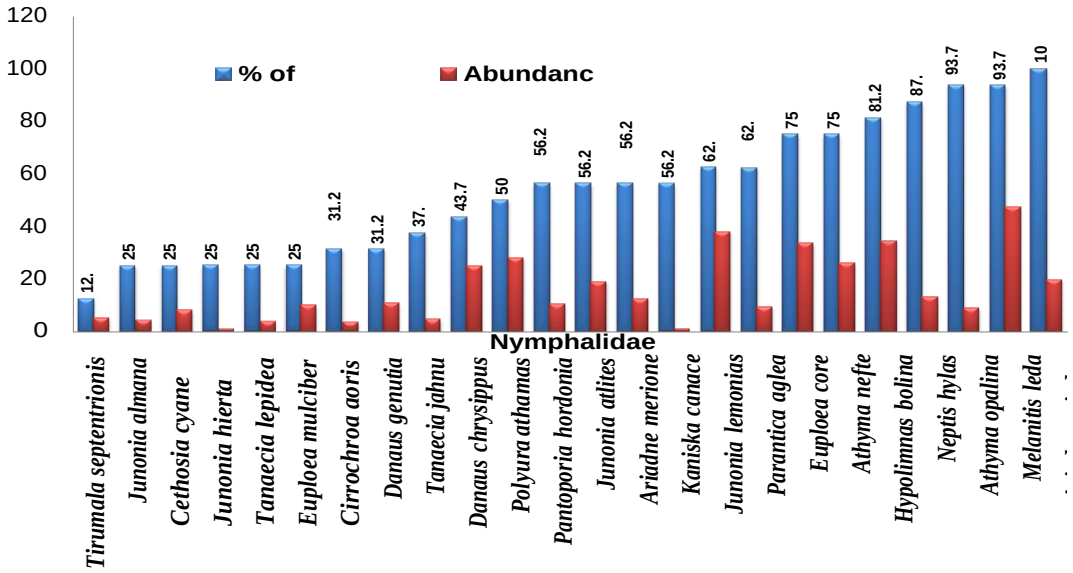


Fig. 4.20A. :-Seasonal abundance of the family Nymphalidae at the site II (South Amchang) during the study year 2014

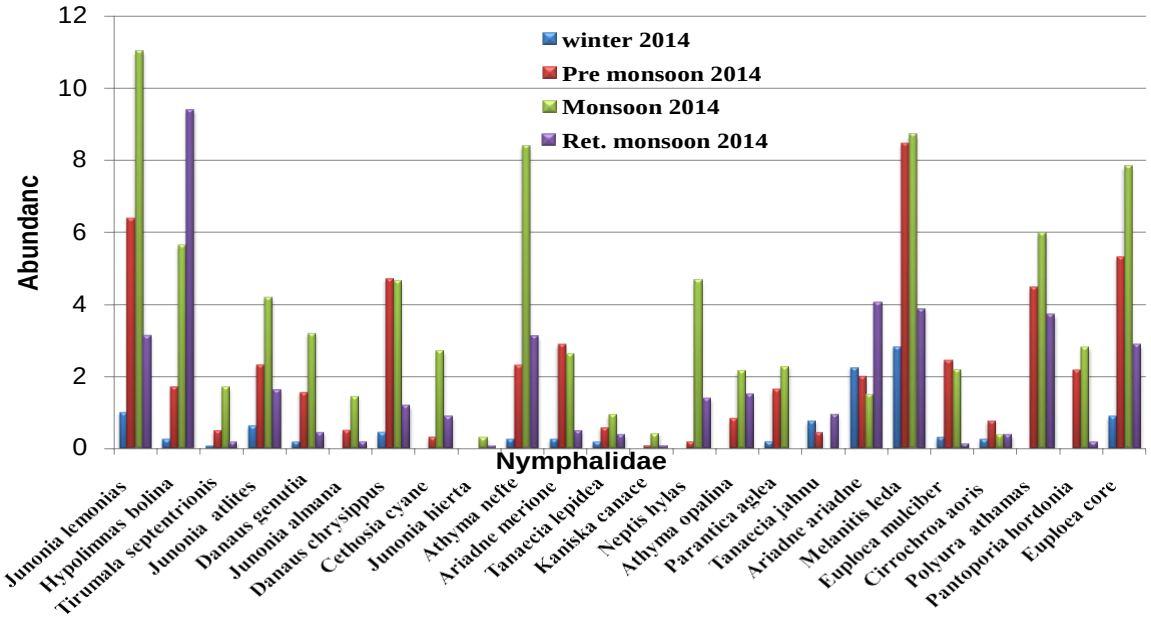
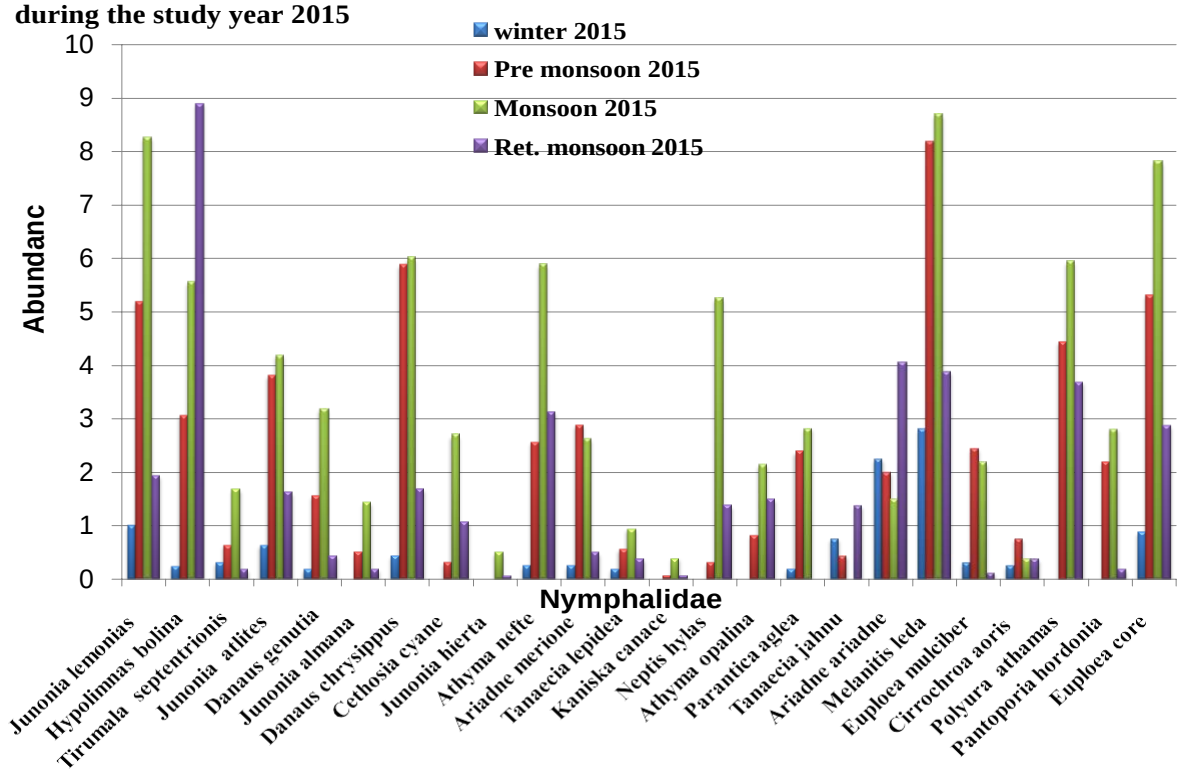


Fig.4.20B. :-Seasonal abundance of the family Nymphalidae at the site II (South Amchang) during the study year 2015



Abundance, % of frequency occurrence and density of butterfly of the family Pieridae at the site II (South Amchang)

A total number of nine species were recorded and identified during the entire study period. Three species were categorised as very common; four common and only two were occasional. Their frequency of occurrence and abundance were as follows – *Catopsilia pyranthe* (87.5%, 28.19); *Eurema hecabe* (75%, 19.88); *Catopsilia crocale (*75%, 17.13); *Pieris canidia (*68.75%, 7.88); *Delias descombesi* (56.25%, 10.88); *Delias eucharis (*100%, 9.00); *Leptosia nina (*93.75%, 36.19); *Catopsilia pomona (*43.75%, 10.63) and *Appias libythea (*62.5%, 34.44) (Fig. 4.21). *Leptosia nina (*36.19) had highest abundance and *Pieris canidia* (7.880) had shown lowest abundance. All species of the Pieridae family had been observed throughout the year.

While analysing seasonal abundance, out of three very common species (*Catopsilia pyranthe, Delias eucharis and Leptosia nina)* (Fig.4.21A & 4.21B) *Leptosia nina* had shown highest abundance during monsoon season and density of other two species reached peak value during ret.monsoon of both the study years. Four numbers common species *Eurema hecabe, Catopsilia crocale, Pieris canidia* and *Appias libythea* were also represented high abundance during monsoon period. Their presence throughout the year indicated that they were susceptible to all kind of environmental changes. Population densities of all species were gradually decline from the middle part of ret.monsoon. Both the occasional species (*Delias descombesi and Catopsilia pomona)* were totally absent during winter season. Fig.4.21A&4.21B indicated that butterfly species were more or less evenly distributed in terms of abundance.

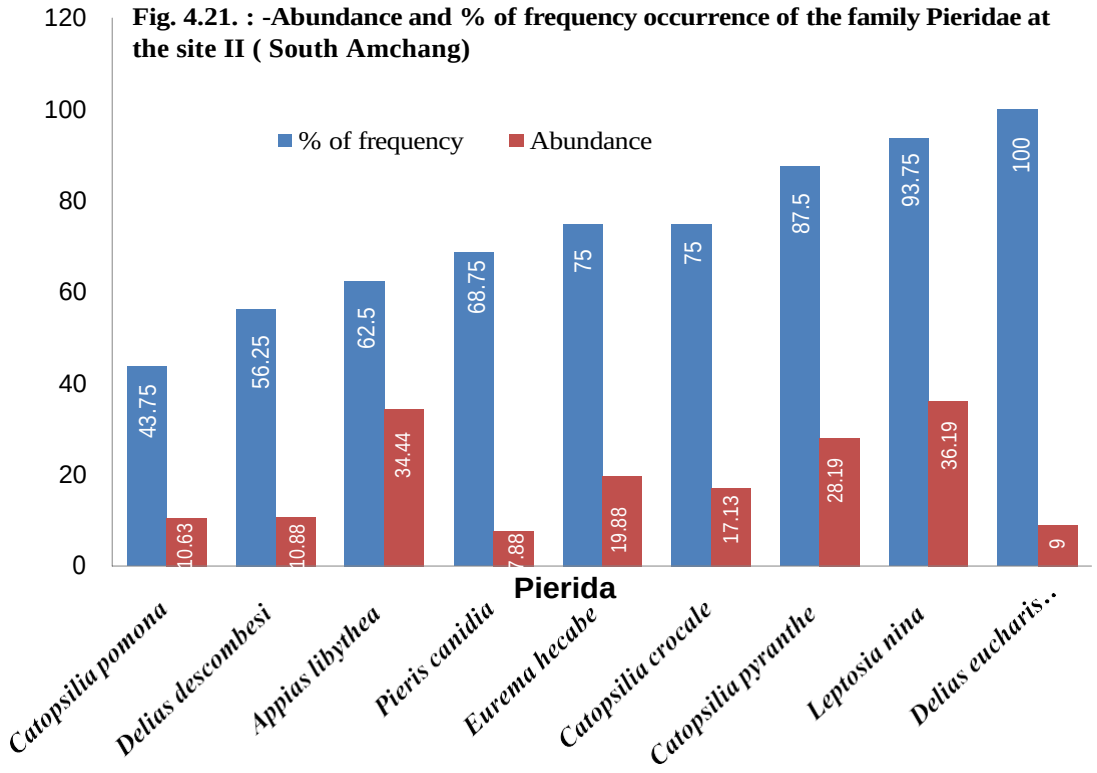


Fig. 4.21. : -Abundance and % of frequency occurrence of the family Pieridae at the site II (South Amchang)

Fig. 4.21A. :-Seasonal abundance of the family Pieridae at the site II (South Amchang) during the year 2014

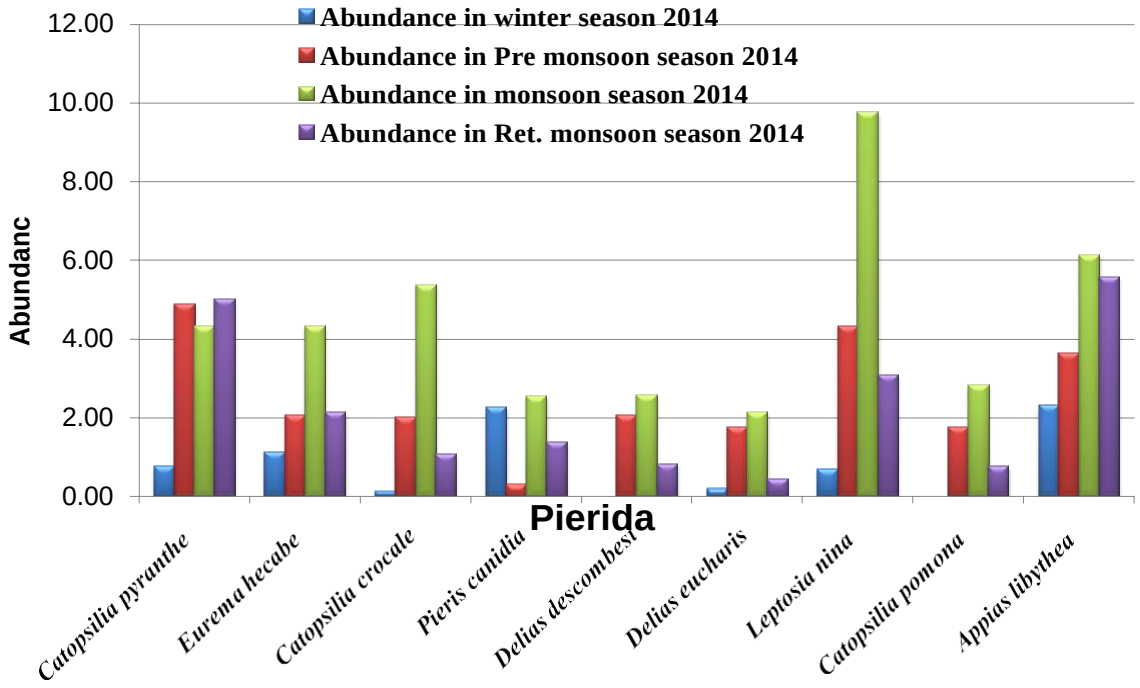
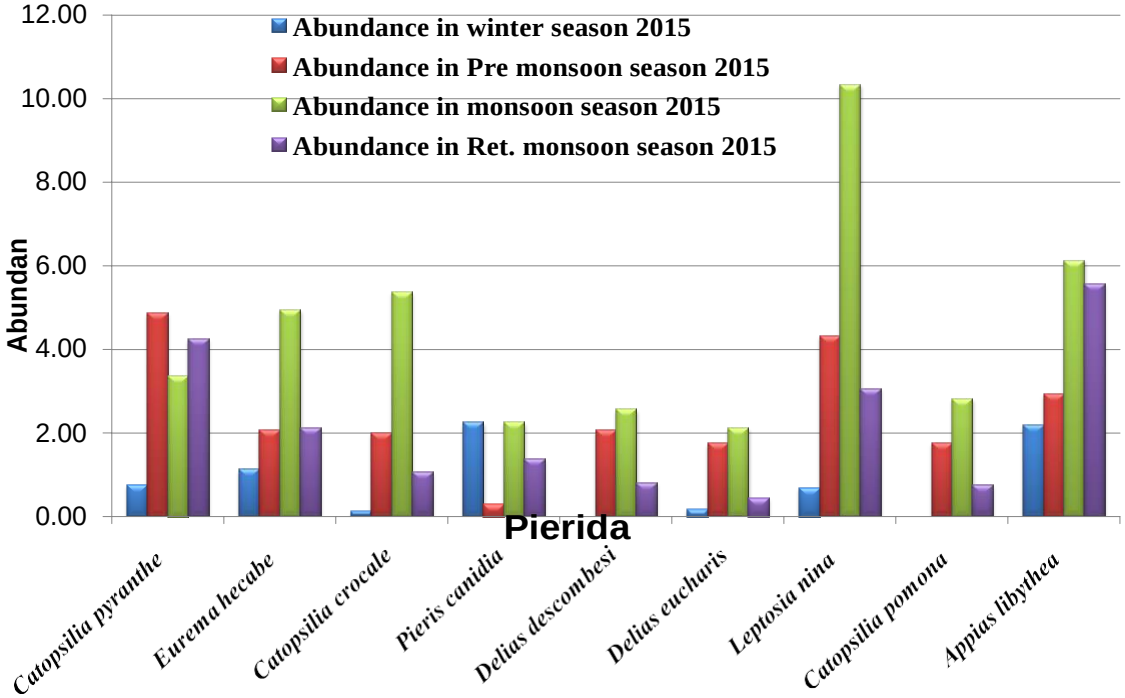


Fig. 4.21B.:-Seasonal abundance of the family Pieridae at the site II (South Amchang) during the year 2015



4.3.2.4 Abundance, % of frequency occurrence and density of butterfly of the family Lycaenidae at the site II (South Amchang)

Only three species of this family were recorded and their frequency and abundance were *Anthene emolus (*31.25, 3.63)*; Rapala pheretima (*25, 4.38) and *Castalius rosimon (*25, 7.69) respectively (Fig.4.22). All of them were catagorised in rare species. Their seasonal abundance sucesseasibly winter, pre monsoon, monsoon and ret.monsoon were as follows *;- Anthene emolus* (0.00, 0.56, 1.00, 1.88 in the year 2014 and 2.56, 1.13, 3.50, 1.00 in the year 2015), *Rapala pheretima (*0.00, 1.38, 0.81, 2.44 during the year 2014 and 1.38,1.69, 2.75, 1.19 during the year 2015), *Castalius rosimon (*0.00, 0.94,1.69,0.00 during the year 2014 and 0.00, 1.75, 3.31, 0.00) during the year 2015 (Fig. 4.22A). All of them were found silent during winter season whereas *Castalius rosimon* was active only on pre monsoon and monsoon seasons. Thus abundance of butterfly species during monsoon season varied significantly as compared to other seasons.

Fig.4.22.:-Abundance and frequency of occurrence of the family Lycaenidae and Satyridae at the site II (South Amchang)

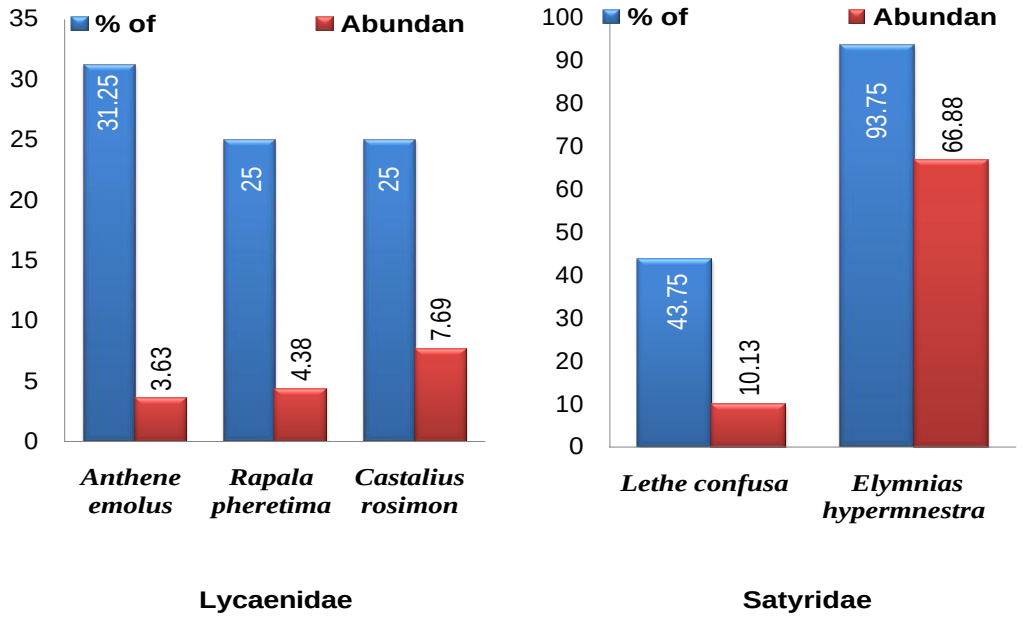
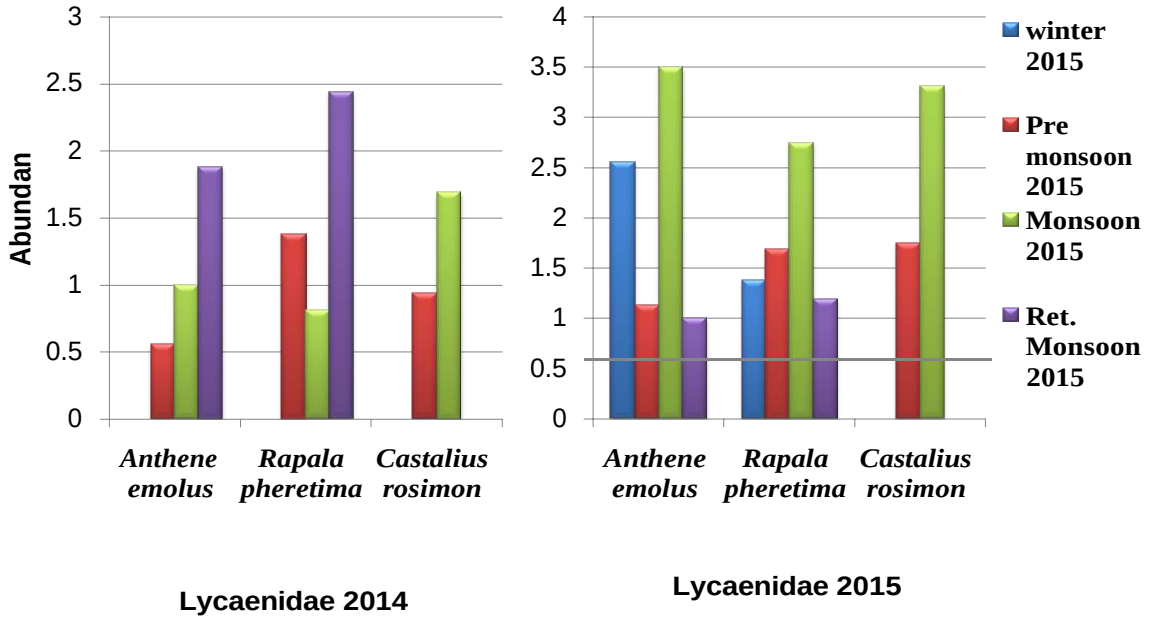


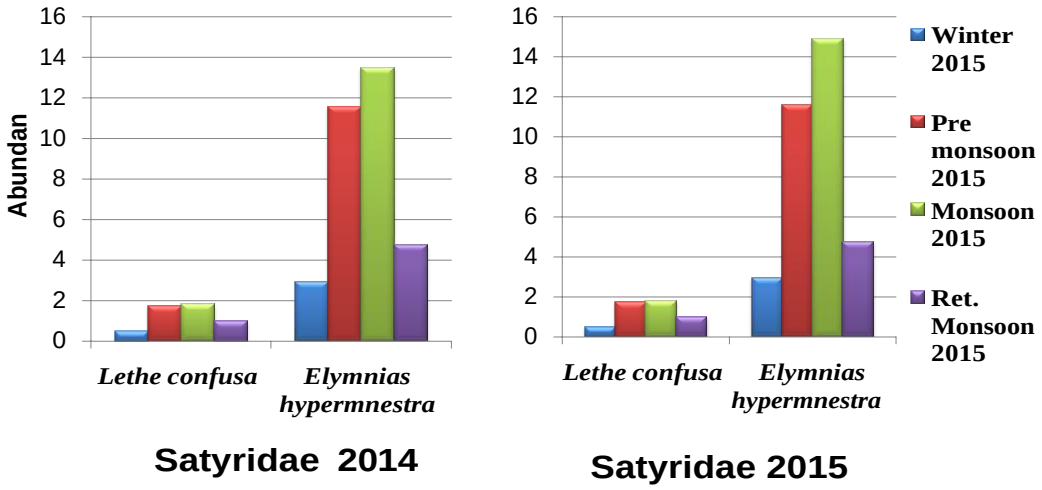
Fig.4.22A.:-Seasonal abundance of the family Lycaenidae at the site II (South Amchang) during the year 2014& 2015



4.3.2.5 Abundance, % of frequency occurrence and density of butterfly of the family Satyridae at the site II (South Amchang)

Only two species were recorded and they were *Lethe confusa and Elymnias hypermnestra*. Frequency of occurrence and abundance of *Elymnias hypermnestra* were 93.75% and 66.88 which was categorised as occasional species. The other species *Lethe confusa* had shown lower abundance. Both the species occurred throughout the year but their abundance was higher in monsoon period than other season (Fig. 4.22 & 4.22B).

Fig. 4.22B. :-Seasonal abundance of the family Satyridae at the site II (South Amchang) during the year 2014& 2015



4.3.3. Diversity and Richness at the site II (South Amchang)

The richness indices analysis indicated that, in this landscape the family Nymphalidae was the richest family with 24 species (R_1 =2.6413 R_2 =0.3086), followed by Pieridae with nine species (R_1 =1.0085; R_2 =0.1705), Lycaenidae with three species (R_1 =0.3620; R_2
=0.1894), Papilionidae with 9 species (R_1 =1.0928, R_2 =0.2315) and Satyridae with two species (R_1 =0.1405, R_2 =0.0570 (Table 4.12) .

