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A Preliminary Report on the Diversity of Butterflies (Insecta: Lepidoptera) in and Around the Forest Areas of Jateswar Mandir, Barbil, Odisha, India

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Abstract: Butterflies are bright coloured scaly winged insects of order Lepidoptera and one of the important species for conservation of invertebrates. A short-term survey was conducted in and around the forest area of Jateswar Mandir, Barbil, Odisha, India for a period of 3 days to study the diversity of butterflies and their distribution among respective families, subfamily, and genera. During the survey, a total number of 22 species of butterflies belonging to 5 families, 11 subfamily and 15 genera were recorded. It was observed that family Nymphalidae is the most dominating family in the study area. The butterfly species observed in the study area are classified as very common (6), common (28), less common (16) and rare (2). The Simpson's diversity index was found highest in forest (0.94) followed by mixed-vegetation (0.11) and water bodies (0.19). There are many factors affecting their suitable habitat. Since it is a mine area and there are many visiting places for visitors, their habitat is being disturbed and lost, so the diversity of butterfly is relatively low here and since butterfly is a bio-indicator species, it can be said that the habitat is suitable for them not for long.

Keywords: Butterfly, Diversity, Diversity indices, Jateswar Mandir, Nymphalidae, Simpson diversity index

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Introduction

Butterfly belongs to the Lepidoptera (name comes from the Greek *lepidō* "scale" and *ptera* "wings" which refers to a feature by which adult butterflies can be distinguished from others) family, which is the largest order of the Insecta class of the Arthropoda group. Order Lepidoptera is one of the important components of biodiversity. They prefer

specific habitats, and their diversity is restricted to different seasons. Except near the poles, around the world they are found everywhere (Abdullahi *et al.*, 2018). Based on the Wikipedia, butterflies are classified into six families: the Pieridae (Whites and allies); the Papilionidae (swallowtails); the Nymphalidae (Brush-footed or four-footed

butterflies); the Hesperidae (skippers); the Libytheidae (snout butterflies); and the small Lycaenidae (Blues, coppers, hairstreaks).

India is considered as one of the 17th mega diversity countries of the world where richness of plant as well as animal life observed. More than 1700 species of butterflies are found in world and about 1500 species are reported from India.

Butterflies are important component of biodiversity because they are good indicators of environmental changes, climatic conditions, and seasons, as well as ecologically important due to the role they play in food chain of forest ecosystem and can serve to formulate Strategies for conservation. Actually, they are well adapted to the landscape and to any alteration in their habitat as a result of human-induced activities such as farmland intensification and intensive logging, they react quickly (Mora *et al.*, 2011). Any change in climate that affects the diversity of species and is expected to affect the ecosystems (Scott and Lemieux, 2005). Their eggs, larvae, and adult stages form the food for various birds and reptiles. They also help in pollination of flowers. Hence, butterflies play an important role in ecosystem and co-evolutionary relatedness between them and plants as well as their lives are interlinked. Butterflies, being exothermic, are highly sensitive to climate change and have a short generation time which makes them suitable model organisms for study.

Vu (2009) described that forest edges have a greater diversity of butterflies and have greater manifestation to open forest. Unlike bamboo forests where butterfly species diversity is low, streams play an important role in the conservation of butterfly diversity in forest areas (Vu and Vu, 2011). India has a total of 1504 butterfly species and 285 species are found in South India (Kunte *et al.*, 2012). The peninsular India and Western Ghats have 351 and 334 species, respectively. Butterfly diversity in Haldia industrial area shows lower number of butterfly species, diversity and evenness index compared to adjacent rural belt and it is recommended that industrial areas are

harmful places for butterflies (Pahari *et al.*, 2018). Leon-Cortes *et al.* (2019) reported that the most diverse species of butterfly in the study area were belonging to Nymphalidae family with 31 species followed by Hesperidae (12), Pieridae (19) and Lycaenidae (16).

There is a need for documentation of diversity of butterfly species from the area near Jateswar Temple under Barbil, because there has been no work done on butterflies from this area. Hence, to fulfil this lacuna, an attempt has been made in the present study to provide information based on the checklist of butterflies and their diversity in the study area.

