



Studies on ecology of Lepidopteron fauna of Agro-ecosystem in Marathwada region of Maharashtra State (India)

*Ranjitsingh K. Nimbalkar and Sambahji S. Shinde

Department of Zoology, Vivekanand College, Aurangabad (MS) India

*Department of Zoology, V.P. College, Vaijapur Dist Aurangabad (MS) India

*rknimbalkar@gmail.com

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Abstract

In the present study we record the maximum number of butterfly species than the species moths viz., family Lycaenidae (15 species), Nymphalidae (10 species), Hesperidae (8 species), Pieridae (7 species), and from Papilionidae, Danaidae and Acraeidae six, three and one species respectively. In the present study we record 99 species of order Lepidoptera comprising 49 species of moth and 50 species of butterflies. Moths from this order belong to eight families out of these Pterophoridae and Hyblaeidae consist single species. Family Eupterotidae and Hypsidae constitute with two species family Arctiidae comprises three species and family Sphingidae, Pyralidae and Noctuidae constitute with seven, eleven and twenty two species of moths respectively. Study on the occurrence of cotton bollworm, *Helicoverpa armigera* and tobacco cutworm *Spodoptera litura* was conducted by using Pheromones traps.

INTRODUCTION

Biodiversity is a function of the number of any taxon present, the evenness with which the taxons are distributed among the species evenness and the interaction component of richness and evenness (Ludwig and Reynolds, 1988). The tropical regions are known for their richness of species diversity (Mathew and Rahamathulla, 1993). The role of insects in the maintenance of essential life support systems in natural habitats is well recognized (Wells *et al.*, 1983). Our knowledge on the insect fauna of Indian region is based on the studies of pioneer workers like Hampson (1891), Lefroy (1909) and Mathew and Rahamathulla (1995). At present about 80 per cent of the world's known animals are insects, and lepidopterans accounts for 112,000 species, which include both butterflies and moths (Hutchins, 1972; Gunathilagaraj *et al.*, 1998). Lepidopteran insects are of diversified nature and they occur both as crop pests and pollinators.

Lefroy (1909) had enumerated 10,000 species of lepidopterans of which 8,000 species were moths and 1,500 species were butterflies described in fauna of India Hampson's (1894). Butterflies were more frequent to flowers with tubular corollas than to non-tubular ones, to flowers coloured red, yellow, blue and purple than those coloured white and pink and to flower sources available for longer periods in the year (Nimbalkar *et al.*, 2011). According to Shinde *et al.*, (2013) species richness of lepidoptera in forest does not vary in forest but, season had a large effect on the number of individual sampled.

Butterflies are essential part of any natural ecosystem as their adults perform pollination and larvae enact as primary herbivores thereby transferring radiant energy trapped by plants to the next tropical level. Among insects, butterflies are the most studied group; rendering dual roles as pollinators and as energy transferors.

They are highly sensitive to changes in temperature, humidity and light; parameters that are easily influenced by habitat deterioration (Murphy *et al.*, 1990). Therefore, butterflies are good indicator species to monitor ecological changes in a habitat. Hence, to study the role of lepidopteran fauna in agricultural ecosystem in Marathwada region has enormous importance to study the ecology of lepidopteran pests.

MATERIALS AND METHODS

Study details

The Maharashtra State is between 18° 0' 0 N, latitude and 74° 0' 0 E longitude the geographical area of the Maharashtra State is 308000 Sq. km. and South Central part of Maharashtra is popularly known as "Marathwada", which consist of eight district and lies in between 17°- 35 to 20°- 40' North latitude and 74°- 40 to 704' East longitude. The mean sea level (MSL) varied from 300 (minimum) to 900 M (maximum).

Ecology of Lepidopteran fauna was studied during June 2010 to May 2012 from Agro-ecosystem of Marathwada region. In this study, collection was made by using sweep nets, larval collection and rearing and also by visual observation from the cropped areas at weekly intervals and daily collection from light traps and those attracted to the lights of residential buildings. The day flying lepidopterans viz., butterflies and some sphingids like *Macroglossum* sp. which visit flowers were collected by using sweep nets in various habitats (Rao *et al.*, 2004). We also sampled Lepidoptera by using 12 W universal backlight traps powered by 12 V batteries. Backlight traps are widely considered to be the standard technique for sampling moth communities, although the method is biased toward collecting phototactic species. Those lepidopterans attracted to light trap were collected in the next day morning (Mathew and Rahamathulla, 1995). The adult lepidopteran representatives of different species attracted to the lights of residing area were also collected by using sweep nets (Kirti and Sodhi, 2003). The larva was collected from various crop plants and they were reared on their same host plants to emerge as adults and to record their possible hosts (Nair, 2002). Pheromone Traps (12/hectar) were installed in the farms to collect the attracted moths.