Family Papilionidae recorded the following values – Simpson‟s Index=0.1686; Shannon-Weiner index=1.9454; Hill‟s Diversity Number N_1 =6.9947; N_2 = 5.9324; Evenness index E=0.8480. .

Family Pieridae recorded the following values – Simpson‟s index=0.14340; Shannon-Weiner index=2.05441; Hill‟s Diversity Number N_1 =7.80050; N_2 = 6.97400; Evenness index E= 0.8940.

Family Nymphalidae recorded the following values – Simpson‟s index=0.0688; Shannon-Weiner index=2.8604; Hill‟s Diversity Number N_1 =17.4630; N_2 =14.5340; Evenness index E=0.8323.

Family Lycaenidae recorded the following values Simpson‟s index=0.3713; Shannon-Weiner index=1.0442; Hill‟s Diversity Number N_1 =2.8408; N_2 =2.6932; Evenness index E= 0.9481. Family Satyridae recorded the following values - Simpson‟s index=0.7716; Shannon-Weiner index=0.3892; Hill‟s Diversity Number N_1 = 1.4758; N_2 = 1.296; Evenness index E=0.8782

Table 4.12 Family-wise diversity indices of butterflies at the site II (South Amchang)

	Papilionidae	**Nymphalidae**	**Pieridae**	**Lycaenidae**	**Satyridae**
		Richness			
S	9	24	9	3	2
R_1	1.0928	2.6413	1.0085	0.362	0.1405
R_2	0.2315	0.3086	0.1705	0.1894	0.057
		Diversity			
ƛ	0.1686	0.0688	0.1434	0.3713	0.7716
H"	1.9454	2.8604	2.05441	1.0442	0.3892
N_1	6.9947	17.463	7.8005	2.8408	1.4758
N_2	5.9324	14.534	6.974	2.6932	1.296
		Evenness			
E	0.848	0.8323	0.894	0.9481	0.8782

The Shannon-Weiner index for South Amchang is well documented month-wise in Table 4.13. The family Papilionidae showed moderate diversity index almost all the months studied except few months such as November and December 2014 & 2015 (0.6931, 0.5623, 0.9503, 0.5623). The highest diversity index was observed during the months of July of both the years (1.9875, 2.0342).

In the family Pieridae, moderate diversity index was observed during some months such as November, December and January of both the years of study (1.3762, 1.3819, 1.3752, 1.3820) while most of the months showed high diversity index such as during March, April, June, July and August (1.718 to 1.918). The highest diversity index was observed during the month of May of both the years (2.0407, 2.0407).

The family Nymphalidae showed high diversity index during most of the months studied except December and January of both year (1.9355, 1.8157 and1.9355, 1.8155). The highest diversity index was observed during the months of June, July and August (2.7422, 2.7566, 2.7682, 2.7827, and 2.8003).

The family Lycaenidae also showed moderate diversity index almost all the months studied except the months of October, November, December and January during which the diversity index was (indicated "0") very least. The maximum diversity index was observed during the month of July (0.3126, 0.3772).

The family Satyridae showed least diversity index in most of the months when compared to other families. Very few months showed moderate diversity index. The least diversity index was observed during the month of December 2014 (0.2712) and the highest diversity index was observed during the month of September.

Table 4.13. Month-wise Shannon-Weiner Index computed for the butterflies in the South Amchang .

	2014												2015											
Family	**Jan**	**Feb**	**March**	**April**	**May**	**June**	**July**	**Augus**	**Sept**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**March**	**April**	**May**	**June**	**July**	**Augus**	**Sept**	**Oct**	**Nov**	**Dec**
Papilionida	1.0114	1.4127	1.7216	1.9017	1.9776	1.9597	1.9875	1.5999	1.2575	1.5444	0.6931	0.5623	0.9763	1.4143	1.7626	1.948	1.8517	1.9167	2.0342	1.631	1.6547	1.4986	0.9503	0.5623
Nymphalida	1.9355	2.2131	2.5376	2.5993	2.6497	2.7422	2.7566	2.9302	2.6007	2.3864	2.1874	1.8157	1.9355	2.269	2.521	2.6367	2.6825	2.7682	2.7827	2.8003	2.6594	2.4687	2.1874	1.8155
Pierida	1.6417	1.561	1.7218	1.762	2.0407	1.9805	1.8854	1.8007	1.9118	1.7658	1.3762	1.3819	1.5963	1.5765	1.7715	1.7462	2.0407	2.0025	1.8621	1.8007	1.9113	1.8118	1.3762	1.3819
Satyrida	0.5004	0.4195	0.2827	0.4227	0.4101	0.3966	0.3622	0.2911	0.5297	0.4869	0.2954	0.2712	0.5007	0.4195	0.2927	0.2928	0.4227	0.4201	0.3977	0.3622	0.2213	0.5297	0.4967	27.13
Lycaenid	0	0.0605	0.0660	0.1409	0.2284	0.3006	0.3126	0.2187	0.1309	0.1058	0	0	0.0385	0.0529	0.1265	0.1694	0.3863	0.3966	0.3772	0.2408	0.0914	0	0	0

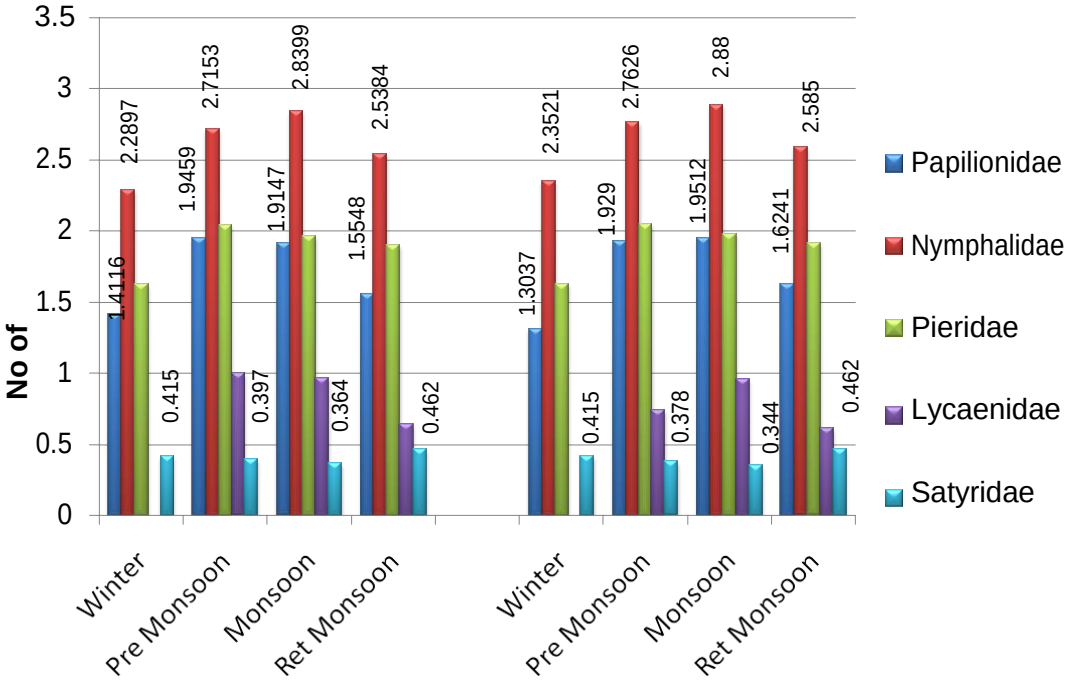
Analysing this above index it had been observed that gradually the diversity and richness picked up from pre monsoon onwards in almost all families studied and it reached peak during monsoon and then faces the declining trend from ret.monsoon onwards. The trend is very clearly expressed in the Figure 4.23. Among the five families studied, the family Nymphalidae showed the best representation in almost all seasons than other families. It showed best richness (R_1 = 2.6413, R_2 =0.3086) highest diversity ɥ =0.0688 (H"=2.806, highest abundance N_1 =17.4630, N_2 = 14.534) while the family Satyridae showed least representation during all the seasons.

Season-wise Shannon-Weiner Index (Table 4.14, Fig. 4.23) of South Amchang indicated that the diversity of butterfly population was very high during pre monsoon (Papilionidae=1.9459, Pieridae=2.0405, Nymphalidae= 2.7153, Lycaenidae=0.9950 and Satyridae=0.3967) and ret. monsoon indices were (Papilionidae=1.5548, Pieridae =1.9010, Nymphalidae=2.5384, Lycaenidae=0.6365 and Satyridae=0.4620) while it showed moderate level during monsoon (Papilionidae=1.9147, Pieridae=1.9641, Nymphalidae=2.8399, Lycaenidae=0.9637 and Satyridae = 0.3637) and very poor diversity during the winter season (Papilionidae=1.4116, Pieridae=1.6235, Nymphalidae=2.2897, Lycaenidae=0, and Satyridae=0.4147).

Table 4.14 Season-wise observation of Shannon Index in South Amchang

	For the year 2014				**For the year 2015**			
	Winter	Pre monsoon	Monsoon	Ret monsoon	Winter	Pre monsoon	Monsoon	Ret monsoon
Papilionidae	1.4116	1.9459	1.9147	1.5548	1.3037	1.929	1.9512	1.6241
Nymphalidae	2.2897	2.7153	2.8399	2.5384	2.3521	2.7626	2.88	2.585
Pieridae	1.6235	2.0405	1.9641	1.901	1.6243	2.0442	1.9756	1.9135
Lycaenidae	0	0.995	0.9637	0.6365	0	0.7418	0.9538	0.6058
Satyridae	0.4147	0.3967	0.3637	0.462	0.4147	0.3779	0.3436	0.462

Fig. 4.23 Season-wise distribution of butterfly population in the Site II(South Amchang)



Butterfly diversity and occurrence at the site III (Bonda)

Species of butterflies at the site III (Bonda)

42 species of butterflies of five families were recorded at the Bonda study site during the entire study period. The percentage of individuals for each family with their common name and scientific name were given in Table 4.15.

Table 4.15. Family-wise list of butterflies recorded at the Site III (Bonda) and percentage

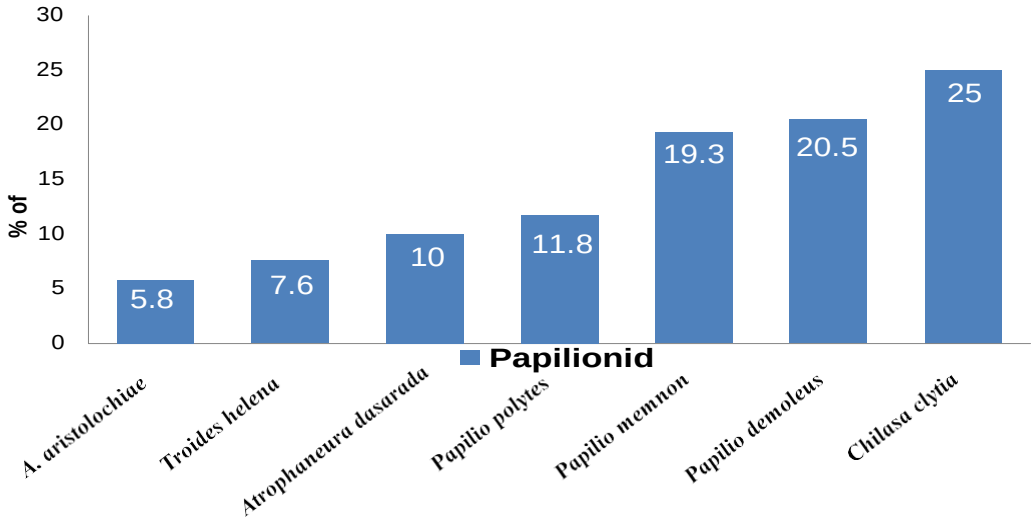
Family	S.L No	Scientific name	Abbreviation	Common name	% of contribution
Papilionidae	1	*Papilio polytes* Linnaeus,1758	PA1	Common Mormon	11.8
	2	*Troides helena* Linnaeus,1758	PA2	Common Birdwing	7.6
	3	*Atrophaneura dasarada* (Moore,1857)	PA3	Great Windmill	10
	4	*Atrophaneura aristolochiae* Fabricius,1775	PA4	Common Rose	5.8
	5	*Papilio demoleus* Linnaeus,1758	PA5	Lime Butterfly	20.5
	6	*Chilasa clytia* Linnaeus,1758	PA6	Common Mime	25
	7	*Papilio memnon* Linnaeus, 1758	PA7	Great Mormon	19.3
Nymphalidae	1	*Junonia lemonias* Linnaeus,1758	N1	Lemon Pansy .	9.7
	2	*Hypolimnas bolina* Linnaeus ,1758	N2	Great Eggfly	6.1
	3	*Tirumala septentrionis* Butler,1874	N3	Dark Blue Tiger	3
	4	*Junonia atlites* Linnaeus,1763	N4	Grey Pansy	4.5
	5	*Danaus genutia* Cramer,1779	N5	Striped Tiger	7.4
	6	*Junonia almana* Linnaeus,1758	N6	Peacock Pansy	3.5
	7	*Danaus chrysippus* Linnaeus, 1758	N7	Plain Tiger	4
	8	*Cethosia cyane* Drury,1770	N8	Leopard Lacewing	4.4
	9	*Junonia hierta* Fabricius,1798	N9	Yellow Pansy	1
	10	*Athyma nefte* Cramer,1779	N10	Colour Sergeant	17.6
	11	*Ariadne merione* Cramer1777	N11	Common Castor	1.9
	12	*Tanaecia lepidea* Butler,1868	N12	Grey Count	1.3
	13	*Neptis hylas* Linnaeus,1758	N13	Common Sailer	3.8
	14	*Athyma opalina* Kollar,1844	N14	Himalayan Sergeant	3
	15	*Parantica aglea* Moore,1883	N15	Glassy Tiger	1.8
	16	*Tanaecia jahnu* Moore,1857	N16	Plain Earl	1.6

	17	*Ariadne ariadne* Linnaeus,1763	N17	Angled Castor	4.1
	18	*Melanitis leda* Linnaeus,1758	N18	Common Evening Brown	7.2
	19	*Cirrochroa aoris* Doubleday,1778	N19	Large Yeoman	3.9
	20	*Pantoporia hordonia* Stoll,1790	N20	Common Lascar	2.7
	21	*Euploea core* Cramer,1780	N21	Common Crow	6.6
	22	*Junonia iphita* Cramer,1779	N22	Chocolate Pansy	0.8
Pierida	1	*Catopsilia pyranthe* Linnaeus,1758	P1	Mottled Emigrant	22.7
	2	*Eurema hecabe* Linnaeus,1758	P2	Common Grass Yellow.	16.7
	3	*Catopsilia crocale* Cramer,1775	P3	Common Emigrant	6.6
	4	*Pieris canidia* Sparrman,1768	P4	Indian Cabbage White	8.2
	5	*Delias descombesi* Boisduval,1836	P5	Red-spot jezebel	4.9
	6	*Delias eucharis* Drury,1773	P6	Common jezebel	3.1
	7	*Leptosia nina* Fabricius,1793	P7	Psyche	18.9
	8	*Catopsilia pomona* Fabricius,1775	P8	Common Emigrant	6
	9	*Appias libythea* Fabricius,1775	P9	Striped Albatross	12.9
Lycaenid	1	*Anthene emolus (*Godart,1824)	L1	Common Ciliate Blue	45.1
	2	*Castalius rosimon* Fabricius,1775	L2	Common Pierrot	54.9
Satyridae	1	*Lethe confusa* Aurivillius,1898	S1	Banded Tree Brown	34.2
	2	Elymnias hypermnestra Linnaeus, 1763	S2	Common Palmfly	65.8

Papilionidae: -

Seven species of Papilionidae butterflies were recorded during the entire study period (Table 4.15). Among the 7 species observed, the *Chilasa clytia* (PA6) was the most highly distributed species with 25% followed by *Papilio demoleus* (PA5) with 20.5%*; Papilio memnon* (PA7) with 19.3%; *Papilio polytes* (PA1) with 11.8%; *Atrophaneura dasarada* (PA3) with 10%; *Troides helena* (PA2) with 7.6% and the least distributed species was *Atrophaneura aristolochiae* (PA4) with 5.8% respectively.(Fig. 4.24).

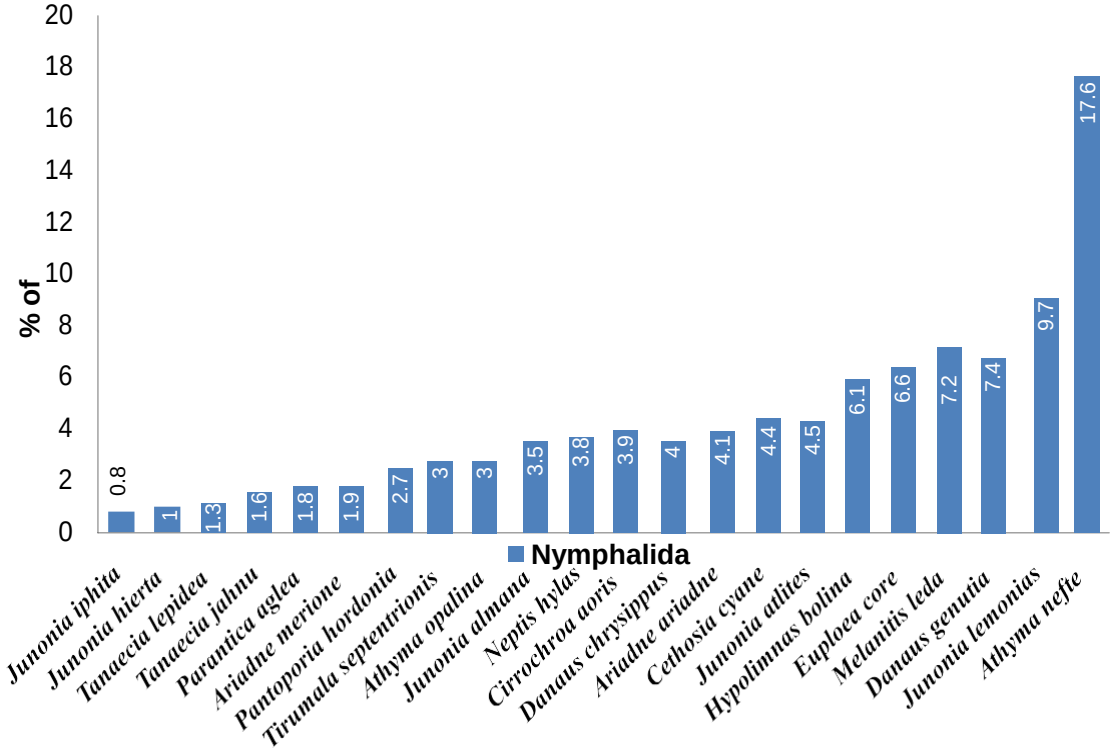
Fig. 4.24.:- Percentage contribution of different species of the family Papilionidae at the site III(Bonda) during the study period



Nymphalidae:-

Twenty two species of butterflies were recorded during the entire study period (Table 4.15). Among them, *Athyma nefte* (N10) was the most highly distributed specie with 17.6% of individuals followed by *Junonia lemonias* (N1) with 9.7%, *Hypolimnas bolina* (N2) with 6.1%, *Tirumala septentrionis* (N3) with 3%, *Junonia atlites* (N4) with 4.5%, *Danaus genutia* (N5) with 7.4%, *Junonia almana* (N6) with 3.5%, *Danaus chrysippus* (N7) with 4%, *Cethosia cyane* (N8) with 4.4%, *Junonia hierta (*N9) with 1%, *Ariadne merione* (N11) with 1.9%, *Tanaecia lepidea* (N12) with 1.3%, *Neptis hylas* (N13) with 3.8%, *Athyma opalina* (N14) with 3%, *Parantica aglea* (N15) with 1.8%, *Tanaecia jahnu* (N16) with 1.6%, *Ariadne ariadne (*N17) with 4.1%, *Melanitis leda* (N18) with 7.2%, *Cirrochroa aoris (*N19) with 3.9%, *Pantoporia hordonia (*N20) with 2.7% and *Euploea core* (N21) with 6.6% respectively. The species *Junonia iphita (*N22) was the least distributed species with 0.8% (Fig.4.25).

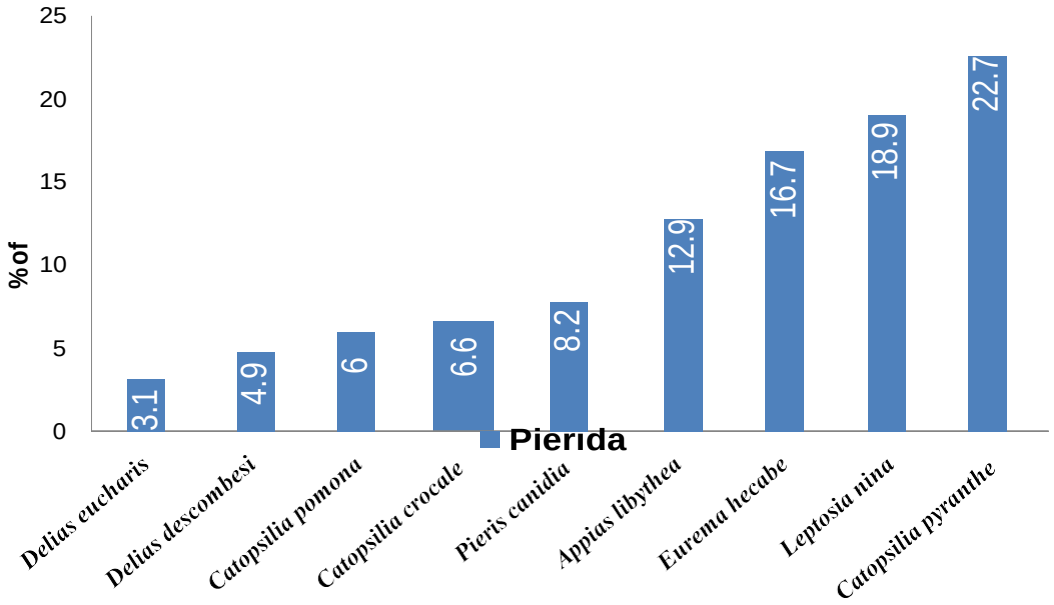
Fig. 4.25. Percentage contribution of different species of the family Nymphalidae at the site III (Bonda).



Pieridae:-

Nine species of pieridae butterflies were recorded during the entire study period (Table 4.15). Among them, *Catopsilia pyranthe* (P1) was the most highly distributed species with percentage contribution 22.7% followed by *Leptosia nina* (P7) with 18.9%, *Eurema hecabe* (P2) with 16.7%, *Catopsilia crocale* (P3) with 6.6%, *Pieris canidia (*P4) with 8.2%, *Delias descombesi* (P5) with 4.9% and *Appias libythea* (P9) with 12.9% respectively. The species *Delias eucharis* (P6) was the least distributed one (Fig. 4.26) and its contribution was only 3.1%.

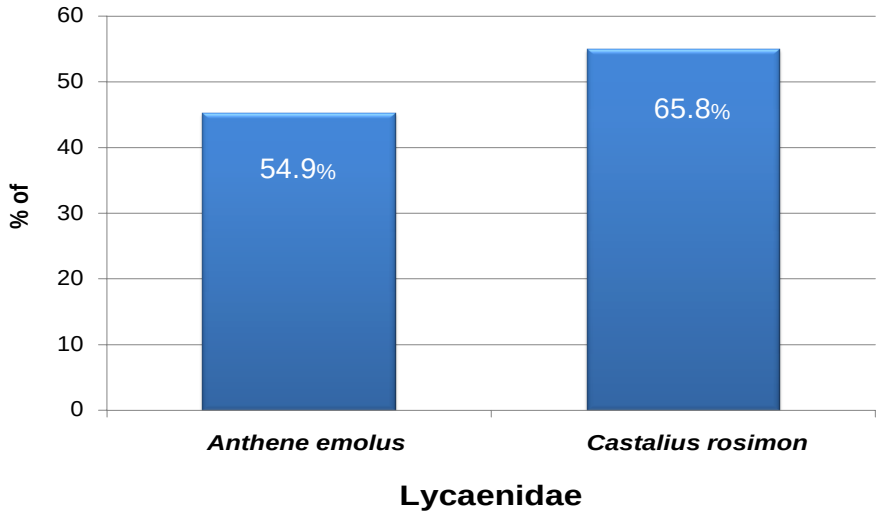
Fig. 4.26. :-Percentage contribution of different species of the family Pieridae at the site III (Bonda).



Lycaenidae:-

Only two species of Lycaenidae butterflies were recorded during the entire study period (Table 4.15). They were *Anthene emolus (*L1) with 45.1% and *Castalius rosimon* (L2) with 54.9%. Between them, the *Castalius rosimon* (L2) was the most highly distributed species with more numbers of individuals (Fig. 4.27.).