Materials and Methods

Study area and Sampling site:

The present study was carried out in the area near Jateswar Temple (22.0832563°N 85.4164512°E) in Kendujhar district under Barbil (also known as Iron city) municipality of Odisha state located in Eastern India (Fig. 1). The climate of the area in January can be considered as mild and dry. In fact, January is the winter season here and is usually the coldest month of the year. Daytime maximum temperatures average around a comfortable 25°C (77°F), whilst at night 11°C (51°F) is normal. On average, January is the area's 3rd driest month of the year, with about 14 mm of precipitation, making it a dry time to visit. On the upside it corresponds to an average of 8.1 h of sunlight per day. The study area has thick trees, bushes, large water bodies and a waterfall, which turns the area into a dense forest. 3 sample sites were selected in the study area, namely, Forest, water bodies and mixed vegetation.

Survey Method:

A field survey on butterflies was conducted for three days from 22nd January to 25th January 2023 in the study area. In the study area, during walking through the three selected sites based on habitats present in the study area, butterflies were accessed from 9 am to 12 pm in the morning by random observations. In the field, photographs of

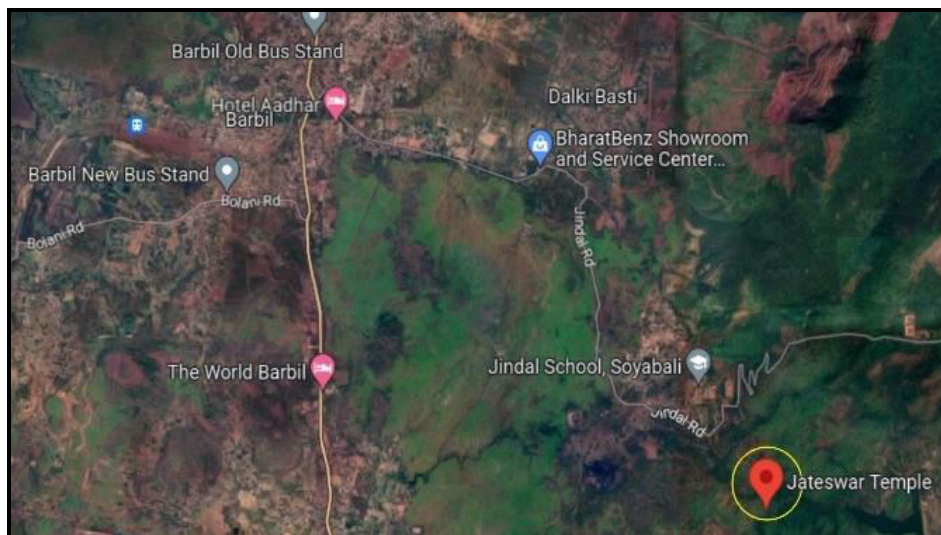


Fig. 1: Location of study area near Jateswar Temple in Kendujhar district under Barbil municipality of Odisha (<https://www.google.com/maps/place/Jateswar+Temple>).

the butterflies were taken with the help of camera for the identification purpose (Dey *et al.*, 2017).

Identification of the butterfly species:

Photographs of butterflies were used to identify butterfly species. Colour patterns, shapes, and sizes as well as their designs were considered in identification of butterfly species with the help of entomological experts and related with available literature as well as described by Sunil *et al.* (2016) and Kumar *et al.* (2016).

Statistical Data analysis:

For Statistical Analysis of data, identified butterfly species observed at three sample sites in the study area were analysed by using Simpson index of diversity formula adopted (Sunil *et al.*, 2016; Ashok, 2017) and Species richness.

Numerical species richness (S) = number of species per specified number of individuals

The mathematical formula of Simpson's diversity index is calculated as follow:

$$(D) = 1 - [\sum n_i(n_i - 1) / N(N - 1)]$$

Where, Σ = Sum of (Total); n_i = The number of individuals of each different species; N = The total number of individuals of all the species.

Graphical representation was prepared by using MS - Excel software (Ver, 2007).