The collected species were identified directly in the field visually with the help of field guides Gay *et al.* (1992) and Lefroy (1909). All scientific names follow by Varshney (1983) and

common English names follow Wynter-Blyth (1957), Classification of butterflies is after Gaonkar (1996). The Diversity indices and Evenness index were worked out following Simpson (1949), Shannon-Weiner (1949) and Pielou (1977) methodology.

Statistical analysis

The diversity indices and evenness index for the families were calculated by using the Shannon Weiner, Simpson diversity indices, evenness index given by Pielou (1975 and 1977) and Anne Magurran (1988).

RESULTS AND DISCUSSION

Marathwada region is one of the five regions in Maharashtra state and covers geographic area of 64,813 sq. km. and falls under dry mild cool and humid climatic situation and receives rains during June to September due to South West monsoon. The mean annual rainfall of the all Maharashtra State is 700 mm to 1200 mm and mostly resave during June to October. The annual maximum and minimum temperature ranges between 13°C to 47°C. The region coincides with the Aurangabad division. The river Godavari is a largest river in the south-central India flows from five major districts of this region. This region has major area under jowar. The productivity of some of the food crops like wheat, paddy and cash crops such as cotton has however remained low. Genetically modified plants like cotton, soybean are becoming popular. Vegetable crops like bhendi, brinjal, raddish, tomato also grows in this region. New formulations of bio-pesticides and bio-fertilizers are increasingly popular in the region.

Diversity of butterfly

In the present study we record the maximum number of butterfly species than the species moths viz., family Lycaenidae (15 species), Nymphalidae (10 species), Hesperidae (8 species), Pieridae (7 species), and from Papilionidae, Danaidae and Acraeidae six, three and one species respectively. This may be happens due to the moths are nocturnal in habit. Most of the area is covered. Teak, Mango, Neem trees and the herbs from the study area namely *Celosia argentea*, *Tridax procumbens* and *Tephrosia purpurea* are more used by butterflies, due to the flowering period of these herbs is throughout the year. The shrubs namely *Calotropis gigantea* and *Lantana camara* also have a flowering period throughout the year, so they are more used by butterflies as their food plants.

A few species of butterflies were observed feeding on either animal droppings, ripe fruits or while mud puddling. We observed *Graphium sarpedon* as pests of citrus leaf, *Pseudozizeeria maha*, *Everes lacturnus*, *Virachola isocrates*, *Rapala varuna*, from family Lycaenidae feeds on Guava plant during day time and among these *Everes lacturnus* attract towards light during night. However, *Lampides boeticus*, *Euchrysops cnejus*, *Lampides boeticus*, *Euchrysops cnejus* observed feeding on Pods of Pulses. (Table 1)

Diversity of Moths

In the present study we record 99 species of order Lepidoptera comprising 49 species of moth and 50 species of butterflies. Moths from this order belong to eight families out of these Pterophoridae and Hyblaeidae consist single species. Family Eupterotidae and Hypsidae constitute with two species family Arctiidae comprises three species and family Sphingidae, Pyralidae and Noctuidae constitute with seven, eleven and twenty two species of moths respectively. Study on the occurrence of cotton bollworm, *Helicoverpa armigera* and tobacco cutworm *Spodoptera litura* was conducted by using Pheromones traps. Moths are nocturnal and phototropic and the species that was caught with help of light source are also given in tables.

Among The Pyralids *Paralipsa gularis*, *Pyralis farinalis* and *Maruca testulalis*, have been reported to infest on soybean. *Sylepta derogate* on cotton plant, *Noorda blitealis* on moringa, *Antigastra calalaunalis* on Sesame tree which confirms the observation in Kerala state by Mathew and Menon (1984) and Karaikal region by Adiroubane and Kuppammal (2010).