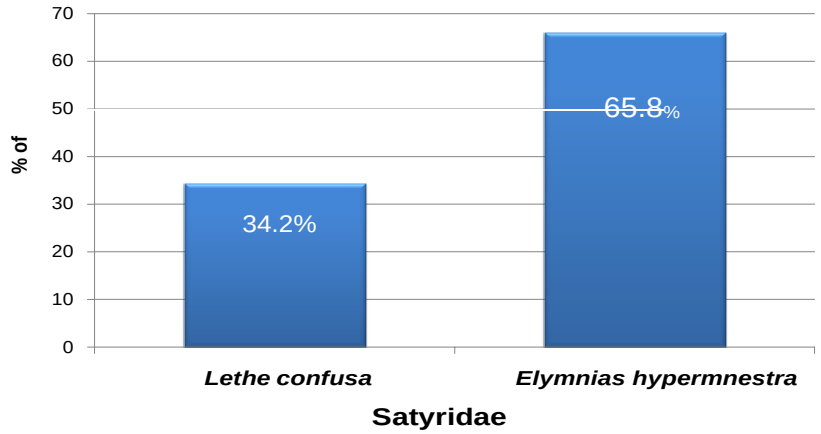
Fig. 4.27. Percentage contribution of different species of the family Lycaenidae at the site III (Bonda)



Satyridae:-

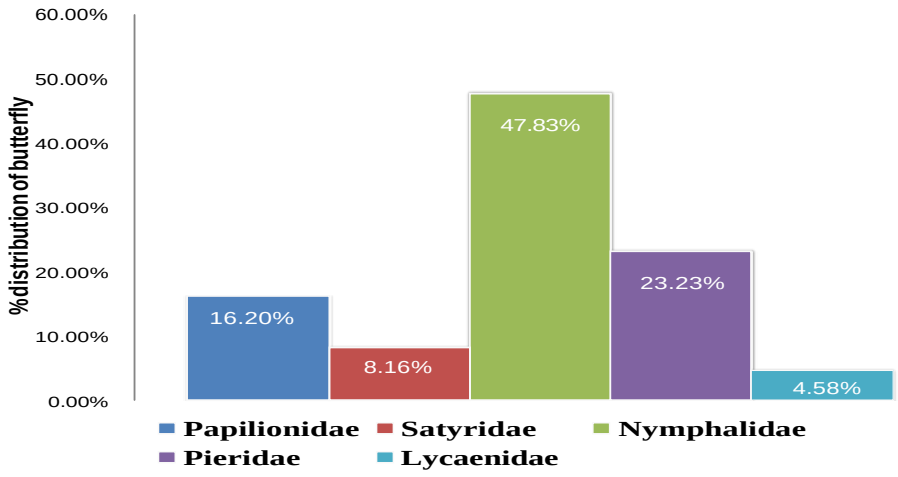
Only two species of Satyridae butterflies were recorded during the entire study period (Table 4.15). They were *Lethe confuse* (S1) with 34.2% and *Elymnias hypermnestra* (S2) with 65.8% (Fig. 4.28).

Fig. 4.28. Percentage contribution of different species of the family Satyridae at the site III (Bonda)



In the Bonda site, most of the members belong to the family Nymphalidae and was highly distributed family with more numbers of individuals. This was followed by Pieridae, Papilionidae, Lycaenidae and Satyridae (Table 4.15). The percentage contribution of the family Papilionidae was 16.2%; Pieridae 23.23%; Nymphalidae 47.83%; Lycaenidae 4.58% and Satyridae 8.16% respectively (Fig. 4.29).

Fig. 4.29 Percentage contribution of different families of butterflies at the site III (Bonda)



Butterfly diversity, abundance and occurrence at the site III (Bonda)

Total 42 numbers of butterfly species had been identified in this area during the study period. Out of these, 7 species belonged to the family of Papilionidae, 22 belonged to the family Nymphalidae, 9 belonged to the family Pieridae, 2 in the family Lycaenidae and only two belonged to Satyridae family. On the basis of frequency of occurrence, these species had been categorized into five different classes i.e. very common (80-100%), common (60-80%), occasional (40-60%), rare (20-40%) and very rare (0-20%). 21 species represented very common, 8 common, 10 occasional, and only 3 nos represented rare species.

Table no: - 4.16 Frequency of occurrence, Species density and Abundance of butterfly at the site III (Bonda)

Family	S L. No	Scientific name	% of frequency	Density (nos per sq. meter)	Abundance	Occurance
Papilionidae	1	*Papilio polytes*	75	0.000375	23.44	Common
	2	*Troides helena*	62.5	0.000244	15.25	Common
	3	*Atrophaneura dasarada*	81.25	0.000319	19.94	Very Common
	4	*Atrophaneura aristolochiae*	62.5	0.000186	11.63	Common
	5	*Papilio demoleus*	93.75	0.000653	40.81	Very Common
	6	*Chilasa clytia*	93.75	0.000797	49.81	Very Common
	7	*Papilio memnon*	87.5	0.000616	38.50	Very Common
Nymphalidae	1	*Junonia lemonias*	100	0.000916	57.25	Very Common
	2	*Hypolimnas bolina*	93.75	0.000578	36.13	Very Common
	3	*Tirumala septentrionis*	56.25	0.000278	17.38	Occasional
	4	*Junonia atlites*	68.75	0.000427	26.69	Common
	5	*Danaus genutia*	87.5	0.000698	43.63	Very Common
	6	*Junonia almana*	56.25	0.000333	20.81	Occasional
	7	*Danaus chrysippus*	50	0.000375	23.44	Occasional
	8	*Cethosia cyane*	43.75	0.000419	26.19	Occasional
	9	*Junonia hierta*	43.75	0.000091	5.69	Occasional
	10	*Athyma nefte*	100	0.00166	103.7	Very common
	11	*Ariadne merione*	25	0.000178	11.13	Rare
	12	*Tanaecia lepidea*	56.25	0.000125	7.81	Occasional
	13	*Neptis hylas*	56.25	0.000354	22.13	Occasional
	14	*Athyma opalina*	25	0.000282	17.63	Rare
	15	*Parantica aglea*	56.25	0.000173	10.81	Occasional

	16	*Tanaecia jahnu*	87.5	0.000155	9.69	Very Common
	17	*Ariadne ariadne*	93.75	0.000387	24.19	Very Common
	18	*Melanitis leda*	93.75	0.000679	42.44	Very Common
	19	*Cirrochroa aoris*	37.5	0.000366	22.88	Rare
	20	*Pantoporia hordonia*	100	0.000254	15.88	Very Common
	21	*Euepolea core*	93.75	0.000619	38.69	Very Common
	22	*Junonia iphita*	50	0.000073	4.56	Occasional
Pieridae	**1**	*Catopsilia pyranthe*	100	0.001038	64.88	Very Common
	2	*Eurema hecabe*	68.75	0.000762	47.63	Common
	3	*Catopsilia crocale*	87.5	0.000304	19.00	Very Common
	4	*Pieris canidia*	75	0.000377	23.56	Common
	5	*Delias descombesi*	87.5	0.000225	14.06	Very common
	6	*Delias eucharis*	75	0.000143	8.94	Common
	7	*Leptosia nina*	75	0.000863	53.94	Common
	8	*Catopsilia pomona*	50	0.000274	17.13	occasional
	9	*Appias libythea*	100	0.00059	36.88	Very common
Lycaenidae	**1**	*Anthene emolus*	100	0.000407	25.44	Very common
	2	*Castalius rosimon*	93.75	0.000496	31.00	Very common
Satyridae	**1**	*Lethe confusa*	81.25	0.000549	34.31	Very common
	2	*Elymnias hypermnestra*	100	0.001058	66.13	Very common

Table No:-4.16A. Seasonal abundance of butterfly species in the site II (Bonda)

Seasonal abundance of butterfly species in the Bonda study site			**Abundance Year 2014**				**Abundance Year 2015**			
Family	**SL. No**	**Scientific name**	**Winter**	**Pre monsoon**	**Monsoon**	**Ret. Monsoon**	**Winter**	**Pre monsoon**	**Monsoon**	**Ret. Monsoon**
Papilionidae	**1**	*Papilio polytes*	0.50	3.06	5.25	1.56	0.56	3.44	6.06	3.06
	2	*Troides helena*	0.13	3.94	2.81	2.56	0.00	2.00	3.00	0.81
	3	*Atrophaneura dasarada*	0.00	2.31	4.81	4.31	0.06	1.94	4.31	2.19
	4	*Atrophaneura aristolochiae*	0.00	1.94	2.94	0.75	0.31	2.00	2.94	0.75
	5	*Papilio demoleus*	1.00	5.69	9.69	4.56	1.19	5.69	8.94	3.88
	6	*Chilasa clytia*	0.50	10.69	11.19	2.75	0.38	10.31	11.25	2.75

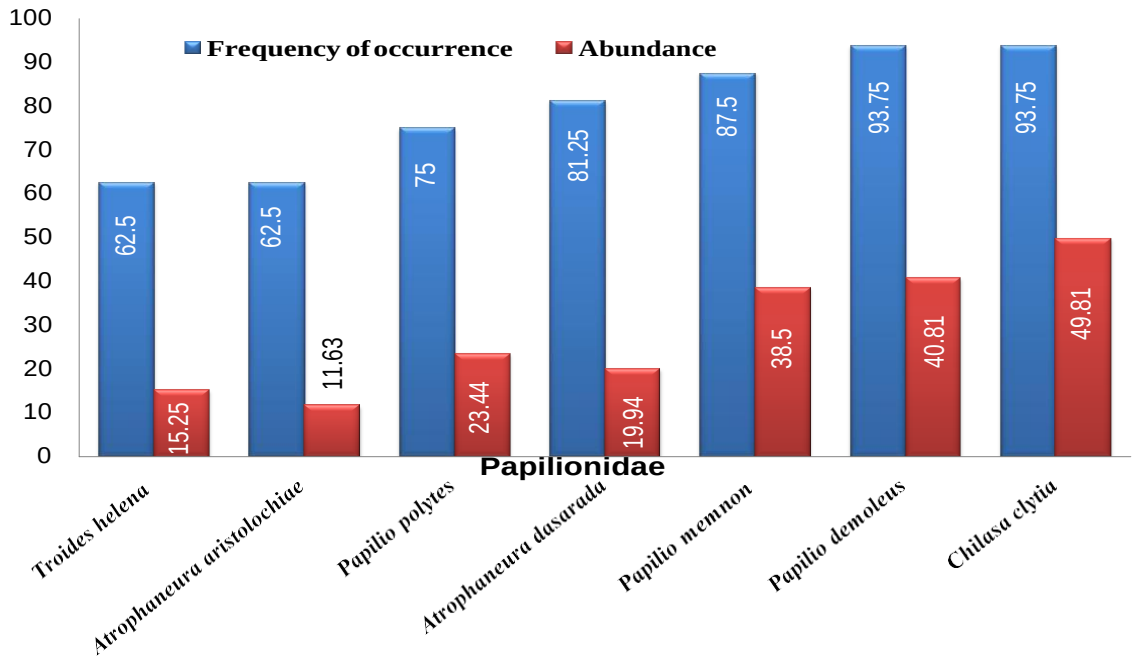
	7	*Papilio memnon*	0.06	6.13	8.38	4.38	0.06	6.13	8.25	5.19
Nymphalidae	**1**	*Junonia lemonias*	3.06	9.69	11.63	6.25	2.38	9.06	10.63	4.56
	2	*Hypolimnas bolina*	0.19	1.69	5.63	9.38	0.19	2.63	7.31	9.13
	3	*Tirumala septentrionis*	0.19	0.50	6.31	0.88	0.31	1.25	6.81	1.13
	4	*Junonia atlites*	0.63	2.31	4.19	5.06	0.31	3.81	4.19	6.19
	5	*Danaus genutia*	0.38	5.13	9.56	6.38	0.31	4.38	11.94	5.56
	6	*Junonia almana*	0.00	2.38	5.31	2.88	0.00	1.00	4.63	4.63
	7	*Danaus chrysippus*	0.44	4.69	4.63	1.19	0.31	5.88	4.63	1.69
	8	*Cethosia cyane*	0.13	5.69	5.50	2.81	0.13	3.81	6.06	2.06
	9	*Junonia hierta*	0.00	0.00	2.69	0.13	0.00	0.00	2.56	0.31
	10	*Athyma nefte*	0.94	8.50	22.69	20.38	0.81	8.50	22.13	19.81
	11	*Ariadne merione*	0.25	3.00	2.56	0.44	0.19	1.13	3.00	0.56
	12	*Tanaecia lepidea*	0.06	0.44	1.44	1.44	0.06	0.56	0.94	2.88
	13	*Neptis hylas*	0.00	0.19	5.94	4.75	0.00	0.19	5.13	5.94
	14	*Athyma opalina*	0.00	3.63	5.00	1.50	0.00	0.81	2.13	4.56
	15	*Parantica aglea*	0.19	1.63	2.81	0.31	0.13	2.94	2.81	0.00
	16	*Tanaecia jahnu*	0.75	1.69	2.38	0.94	0.63	1.06	1.00	1.25
	17	*Ariadne ariadne*	1.94	3.00	4.13	4.06	1.25	3.13	2.63	4.06
	18	*Melanitis leda*	1.44	5.63	8.69	3.88	2.06	8.19	8.69	3.88
	19	*Cirrochroa aoris*	1.00	1.19	6.44	4.13	1.00	1.19	3.81	4.13
	20	*Pantoporia hordonia*	0.75	2.19	2.81	2.00	0.75	2.19	2.81	2.38
	21	*Euploea core*	3.69	8.00	7.81	2.88	2.13	7.19	4.31	2.69
	22	*Junonia iphita*	0.25	0.50	1.06	0.50	0.25	0.50	1.00	0.50
Pieridae	**1**	*Catopsilia pyranthe*	2.38	10.00	12.56	7.56	2.25	10.00	12.56	7.56
	2	*Eurema hecabe*	0.81	5.69	14.00	3.63	0.81	5.69	13.38	3.63
	3	*Catopsilia crocale*	0.56	2.75	5.38	1.19	0.31	2.25	5.38	1.19
	4	*Pieris canidia*	4.81	1.63	0.88	4.56	4.63	1.63	0.88	4.56
	5	*Delias descombesi*	0.00	1.38	2.06	3.06	0.00	2.06	2.56	2.94
	6	*Delias eucharis*	0.19	1.75	2.13	0.44	0.13	1.75	2.13	0.44
	7	*Leptosia nina*	7.06	4.31	9.75	5.56	6.75	4.31	10.31	5.88
	8	*Catopsilia pomona*	0.00	2.88	4.19	2.75	0.00	1.75	2.81	2.75
	9	*Appias libythea*	2.31	2.19	6.13	5.56	2.56	2.94	8.19	5.56
Ly	**1**	*Anthene*	0.00	2.81	5.63	4.31	0.00	2.81	5.56	4.31

		emolus								
	3	*Castalius rosimon*	2.19	7.00	4.25	3.44	2.19	7.00	4.25	2.06
Satyrida	**1**	*Lethe confusa*	0.50	11.44	5.88	1.00	0.31	1.75	12.44	1.00
	2	*Elymnias hypermnestra*	2.94	11.56	13.50	4.75	2.19	11.56	14.88	4.75

Abundance, % of frequency occurrence and density of butterfly of the family Papilionidae at the site III (Bonda)

Out of seven species of butterflies in the family Papilionidae, four were represented as very common and three were common. Species with their frequency of occurrence, density per sq.km and abundance were as follows :- *Papilio polytes* (75%, 375, 23.44, Common); *Troides helena (*62.5%, 244, 15.25, Common); *Atrophaneura dasarada* (81.25%, 319, 19.94, very common); *Atrophaneura aristolochiae* (62.5%, 186, 11.63, common); *Papilio demoleus* (93.75%, 653, 40.81, very common); *Chilasa clytia* (93.75%, 797, 49.81, very common); *Papilio memnon* (87.5%, 616, 38.5, very common) (Fig4.30). *Chilasa clytia* was most abundant species. They had been observed during the month of November, December and January also. Similar trend had also seen in case of very common species *Papilio demoleus* and *Atrophaneura dasarada.* Except those, all Papilionidae butterflies were represented throughout the year.

Fig.4.30.- Abundance and %of frequency occurrence of the family Papilionidae at the site III (Bonda) during the entire study period.



While analysing the seasonal abundance of *Papilio polytes, Troides helena, Atrophaneura dasarada, Atrophaneura aristolochiae, Papilio demoleus, Chilasa clytia* and *Papilio memnon* it was observed that all species had represented high abundance during the monsoon except *Troides helena* which had shown high abundance during pre monsoon period in 2014 (Fig.4.30A & Fig.4.30B). At the end of monsoon period their density and abundance were gradually decreasing unless it reached low value in winter season.

Seasonal abundance in winter, pre monsoon, monsoon and ret.monsoon were as follows:-*Papilio polytes* (0.50, 3.06, 5.25, 1.56); *Troides helena* (0.13, 3.94, 2.81, 2.56); *Atrophaneura dasarada* (0.00, 2.31, 4.81, 4.31); *Atrophaneura aristolochiae* (0.00, 1.94, 2.94, 0.75); *Papilio demoleus* (1.00, 5.69, 9.69, 4.56); *Chilasa clytia* (0.50, 10.69, 11.19 ,2.75); *Papilio memnon* (0.06, 6.13 ,8.38 ,4.38) (Fig.4.30A and Fig.4.30B). Seasonal variation as well as environmental changes did not affect much and therefore most of species present throughout the year. But *Atrophaneura dasarada*

and *Atrophaneura aristolochiae* were totally absent during winter season in 2014. Similar trend were also seen during the study year 2015.

Fig.4.30A.-Seasonal abundance of the family Papilionidae at the site III (Bonda) during 2014.

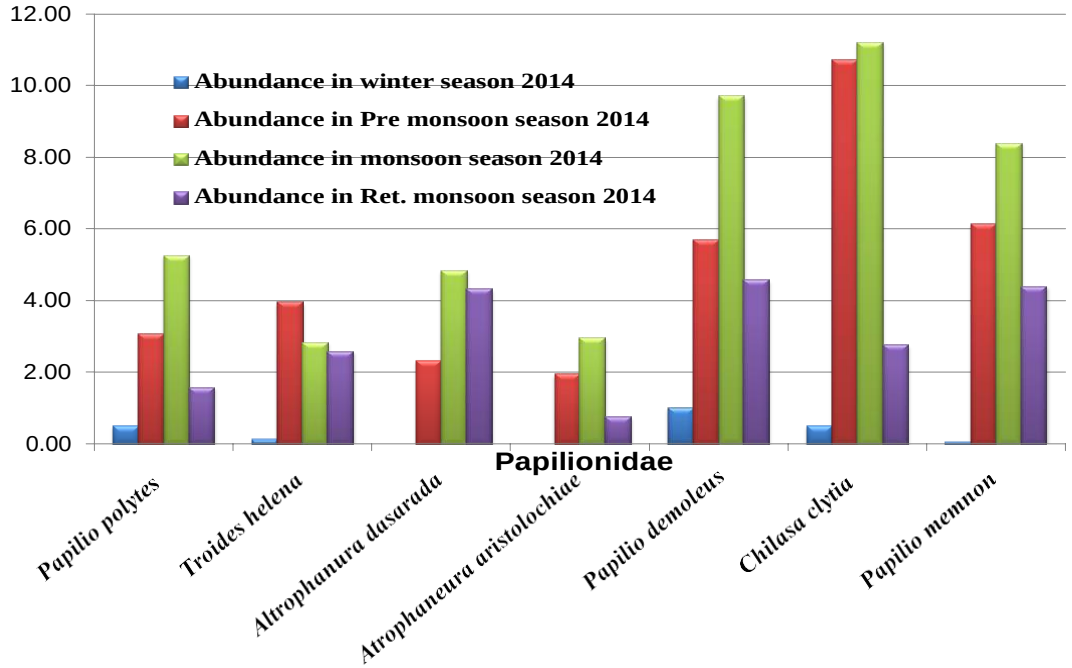
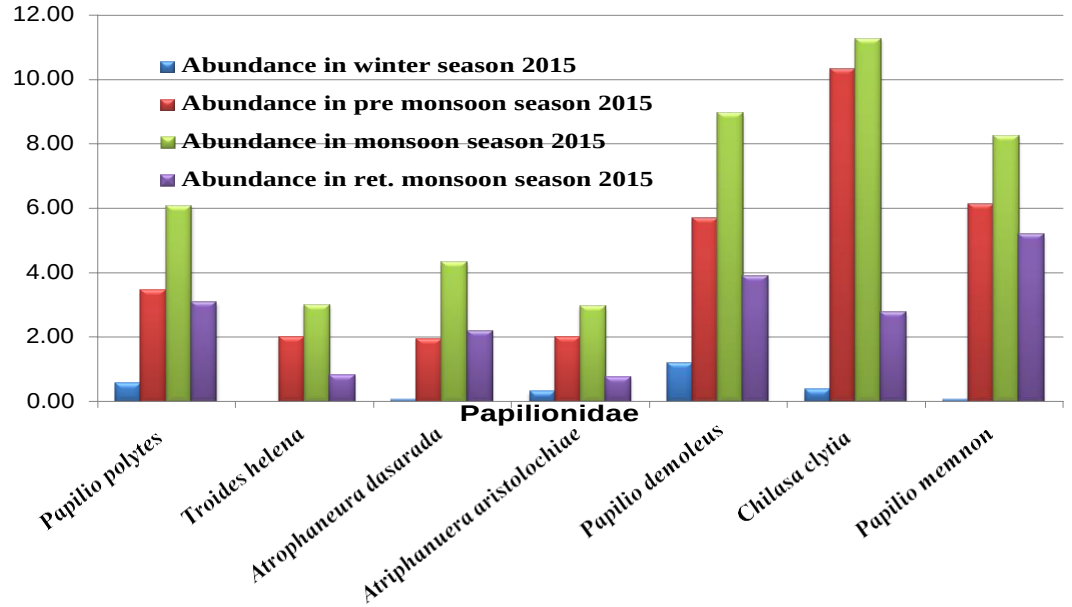


Fig. 4.30B. :-Seasonal abundance of the family Papilionidae at the site III (Bonda) during 2015



4.4.2.2. Abundance, % of frequency occurrence and density of butterfly of the family Nymphalidae at the site III (Bonda).

This family had contributed maximum numbers of individuals of species in Bonda study site. Out of twenty two species, nine species had been categorised as very common as seen from the percentage of frequency occurence. Another nine species had been represented as occasional, one common and three in rare category. Frequency of occurrence, density per sq. Km and abundance of very common species were (Fig.4.31) *Junonia lemonias* (100%, 916, 57.25); *Hypolimnas bolina* (93.75%, 578, 36.13); *Danaus genutia (*87.5%, 698, 43.63); *Athyma nefte* (100%, 166, 103.75); *Tanaecia jahnu* (87.5%, 155, 9.69); *Ariadne ariadne (*93.75%, 387, 24.19); *Melanitis leda (*93.75%, 679, 42.44); *Pantoporia hordonia (*100%, 254, 15.88) and *Euploea core* (93.75%, 619, 38.69).

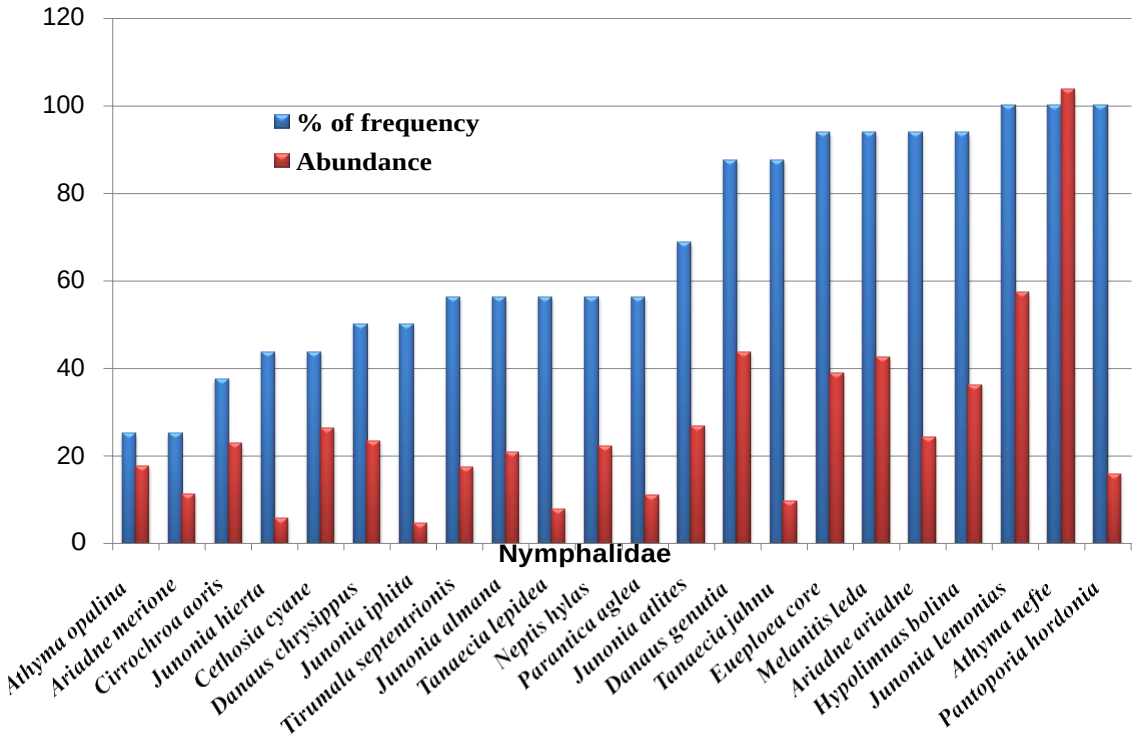
Athyma nefte had shown highest abundance and *Tanaecia jahnu* had shown least abundance. It had been observed that most of species represented throughout the year. *Tanaecia jahnu and Pantoporia hordonia* were totally absent during the months of November, December and January of both the study years. This showed that some of them might locally migrate from this area due to the change in climate or habitat or there was need for more survey in near future.