Results

Checklist of the butterfly species in the study area:

The checklist of the species of butterfly observed in the study area and their larval host plants in India (Nitin *et al.*, 2018) is presented in Table 1 and Figure 2. The results showed that a total of 102 individuals and 22 species of butterfly belong to 5 families were recorded in the study area. Nymphalidae was the richest family in the study area that comprised (11 and 50%) species of butterfly followed by Pieridae with (5 and 23%) species, Lycaenidae with (3 and 14%) species, Papilionidae and Hesperidae families were the lowest with (3 and 14%) and (1 and 4%) species, respectively (Figs. 3, 4).

Table 2 illustrates that 3 species (Common grass blue, Common sailor, and Common grass yellow), are found at 3 sample sites. Larger banded swift, Centaur Oak blue, Plain tiger, Tawny coaster, Common rose, and Common Albatross these 4 species, were found only in the forest sample site. Only the butterfly species found in the mix-vegetation sample site are, Common leopard,

Table 1: Checklist of the butterfly species with their host plants recorded in 3 sample sites

S. No.	COMMON NAME	SCIENTIFIC NAME	SUBFAMILY	LARVAL HOST PLANTS (IN INDIA)	LOCATION (SAMPLE SITES)
Family: Hesperidae (1 Subfamily, 1 Genera, 1 Species)					
01	Larger banded swift (Moore, 1878)	<i>Pelopidas subochracea</i>	Hesperinae	<i>Axonopus compressus</i>	Forest
Family: Lycaenidae (1 Subfamily, 3 Genera, 3 Species)					
02	common grass blue (Godart, 1824)	<i>Zizina labradus</i>	Polyommatae	<i>Ruellia tuberosa</i> , <i>Hygrophila serpyllum</i> , <i>Tribulus terrestris</i> , <i>Hygrophila auriculata</i> , <i>Hygrophila ringens</i> , <i>Ruellia prostrata</i> , <i>Ruellia simplex</i> , <i>Phaulopsis imbricata</i>	Forest, water bodies and mixed vegetation
03	Centaur Oak blue (Fabricius, 1775)	<i>Arhopala centaurus</i>	Theclinae	<i>Lagerstroemia speciosa</i> , <i>Terminalia elliptica</i> , <i>Terminalia paniculate</i> , <i>Schleichera oleosa</i> , <i>Lagerstroemia speciosa</i> , <i>Xylia xylocarpa</i> , <i>Hopea ponga</i>	Forest
04	Plain cupid (Horsfield, 1829)	<i>Luthrodes pandava</i>	Polyommatae	<i>Saraca asoca</i> , <i>Cycas pectinate</i> , <i>Cycas circinalis</i> , <i>Cycas revoluta</i> , <i>Cycas rumphii</i> , <i>Bauhinia vahlii</i> , <i>Canavalia gladiata</i> , <i>Butea monosperma</i> , <i>Xylia xylocarpa</i> , <i>Acacia nilotica</i> , <i>Schleichera oleosa</i> , <i>Moullava spicata</i> , <i>Bauhinia variegata</i> , <i>Holoptelea integrifolia</i>	Water bodies and mixed vegetation
Family: Nymphalidae (7 Subfamily, 10 Genera, 11 Species)					
05	Common leopard (Drury, 1773)	<i>Phalanta phalantha</i>	Heliconiinae	<i>Flacourtia jangomas</i> , <i>Flacourtia inermis</i> , <i>Flacourtia indica</i> , <i>Populus deltoides</i> , <i>Populus ciliate</i> , <i>Barleria prionitis</i> , <i>Flacourtia montana</i> , <i>Salix tetrasperma</i>	Mixed vegetation
06	Gray pansy (Linnaeus, 1763)	<i>Junonia atlites</i>	Nymphalinae	<i>Hygrophila auriculata</i> , <i>Oryza sativa</i>	Forest and mixed vegetation
07	Lemon pansy (Linnaeus, 1758)	<i>Junonia lemonias</i>	Nymphalinae	<i>Barleria buxifolia</i> , <i>Barleria cristata</i> , <i>Barleria prionitis</i> , <i>Cnnabis sativa</i> , <i>Lepidagathis</i>	Forest and mixed vegetation