Among family Noctuidae we found four species feed on cotton, three on citrus, hence this observation confirms the report of (Pruthi *et al.*, 1945), two on Jowar plant. Two species viz., *Eupithecia annulata* and *Zalissa venosa* occurred on pulses. *Helicoverpa armigera* was found on bolls of cotton, bhendi plants, which confirms the previous report of (Rajashekhargouda *et al.*, 1984). The other species recorded during the study was pest of trees and weeds. (Table 2)

Shannon-Weiner index

These are the single figure numerical measures of diversity which incorporate species richness and equitability (i.e. evenness) (Hayek and

Buzas, 1997; Magurran, 1988; Pielou, 1969, 1975). The values for the Shannon H' to the log-base 10. In the present analysis, the Shannon H' and Shannon H_{max} are calculated using the log-base 10. Use of other log bases (commonly 2 or natural log base e) alters the number calculated. The highest Shannon's index is observed for the monsoon season (1.925) followed by postmonsoon (1.893) and premonsoon (1.762) seasons.

Index	Premonsoon	Monsoon	Postmonsoon
Shannon H' Log Base 10.	1.762	1.925	1.893
Shannon Hmax Log Base 10.	1.924	1.982	1.987
Shannon J'	0.952	0.978	0.968

From result, it is inferred that the occurrence of species of different families were highly diversified during monsoon (June to September), followed by postmonsoon and the species shows least diversification during premonsoon. (Figure 1, Table 3).

Simpson's Index (D)

Simpson's index is one of a number of diversity indices. It is used to measure the diversity of a habitat. It takes into account the number of species present as well as the relative abundance of each species. The Simpson index represents the probability that two randomly selected individuals in the habitat will not belong to the same species.

Index	Pre Monsoon	Monsoon	Post Monsoon
Simpson's Index (D)	0.016	0.012	0.013
Simpson's Index of Diversity (1-D)	0.984	0.988	0.987
Simpson's Reciprocal index of Divesity (1/D)	62.497	83.264	79.513

A low Simpson index value equates to high diversity whereas a high value correlates to a low diversity. The results of this statistic are represents the low Simpson index (D) equates to high diversity as seen during the monsoon season (Figure 2, Table 4).

Table 2 Diversity of moth (Lepidoptera) studied during June 2010 to May 2012 from Agro-ecosystem of Marathwada region