The seasonal variations in relative abundance of butterflies for very common species were found to be significant in winter season. Their abundance seasonwise were (Fig. 4.31A & 4.31B):- *Junonia lemonias* (3.06, 9.69, 11.63, 6.25); *Hypolimnas bolina* (0.19, 1.69, 5.63, 9.38); *Danaus genutia (*0.38, 5.13, 9.56, 6.38); *Athyma nefte* (0.94, 8.50, 22.69, 20.38); *Tanaecia jahnu* (0.75, 1.69, 2.38, 0.94); *Ariadne ariadne* (1.94, 3.00, 4.13, 4.06); *Melanitis leda*(1.44, 5.63, 8.69, 3.88); *Pantoporia hordonia (*0.75, 2.19, 2.81, 2.00); *Euploea core* (3.69, 8.00, 7.81, 2.88) during the year 2014 and *Junonia lemonias* (2.38, 9.06, 10.63 ,4.56); *Hypolimnas bolina* (0.19, 2.63, 7.31, 9.13); *Danaus genutia* (0.31, 4.38, 11.94, 5.56); *Athyma nefte* (0.81, 8.50, 22.13, 19.81); *Tanaecia jahnu* (0.63, 1.06, 1.00, 1.25); *Ariadne ariadne* (1.25, 3.13, 2.63,

4.06); *Melanitis leda*(2.06, 8.19, 8.69, 3.88); *Pantoporia hordonia* (0.75, 2.19, 2.81, 2.38); *Euploea core* (2.13, 7.19, 4.31, 2.69) during the year 2015.

The species *Athyma nefte* were represented highest abundance during monsoon and ret.monsoon season and their density gradually decreasing from ret.monsoon. All species were found active throughout the year, their season wise distribution were not uniform. The possible differences in the relative abundance for their representation of each individual species can be attributable to the differences in habitat condition which may be due to seasonal variation only. It was observed that diversity and abundance were highest in this study site during monsoon and ret. monsoon season.

Fig.4.31.-Abundance and % of frequency occurrence of butterfly species of the family Nymphalidae at the site III (Bonda) during 2014 &2015.



Frequency occurrence, density per sq. Km and abundance of occasional species of the family Nymphalidae were (Fig.4.31)**:-***Tirumala septentrionis* (56.25%, 278, 17.38); *Junonia almanac (*56.25%, 333, 20.81); *Danaus chrysippus* (50%, 375, 23.44);

Cethosia cyane(43.75%, 419, 26.19); *Junonia hierta* (43.75%, 91, 5.69); *Tanaecia lepidea* (56.25%, 125, 7.81); *Neptis hylas* (56.25%, 354, 22.13); *Parantica aglea (*56.25%, 173, 10.81); *Junonia iphita* (50%, 73, 4.56).

Junonia hierta had shown lowest abundance and they were totally absent in the months of September to February which clearly indicated that they were less tolarent about variation of environmental parameters as well as seasonal changes.

In Banda study site, all butterflies belonging to family Nymphalidae studied were at the maximum numbers during the monsoon or ret.monsoon /rainy season. Fluctuations in their number in most of the families largely coincided with the late winter and summer seasons only. Low density was exhibited by most of the families during November, December and January of both the years (2014 and 2015) during which the environmental conditions prevailed was not favourable for them. During the year 2014 all species were represented high abundance either in monsoon season or in ret.monsoon. Their density were gradually increased from the end of winter and reached high in monsoon or pre monsoon and again faced the declining trend up to winter.

Tirumala septentrionis (Fig.4.31, 4.31A and 4.31B) (0.19, 0.50, 6.31, 0.88); *Junonia almana* (0.00, 2.38, 5.31, 2.88); *Danaus chrysippus*(0.44, 4.69, 4.63, 1.19); *Cethosia cyane*(0.13, 5.69, 5.50, 2.81); *Junonia hierta* (0.00, 0.00, 2.69, 0.13); *Tanaecia lepidea*(0.06, 0.44, 1.44, 1.44); *Neptis hylas*(0.00 ,0.19, 5.94, 4.75); *Parantica aglea*(0.19, 1.63, 2.81, 0.31); *Junonia iphita* (0.25, 0.50, 1.06, 0.50). Similar trend were also seen during the year 2015. *Tirumala septentrionis*(0.31, 1.25, 6.81, 1.13); *Junonia almana*(0.00, 1.00, 4.63, 4.63); *Danaus chrysippus*(0.31,5.88,4.63,1.69); *Cethosia cyane* (0.13, 3.81, 6.06, 2.06), *Junonia hierta* (0.00, 0.00, 2.56, 0.31), *Tanaecia lepidea* (0.06, 0.56, 0.94, 2.88), *Neptis hylas* (0.00, 0.19, 5.13, 5.94), *Parantica aglea* (0.13, 2.94, 2.81, 0.00), *Junonia iphita* (0.25, 0.50, 1.00, 0.50). While observing the abundance pattern it was found that *Junonia hierta* was totally absent during winter and pre monsoon period. This was mainly because of the

combined effects of biotic and abiotic factors that prevailed in Bonda which was not acceptable for them to survive.

Only one common species was catagorised in Bonda site that was *Junonia atlites* whose frequency of occurrence, density per sq.km and abundance were 68.75%, 427, and 26.69 respectively. There were three rare spacies observed at Bonda study site and their frequency occurrence and abundance were (Fig. 4.31)-*Ariadne merione* (25%, 178, 11.13); *Athyma opalina (*25%, 282, 17.63) and *Cirrochroa aoris* (37.5%, 366, 22.88). Seasonal abundance of these species was in similar trends. *Ariadne merione* (0.19, 1.13, 3.00, 0.56); *Athyma opalina* (0.00, 0.81, 2.13, 4.56); *Cirrochroa aoris* (1.00, 1.19, 3.81, 4.13); *Athyma opalina* was totally absent during winter season of both the study year as they were not tolerant about environmental changes for which they might migrate for searching their suitable habitat.

Fig.4.31A:-Seasonal abundance of butterfly species of the family Nymphalidae at the site III (Bonda) during 2014.

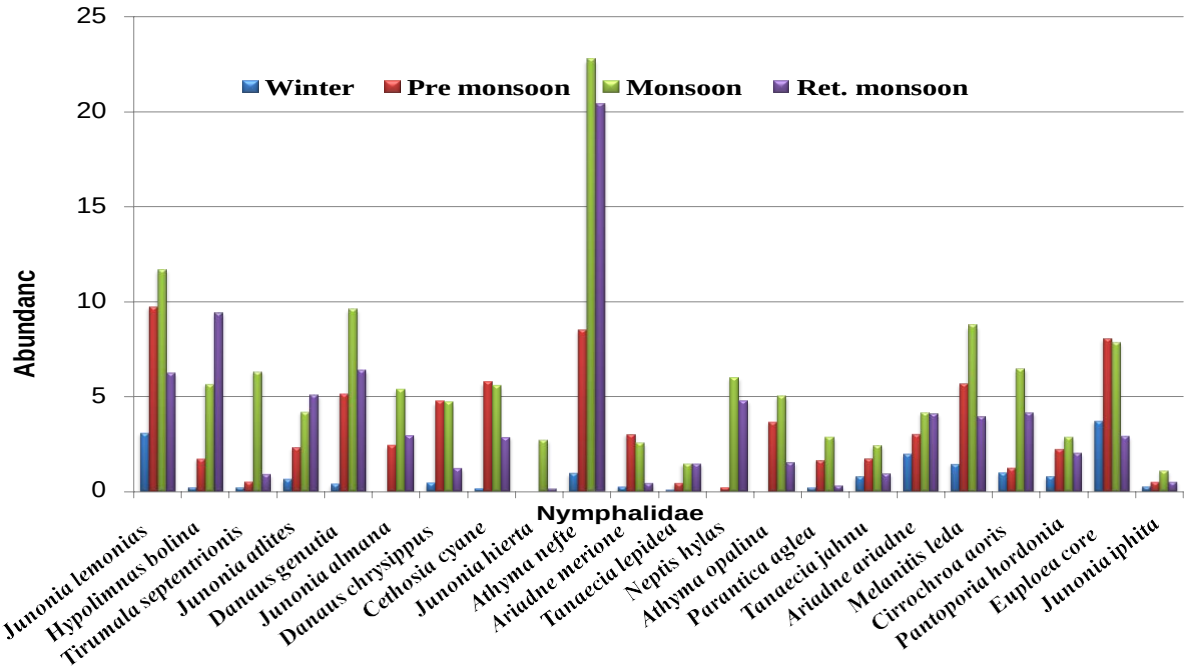
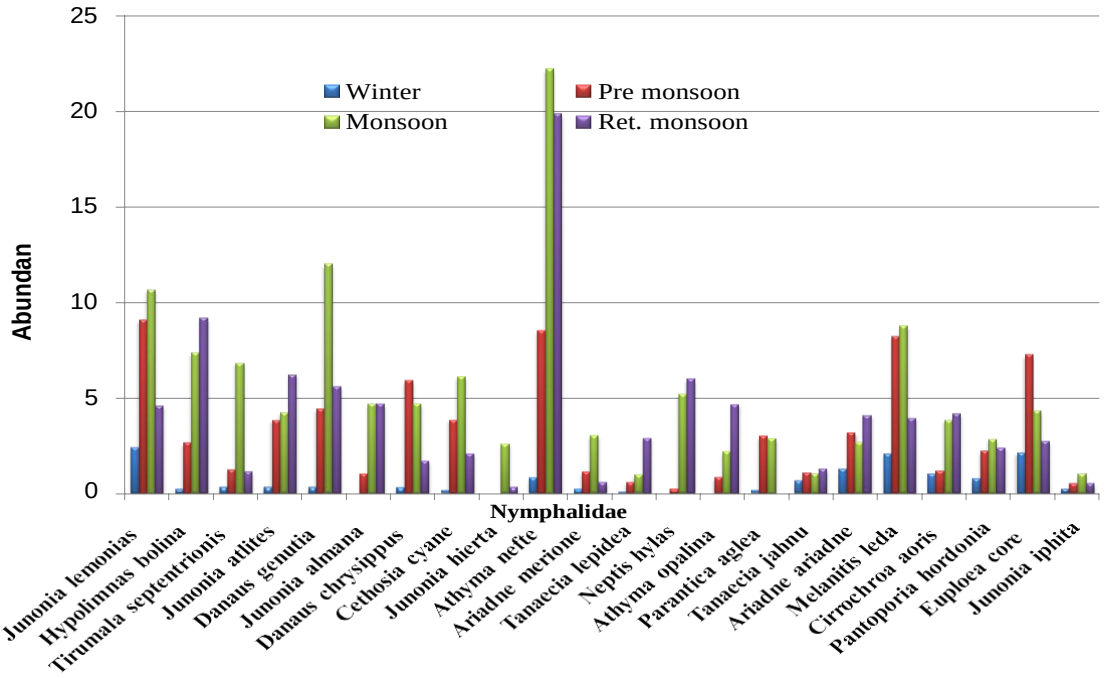


Fig.4.31B:-Seasonal abundance of butterfly species of the family Nymphalidae at the site III (Bonda) during 2015



4.4.2.3 Abundance, % of frequency occurrence and density of butterfly of the family Pieridae at the site III (Bonda):-

A total numbers of nine species were recorded and identified. Four species were found very common; four common and only one was occasional. Their frequency of occurrence, density per sq.km and abundance were (Fig.4.32) *Catopsilia pyranthe* (100%, 1038, 64.88, very common); *Eurema hecabe* (68.75%, 762, 47.63, common); *Catopsilia crocale (*87.5%, 304, 19.00, very common); *Pieris canidia (*75%, 377, 23.56, common); *Delias descombesi (*87.5%,225,14.06 very common); *Delias eucharis (*75%,143, 8.94 common); *Leptosia nina(*75%, 863, 53.94 common); *Catopsilia pomona (*50%, 274, 17.13 occasional) and *Appias libythea (*100%, 59, 36.88 very common). *Catopsilia pyranthe* (64.88) had highest abundance and *Delias eucharis* (8.94) had shown least abundance during the entire study period. All species of the Pieridae family had been observed throughout the year.

While analysing the seasonal abundance, out of four very common species, three *Catopsilia pyranthe*, *Catopsilia crocale and Appias libythea* had shown highest

abundance during monsoon season but in case of *Delias descombesi* density reached peak value during ret. monsoon of both the study year.

Three numbers of common species *Eurema hecabe, Delias eucharis* and *Leptosia nina* were also represented high abundance during monsoon period except *Pieris canidia* which had shown highest abundance in ret.monsoon. Their presence throughout the year indicated that they were susceptible to all kind of environmental changes. Abundance and density of all species were gradually decline from the middle part of ret. monsoon.

Occasional species *Catopsilia pomona* was totally absent during winter season. It appeared that the butterfly abundance increased correspondingly to monsoon and ret.monsoon season while decreased in winter season, possibly with the change in atmospheric temperature and humidity of the habitat concerned.

Fig. 4.32.:-Abundance and % of frequency occurrence of the family Pieridae at the site III (Bonda)

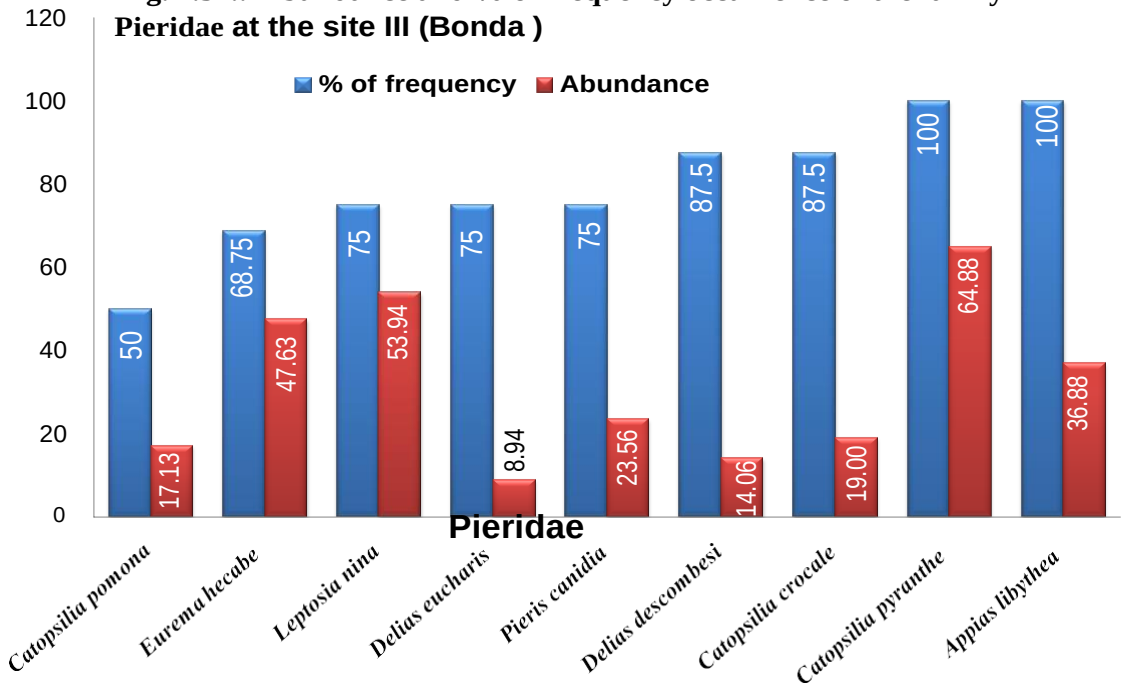


Fig.4.32A.:-Seasonal abundance of the family Pieridae at the site III (Bonda) during 2014

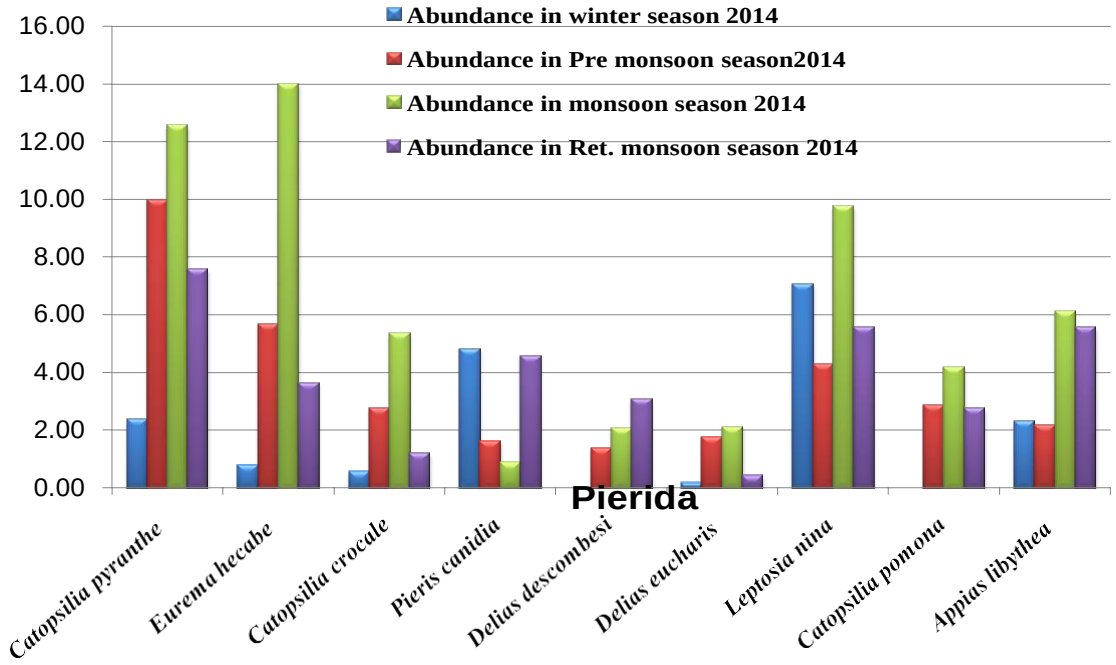
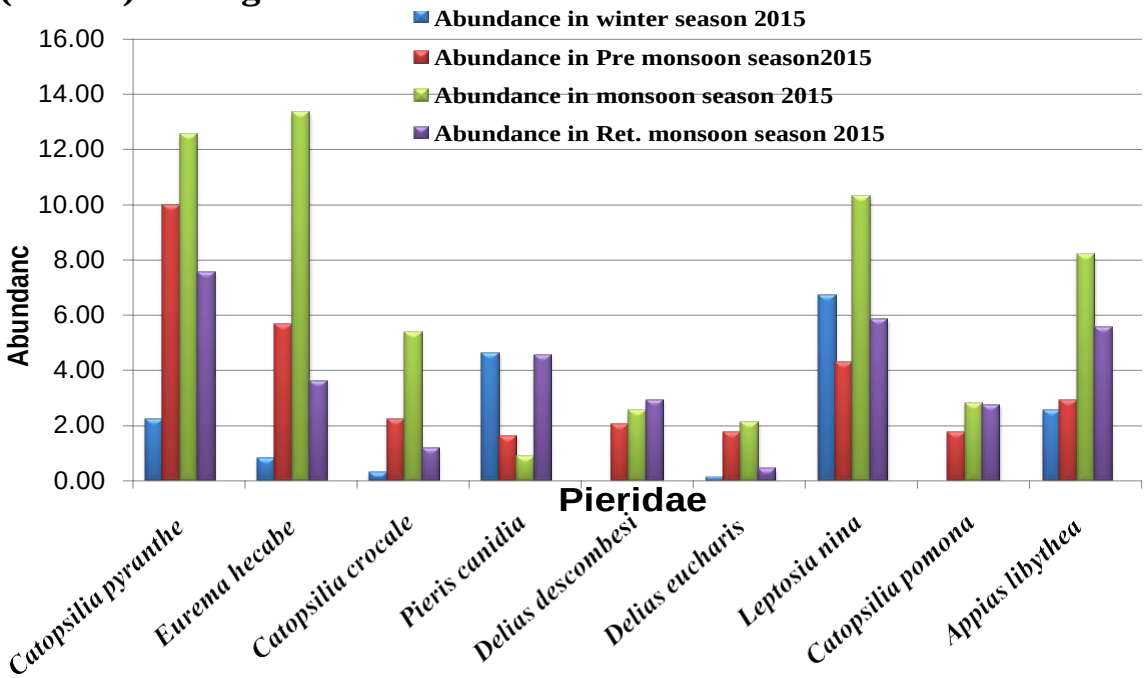


Fig.4.32B.:-Seasonal abundance of the family Pieridae at the site III (Bonda) during 2015



4.4.2.4 Abundance, % of frequency occurrence and density of butterfly of the family Lycaenidae at the site III (Bonda)

Only two species of this family were recorded and they were *Anthene emolus* (frequency of occurrence 100%, abundance 25.44) and *Castalius rosimon (*frequency of occurrence 93.75%, abundance 31.00) (Fig.4.33). Both of them were catagorised in very common species. Their seasonal abundance were (Fig.4.33A) *;- Anthene emolus (*0.00, 2.81, 5.63, 4.31) and *Castalius rosimon* (2.19, 7.00, 4.25, 3.44) during the year 2014 and almost same trend were observed during the study year 2015. *Castalius rosimon* was found throughout the year but their density and abundance were varied significantly during winter season and the other species *Anthene emolus* was silent during winter season. Thus abundance of butterfly species during monsoon season varied significantly as compared to other seasons.

Fig. 4.33. :-Abundance and % of frequency occurrence of the family Lycaenidae and Satyridae at the site III (Bonda)

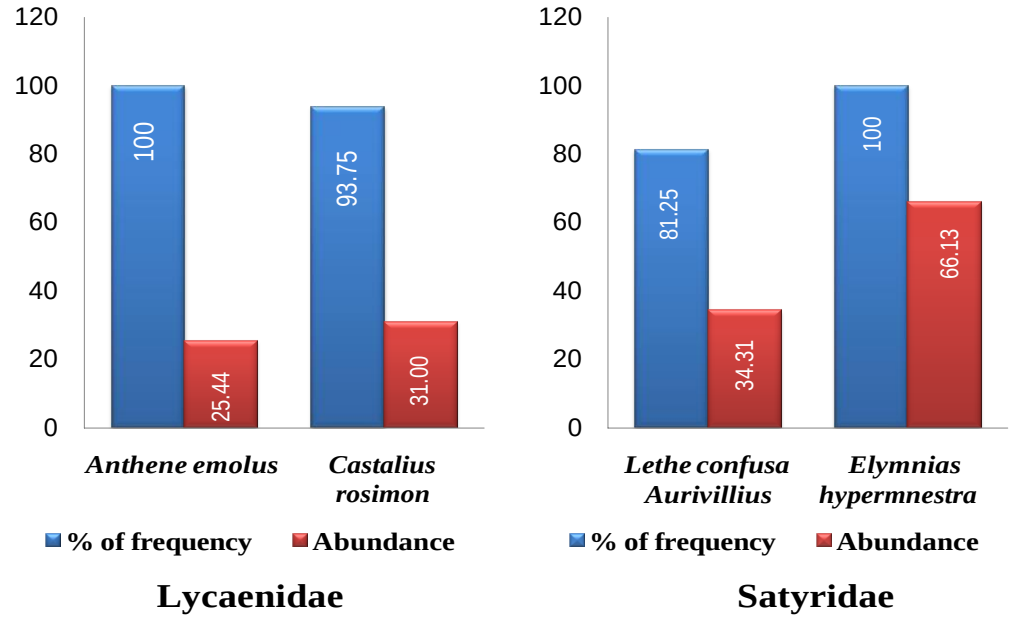
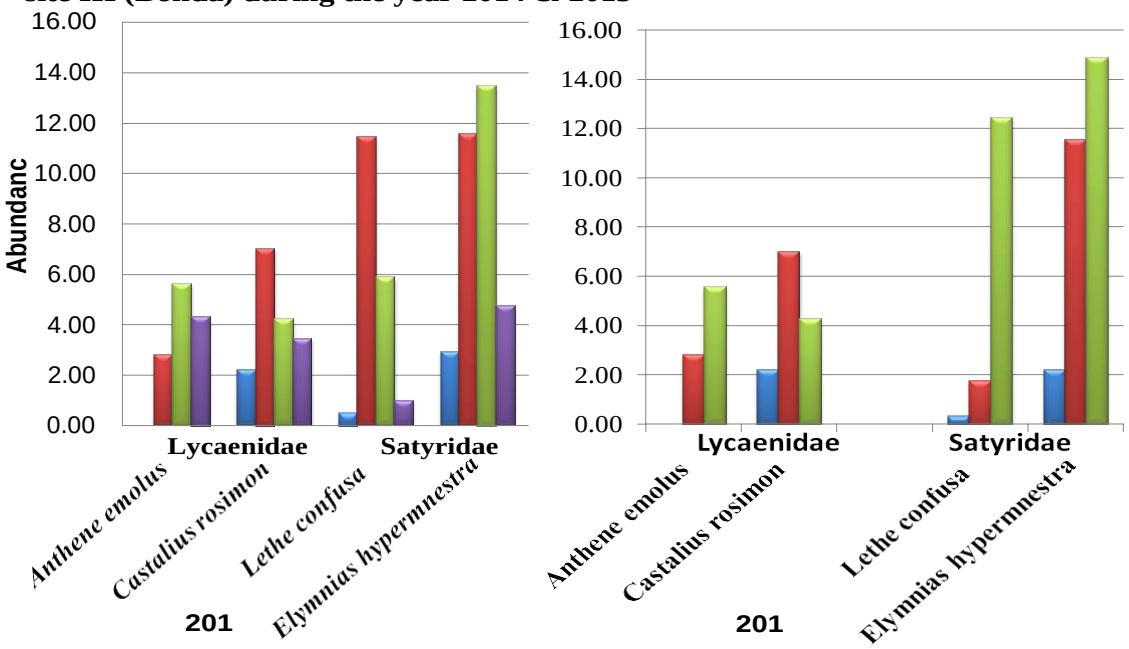


Fig. 4.33A. :-Seasonal abundance of the family Lycaenidae and Satyridae at the site III (Bonda) during the year 2014 & 2015



4.4.2.5 Abundance, % of frequency occurrence and density of butterfly of the family Satyridae at the site III (Bonda)

Only two species were recorded and they were *Lethe confusa* and *Elymnias hypermnestra*. Frequency of occurrence and abundance of *Elymnias hypermnestra* were 100% and 66.13 which was catagorised as very common species. The other species *Lethe confusa* had shown lower abundance (34.31). Both the species occurred throughout the year but their abundance was higher in monsoon than other season (Fig.4.33 & 4.33A).