				<i>keralensis</i> , <i>Lepidagathis cuspidate</i> , <i>Ruellia simplex</i> , <i>Rostellularia crinite</i> , <i>Sida</i> sp., <i>Justicia procumbens</i> , <i>Hygrophila auriculata</i>	
08	Common crow (Cramer, 1780)	<i>Euploea core</i>	Danainae	<i>Ceropegia vincaefolia</i> , <i>Cascabela thevetia</i> , <i>Tylophora dalzellii</i> , <i>Tylophora indica</i> , <i>Ficus benamina</i> , <i>Ficus religiosa</i> , <i>Ficus benghalensis</i> , <i>Ficus pumila</i> , <i>Ficus racemose</i> , <i>Ficus</i> sp. 1, <i>Ficus virens</i> , <i>Ficus arnottiana</i> , <i>Ficus drupacea</i> var. <i>pubescens</i> , <i>Ficus longifolia</i> , <i>Ficus macrocarpa</i> , <i>Ficus tsiela</i> , <i>Thevetia peruviana</i> , <i>Ichnocarpus frutescens</i> , <i>Adenium obesum</i> , <i>Personsia inodora</i> , <i>Asclepias curassavica</i> , <i>Holarrhena antidysenterica</i> , <i>Cryptolepis buechanani</i> , <i>Carissa carandas</i> , <i>Carissa spinarum</i> , <i>Carissa congesta</i> , <i>Streblus asper</i> , <i>Nerium oleander</i> , <i>Hemidesmus indicus</i> , <i>Mimusops elengi</i> ,	Forest and water bodies
09	Plain tiger (Linnaeus, 1758)	<i>Danaus chrysippus</i>	Danainae	<i>Asclepias curassavica</i> , <i>Calotropis gigantea</i> , <i>Calotropis procera</i> , <i>Gomphocarpus physocarpus</i> , <i>Oxystelma esculentum</i> , <i>Ceropegia media</i> , <i>Ceropegia vincaefolia</i> , <i>Tylophora dalzellii</i> , <i>Cryptolepis buechanani</i> , <i>Pergularia daemia</i> , <i>Caralluma umbellata</i>	Forest
10	Blue tiger (Cramer, 1775)	<i>Tirumala limniace</i>	Danainae	<i>Asclepias curassavica</i> , <i>Calotropis gigantea</i> , <i>Saccharum officinarum</i> , <i>Calotropis procera</i> , <i>Cosmostigma racemosum</i> , <i>Tylophora dalzellii</i> , <i>Asclepias curassavica</i> , <i>Wattakaka volubilis</i> , <i>Holarrhena antidysenterica</i> , <i>Tylophora indica</i> , <i>Calotropis procera</i> , <i>Vallisneria spiralis</i>	Forest and mixed vegetation
11	Common four ring (Kirby, 1871)	<i>Ypthima huebneri</i>	Satyrinae	<i>Ottocloa nodosa</i> , <i>Cynodon dactylon</i> , <i>Axonopus compressus</i>	Mixed vegetation
12	Common Evening Brown	<i>Melanitis leda</i>	Satyrinae	<i>Pennisetum setaceum</i> , <i>Pennisetum glaucum</i> , <i>Axonopus compressus</i> , <i>Zea</i>	Mixed vegetation