Sr. No.	Common name	Scientific name	Food plant	Locality and GPS Co-ordinates			Abundance
				Location	Latitude	Longitude	
Family Pyralidae (11)							
1	Cotton leaf roller	<i>Sylepta derogata</i>	Cotton	Vihmandwa	19° 26' 40.45"	75° 34' 45.30"	R
2	Chickoo moth	<i>Nephopteryx eugraphella</i>	Chickoo	Parbhani	19° 15' 09.31"	76° 50' 42.06"	C
3	Stored nut moth	<i>Paralipsa gularis</i>	Soybean	Vaijapur	19° 56' 07.97"	74° 43' 21.26"	C
4	Meal Moth	<i>Pyralis farinalis</i>	Soybean	Parbhani	19° 15' 09.31"	76° 50' 42.06"	C
5	Moringa Leaf Webber	<i>Noorda blitealis</i>	Moringa	Pimpri Raja	19° 48' 40.91"	75° 31' 19.89"	C
6	Brinjal shoot and fruit borer	<i>Leucinodes orbonalis</i>	Brinjal	Paithan	19° 29' 12.75"	75° 22' 45.44"	C
7	Amaranthus leaf webber	<i>Hymenia recurvalis</i>	<i>Amaranthus caudatus</i>	Parbhani	19° 15' 09.31"	76° 50' 42.06"	VC
8	Spotted pod borer	<i>Maruca testulalis</i>	Soybean	Mantha	19° 38' 11.08"	76° 22' 40.65"	R
9	Sesame leaf webber	<i>Antigastra catalaunalis</i>	Sesame	Kannad	20° 21' 43.58"	75° 11' 48.57"	VC
10	Cucumber Caterpillar	<i>Eudiotypes indicus</i>	Cucumber	Vaijapur	19° 56' 07.97"	74° 43' 21.26"	R
11	Sweet potato stem borer	<i>Omphisa anastomosalis</i>	Sweet potato	Parbhani	19° 15' 09.31"	76° 50' 42.06"	R
Family Noctuidae (22)							
12	Tobacco cutworm	<i>Spodoptera litura</i>	Tobacco	Parbhani	19° 15' 01.01"	76° 50' 51.21"	C
13	Cotton bollworm	<i>Helicoverpa armigera</i>	Cotton, Bendi	Vihmandwa	19° 26' 40.45"	75° 34' 45.30"	C
14	Spotted bollworm	<i>Earias vittella</i>	Cotton	Nanded	19° 07' 52.32"	77° 30' 33.80"	C
15	Pulse leaf roller	<i>Anticarsia irrotata</i>	Jowar	Vihmandwa	19° 26' 40.45"	75° 34' 45.30"	C
16	Bendi semilooper	<i>Acontia graellsii</i>	Bendi	Nanded	19° 07' 52.32"	77° 30' 33.80"	C
17	Pulse flower webber	<i>Eublemma hemirrhoda</i>	Jowar	Nanded	19° 07' 52.32"	77° 30' 33.80"	R
18	Cotton semilooper	<i>Tarache nitidula</i>	Cotton	Paithan	19° 29' 12.75"	75° 22' 45.44"	C
19	Safflower shoot caterpillar	<i>Perigea capensis</i>	Safflower	Mantha	19° 38' 11.08"	76° 22' 40.65"	C
20	Triangle moth	<i>Trigonodes hyppasia</i>	<i>Tridax procumbens</i>	Latur	18° 21' 51.57"	76° 35' 18.56"	C
21	Moths of Borneo	<i>Remigia undata</i>	<i>Tridax procumbens</i>	Nanded	19° 07' 52.32"	77° 30' 33.80"	C
22	----	<i>Eupithecia annulata</i>	Flower buds of pulses	Vaijapur	19° 56' 07.97"	74° 43' 21.26"	VC
23	Castor semilooper	<i>Parallelia algira</i>	Castor	Latur	18° 21' 51.57"	76° 35' 18.56"	C
24	----	<i>Grammodes stolidia</i>	----	Parbhani	19° 15' 01.01"	76° 50' 51.21"	R
25	----	<i>Zalissa venosa</i>	Flower buds of pulses	Pimpri Raja	19° 48' 40.91"	75° 31' 19.89"	C

26	-----	<i>Pericyma glaucinans</i>	-----	Parbhani	19° 15' 09.31"	76° 50' 42.06"	R
27	-----	<i>Plusia orichalcea</i>	-----	Parbhani	19° 15' 09.31"	76° 50' 42.06"	R
28	Fruit sucking moths	<i>Othreis fullonica</i>	Citrus	Vihamandwa	19° 26' 40.45"	75° 34' 45.30"	VC
29	Fruit sucking moths	<i>Othreis ancilla</i>	Citrus	Vihamandwa	19° 26' 40.45"	75° 34' 45.30"	C
30	Pink stem borer	<i>Sesamia inferens</i>	Sorghum	Nanded	19° 07' 52.32"	77° 30' 33.80"	VC
31	Cotton semilooper	<i>Anomis flava</i>	Cotton	Vihamandwa	19° 26' 40.45"	75° 34' 45.30"	VC
32	Brinjal leaf folder	<i>Antoba olivacea</i>	Brinjal	Parbhani	19° 15' 09.31"	76° 50' 42.06"	C
33	Fruit sucking moths	<i>Othreis materna</i>	Citrus	Paithan	19° 29' 12.75"	75° 22' 45.44"	C
	Family Arctiidae (3)						
34	Woolly bear	<i>Pericallia ricini</i>	Horsegram	Parbhani	19° 15' 01.01"	76° 50' 51.21"	VC
35	Hairy caterpillar	<i>Cretonotus gangis</i>	Horsegram	Pimpri Raja	19° 48' 40.91"	75° 31' 19.89"	VC
36	Sunhemp hairy caterpillar	<i>Utethesia pulchella</i>	Cluster bean	Nanded	19° 07' 52.32"	77° 30' 33.80"	C
	Family Eupterotidae (2)						
37	Moringa hairy caterpillar	<i>Eupterote mollifera</i>	Moringa	Mantha	19° 38' 11.08"	76° 22' 40.65"	C
38	Hairy caterpillar	<i>Eupterote undata</i>	Horsegram	Paithan	19° 29' 12.75"	75° 22' 45.44"	VC
	Family Pterophoridae (1)						
39	Red gram plume moth	<i>Exelastis atomosa</i>	Horsegram	Parbhani	19° 15' 01.01"	76° 50' 51.21"	C
	Family Sphingidae (7)						
40	Humming Bird hawk moth	<i>Cephonodes hylax</i>	Boerhavia diffusa	Latur	18° 21' 51.57"	76° 35' 18.56"	VR
41	Nuna sphingid	<i>Macroglossum particolor</i>	<i>Tridax procumbens</i>	Pimpri Raja	19° 48' 40.91"	75° 31' 19.89"	R
42	Pungam sphingid	<i>Ambulyx pagana</i>	<i>Tridax procumbens</i>	Nanded	19° 07' 52.32"	77° 30' 33.80"	C
43	Pulse horn worm	<i>Herse convolvuli</i>	Cow pea	Parbhani	19° 15' 01.01"	76° 50' 51.21"	C
44	Sphinx moth	<i>Theretra gnoma</i>	Boerhavia diffusa	Parbhani	19° 15' 01.01"	76° 50' 51.21"	VC
45	Grapevine sphingid	<i>Hippotion celerio</i>	<i>Cissus rotundifolia</i>	Osmanabad	18° 07' 40.50"	74° 04' 45.84"	C
46	Sesamum horn worm	<i>Acherontia styx</i>	Sesame	Kannad	20° 21' 43.58"	75° 11' 48.57"	VC
	Family Hypsidae (2)						
47	Fig moth	<i>Hypsa ficus</i>	-----	Latur	18° 21' 51.57"	76° 35' 18.56"	R
48	Hairy caterpillars	<i>Argina cribraria</i>	Horsegram	Mantha	19° 38' 11.08"	76° 22' 40.65"	C
	Family Hyblaecidae (1)						
49	Teak defoliator	<i>Hyblaea puera</i>	Teak	Kannad	20° 21' 43.58"	75° 11' 48.57"	VC