4.4.3. Diversity and Richness at the site III (Bonda)

The result of the family-wise diversity indices analysis indicated (Table 4.17) that in Bonda, family Nymphalidae was recorded as the rich family with 22 species (R_1 =2.2949; R_2 =0.2267) followed by the families Pieridae with nine species (R_1 =0.9492; R_2 =0.1330), Papilionidae with seven species (R_1 =0.7437; R_2 =0.1239), Lycaenidae with two species (R_1 =0.1469; R_2 =0.0666) and Satyridae with two species (R_1 =0.1355; R_2 =0.0499). .

Family Nymphalidae recorded the following values– Simpson‟s index=0.07454; Shannon-Weiner index=2.8332; Hill‟s Diversity Number N_1 =16.9945; N_2 =13.4149; Evenness index E=0.7894. .

Family Papilionidae recorded the following values – Simpson‟s index 0.1747; Shannon-Weiner index 1.8330, Hill‟s Diversity Number N_1 =6.2517; N_2 =5.7247; Evenness index: E=0.9157 .

Family Pieridae recorded the following values – Simpson‟s index = 0.1496; Shannon-Weiner index = 2.0246; Hill‟s Diversity Number N_1 =7.5712; N_2 =6.6856; Evenness index E=0.8832.

Lycaenidae recorded the following value– Simpson‟s index=0.5049; Shannon- Weiner index=0.6883; Hill‟s Diversity Number N_1 =1.9902; N_2 =1.9808; Evenness index E

=0.9953 (Table 4.17).

Family Satyridae recorded the following values – Simpsons‟ index = 0.5502; Shannon-Weiner index=0.6421; Hill‟s Diversity Number N_1 =1.9004; N_2 =1.8176; Evenness index E=0.9565. According to Simpson”s index (ƛ) smaller values of the index implies higher diversity and so in this landscape the highly diversified family was Nymphalidae. Again according to Shannon-Weiner index (H“), more the value of the index, more is the diversity and vice-versa.

From this observed results, it was concluded that in the Bonda study site, the family Nymphalidae was highly represented and densely distributed, with more number of individuals.

Table 4.17. Family-wise diversity indices of butterflies in the Site III (Bonda)

	Papilionidae	Nymphalidae	Pieridae	Lycaenidae	Satyridae
Richness					
S	7	22	9	2	2
R1	0.7437	2.2949	0.9492	0.1469	0.1355
R2	0.1239	0.2267	0.133	0.0666	0.0499
Diversity					
ƛ	0.1747	0.07454	0.1496	0.5049	0.5502
H´	1.833	2.8332	2.0246	0.6883	0.6421
N1	6.2517	16.9945	7.5712	1.9902	1.9004
N2	5.7247	13.4149	6.6865	1.9808	1.8176
Evenness					
E	0.9157	0.7894	0.8832	0.9953	0.9565

λ: Simpson‟s index, H‟ : Shannon-Weiner index, Evenness indices E , Number of abundant species (N1) = eH' ,Number of very abundant species (N2) = 1/λ

The Shannon-Weiner diversity index for Bonda study site is well documented month-wise in Table 4.18. The family Papilionidae showed moderate diversity index almost all the months studied except the month of January and December 2014 and January, November and December 2015 during which the index was very least (1.0549 , 0.5623, 0.6931, 1.0133, 0). The highest diversity index was observed during the month of September (1.8504) in the year 2014 and during the month of August (1.8257) in the year 2015 while moderate index was observed during the month of March, April and May (1.8133, 1.7554, 1.7840, 1.6849, 1.7499, 1.7436) the year of study period. In the family Pieridae, the least diversified months were January and December 2014 & 2015 (1.4037, 1.4743, 1.4212, and 1.4366). The highest diversity index was observed during the month of June 2014 & 2015 (2.0547, 2.0244) while the moderate index was

observed during the months of September and March 2014 & 2015 (1.9789, 1.8505, 1.9789, 1.8658).

Table 4.18. Month-wise Shannon-Weiner Index computed for the butterflies in the Site III (Bonda)

	Year 2014											
Month	Jan	Feb	Mar	April	May	June	July	August	Sept	Oct	Nov	Dec
Papilionidae	1.0549	1.2500	1.8133	1.7554	1.784	1.8307	1.8074	1.7983	1.8504	1.7626	1.2510	0.5623
Nymphalidae	2.0116	2.2627	2.5158	2.7825	2.6708	2.8253	2.7666	2.786	2.5885	2.4332	2.505	2.1261
Pieridae	1.4037	1.6192	1.8505	1.9503	1.9496	2.0547	1.9127	1.7106	1.9789	1.9743	1.5873	1.4743
Lycaenidae	0.0000	0.0000	0.3830	0.6082	0.6682	0.6921	0.6744	0.6806	0.6492	0.6058	0.6295	0.0000
Satyridae	0.5004	0.4195	0.2827	0.6842	0.6870	0.6927	0.3622	0.2911	0.5297	0.4869	0.2954	0.2712
	Year 2015											
Papilionidae	0.6931	1.4122	1.6849	1.7499	1.7436	1.8228	1.815	1.8257	1.8071	1.6599	1.0133	0.0000
Nymphalidae	1.2707	1.5438	2.4404	2.650	2.7033	2.8232	2.7456	2.7324	2.6272	2.6173	2.6218	2.0424
Pieridae	1.4212	1.5438	1.8658	1.8868	1.9721	2.0244	1.9062	1.8248	1.9789	1.9737	1.5757	1.4366
Lycaenidae	0.0000	0.0000	0.3830	0.6082	0.6682	0.6929	0.6744	0.6806	0.6492	0.6058	0.6295	0.0000
Satyridae	0.0000	0.4195	0.2827	0.4227	0.4101	0.6929	0.6824	0.6765	0.5297	0.4869	0.2954	0.2712

.

The family Nymphalidae showed its high diversity index almost all the months studied except the months of January 2014 & 2015 during which the index was very least (2.0116, 1.2707). The highest diversity index was observed during the months of June in the year 2014 & 2015 (2.8253, 2.8232). The family Lycaenidae showed its highest diversity index during the months of August (0.6806, 0.6806**)**. The least diversity index was observed during the months of January, February and December where index indicated (0). The family Satyridae very few months alone showed moderate diversity index. The moderate diversity index was observed during the month of November, December, and March (0.2954, 0.2712, 0.2827, 0.2954, 0.2712, 0.2827) while among the remaining months of the study period several month showed moreless same index except the month of January 2015 in where index shows (0). „0". this indicated that between the two families studied, the members of the Satyridae showed the poorest diversity in the Bonda study site.

Table 4.19. Season-wise observation of Shannon Index in the Site III (Bonda)

	year 2014				year 2015			
	Winter	Pre-monsoon	Monsoon	Ret monsoon	Winter	Pre-monsoon	Monsoon	Ret monsoon
Papilionidae	1.2977	1.7901	1.8296	1.8237	1.4083	1.7564	1.8368	1.7795
Nymphalidae	2.3906	2.7301	2.8608	2.603	2.4558	2.6955	2.7983	2.6783
Pieridae	1.5426	1.9799	1.9402	2.0189	1.5158	1.981	1.9395	2.0154
Lycaenidae	0	0.5991	0.6834	0.6868	0	0.5991	0.6842	0.6295
Satyridae	0.4147	0.6931	0.6136	0.462	0.3768	0.3891	0.6892	0.462

Fig. 4.34 Season-wise distribution of butterfly of different families at the site III (Bonda) as per Shannon Index

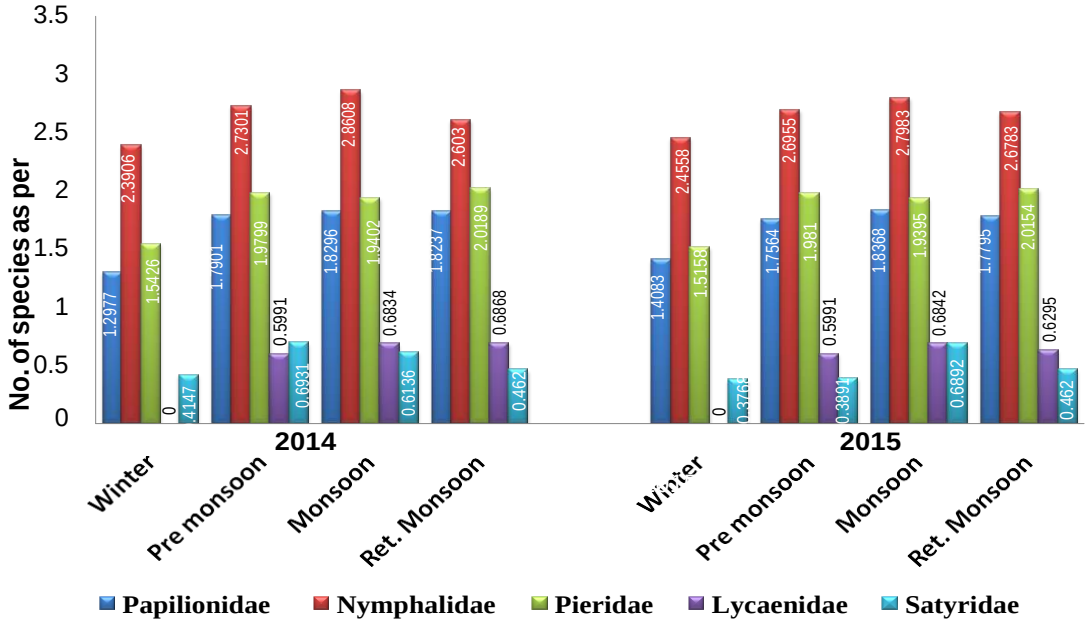


Table No: - 4.20 Enviornmental parameter recorded at the Ghagua site during the study periods

	Min. Temp °C	Max. Temp °C	Relative Humidity %	Average wind speed km/hr
2014 Jan	13	26	79	2
Feb	12	23	88	0
March	16	30	81	1
April	22	34	71	3
May	22	32	84	2
June	26	33	91	2
July	27	33	90	1
Aug	25	32	91	1
Sept	24	33	92	1
Oct	22	31	89	0
Nov	15	27	90	1
Dec	12	21	94	1
2015 Jan	12	21	92	1
Feb	12	24	84	3
March	21	27	80	3
April	19	31	86	4

May	22	32	89	3
June	24	33	89	3
July	26	34	88	2
Aug	25	32	90	1
Sept	25	33	91	0
Oct	22	31	91	1
Nov	18	28	87	2
Dec	12	23	94	0

Correlation of environmental perameter with butterfly diversity and density

Correlation of environmental perameters with butterfly diversity and density at the site I (Ghagua).

Month-wise occurrence of 47 species of butterflies belonging to five families was recorded in this study site. The five families studied were Papilionidae, Pieridae, Nymphalidae, Lycaenidae and Satyridae. Among the 47 species of butterflies, *Kaniska canace* (N13), *Junonia iphita (*N25) *and Rapala pheretima (*L2) were found only in Ghagua site (Table 4.5).

The density of Nymphalidae was reported high (Fig.4.35 and 4.39) ranging from 473 to 550 during April to September 2014 and 2015 because of the fact that relative humidity (84% and 92%) and average wind speed recorded (1 to 2 km/hr) respectively. The maximum temperature recorded was from 33°C to 34°C. Again low population density was observed during the period from October to February. Minimum and maximum temperature recorded were gradually falling down ranging from 22°C, to 12°C and 31°C to 12°C (table 4.20 and Fig. 4.39).

Papilionidae density was very high (166, 159) during August 2014 & 2015 (Fig.4.35& 4.38). It was observed that during that period high relative humidity were (91%, 90%). The density and abundance were observed low during December and January of 2014 and 2015 (<15) as the environmental parameters were changed greatly during that period. In the month of June to August of both the years temperature was moderate between (28– 32°C), humidity between 80% –92% and wind speed also moderate (1 – 3 km/h). This favourable situation resulted in the greater explosion (>150) of the Papilionidae individuals (Fig. 4.38). While during winter season specially during the months of November, December, January and February 2014 &

2015, the environmental conditions were greatly changed, the temperature falls (12°C – 9°C) and very scanty rainfall as well as low humidity < 80% (Table 4.20) resulted in the steep fall of the butterfly population (Fig. 4.35 and Fig. 4.38).

The results showed that the density of the family Lycaenidae was observed very high during April and September (>30) in 2014 &2015 when compared with all other months (Fig. 4.41). The temperature, relative humidity and wind speed observed during these months were 22°C - 24°C, 80% - 90% and 1 – 3 km/hr respectively. Very low density (<10) was observed during the months of January, February and December of both the study year. Minimum temperature falls down upto (8°C-9°C), very scanty rainfall also occurred and relative humidity also falls from 90% to 75%. Because of the unfavourable climatic conditions, the butterfly may migrate for sarching suitable habitat (Fig. 4.35 and 4.41).

In case of the family Satyridae also density were observed to increase gradually from the month of March to August of both the years ranging from 41 – 90 because of gradual increase in humidity (70% – 90%) and temperature (22°C – 34°C). Very poor density (< 20) was observed in December to February of both the years of study as these are the months of winter (Table 4.20, Fig. 4.35 and 4.41).

In the Ghagua site, most of the families showed their peak of diversity as well as density during April to September of both the years (Fig. 4.35). This was mainly because of the reason that all the environmental parameters might be favourable for their survival (Table 4.20). It was the period of monsoon and ret.monsoon resulted in growth of floral diversity. Several studies revealed that habitat specificity is directly linked to the availability of host plants for larvae and adult butterfly (Thomas 1995). It was the season of growing new leafy crops and flowering plants which provide abundant quantity of nectar to butterfly.

Fig. 4.35. Month and year-wise population distribution of butterflies of different families at the site I (Ghagua)

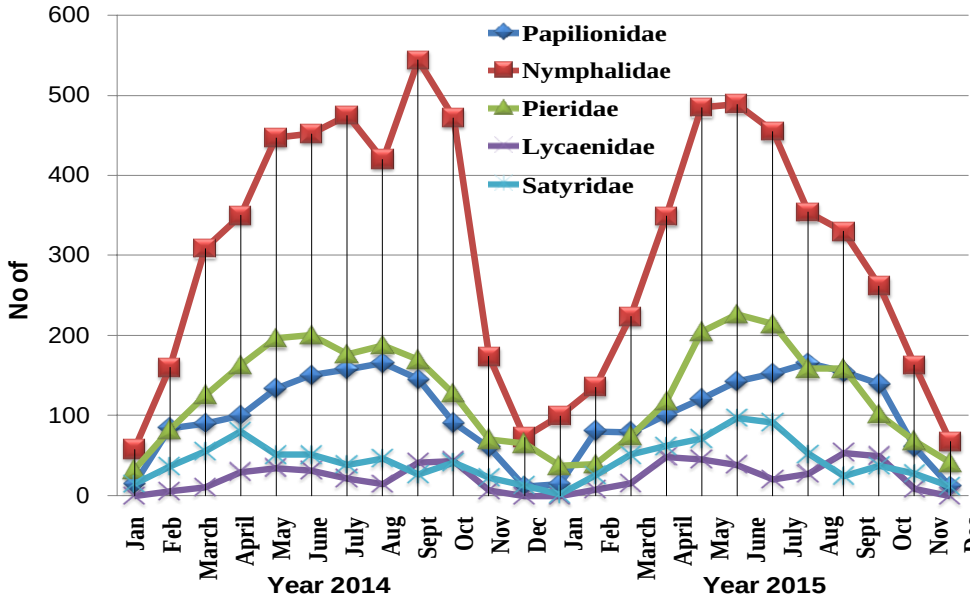


Table No:- 4.20A:- Enviornmental parameter recorded at the Site II South Amchang during the study periods

	Min. Temp °C	Max. Temp °C	Relative Humidity %	Average wind speed km/hr
2014 Jan	11	24	80	1
Feb	12	23	88	0
March	15	30	81	1
April	22	34	71	3
May	22	32	84	2
June	26	33	91	2
July	27	33	90	1
Aug	25	32	91	1
Sept	24	33	92	1
Oct	22	31	89	0
Nov	15	27	90	1
Dec	12	21	94	1
2015 Jan	12	21	92	1
Feb	12	24	84	3
March	21	27	80	3
April	19	31	86	4
May	22	32	89	3

June	24	33	89	3
July	26	34	88	2
Aug	25	32	90	1
Sept	25	33	91	0
Oct	22	31	91	1
Nov	18	28	87	2
Dec	12	23	94	0

4.5.2. Correlation of environmental perameters with butterfly diversity and density at the site II (South Amchang)

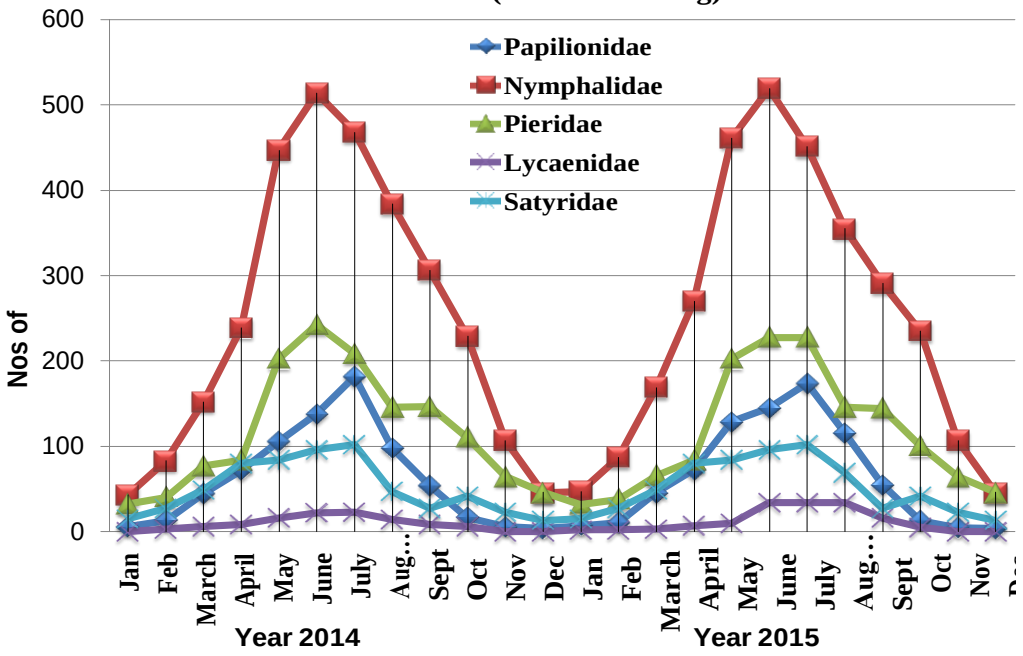
The results of correlation analyses studied between butterfly population density of chosen families and abiotic factors such as temperature, relative humidity and wind velocity were presented in the Table 4.20A, Fig 4.36. In this site the Papilionidae density was found high > 170 i.e (182, 174) during the month of July in 2014 and 2015 (Fig. 4.36 and 4.38) due to moderate temperature (33°C, 34°C) and a conductive relative humidity (90%, 88%), and low average wind speed (1 km/hr, 2Km/hr) in 2014 and 2015. This was the season of rainy months. Very low density (<10) was observed during winter season of December, January and February due to low temperature (12°C- 10°C) and very scanty rainfall and humidity (90%) (Fig. 4.36 and 4.39, Table 4.20A).

The density of the family Pieridae was also found very high during June and July of both the study years (243, 209; 228, 228) due to high relative humidity (88% - 91%), moderate value of wind speed (3 km/hr) and moderate temperature (33°C – 34°C). The increase of population started from the month of March and it reached its peak during the month of June /July/August and then it slowly declined from September and reached a very low level during December/January because of scanty rainfall, low environmental temperature (8°C to 12°C), low relative humidity (77% and 88%) (Fig. 4.36 and Table 4.20A). Butler and Strazanac (2000) indicated that population shift may be directly related to weather conditions or indirectly to the effects of temperature or rainfall pattern or natural enemies or foliage chemistry or other factors. However the indirect effects of environmental stresses on host plant density or natural enemies which thereby affect butterfly dynamics may not be explained very easily.

The result of population density of Nymphalidae were reported high during the month of June (514, 519) in 2014 and 2015 because of the fact that during these months heavy growth of plants with rich canopy. The relative humidity was (95%), the average wind speed recorded was moderate for the same period (2 km/hr, 3 km/hr) with a moderate temperature (33°C). The density was found increasing from the month of March onwards and reached maximum during June, July. The fall of the population started from the month of August/Sepetmber and reached its low level during the month of December and January (<30) .During that period environmental conditions were not favourable to the organisms studied (Table 4.20A, Fig. 4.36).

Almost the same trend was observed among the members of the family Lycaenidae and Satyridae and it is well illustrated in the Table 4.20A, Fig. 4.36, Fig 4.41 and Fig. 4.42. In the South Amchang study site, most of the families studied showed their peak of diversity during the month of June to August. It might be because of the favourable climatic conditions prevailed.

Fig. 4.36. Month and year-wise population density of butterflies of different families at the site II (South Amchang)



4.5.3. Correlation of environmental perameters with butterfly diversity and density at the site III (Bonda)

Month-wise density of 42 species of butterflies belonging to five families was recorded in the Bonda study site. In this study site, the Papilionidae density was estimated very high (275, 251) during the month of August. The environmental parameters recorded were relative humidity (91%), moderate wind speed (2 km/hr) and temperature (32°C). The increase in diversity as well as their density started gradually from the end of February and reached peak value during August and started falling from September onwards and reached the low level during November, December and January onwards (Table 4.20, Fig. 4.37 and 4.38).

Diversity and density of the family Pieridae were also observed increasing gradually (102) from the month of March and it reached the peak (>300) during July and August of both the study year. In this period rainfall, humidity, temperature and wind speed may favourable for explosion of butterfly population (Fig. 4.37). The density then declined from September onwards and reached its low level during December and January (<60) due to less rainfall, low relative humidity, high wind speed and minimum environmental temperature (<10°C) (Fig. 4.37 and Fig. 4.40, Table 4.20A). Similar trend had been observed in case of the family Nymphalidae and Satyridae also which had already been clearly distinguishable in the Fig 4.37, Fig 4.39and Fig. 4.42. Very high (>60) density of the family Lycaenidae were observed during April 2014 & 2015 and low density observed in December and January. The relative humidity, wind speed and temperature in April 2014 recorded were 77%, 3, 32°C (Fig. 4.37 & Fig. 4.41). These environmental conditions that prevailed during this period may be suitable for the survival of butterfly. During winter season it was observed that Lycaenidae family was totally silent. They were less tolerant in seasonal variation.