	(Linnaeus, 1758)			<i>mays</i> , <i>Eleusine indica</i> , <i>Sorghum halepense</i> , <i>Bambusa arundinacea</i> , <i>Cynodon dactylon</i> , <i>Saccharum officinarum</i> , <i>Oryza sativa</i> , <i>Oplismenus compositus</i> , <i>Brachiaria mutica</i>	
13	Common sailor (Linnaeus, 1758)	<i>Neptis hylas</i>	Limenitinae	<i>Elaeocarpus ganitrus</i> , <i>Lablab purpureus</i> , <i>Ceiba pentandra</i> , <i>Desmodium gangeticum</i> , <i>Urena lobata</i> , <i>Bombax ceiba</i> , <i>Paracalyx scariosus</i> , <i>Vigna vexillate</i> , <i>Nothapodytes nimmoniana</i> , <i>Pseudarthria viscida</i> , <i>Canavalia gladiata</i> , <i>Helicteres isora</i> , <i>Vigna unguiculata</i> , <i>Xylia xylocarpa</i> , <i>Mucuna pruriens</i>	Forest, water bodies and mixed vegetation
14	Common castor (Cramer, 1777)	<i>Ariadne merione</i>	Biblidinae	<i>Tragia praetervisa</i> , <i>Tragia plukenetii</i> , <i>Tragia involucrate</i> , <i>Ricinus communis</i>	Forest and mixed vegetation
15	Tawny coaster (Linnaeus, 1758)	<i>Acraea terpsicore</i>	Acraeinae	<i>Turnera ulmifolia</i> , <i>Passiflora foetida</i> , <i>Passiflora edulis</i> , <i>Passiflora incarnata</i> , <i>Adenia hondala</i> , <i>Turnera subulate</i> , <i>Passiflora suberosa</i>	Forest
Family: Papilionidae (1 Subfamily, 1 Genera, 2 Species)					
16	Common rose (Fabricius, 1775)	<i>Pachliopta aristolochiae</i>	Papilioninae	<i>Thottea siliquosa</i> , <i>Thottea sivaranjani</i> , <i>Aristolochia tagala</i> , <i>Aristolochia littoralis</i> , <i>Aristolochia indica</i>	Forest
17	Lime (Linnaeus, 1758)	<i>Papilio demoleus</i>	Papilioninae	<i>Citrus limon</i> , <i>Citrus aurantium</i> , <i>Citrus latifolia</i> , <i>Citrus maxima</i> , <i>Psoralea corylifolia</i> , <i>Chloroxylon swietenia</i> , <i>Michelia champaca</i> , <i>Citrus aurantium</i> , <i>Limonia acidissima</i> , <i>Ziziphus mauritiana</i> , <i>Aegle marmelos</i> , <i>Murraya koenigii</i> , <i>Glycosmis pentaphylla</i> , <i>Clausena dentata</i>	Water bodies
Family: Pieridae (2 Subfamily, 3 Genera, 5 Species)					
18	Lemon emigrant (Fabricius, 1775)	<i>Catopsilia pomona</i>	Coliadinae	<i>Senna tora</i> , <i>Senna alata</i> , <i>Senna siamea</i> , <i>Senna occidentalis</i> , <i>Cassia renigera</i> , <i>Cassia roxburghii</i> , <i>Cassia javanica</i> , <i>Cassia fistula</i> , <i>Dalbergia latifolia</i> , <i>Butea monosperma</i> , <i>Bauhinia racemose</i> , <i>Sesbania</i>	Forest and mixed vegetation

				<i>grandiflora</i>	
19	Mottled emigrant (Linnaeus, 1758)	<i>Catopsilia pyranthe</i>	Coliadinae	<i>Lasiosiphon glaucus</i> , <i>Senna tora</i> , <i>Senna auriculata</i> , <i>Senna occidentalis</i> , <i>Cassia renigera</i> , <i>Cassia fistula</i> , <i>Sesbania sesban</i> , <i>Sesbania bispinosa</i> , <i>Sesbania grandiflora</i> , <i>Gnidia glauca</i>	Forest and mixed vegetation
20	Common grass yellow (Linnaeus, 1758)	<i>Eurema hecabe</i>	Coliadinae	<i>Aeschynomene americana</i> , <i>Aeschynomene indica</i> , <i>Senna tora</i> , <i>Senna siamea</i> , <i>Senna alata</i> , <i>Albizia procera</i> , <i>Sesbania sesban</i> , <i>Sesbania bispinosa</i> , <i>Sesbania grandiflora</i> , <i>Chamaecrista mimosoides</i> , <i>Caesalpinia pulcherrima</i> , <i>Caesalpinia coriaria</i> , <i>Caesalpinia sappan</i> , <i>Albizia saman</i> , <i>Calliandra haematocephala</i> , <i>Delonix regia</i> , <i>Smithia sensitive</i> , <i>Mimosa pudica</i> , <i>Pithecellobium dulce</i> , <i>Peltophorum pterocarpum</i> , <i>Cassia fistula</i> , <i>Moullava spicata</i> , <i>Chamaecrista kleinii</i> ,	Forest, water bodies and mixed vegetation
21	One spot grass yellow (Moore, 1886)	<i>Eurema andersonii</i>	Coliadinae	<i>Ventilago goughii</i> , <i>Ventilago maderaspatana</i>	Forest and mixed vegetation
22	Common Albatross (Boisduval, 1836)	<i>Appias albino</i>	Pierinae	<i>Crateva religiosa</i> , <i>Cleome rutidosperma</i> , <i>Drypetes roxburghii</i> , <i>Crateva religiosa</i> ,	Forest