Table 1 Diversity of Butterfly (Lepidoptera) studied during June 2010 to May 2012 from Agro-ecosystem of Marathwada region

Sr. No.	Common name	Scientific name	Food Plant	Locality and GPS Co-ordinates			
				Location	Latitude	Longitude	Abundance
A	Family Papilionidae (6)						
1	Common Blue bottle	<i>Graphium sarpedon</i> (Linnaeus)	Citrus	Vihmandwa	19° 26' 40.45"	75° 34' 45.30"	VC
2	Crimson Rose	<i>Pachliopta hector</i> (Linnaeus)	<i>Tridax procumbens</i>	Nanded	19° 07' 52.32"	77° 30' 33.80"	VC
3	Common Rose	<i>Pachliopta aristolochiae</i> (Fabricius)	<i>Lantana camara</i>	Kannad	20° 21' 43.58"	75° 11' 48.57"	VC
4	Lime Butterfly	<i>Papilio demoleus</i> (Linnaeus)	<i>Tridax procumbens</i>	Osmanabad	18° 07' 40.50"	74° 04' 45.84"	C
5	Tailed Jay	<i>Graphium agamemnon</i> (Linnaeus)	<i>Lantana camara</i>	Vajapur	19° 56' 07.97"	74° 43' 21.26"	C
6	Common Mormon	<i>Papilio polytes polytes</i> (Linnaeus)	<i>Lantana camara</i>	Nanded	19° 07' 52.32"	77° 30' 33.80"	C
B	Family Acraeidae (1)						
1	Tawny coster	<i>Acraea violae</i> (Fabricius)	<i>Tridax procumbens</i>	Vajapur	19° 56' 07.97"	74° 43' 21.26"	C
C	Family Danaidae (3)						
1	Blue Tiger	<i>Tirumala limniace</i> (Gmelin)	----	Latur	18° 21' 51.57"	76° 35' 18.56"	C
2	Plain Tiger	<i>Danaus chrysippus</i> (Linnaeus)	Calotropis	Nanded	19° 07' 52.32"	77° 30' 33.80"	C
3	Common Crow	<i>Euploea core</i> (Cramer)	Nerium oleander	Kannad	20° 21' 43.58"	75° 11' 48.57"	C
D	Family Lycaenidae (15)						
1	Pale Grass Blue	<i>Pseudozeeria maha</i> (Kollar)	Guava	Parbhani	19° 15' 01.01"	76° 50' 51.21"	R
2	Common Pierrot	<i>Castalius rosimum</i> (Fabricius)	<i>Lantana camara</i>	Osmanabad	18° 07' 40.50"	74° 04' 45.84"	VR
3	Indian Cupid	<i>Everes lacturnus</i> (Cantlie)*	Guava	Kannad	20° 21' 43.58"	75° 11' 48.57"	C
4	Pale Grass Blue	<i>Zizeeria maha ossa</i> (Swinhoe)*	<i>Tephrosia</i>	Nanded	19° 07' 52.32"	77° 30' 33.80"	C