Fig. 4.37. Month and year-wise population density of butterflies of different families at the site III (Bonda)

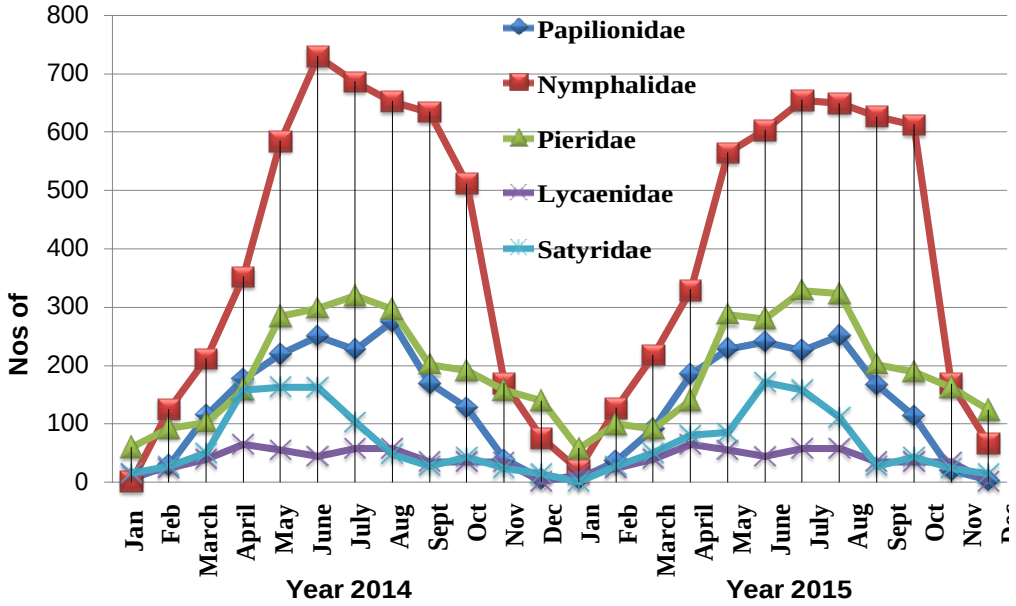


Fig. 4.38. Month and year-wise population diensity of the family Papilionidae in different sites

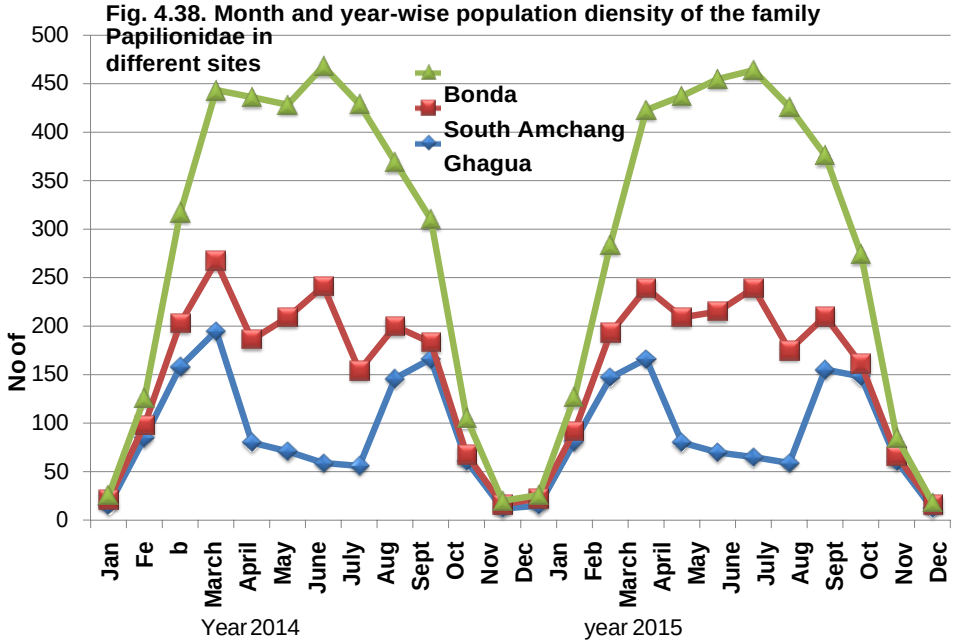


Fig. 4.39. Month and year-wise population density of the family Nymphalidae in different sites

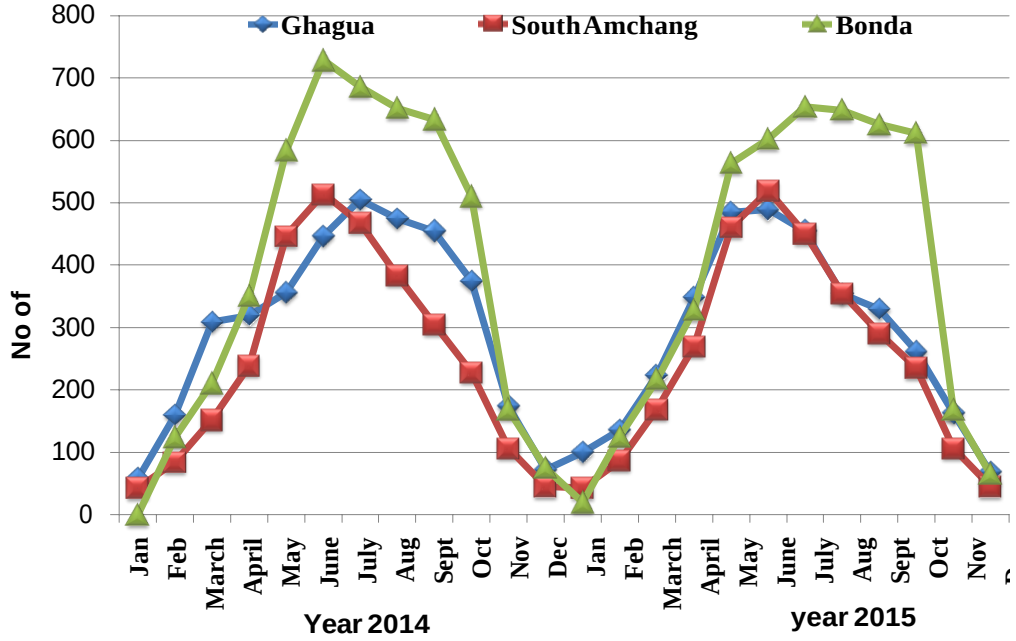


Fig. 4.40. Month and year-wise population density of the family Pieridae in different sites

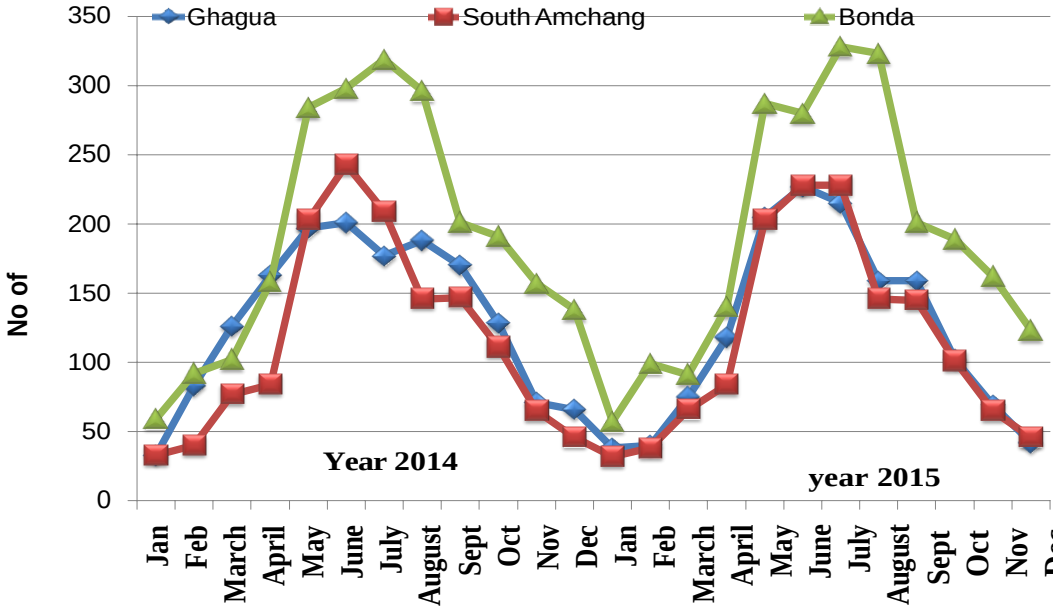


Fig. 4.41. Month and year-wise population density of the family Lycaenidae in different sites

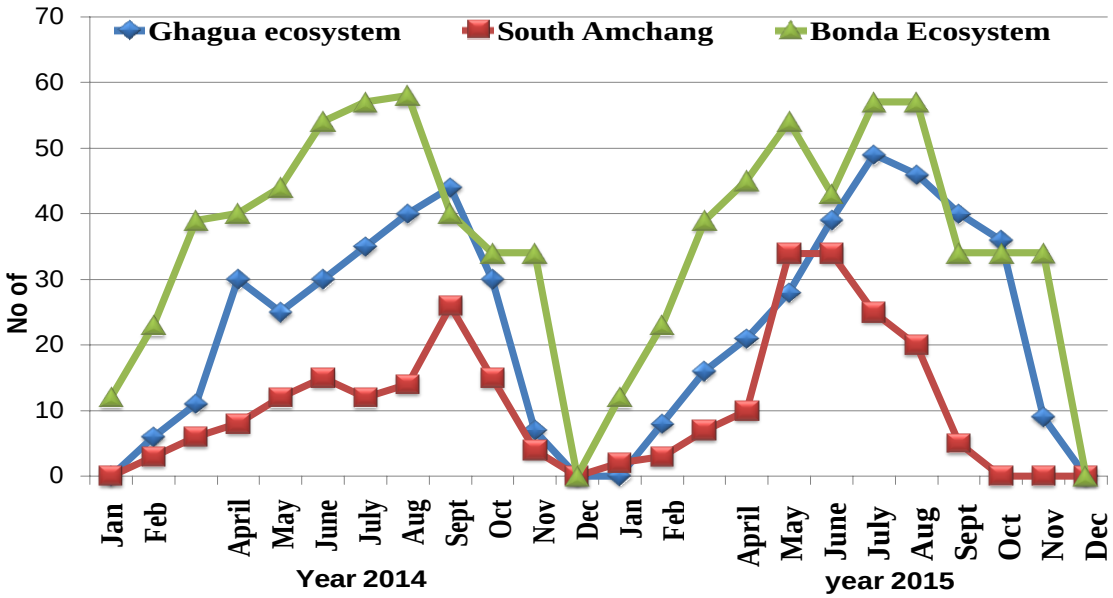


Fig. 4.42. Month and year-wise population density of the family Satyridae in different sites

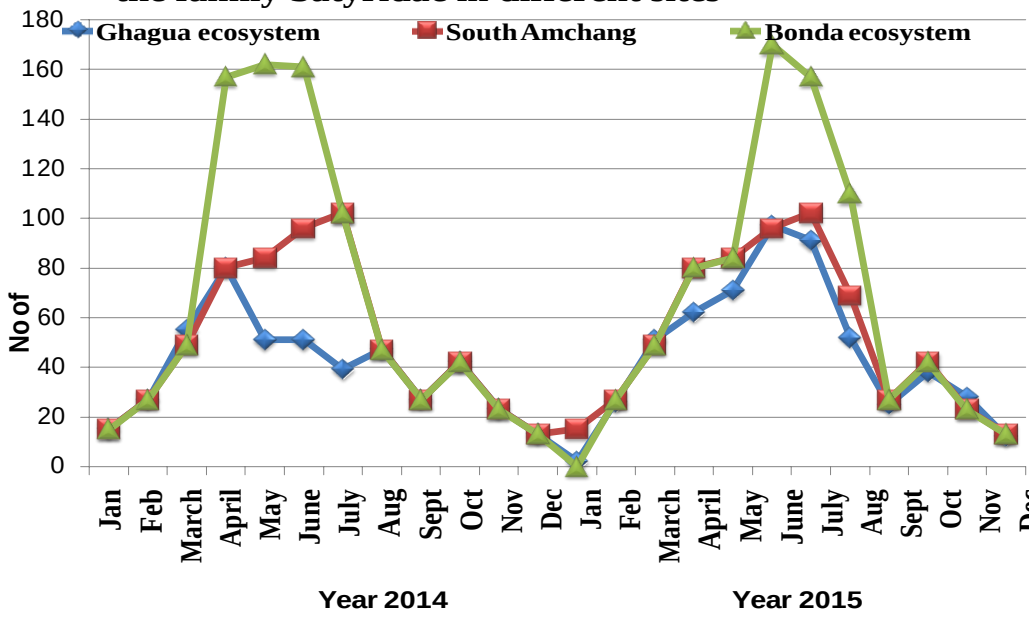


Table 4.21. Correlation and regression analyses of population density of butterflies in relation to the minimum temperature in different sites.

	Site I (Ghagua)	Site II (South Amchang)	Site III (Bonda)
Family	r	r	r
Papilionidae	0.3642	0.6408	0.8896
Nymphalidae	0.8255	0.8855	0.9478
Pieridae	0.8654	0.8509	0.8401
Lycaenidae	0.699	0.7639	0.7709
Satyridae	0.6223	0.679	0.654
r = Correlation co-efficient, b = Regression co-efficient, a = Intercept y			

Table 4.22.Correlation and regression analyses of population density of butterflies in relation to the maximum temperature in different Sites

	Site I (Ghagua)	Site II (South Amchang)	Site III (Bonda)
Family	r	r	r
Papilionidae	0.5132	0.622	0.8795
Nymphalidae	0.89	0.8448	0.8827
Pieridae	0.8717	0.7945	0.7509
Lycaenidae	0.7512	0.6896	0.8415
Satyridae	0.7217	0.6664	0.697

Table 4.23.Correlation and regression analyses of population density of butterflies in relation to the relative humidity in different sites

	Site I (Ghagua)	Site II (South Amchang)	Site III (Bonda)
Family	r	r	r
Papilionidae	-0.4386	-0.0628	0.0039
Nymphalidae	-0.0873	0.1146	0.2216
Pieridae	0.0507	0.208	0.3028
Lycaenidae	0.0647	0.1378	-0.3077
Satyridae	-0.3528	-0.247	-0.2674

Table 4.25. Correlation and regression analyses of population density of butterflies in relation to the wind speed in different sites			
Family	Site I (Ghagua)	Site II(South Amchang)	Site III (Bonda)
	r	r	r
Papilionidae	0.17601	0.54694	0.24909
Nymphalidae	0.23916	0.26459	0.01275
Pieridae	0.17836	0.15907	0.04448
Lycaenidae	0.17565	0.11974	0.4486
Satyridae	0.56388	0.57477	0.46205

Table No:-4.26 Probability of different families of butterfly in Amchang Wildlife Sanctuary			
	Ghagua site (P)	South Amchang site (P)	Bonda site (P)
Family			
Papilionidae	0.0472	0.0331	0.0697
Nymphalidae	0.1584	0.1321	0.2057
Pieridae	0.0666	0.0609	0.0999
Lycaenidae	0.0123	0.0100	0.0197
Satyridae	0.0224	0.0269	0.0351

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 and wind speed had an influential impact on the availability, density and diversity in various sites studied. The regression equation and regression line were well marked in Fig. 4.30 – 4.44. In the Ghagua study site the density of the butterfly families showed no significant difference to minimum temperature. In the South Amchang study site density of the butterfly families showed an overall positive correlation to minimum temperature (Pieridae: r= 0.8509, Nymphalidae: r =0.8855, and Satyridae: r=6790,), the values were statistically significant (Table 4.21). In the Bonda site density of the butterfly families showed an overall positive correlation to minimum temperature (Pieridae: r=0.8401; Nymphalidae: r=0.9478, and Satyridae: r=0.6540) the values were

statistically significant at 1% level (Table4.21). Lycaenidae: r=0.7709 the value were statistically significant.

In the site I (Ghagua), the density of all families showed an overall positive correlation to maximum temperature (Pieridae:r=0.8717;Nymphalidae:r=0.8900; Papilionidae :r=0.5132 and Lycaenidae:r=0.7512). Similarly the probability of different families at ghagua site were Papilionidae P=0.04722, Nymphalidae P= 0.15841, Pieridae P=0.06664, Lycaenidae P=0.0123 and Satyridae P=0.0223, the values mere statistically significant (Table 4.22 & 4.26).

In the site II (South Amchang) with reference to the factor maximum temperature butterfly of all the families showed positive correlation (Papilionidae :r= 0.6220; Nymphalidae:r=0.8448;Pieridae:r=0.7945;Lycaenidae:r=0.6896 and Satyridae :r= 0.6664), Similarly the probability of different families at South Amchang study site were Papilionidae P= 0.0331, Nymphalidae P= 0.1321, Pieridae P= 0.0608, Lycaenidae P= 0.0099 and Satyridae P= 0.0269, the values were statistically significant (Table 4.22 & 4.26).

In the site III (Bonda) with reference to the factor of maximum temperature butterflies of all the families showed positive correlation (Pieridae:r=0.7509; Nymphalidae: r = 0.8827; Papilionidae:r=0.8795; Lycaenidae:r=0.8415; and Satyridae:r =0.6970), Similarly the probability of different families at Bonda study site were Papilionidae P= 0.0696, Nymphalidae P= 0.2056 , Pieridae P= 0.0999 , Lycaenidae P= 0.0197 and Satyridae P= 0.0350 , the values were statistically significant (Table 4.22 & 4.26).

In Ghagua density of butterfly families showed negative significant to relative humidity (Papilionidae**:** r=-0.4386; Nymphalidae**: r=**-0.0873; Pieridae**: r=**0.0507; Lycaenidae**: r=**0.0647; Satyridae**: r=**-0.3528). In the South Amchang also with reference to the factor relative humidity, butterfly of all the families showed negative correlation (Pieridae : r= -0.0628; Satyridae**: r=** -0.2470).

In case of other familes, the values of correlation factors were (Nymphalidae**: r= =**0.1146; Pieridae**: r=**0.2080, Lycaenidae: r=0.1378) were showing positive significant. In the Bonda site with reference to the factor relative humidity butterflies of the family Lycaenidae and Satyridae showed negative correlation (Lycaenidae :r=-

0.3077 Satyridae: r=-0.2674 Table 4.23). In case of other families (Papilionidae: r=0.0039; Nymphalidae: r=0.2216; Pieridae: r=0.3028) shows positive correlation.

In the Ghagua the density of the butterflies of the families showed no significant difference to wind speed and factors are as Papilionidae: r=0.17601, Nymphalidae r=0.23916; Pieridae:r =0.17836, Lycaenidae: r=0.17565; Satyridae: r=0.56388.

In South Amchang with reference to the factor wind speed butterflies of all the families showed following correlation. (Pieridae: r =0.15907; Nymphalidae: r =0.26459, and Satyridae: r = 0.57477; Papilionidae: r=0.54694 and Lycaenidae: r= 0.11974). The values were statistically significant at 1% level (P <0.01) (Table 4.25).

In the Bonda study site also density of the butterflies of the families showed an overall positive correlation to wind speed (Pieridae: r =0.04448). The value were statistically significant at 1% level (P <0.01) (Table 4.25).

Similarity of butterfly species between the study sites

Similarity of butterfly species were analysed between sites using specified formula of Bray-Curtis measure (B). Total number of species collected in the three sites were 47, 47 and 42 respectively. The number of similar species observed between Ghagua and South Amchang were 45; between South Amchang and Bonda were 42 and between Bonda and Ghagua were 42. Similarity index was also calculated and indicated in Table 4.27. Season-wise similarity indices computed between Ghagua and South Amchang were (winter =0.7258, pre-monsoon=0.7686, monsoon= 0.8455, ret. monsoon = 0.7175 during the year 2014 and winter=0.6489, pre-monsoon= 0.8598, monsoon=0.8926, ret.monsoon=0.7823 in the year 2015). In case of South Amchang and Bonda these indices were:- winter =0.6174, pre-monsoon= 0.6608, monsoon = 0.7291, ret.monsoon =0.6084 during the year 2014 and winter = 0.5767, pre- monsoon =0.7466, monsoon = 0.7153, ret.monsoon = 0.5876 during the year 2015). Similarly seasonal similarity indices calculated between Bonda and Ghagua study sites were: winter =0.5980, pre-monsoon = 0.6757, monsoon =0.6193, ret.monsoon =0.6821 during the year 2014 and winter =0.5852, pre-monsoon =0.7563, monsoon =0.6446, ret.monsoon=0.6473 during the year 2015. Similarity index was maximum during monsoon (0.8455 & 0.8966) between Ghagua and South Amchang and (0.7291 &

0.7153) between South Amchang and Bonda during the study years 2014 & 2015 but in case of Bonda and Ghagua similarity indices was seen maximum in pre-monsoon season (0.6757 & 0.7563). On the other hand it had been observed minimum similarity during the winter season while comparing with all three communities. On the whole, the value always remained less than unity. Dissimilarity index is reverse sequence as compared to the similarity index. More or less uniform environmental conditions were revealed by higher value of similarity index, in contrast lower value indicates distinct heterogeneity. It is established that none of the communities of the study sites result into 1 or 0 which indicates that neither the community is completely overlap nor they are completely dissimilar but are very close to each other. In monsoon season the value of similarity index was maximum due to high moisture content in soil, comparatively low temperature, bright light and higher organic content through humification which mostly bring about uniformity in the weather conditions. On the other hand, minimum value in winter season indicates higher heterogeneity in climatic conditions which results poor plant growth. Such seasonality is common among butterflies and has been attributed to availability of food plants, local migration and response to adverse conditions [Kunte, K, 1997, Kunte. K, 2000].

Table No 4.27 :-Seasonwise similarity indices between

	Ghagua and South Amchang study site	**South Amchang and Bonda study site**	**Bonda and Ghagua study site**
Winter 2014	0.7258	0.6174	0.5980
Pre-monsoon	0.7686	0.6608	0.6757
Monsoon	0.8455	0.7291	0.6193
Ret.monsoon	0.7175	0.6084	0.6821
Winter 2015	0.6489	0.5767	0.5852
Pre-monsoon	0.8598	0.7466	0.7563
Monsoon	0.8926	0.7153	0.6446
Ret.monsoon	0.7823	0.5876	0.6473

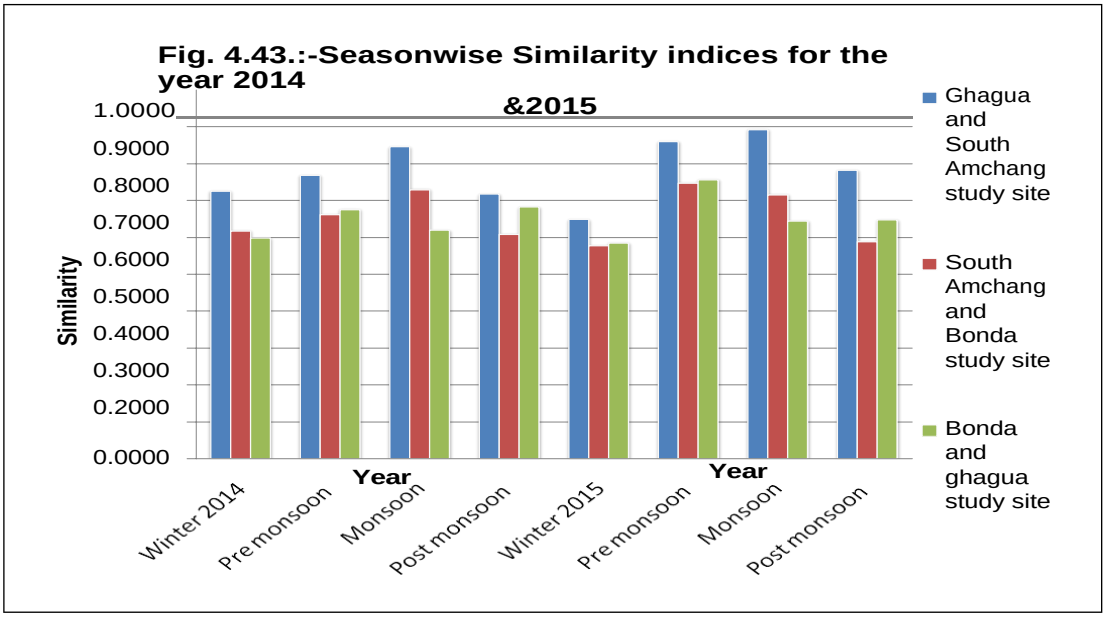


Table 4.22A.Correlation and regression analyses of population density of butterflies in relation to the maximum temperature in different ecosystems

	Ghagua eco-system			South Amchang eco-system			Bonda eco-system		
Family	**r**	**b**	**a**	**r**	**b**	**a**	**r**	**b**	**a**
Papilionidae	0.5132	0.039426	25.7801	0.6220	0.044996	26.4911	0.8795	0.039131	24.13220
Nymphalidae	0.8900	0.024346	21.97385	0.8448	0.021737	23.86186	0.8827	0.014981	23.45348
Pieridae	0.8717	0.058614	21.87964	0.7945	0.047755	23.79377	0.7509	0.035690	22.52852
Lycaenidae	0.7512	0.172616	25.23371	0.6896	0.259576	26.6186	0.8415	0.190835	22.15315
Satyridae	0.7217	0.123667	24.05171	0.6664	0.091791	24.38811	0.6970	0.052541	25.81530

r = Correlation co-efficient
b = Regression co-efficient
a = Intercepty

Table 4.23A.Correlation and regression analyses of population density of butterflies in relation to the relative humidity in different ecosystems

	Ghagua eco-system			South Amchang eco-system			Bonda eco-system		
Family	**r**	**b**	**a**	**r**	**b**	**a**	**r**	**b**	**a**
Papilionidae	-0.4386	-0.04258	91.37988	-0.0628	-0.00574	87.9044	0.0039	0.000218	87.512749
Nymphalidae	-0.0873	-0.00301	88.45423	0.1146	0.00372	86.60336	0.2216	0.004754	85.675842
Pieridae	0.0507	0.00431	86.99339	0.2080	0.01580	85.7088	0.3028	0.018190	84.073524
Lycaenidae	0.0647	0.01879	87.09537	0.1378	0.06555	86.85606	-0.3077	-0.088197	90.860077
Satyridae	-0.3528	-0.07639	90.80455	-0.2470	-0.04299	89.85799	-0.2674	-0.025482	89.247866
r =Correlati	n co-efficient								

b = Regression co-efficient
a = Intercept y

2

Table 4.25A. Correlation and regression analyses of population density of butterflies in relation to the wind speed in different ecosystems

Family	Ghagua eco-system			South Amchang eco-system			Bonda eco-system		
	r	**b**	**a**	**r**	**b**	**a**	**r**	**b**	**a**
Papilionidae	0.17601	0.00361	1.25826	0.54694	0.01055	0.91672	0.24909	0.00296	1.19041
Nymphalidae	0.23916	0.00174	1.05584	0.26459	0.00182	1.12623	0.01275	0.00006	1.56069
Pieridae	0.17836	0.00320	1.17653	0.15907	0.00255	1.28752	0.04448	0.00056	1.47582
Lycaenidae	0.17565	0.01076	1.32767	0.11974	0.01202	1.45761	0.44860	0.02714	0.56237
Satyridae	0.56388	0.02577	0.48271	0.57477	0.02112	0.44574	0.46205	0.00929	0.96128

r = Correlation co-efficient
b = Regression co-efficient
a = Intercept y

4

Fig. 4.44. Regression line drawn on Min. Temp. (0C) and population density of different families in Ghagua.