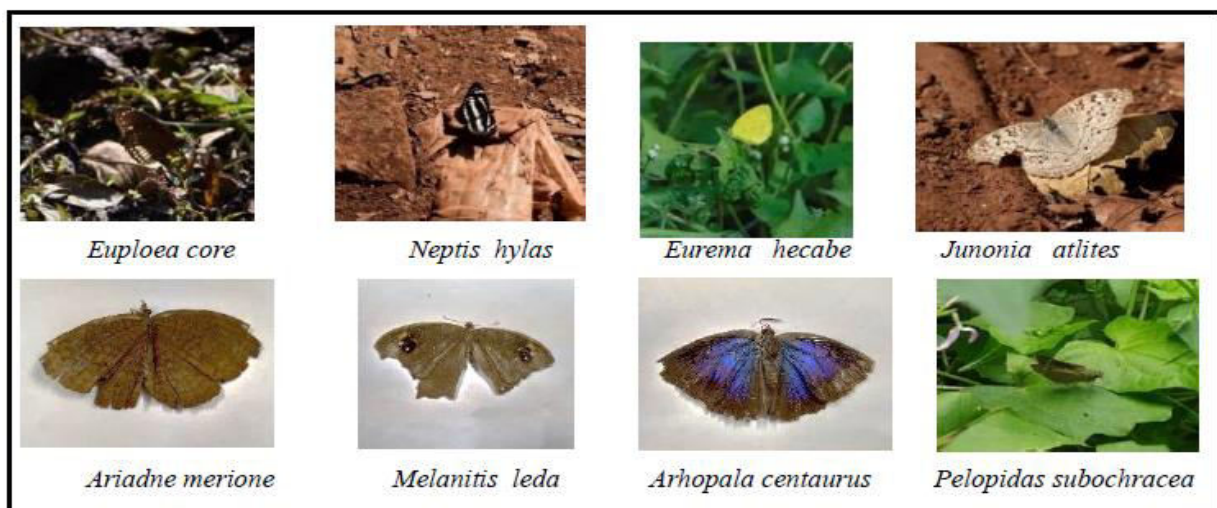


Fig. 2: Some butterflies observed during the present study.

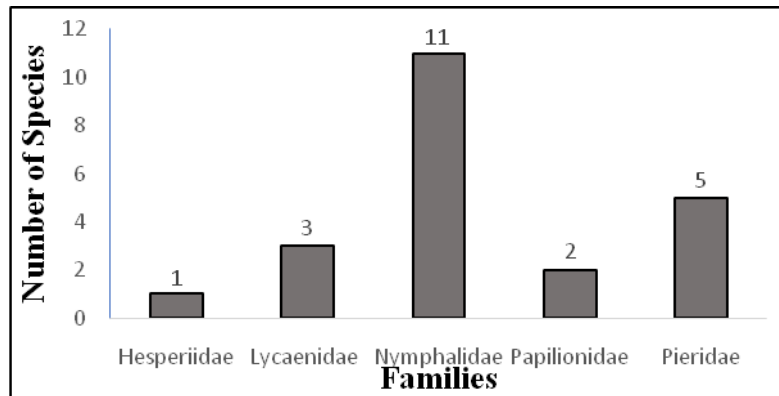


Fig. 3: Number of the species of butterfly in a family wise composition in the study area.