5	Zebra Blue	<i>Syntarucus plinius</i> (Fabricius)	<i>Lantana camara</i>	Nanded	19° 07' 52.32"	77° 30' 33.80"	C
6	Anar Butterfly	<i>Virachola</i> (Fabricius) <i>isocrates</i>	Guava	Nanded	19° 07' 52.32"	77° 30' 33.80"	R
7	Silver Streak Blue	<i>Iraota timoleon</i> (Stoll)	Mud Puddling	Paithan	19° 29' 12.75"	75° 22' 45.44"	C
8	Lime Blue	<i>Chilades laius</i> (Stoll)	<i>Urena lobata</i>	Osmanabad	18° 07' 40.50"	74° 04' 45.84"	C
9	Indigo Flash	<i>Rapala varuna</i> (Cramer)	Guava	Latur	18° 21' 51.57"	76° 35' 18.56"	C
10	Pea Blue	<i>Lampides</i> (Linnaeus) <i>boeticus</i>	Pods of Pulses	Nanded	19° 07' 52.32"	77° 30' 33.80"	C
11	Gram Blue	<i>Euchrysops</i> (Linnaeus) <i>cnejus</i>	Pods of Pulses	Parbhani	19° 15' 01.01"	76° 50' 51.21"	C
12	Tiny Grass Blue	<i>Zizula hylax</i> (Fabricius)	<i>Lantana camara</i>	Latur	18° 21' 51.57"	76° 35' 18.56"	C
13	Plum Judy	<i>Abisara echerius</i> (Stoll)	<i>Lantana camara</i>	Paithan	19° 29' 12.75"	75° 22' 45.44"	VC
14	Pea Blue	<i>Lampides</i> (Linnaeus) <i>boeticus</i>	Pods of Pulses	Osmanabad	18° 07' 40.50"	74° 04' 45.84"	VC
15	Gram Blue	<i>Euchrysops</i> (Linnaeus) <i>cnejus</i>	Pods of Pulses	Nanded	19° 07' 52.32"	77° 30' 33.80"	VC

Table 1 Diversity of Butterfly (Lepidoptera) studied during June 2010 to May 2012 from Agro-ecosystem of Marathwada region

Sr. No.	Common name	Scientific name	Status	Locality and GPS Co-ordinates			Abundance
				Location	Latitude	Longitude	
E	Family Pieridae (7)						
1	Common Grass Yellow	<i>Eurema hecabe simulata</i> (Moore)	<i>Lantana camara</i>	Osmanabad	18° 07' 40.50"	74° 04' 45.84"	VC
2	Crimson Tip	<i>Colotis danae danae</i> (Fabricius)	<i>Cassia siamea</i> ,	Vaijapur	19° 56' 07.97"	74° 43' 21.26"	VC
3	Common Jezebel	<i>Delias eucharis</i> (Drury)	<i>Lantana camara</i>	Latur	18° 21' 51.57"	76° 35' 18.56"	C
4	White Orange Tip	<i>Ixias marianne</i> (Cramer)	<i>Calotropis gigantea</i>	Parbhani	19° 15' 01.01"	76° 50' 51.21"	C
5	Small Grass Yellow	<i>Eurema brigitta</i> (Cramer)	<i>Lantana camara</i>	Parbhani	19° 15' 09.31"	76° 50' 42.06"	C
6	Common Emigrant	<i>Catopsilia pomona</i> (Fabricius)	<i>Lantana camara</i>	Osmanabad	18° 07' 40.50"	74° 04' 45.84"	C
7	Common Gull	<i>Cepora nerissa nerissa</i> (Fabricius)	<i>Lantana camara</i>	Paithan	19° 29' 12.75"	75° 22' 45.44"	C
F	Family Nymphalidae (10)						
1	Blue Pansy	<i>Precis orithya</i> (Linnaeus)	<i>Lantana camara</i>	Latur	18° 21' 51.57"	76° 35' 18.56"	C
2	Blue Tiger	<i>Tirumala limniace</i> (Cramer)	<i>Tridax procumbens</i>	Kannad	20° 21' 43.58"	75° 11' 48.57"	R
3	Common Evening Brown	<i>Melanitis leda</i> (Linnaeus)	<i>Tridax procumbens</i>	Kannad	20° 21' 43.58"	75° 11' 48.57"	C
4	Grey Pansy	<i>Junonia atlites</i> (Linnaeus)	<i>Tridax procumbens</i>	Osmanabad	18° 07' 40.50"	74° 04' 45.84"	R
5	Common Castor	<i>Ariadne mertone mertone</i> (Cramer)	Castor	Nanded	19° 07' 52.32"	77° 30' 33.80"	C
6	Danaid Egg fly	<i>Hypolimnas misippus</i> (Linn.)	Mud Puddling	Paithan	19° 29' 12.75"	75° 22' 45.44"	R
7	Great Egg fly	<i>Hypolimnas bolina</i> (Linnaeus)	<i>Tridax procumbens</i>	Parbhani	19° 15' 09.31"	76° 50' 42.06"	C