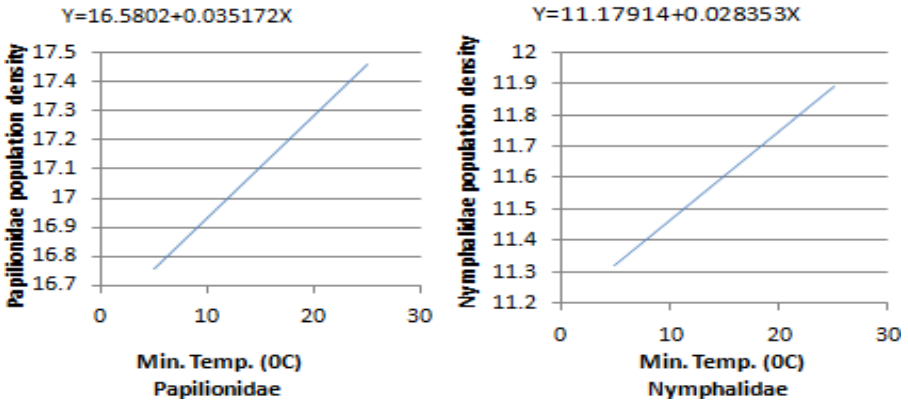


Fig. 4.45. Regression line drawn on Min. Temp. (0C) and population density of different

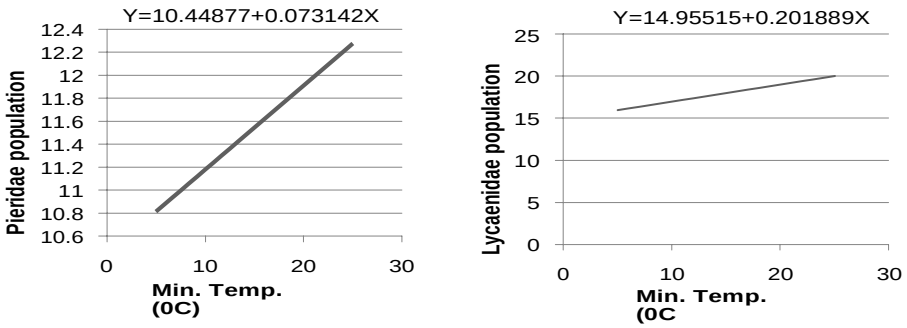


Fig. 4.46. Regression line drawn on Min. Temp. (0C) and population density of different families in Ghagua

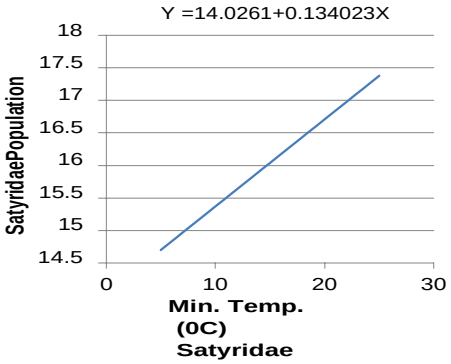


Fig. 4.47. Regression line drawn on Min. Temp. (0C) and population density of

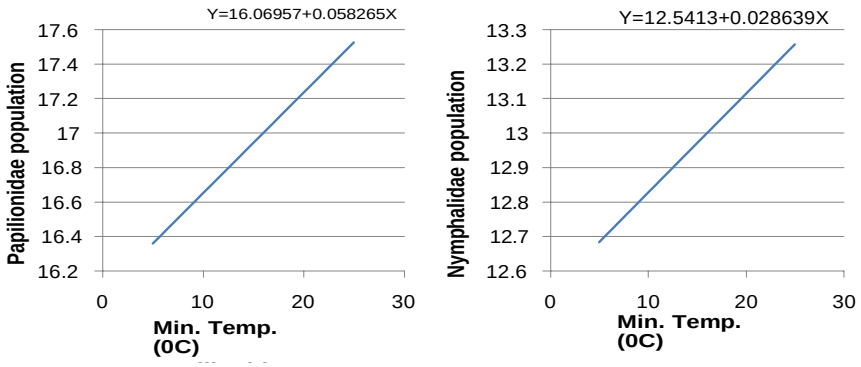


Fig. 4.48. Regression line drawn on Min. Temp. (0C) and population density of different

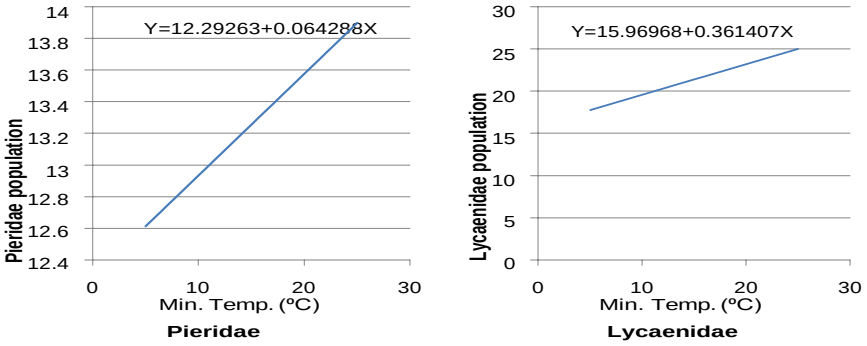


Fig. 4.49. Regression line drawn on Min. Temp. (0C) and population density of different

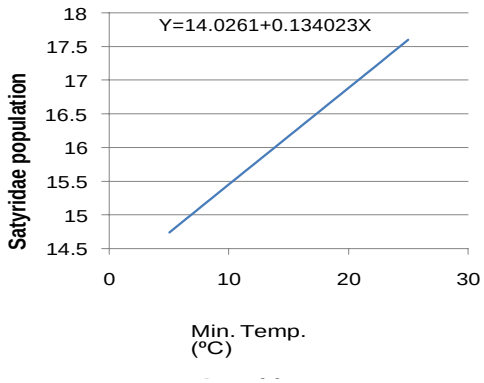


Fig. 4.50. Regression line drawn on Max. Temp. (0C) and population density of

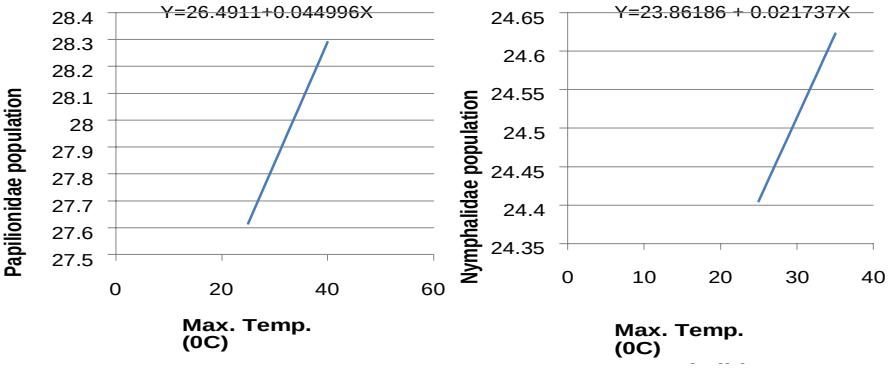


Fig. 4.51. Regression line drawn on Max. Temp. (°C) and population density

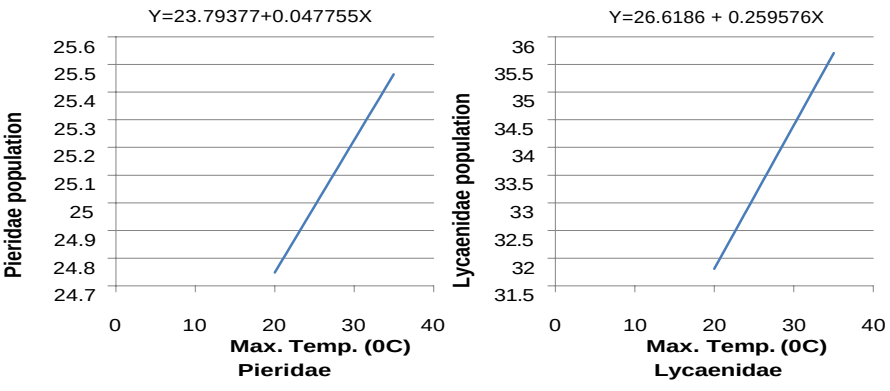


Fig. 4.52. Regression line drawn on Max. Temp. (°C) and population density of different families at the site II (South Amchang)

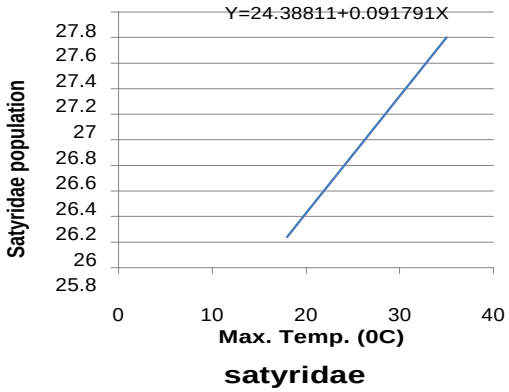


Fig. 4.53. Regression line drawn on Max. Temp. (°C) and population density

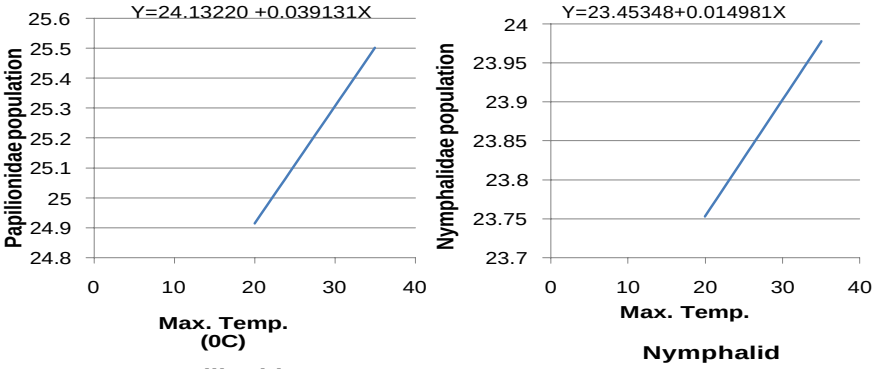


Fig. 4.54. Regression line drawn on Max. Temp. (°C) and population density of different families of butterflies at the site IIII (Bonda)

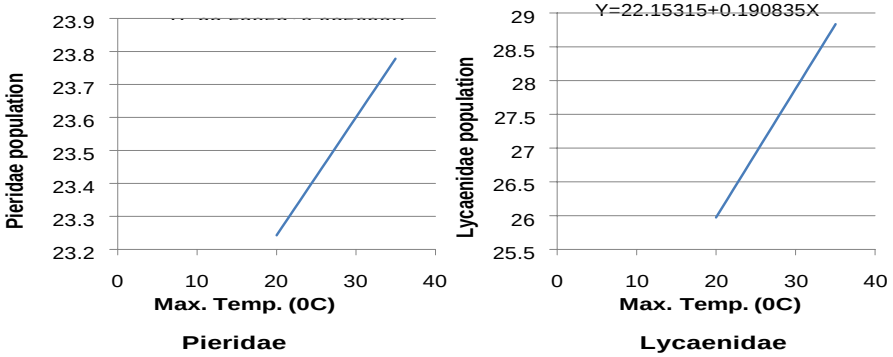


Fig. 4.55. Regression line drawn on Max. Temp. (°C) and population density of different families of butterflies at the site III (Bonda)

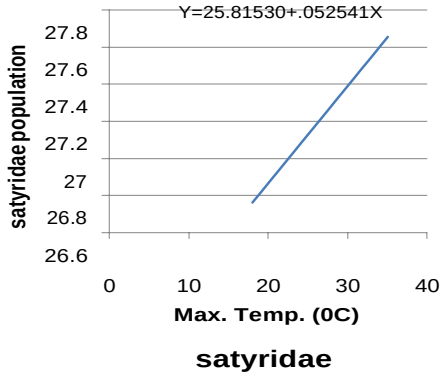


Fig. 4.56. Regression line drawn on relative humidity (%) and population

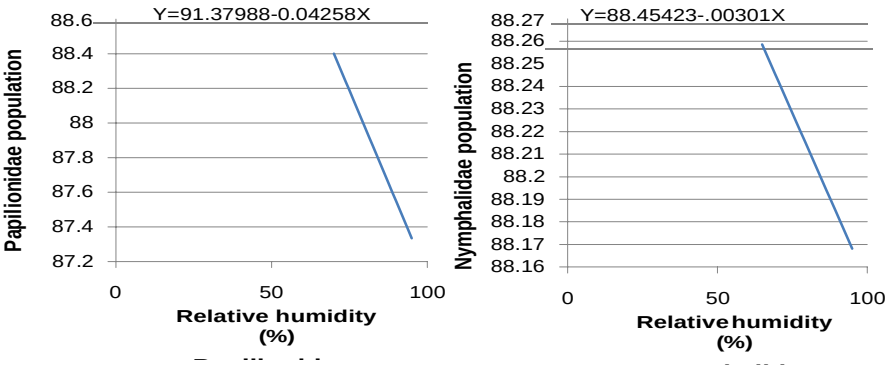


Fig. 4.57. Regression line drawn on relative humidity (%) and population

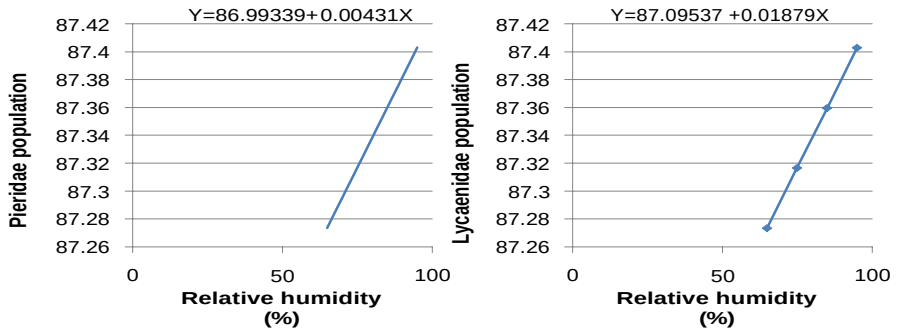


Fig. 4.58. Regression line drawn on relative humidity (%) and population

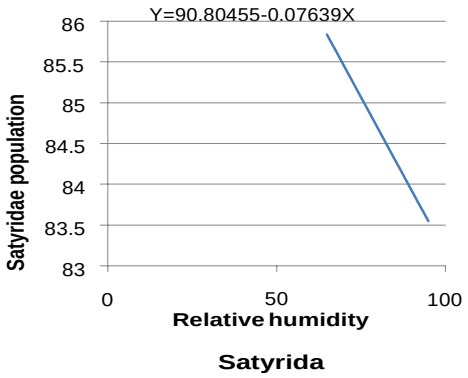


Fig. 4.59. Regression line drawn on relative humidity (%) and population

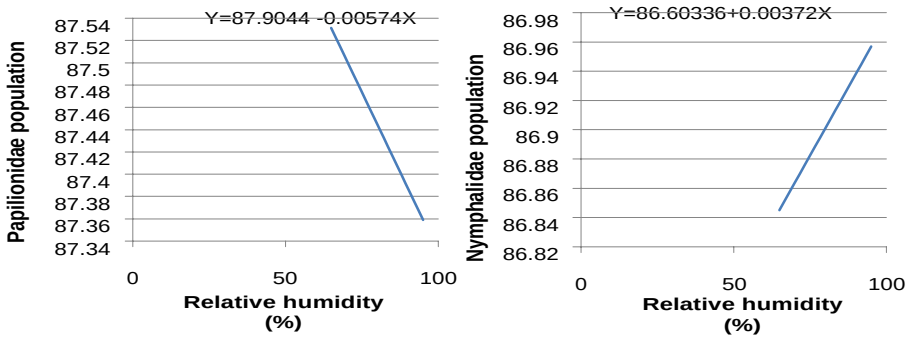


Fig. 4.60. Regression line drawn on relative humidity (%) and population

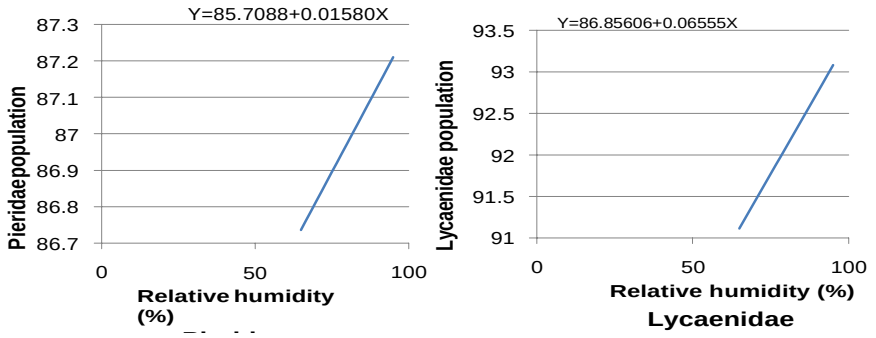


Fig. 4.61. Regression line drawn on relative humidity (%) and population density of different families of butterflies at the site II (South Amchang)

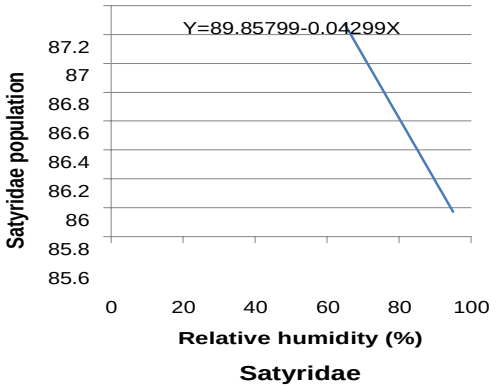


Fig. 4.62. Regression line drawn on relative humidity (%) and population density of different families of butterflies at the site III (Bonda)

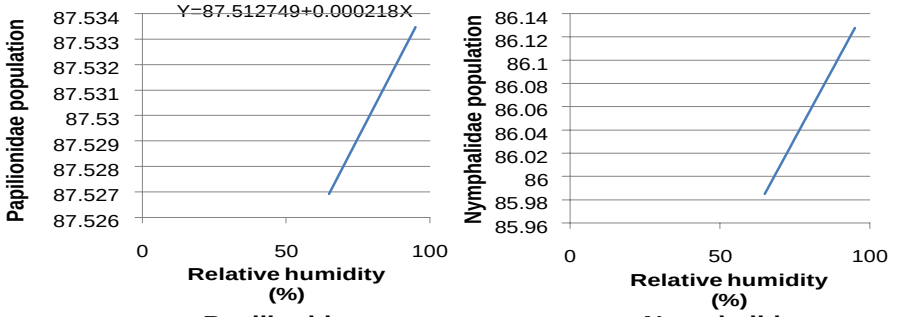


Fig. 4.63. Regression line drawn on relative humidity (%) and population

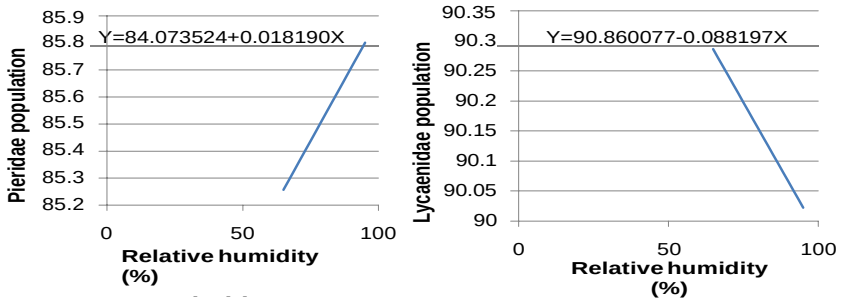
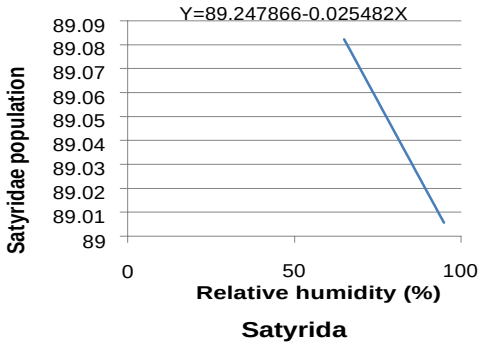


Fig. 4.64. Regression line drawn on relative humidity (%) and population



Vegetation

Vegetation in site I (Ghagua)

In the Ghagua study site, 68 plant species were recorded. Most of them were fruiting trees, which included the Papaya (*Carica papaya*), Jack fruit (*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 crops such as maize (*Zea mays*) and paddy (*Oryza sativa*) were 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)* were also available here. Apart from these there were number of shrubs and herbs also present in this site (Table4.28)

68 species plants were recorded and identified (table 4.31). The *Calotropis gigantea* belong to the family Asclepiadeceae, *Ricinus communis* belong to the family Euphorbiaceae and *Moringa oleifera* belong to the family Moringaceae were the important host plants for most of the adult butterflies and larvae which were represented in large numbers in this study site.

Table No-4.28 Vegetation in the site I (Ghagua)

S.No	Botanical name	Family	Vernacular name (Assamese)	Habit
1	*Mesua ferrea* Linn.	Clusiaceae	Nahor	Tree
2	*Mimusops elengi* Linn.	Sapotaceae	Bakul	Tree
3	*Adhatoda vasica* Nees	Acanthaceae	Bahak	Shrub
4	*Butea monospedlrma*	Fabaceae	Palash	Tree
5	*Clerodendrum colebookianum* Walp	Verbonaceae	Nefafu	Shrub
6	*Erythrina stricta* Linn.	Papilionaceae	Madaar	Tree
7	*Datura fasruosa* Linn	Solanaceae	Datura	Shrub
8	*Bauhinia purpurae* Linn.	Caesalpiniaceae	Kanchan	Tree
9	*Clerodendrum infortunatum* Linn.	Verbonaceae	Vetetita	Shrub
10	*Cascabela thevetia*	Apocynaceae	Karabi	Shrub
11	*Amaranthus viridis* Linn.	Amaranthaceae	Khutora	Herb
12	*Hibiscus rosa-sinensis* Linn.	Malvaceae	Jaba	Shrub
13	*Lantana camara* Linn.	Verbenaceae	Guphul	Shrub
14	*Mimosa pudica* Linn.	Fabaceae	Nilajban	Herb
15	*Cymbidium aloifolium* Swartz.	Orchidaceae	Kapauphul	Orchid
16	*Leucas aspera* Spreng	Lamiaceae	Dron	Herb
17	*Brassica rapa* Linn.	Cruciferae	Sariah	Herb
18	*Ageratum conyzoides* Linn.	Asteraceae	Gondhowa bon	Herb
19	*Solanum indicum* Linn.	Solanaceae	Titbhaguri	Shrub
20	T*agetes erecta* Linn.	Asteraceae	Gendha	Shrub
21	*Zanthoxylum oxyphyllum* Edgew.	Rutaceae	Mezenga	Tree
22	*Catharanthus roseus* G.Don	Apocynaceae	Nayantara	Shrub
23	*Calotropis gigantean* Linn	Apocynaceae	Akon	Shrub
24	*Neolamarckia cadamba* (Raxb) Bosser	Rubiaceae	Kadam	Small tree
25	*Tectona grandis* Linn.	Lamiaceae	Shegun	Tree
26	*Terminalia chebula* Retz.	Combretaceae	Shilikha	Tree
27	*Cedrus deodara* (Roxb.) G.Don	Pinaceae	Devadaru	Tree
28	*Bombax ceiba* Linn.	Malvaceae	Simolu	Tree
29	*Albizia lebbeck* Benth	Fabaceae	Siris	Tree
30	*Gmelina arborea* Linn.	Lamiaceae	Gomari	Tree
31	*Cassia fistula* Linn.	Fabaceae	Sonaru	Tree
32	*Ricinus communis* Linn.	Euphorbiaceae	Aragach	Shrub

33	*Mangifera indica* Linn	Anacardiaceae	Aam	Tree
34	*Ziziphus jujuba* Lamk.	Rhamnaceae	Bogori	Small tree
35	*Psidium guajava* Linn.	Myrtaceae	Modhuriam	Small tree
36	*Chenopodium album* Linn.	Amaranthaceae	Jilmil	Herb
37	*Hibiscus sabdariffa* Linn.	Malvaceae	Mesta	Shrub
38	*Moringa oleifera* Lam.	Moringaceae	Sagina	Small tree
39	*Elaeocarpus floribundus* Blume	Teliaceae	Jalpai	Small tree
40	*Phyllanthus emldica*.	Phyllanthaceae	Amlakhi	Tree
41	*Melia azedarach* Linn.	Meliaceae	Ghoranim	Tree
42	*Camellia sinensis* Linn.	Theaceae	Cha	Shrub
43	*Artocarpus heterophyllus* Lam.	Moraceae	Kathal	Tree
44	*Tamarindus indica* Linn.	Fabaceae	Teteli	Tree
45	*Citrus maxima* Meer.	Rutaceae	Rabab tenga	Small tree
46	*Murrya koenigii* Linn	Rutaceae	Narsing	Shrub
47	*Cocos nucifera* Linn	Arecaceae	Narikal	Tree
48	*Borassus flabellifer* Linn.	Arecaceae	Tal	Tree
49	*Syzygium cumini* Linn	Myrtaceae	Kolajam	Tree
50	*Ficus semieaodata* Buch Ham	Moraceae	Dumaru	Small tree
51	*Averrhoa carambola* Linn.	Oxalidaceae	Kardoi	Small tree
52	*Litchi chinensis* Sonn	Sapindaceae	Lichu	Small tree
53	*Citrus limon* Linn	Rutaceae	Borlebu	Shrub
54	*Carica papaya* Linn.	Caricaceae	Amita	Small tree
55	*Zea mays* Linn.	Poaceae	Makai	Small tree
56	*Oryza sativa* Linn.	Poaceae	Dhan	Herb
57	*Dragea volubilis* (L.F.).	Asclepiadaceae	Khamallata	Climber
58	*Heliotropium indicum* Linn.	Boraginaceae	Hatisura	Herb
59	*Aegle marmelos* Linn.	Rutaceae	Vilva	Tree
60	*Hydnocarpus kurzii* Ward	Achariaceae	Chaulmugra	Small tree
61	*Cassia fistula* Linn.	Fabaceae	Sonaru	Tree
62	*Vachella nilotica* Linn.	Fabaceae	Taruakadam	Tree
63	*Viscum monoicum* Roxb ex.DC	Santalaceae	Roghumala	Climber
64	*Areca catechu* Linn.	Arecaceae	Tamul	Tree
65	*Bauhinia racemosum* Lam.	Fabaceae	Bogakanchan	Shrub
66	*Aristolochia indica* Linn.	Aristolochiaceae	Eshwar mul.	Climber
67	*Calamus rotang* Linn.	Arecaceae	Bet	Climber
68	*Bambusa vulgaris* Schrad	Poaceae	Bah	Grass

Vegetation in site II (South Amchang)

In this study site, totally 65 plant species were identified. Here most of the plants observed were herbs and very few were shrubs and trees. The members of the family Poaceae, Apocynaceae, Verbenaceae, Myrtaceae, Amaranthaceae, Compositae, and Papilionaceae were the dominated families here. *Camellia sinensis, Bambusa vulgaris, Tectona grandis, Albizia lebbeck, Gmelina orborea and Mangifera indica* were the most dominating plants of the South Amchang. *H.indicum* and milk weed plant *Calotropis gigantea* were also commonly present here. These were all the host plants for many of the larvae and adult butterflies observed in this study area (Table 4.31).