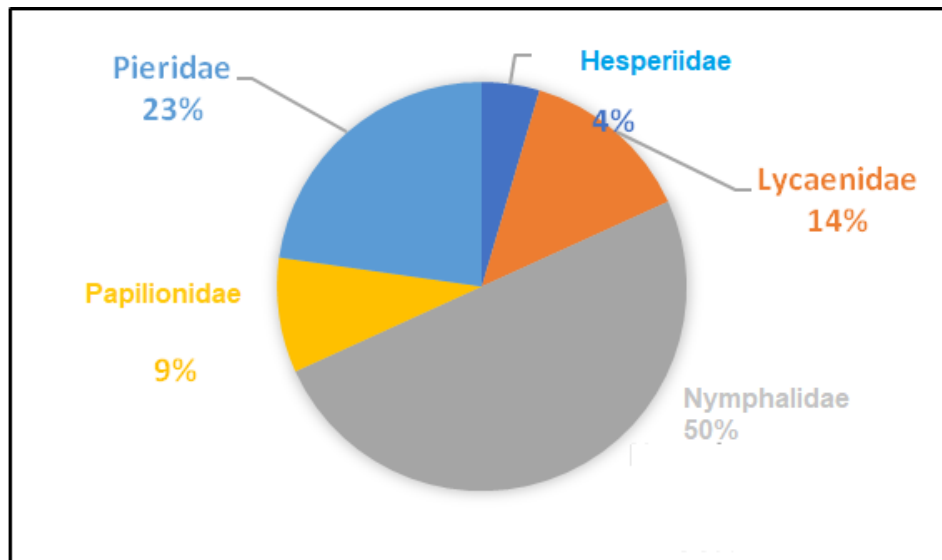


Fig. 4: Family wise percentage composition of the species of butterfly in the study area.

Common four ring and Common Evening Brown. Lime is the only species that was found only in the sample site of in water bodies.

Diversity of the butterfly species in the study area:

The diversity of the species of butterfly observed in the study area is presented in Table 3. The result showed that the highest number of butterflies and Species richness (S) were observed in forest site (54 and 17), followed by mixed vegetation (34 and 14) and water bodies sites (14 and 6).

In the case of Simpson's diversity index (D), the value of D is inversely proportional to the diversity. The value of D ranges between 0 and 1 (If the value of D is close to '0', diversity is high and if the value of D is far from '0' or close to '1',

then diversity is low). Also, as species richness (S) increases, so diversity increases, that means species richness is directly proportional to diversity.

In this study the result showed that value of Simpson's diversity index is lower in forest site or close to '0' than the other two sample sites (Fig. 5), that means, diversity of butterfly species is higher in forest sample site than the others. On the other side, value of species richness is higher in forest sample site than the other two sites, that is also conclude that diversity of butterfly species in higher in forest sample site.

Discussion

During this study in Barbil, the total number of 22 species of butterflies belonging to 5 families, 12

Table 2: Number of different species of butterfly identified in 3 sample sites

S. No.	FAMILY	SPECIES NAME	LOCATION (SAMPLE SITES)			INDIVIDUAL NO. OF BUTTERFLIES	TOTAL NO. OF SPECIES (ACCORDING TO FAMILY)
			FOREST	WATER BODIES	MIX-VEGETATION		
01	Hesperiidae	Larger banded swift	02	00	00	02	02
02	Lycaenidae	Common grass blue	04	02	02	08	15
		Centaur Oak blue	02	00	00	02	
		Plain cupid	00	03	02	05	
03	Nymphalidae	Common leopard	00	00	01	01	56
		Gray pansy	02	00	01	03	
		Lemon pansy	12	00	08	20	
		Common crow	04	02	00	06	
		Plain tiger	04	00	00	04	
		Blue tiger	05	00	03	08	
		Common four ring	00	00	03	03	
		Common Evening Brown	00	00	02	02	
		Common sailor	01	01	01	03	
		Common castor	01	00	03	04	
		Tawny coaster	02	00	00	02	
04	Papilionoidea	Common rose	02	00	00	02	04
		Lime	00	02	00	02	
05	Pieridae	Lemon emigrant	03	00	01	04	25
		Mottled emigrant	01	00	01	02	
		Common grass yellow	03	04	02	09	
		One spot grass yellow	02	00	04	06	
		Common Albatross	04	00	00	04	
Total			54	14	34		102