8	Painted Lady	<i>Vanessa cardui</i> (Linnaeus)	<i>Tridax procumbens</i>	Latur	18° 21' 51.57"	76° 35' 18.56"	R
9	Angled Castor	<i>Ariadne ariadne</i> (Linnaeus)	Castor	Parbhani	19° 15' 01.01"	76° 50' 51.21"	C
10	Common Leopard	<i>Phalanta phalantha</i> (Drury)	<i>Tridax procumbens</i>	Vaijapur	19° 56' 07.97"	74° 43' 21.26"	C
G	Family Hesperidae (8)						
1	Rice Skipper	<i>Parnara guttatus guttatus</i> (Brem.)	<i>Tridax procumbens</i>	Osmanabad	18° 07' 40.50"	74° 04' 45.84"	R
2	Common Banded Awl	<i>Hasora chromus</i> (Cramer)	<i>Tridax procumbens</i>	Latur	18° 21' 51.57"	76° 35' 18.56"	VR
3	Rice Swift	<i>Borbo cinnara</i> (Wallace)	<i>Tridax procumbens</i>	Paithan	19° 29' 12.75"	75° 22' 45.44"	R
4	Grass Demon	<i>Udaspes folus</i> (Cramer)	Mud Puddling	Latur	18° 21' 51.57"	76° 35' 18.56"	C
5	Dark Palm Dart	<i>Teliota ancilla bambusae</i> (Moore)	<i>Tridax procumbens</i>	Parbhani	19° 15' 09.31"	76° 50' 42.06"	VC
6	Indian Skipper	<i>Spialia galba galba</i> (Fabricius)	Mud Puddling	Latur	18° 21' 51.57"	76° 35' 18.56"	VC
7	----	<i>Telicota ancilla</i> (Herrich-Schaffer)	Mud Puddling	Paithan	19° 29' 12.75"	75° 22' 45.44"	R
8	Chestnut Bob	<i>Iambrix salsala</i> (Moore)	<i>Tridax procumbens</i>	Parbhani	19° 15' 01.01"	76° 50' 51.21"	VR