Table 4.29 Vegetation in site II (South Amchang)

S.No	Botanical name	Family	Vernacular name(Assamese)	Habit
1	*Mesua ferrea* Linn.	Clusiaceae	Nahor	Tree
2	*Mimusops elengi* Linn.	Sapotaceae	Bakul	Tree
3	*Adhatoda vasica* Nees	Acanthaceae	Bahak	Shrub
4	*Butea monospedlrma*	Fabaceae	Palash	Tree
5	*Clerodendrum colebookianum* Walp	Verbonaceae	Nefafu	Shrub
6	*Erythrina stricta* Linn.	Papilionaceae	Madaar	Tree
7	*Datura fasruosa* Linn	Solanaceae	Datura	Shrub
8	*Bauhinia purpurae* Linn.	Caesalpiniaceae	Kanchan	Tree
9	*Clerodendrum infortunatum* Linn.	Verbonaceae	Vetetita	Shrub
10	*Cascabela thevetia*	Apocynaceae	Karabi	Shrub
11	*Amaranthus viridis* Linn.	Amaranthaceae	Khutora	Herb
12	*Hibiscus rosa-sinensis* Linn.	Malvaceae	Jaba	Shrub
13	*Lantana camara* Linn.	Verbenaceae	Guphul	Shrub
14	*Mimosa pudica* Linn.	Fabaceae	Nilajban	Herb
15	*Cymbidium aloifolium* Swartz.	Orchidaceae	Kapauphul	Orchid
16	*Leucas aspera* Spreng	Lamiaceae	Dron	Herb
17	*Brassica rapa* Linn.	Cruciferae	Sariah	Herb
18	*Ageratum conyzoides* Linn.	Asteraceae	Gondhowa bon	Herb
19	*Solanum indicum* Linn.	Solanaceae	Titbhaguri	Shrub
20	T*agetes erecta* Linn.	Asteraceae	Gendha	Shrub
21	*Zanthoxylum oxyphyllum* Edgew.	Rutaceae	Mezenga	Tree
22	*Catharanthus roseus* G.Don	Apocynaceae	Nayantara	Shrub
23	*Calotropis gigantean* Linn	Apocynaceae	Akon	Shrub

24	*Neolamarckia cadamba* (Raxb) Bosser	Rubiaceae	Kadam	Small tree
25	*Tectona grandis* Linn.	Lamiaceae	Shegun	Tree
27	*Terminalia chebula* Retz.	Combretaceae	Shilikha	Tree
28	*Cedrus deodara* (Roxb.) G.Don	Pinaceae	Devadaru	Tree
29	*Bombax ceiba* Linn.	Malvaceae	Simolu	Tree
30	*Albizia lebbeck* Benth	Fabaceae	Siris	Tree
31	*Gmelina arborea* Linn.	Lamiaceae	Gomari	Tree
32	*Cassia fistula* Linn.	Fabaceae	Sonaru	Tree
33	*Ricinus communis* Linn.	Euphorbiaceae	Aragach	Shrub
34	*Mangifera indica* Linn	Anacardiaceae	Aam	Tree
35	*Ziziphus jujuba* Lamk.	Rhamnaceae	Bogori	Small tree
36	*Psidium guajava* Linn.	Myrtaceae	Modhuriam	Small tree
37	*Chenopodium album* Linn.	Amaranthaceae	Jilmil	Herb
38	*Hibiscus sabdariffa* Linn.	Malvaceae	Mesta	Shrub
39	*Moringa oleifera* Lam.	Moringaceae	Sagina	Small tree
40	*Elaeocarpus floribundus* Blume	Teliaceae	Jalpai	Small tree
41	*Phyllanthus emldica*.	Phyllanthaceae	Amlakhi	Tree
42	*Camellia sinensis* Linn.	Theaceae	Cha	Shrub
43	*Artocarpus heterophyllus* Lam.	Moraceae	Kathal	Tree
44	*Tamarindus indica* Linn.	Fabaceae	Teteli	Tree
45	*Citrus maxima* Meer.	Rutaceae	Rabab tenga	Small tree
46	*Murrya koenigii* Linn	Rutaceae	Narsing	Shrub
47	*Cocos nucifera* Linn	Arecaceae	Narikal	Tree
48	*Borassus flabellifer* Linn.	Arecaceae	Tal	Tree
49	*Syzygium cumini* Linn	Myrtaceae	Kolajam	Tree
50	*Ficus semieaodata* Buch Ham	Moraceae	Dumaru	Small tree
51	*Averrhoa carambola* Linn.	Oxalidaceae	Kardoi	Small tree
52	*Litchi chinensis* Sonn	Sapindaceae	Lichu	Small tree
53	*Citrus limon* Linn	Rutaceae	Borlebu	Shrub
54	*Carica papaya* Linn.	Caricaceae	Amita	Small tree
55	*Zea mays* Linn.	Poaceae	Makai	Small tree
56	*Oryza sativa* Linn.	Poaceae	Dhan	Herb
57	*Dragea volubilis* (L.F.).	Asclepiadaceae	Khamallata	Climber
58	*Heliotropium indicum* Linn.	Boraginaceae	Hatisura	Herb
59	*Aegle marmelos* Linn.	Rutaceae	Vilva	Tree
60	*Hydnocarpus kurzii* Ward	Achariaceae	Chaulmugra	Small tree
61	*Cassia fistula* Linn.	Fabaceae	Sonaru	Tree
62	*Vachella nilotica* Linn.	Fabaceae	Taruakadam	Tree
63	*Viscum monoicum* Roxb ex.DC	Santalaceae	Roghumala	Climber
64	*Areca catechu* Linn.	Arecaceae	Tamul	Tree
65	*Bauhinia racemosum* Lam.	Fabaceae	Bogakanchan	Shrub

Vegetation of site III (Bonda)

In this Site, vegetation diversity as well as abundance was poor compared to other two sites. Some of the places were covered by teak plantation which was protected by forest department. 58 different plant species belong to different families were observed. Most of them were Verbenaceae, Oxalidaceae, Urticaceae, Palmae, Myrtaceae, Euphorbiaceae, Moringaceae, Poaceae and Leguminosae. The plants species belong to the family Verbenaceae were present in large numbers. There were also many short shrubs growing to the height of four to six feet. Most of the other plants observed were very small shrubs or herbs only. They were randomly distributed here and there in the study area (Table 4.3).

Table No-4.30 Vegetation in site III (Bonda)

S.No	Botanical name	Family	Vernacular name(Assamese)	Habit
1	*Melia azedarach* Linn.	Meliaceae	Ghoranim	Tree
2	*Camellia sinensis* Linn.	Theaceae	Cha	Shrub
3	*Artocarpus heterophyllus* Lam.	Moraceae	Kathal	Tree
4	*Tamarindus indica* Linn.	Fabaceae	Teteli	Tree
5	*Citrus maxima* Meer.	Rutaceae	Rabab tenga	Small tree
6	*Murrya koenigii* Linn	Rutaceae	Narsing	Shrub
7	*Cocos nucifera* Linn	Arecaceae	Narikal	Tree
8	*Borassus flabellifer* Linn.	Arecaceae	Tal	Tree
9	*Syzygium cumini* Linn	Myrtaceae	Kolajam	Tree
10	*Ficus semieaodata* Buch Ham	Moraceae	Dumaru	Small tree
11	*Averrhoa carambola* Linn.	Oxalidaceae	Kardoi	Small tree
12	*Litchi chinensis* Sonn	Sapindaceae	Lichu	Small tree
13	*Citrus limon* Linn	Rutaceae	Borlebu	Shrub
14	*Carica papaya* Linn.	Caricaceae	Amita	Small tree
15	*Zea mays* Linn.	Poaceae	Makai	Small tree
16	*Oryza sativa* Linn.	Poaceae	Dhan	Herb
17	*Dragea volubilis* (L.F.).	Asclepiadaceae	Khamallata	Climber
18	*Heliotropium indicum* Linn.	Boraginaceae	Hatisura	Herb
19	*Aegle marmelos* Linn.	Rutaceae	Vilva	Tree
20	*Hydnocarpus kurzii* Ward	Achariaceae	Chaulmugra	Small tree
21	*Cassia fistula* Linn.	Fabaceae	Sonaru	Tree
22	*Vachella nilotica* Linn.	Fabaceae	Taruakadam	Tree

23	*Viscum monoicum* Roxb ex.DC	Santalaceae	Roghumala	Climber
24	*Areca catechu* Linn.	Arecaceae	Tamul	Tree
25	*Bauhinia racemosum* Lam.	Fabaceae	Bogakanchan	Shrub
26	*Aristolochia indica* Linn.	Aristolochiaceae	Eshwar mul.	Climber
27	*Calamus rotang* Linn.	Arecaceae	Bet	Climber
29	*Bambusa vulgaris* Schrad	Poaceae	Bah	Grass
30	*Mesua ferrea* Linn.	Clusiaceae	Nahor	Tree
31	*Mimusops elengi* Linn.	Sapotaceae	Bakul	Tree
32	*Adhatoda vasica* Nees	Acanthaceae	Bahak	Shrub
33	*Butea monospedlrma*	Fabaceae	Palash	Tree
34	*Clerodendrum colebookianum* Walp	Verbonaceae	Nefafu	Shrub
35	*Erythrina stricta* Linn.	Papilionaceae	Madaar	Tree
36	*Datura fasruosa* Linn	Solanaceae	Datura	Shrub
37	*Bauhinia purpurae* Linn.	Caesalpiniaceae	Kanchan	Tree
38	*Clerodendrum infortunatum* Linn.	Verbonaceae	Vetetita	Shrub
39	*Cascabela thevetia*	Apocynaceae	Karabi	Shrub
40	*Amaranthus viridis* Linn.	Amaranthaceae	Khutora	Herb
41	*Hibiscus rosa-sinensis* Linn.	Malvaceae	Jaba	Shrub
42	*Lantana camara* Linn.	Verbenaceae	Guphul	Shrub
43	*Mimosa pudica* Linn.	Fabaceae	Nilajban	Herb
44	*Cymbidium aloifolium* Swartz.	Orchidaceae	Kapauphul	Orchid
45	*Leucas aspera* Spreng	Lamiaceae	Dron	Herb
46	*Brassica rapa* Linn.	Cruciferae	Sariah	Herb
47	*Ageratum conyzoides* Linn.	Asteraceae	Gondhowa bon	Herb
48	*Solanum indicum* Linn.	Solanaceae	Titbhaguri	Shrub
49	T*agetes erecta* Linn.	Asteraceae	Gendha	Shrub
50	*Zanthoxylum oxyphyllum* Edgew.	Rutaceae	Mezenga	Tree
51	*Catharanthus roseus* G.Don	Apocynaceae	Nayantara	Shrub
52	*Calotropis gigantean* Linn	Apocynaceae	Akon	Shrub
53	*Neolamarckia cadamba* (Raxb) Bosser	Rubiaceae	Kadam	Small tree
54	*Tectona grandis* Linn.	Lamiaceae	Shegun	Tree

4.8 Butterfly and Host plants

The adult butterflies used flower nectar as food and commonly they were foraging on the flowering plants. Some of the identifying flowering plants in where butterflies were observed during the study period were given in the table 4.31.

Table No 4.31 Host plants and butterfly

Family	SL No	Scientific name	Common name	Preferred host plants
Papilionidae	1	*Papilio polytes* Linnaeus	Common Mormon	*Citrus maxima, Murrya koenigii, Citrus spp, Aegle marmelos*
	2	*Troides helena* Linnaeus	Common Birdwing	*Aristolochia* sp., *Aristolochia tagala*.
	3	*Atrophaneura dasarada* Moore	Great Windmill	*Aristolochia* sp.
	4	*Atrophaneura aristolochiae* Fabricius	Common Rose	*Aristolochia* sp.
	5	*Graphium sarpedon* Linnaeus	Common Bluebottle.	*Litchi chinensis, Cinnamomum* sp., *Polyalthia longifolia*.
	6	*Papilio demoleus* Linnaeus	Lime Butterfly	*Aegle marmelos, Murraya koenigii, Citrus* sp., limes and lemons
	7	*Chilasa clytia* Linnaeus	Common Mime	*Litchi chinensis,* Cinnamomum sp., *Miliusa tomentosa, Polyalthia longifolia, Michelia doltospa,* Cinnamomum sp., Litsea sp.
	8	*Papilio memnon* Linnaeus	Great Mormon	*Citrus* sp., *Aegle marmalos, Citrus limon, Murrya koenigii*
	9	*Troides aeacus* C.&R. Felder	Golden Birdwing	*Aristolochia* sp. Panpipuli, Belikol (Aristolochiaceae)
Nymphalidae	10	*Junonia lemonias* Linnaeus	Lemon Pansy .	*Barleria* sp.
	11	*Hypolimnas bolina* Linnaeus	Great Eggfly	*Hibiscus* sp.,
	12	*Tirumala septentrionis* Butler	Dark Blue Tiger	*Ageratum conyzoides, Wattakaka volubilis*
	13	*Junonia atlites*	Grey Pansy	*Barleria* sp.

	Linnaeus		
14	*Danaus genutia* Cramer	Striped Tiger	*Lantana camera, Heliotropium inicum, Crotalaria juncea, Nerium oleander, Barleria cristata rosea, Bauhinia purpurea*
15	*Junonia almana* Linnaeus	Peacock Pansy	*Lantana camera,* Marigold,
16	*Danaus chrysippus* (Linnaeus)	Plain Tiger	*Calotropis* sp, *Lantana camera, Ageratum conyzoids, Heliotropium indicum* ,
17	*Cethosia cyane* Drury	Leopard Lacewing	Passifloraceae
18	*Junonia hierta* Fabricius	Yellow Pansy	Barleria sp. Dry river bed, stony uncultivated fields and roads
19	*Athyma nefte* Cramer	Colour Sergent	*Glochidion* sp.
20	*Ariadne merione* Cramer	Common Castor	*Ricinus communis*
21	*Tanaecia lepidea* (Butler)	Grey Count	*Melastoma malabarium, Careya arborea*
22	*Kaniska canace* Linnaeus	Blue Admiral	*Dioscorea deltoidea, Smilax* sp.
23	*Neptis hylas* Linnaeus	Common Sailer	*Bombax* sp., *Zizyphus* sp., *Dalbergia* sp. , *Pongamia glabra, Moulluva spicata*
24	*Athyma opalina* Kollar	Himalayan Sergeant	*Mehonia nepalensis,* damp places , stones , leaves and bushes
25	*Parantica aglea* Moore	Glassy Tiger	*Calotropis* sp., *Lantana camera, Ageratum conyzoides, Calotropis gigantea*.
26	*Tanaecia jahnu* Moore	Plain Earl	Data Deficient
27	*Ariadne ariadne* Linnaeus	Angled Castor	*Ricinus communis*
28	*Melanitis leda* Linnaeus	Common Evening Brown	*Oryza sativa, Zea mays*
29	*Eupolea mulciber*	Striped Blue Crow	Oleander, *Ageratum conyzoides , Heliotropium indicum, Ficus* sp.
30	*Cirrochroa aoris* Doubleday	Large Yeoman	*Hydnocarpus* sp.
31	*Polyura athamas*	Common Nawab	*Caesalpinia bondrc*

		Drury		
	32	*Pantoporia hordonia* Stoll	Common Lascar	*Acacia* sp.
	33	*Eupolea core* Cramer	Common Indian Crow	*Ficus* sp., *Nerium* sp.
	34	*Junonia iphita* Cramer	Chocolate Pansy	*Carvia callosa, Hygrophila auriculata, Justicia neesii, Lepidagathis prostrata*
Pieridae	35	*Catopsilia pyranthe* Linnaeus	Mottled Emigrant	*Cassia* sp., *Cassia fistula*
	36	*Eurema hecabe Linnaeus*	Common Grass Yellow.	*Acacia* sp., *Cassia* sp., *Acacia arabica*
	37	*Catopsilia crocale* Cramer	Common Emigrant	*Cassia* sp., *Bauhinia racemosa, Butea monosperma,*
	38	*Pieris canidia* Sparrman	Indian Cabbage White	Cabbage, Mustard and other related plants
	39	*Delias descombesi* (Boisduval)	Red-spot jezebel	Data Deficient
	40	*Delias eucharis* Drury	Common jezebel	*Viscum* sp. (Raghumala)
	41	*Leptosia nina* Fabricius	Psyche	*Capparis* sp.
	42	*Catopsilia pomona* Fabricius	Common Emigrant	*Cassia* sp., *Bauhinia racemosa,*
	43	*Appias libythea* Fabricius	Striped Albatross	*Capparis* sp.
Lycaenidae	44	*Rapala pheretima* Hewitson	Copper Flash	*Melastoma malabathricum*
	45	*Anthene emolus* Godart	Common ciliate blue	*Terminalia paniculata, T. Chebula*
	46	*Castalius rosimon* (Fabricius)	Common pierrot	*Zizyphus jujuba*
Satyridae	47	*Lethe confusa*. Aurivillius	Banded tree brown	Moist places and salt encrustations
	48	*Elymnias hypermnestra* Linnaeus	Common palmfly	*Calamus* sp., *Areca* sp.

Threats and anthropogenic factors affecting the butterfly diversity

The majority of the world‟s high biological diversity is located in the tropic. A healthy web of biodiversity is the foundation for ecosystem services that human depend on but it is currently under severe pressure due to anthropogenic disturbance. Amchang Wildlife Sanctuary of Assam has been affected by anthropogenic disturbances which cause threats to biological diversity. The life of butterflies is amides the threats as some destructive organism may destroy before they reach adulthoods. As butterflies form an important food chain especially for birds and some reptiles so they become important parts of nature”s food web. There are many different creatures that make butterflies as part of their diet. While most humans cannot even imagine attempting to eat a butterfly, there are many animals that need to make a meal out of a butterfly to survive. The organisms that destroy butterflies in different stages of their life can be divided into four main categories based on the way they destroy the butterflies. They are viz.

i) Parasitoids

ii) Parasites

iii) Predators

iv) Pathogens

Anthropogenic factors .

Some of the major human impacts on WTS are (1) existing railway track and a highway connecting the capital city to the airport running along the northern and southern boundary of the sanctuary; (2) Three tea estates located to the north, east and southern side of the sanctuary; (3) encroachment by illegal immigrant workers trying to find employment in the nearby urban areas; (4) illegal logging activities of timber smugglers; (5) earth cutting from the hills and establishment of brick-making factories; (6) shifting cultivation in the nearby forest area; and (7) serious threat has been industrial development.

Human influx

In recent years, human migration confounded by population increase. Developmental activity by human being is gradually increasing which is directly affecting the biodiversity. As Amchang Wildlife Sanctuary is just attached to the metro politant capital city of Assam, so it could not escape from human interference. Several ethnic human societies have been living in and around the sanctuary that fully depend on nature reserve for their day to day life. Karbies originally belongs to the Karbi Anglong have settle down in different parts of the sanctuary and they continue to use the sanctuary resources for their livelihood. Besides there are several unauthorised settlement in the vicinity area of the Wildlife Sanctuary and established various type of business settlement in this area. Significantly, there are only five small villages, i.e., Ekrabari, Sowali Lukuwa Sal, Shyam Pathar, Hatisila and Kilinghop inside the Amchang Wildlife Sanctuary before it was declared a sanctuary. Several thickly-populated settlements – Garobasti, Hastinapur, Kangkan Nagar, Pragati Nagar, Malagog, etc., – have cropped up during the subsequent period, undermining its status as a sanctuary.

Villages Hatisila and Kilinghop inside Amchang. .

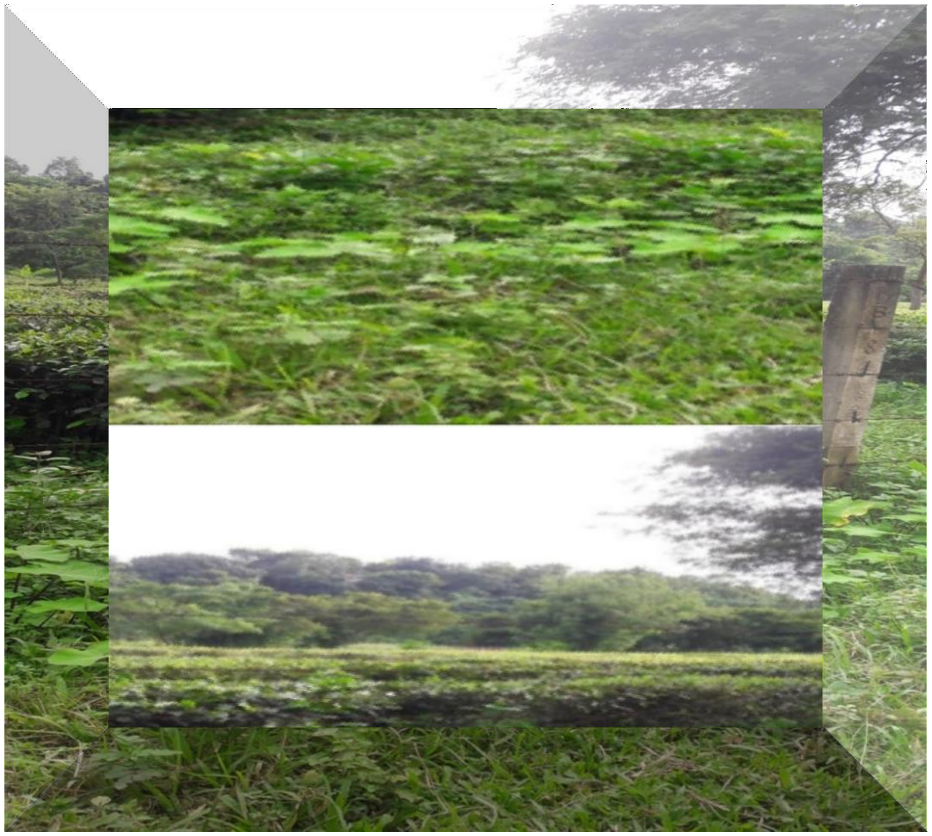
Further there is illegal felling of trees and collection of non timber forest products. According to the local people of Amchang, every day about 150 to 200 cycle-load of green fodder is extracted from the Amchang side of the Sanctuary, while from this side alone about 80 shoulder-load (bhars) of firewood is extracted from the Sanctuary. A situation is more serious on the northern side of the Sanctuary. Areas like Birkuchi and Panikhaiti are located on that side of the Sanctuary. The timber smugglers prefer this side of the Sanctuary to transit their booty because of the location of the Panikhaiti Railway Station just on the fringe of the Sanctuary there. Timber and charcoal are the main items loaded by the smugglers illegally on the railway wagons there.

Impact of Tea Estates on Butterfly diversity.

A major study of the impact of tea estate on butterfly population has been carried out by Mann Barua. Tea estate replace indigenous vegetation with mono culture plantations. It has been found that butterfly species diversity and density is considerably lower in tea estate than in semi ever green forest. This is due to both destruction of habitat and extensive use of pesticide in tea garden.

Degradation of wetland

Khamranga Beel located at Chandrapur exemplifies the rapid degradation of wetlands in and around the city. Mounting anthropogenic pressures and industrial activities within the wetland‟s periphery have hurt its fragile ecosystem and lack of intervention from Government authorities, including the Forest Department, has hastened its degradation process. Conservation of the wetland assumes all the more significance because it is part of the Amchang Wildlife Sanctuary landscape, forming a single, contiguous conservation belt.



KhamrangaBeel.

Excessive fishing and large-scale agricultural activities in its vicinity are also damaging its ecology as are the roads being constructed on the wetland. Stone quarrying activities very close to the wetland and a traditional elephant corridor are also leading to accumulation of stone-dust and silt on the water-body's bed besides spoiling the environment of the Amchang forest.

Stone quarry

Brick industry

Road construction activity in Amchang