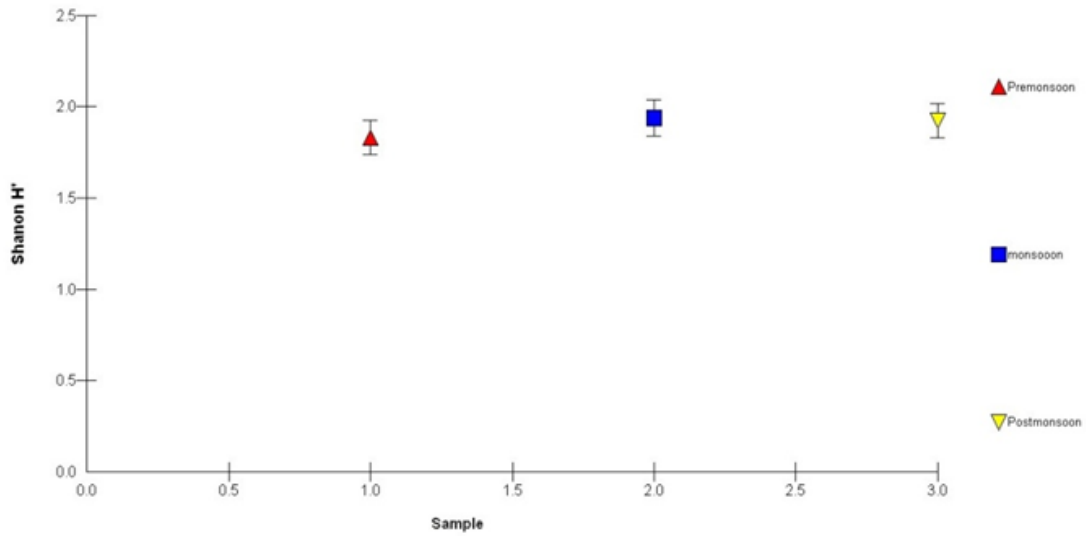


Figure 1 Shanon 'H' Index

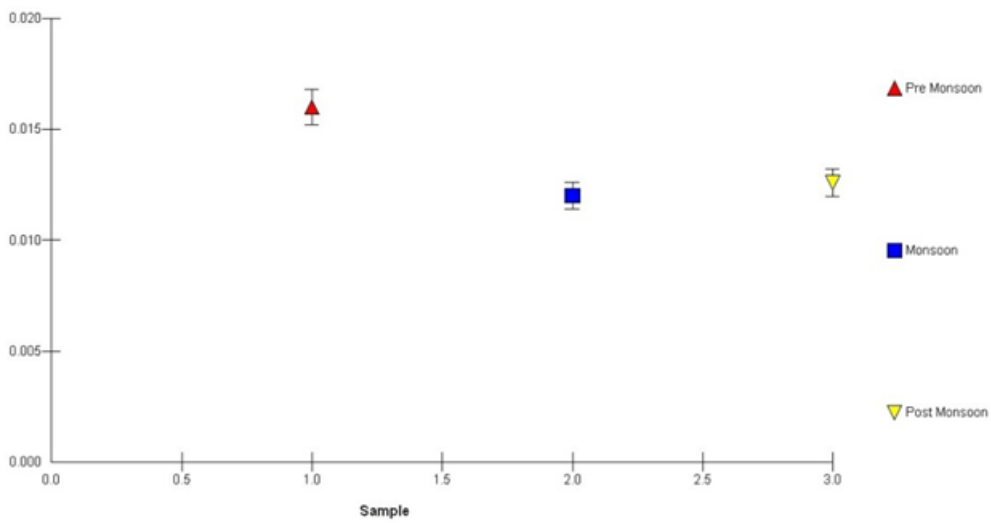


Figure 2 Simpson Index

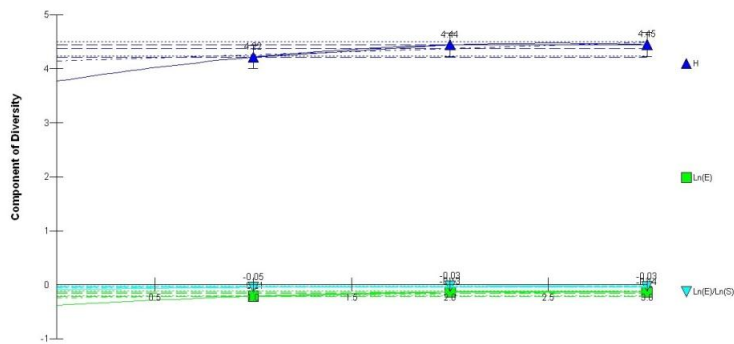


Figure 3 SHE Index

SHE analysis examines the relationship between S (Species Richness), H (Information) and E (Evenness as measured using Shannon-Wiener evenness index) in the samples. It is therefore an approach to look at the contribution of species number and equitability to changes in diversity. SHE analysis follows the way these parameters change with increasing sampling effort. It can be seen that postmonsoon season has a very slight increase in the H number. As shown in Hill's number analysis, the postmonsoon season has more number of species as compared to that of monsoon or premonsoon season. The SHE analysis takes into consideration the species richness and hence shows the negligible increase in the H statistic for postmonsoon period (Figure 3, Table 5).

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