Table 3: Number of butterflies and Simpson Index of Diversity in the study area

LOCATION	NUMBER OF BUTTERFLIES	SPECIES RICHNESS (S)	SIMPSON'S DIVERSITY INDEX (D)
Forest	54	17	0.095
Water bodies	14	06	0.194
Mixed vegetation	34	14	0.111

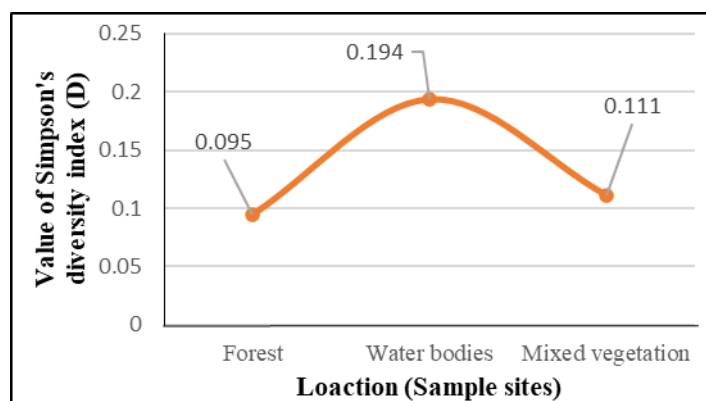


Fig. 5: Area chart showing Diversity indices like Simpson's diversity index (D). Index at Sample site 1: Forest, Sample site 2: Water bodies and Sample site 3: Mixed vegetation.

subfamily, 18 genera were recorded. Among the butterfly species under 5 families observed at 3 sample sites of the study area, 1 of them was abundantly (*Junonia lemonias*), and 6 species were common (*Zizina labradus*, *Luthrodes pandava*, *Euploea core*, *Tirumala limniace*, *Eurema hecabe* and *Eurema andersonii*) while 7 number of the species of butterfly were less common (*Junonia atlites*, *Danaus chrysippus*, *Ypthima huebneri*, *Neptis hylas*, *Ariadne merione*, *Catopsilia pomona* and *Appias albino*). A very small number of 8 species of butterfly were found in the study area (*Pelopidas subochracea*, *Arhopala centaurus*, *Phalanta phalantha*, *Melanitis leda*, *Acraea terpsicore*, *Pachliopta aristolochiae*, *Papilio demoleus* and *Catopsilia pyranthe*) as shown in Table 2.

Kanagaraj and Kathirvely (2018) categories the different species of butterflies as Very Common (6), common (28), less common (16) and rare (2), respectively. A similar observation was also made by Bora and Meitei (2014) who found

diversity among butterfly species in Assam University campus as Very common (20), common (34), uncommon (29), Rare (9) and Very Rare (4).

Based on the family composition of butterfly species checklist observed in the study area maximum number of species was observed in family Nymphalidae (50%) with 7 sub-families, 10 genera, 11 species, which may be due to species adaptation and habitat preference and Hesperidae family of butterfly with least number of species (4%).

Earlier, a preliminary checklist of butterflies was also obtained by Sethy et al. (2014) who reported that Nymphalidae family represented the dominant with 42.5% in the study area and Hesperidae family is not dominant with 7.1%. Singh and Chib (2014) recorded 125 species of butterflies belonging to 78 genera and 5 families. Charn (2015) listed 54 butterfly species belonging to 7 families from forests of Punjab. Sayeswara (2018) recorded family Nymphalidae with highest percentage of butterfly species (44.4%) and family

Hesperiidae with lowest percentage. Koneri and Nangoy (2019) also observed the status of butterflies in Sangihe Island and recorded that family Nymphalidae comprises the highest number of butterfly species with 53.81% and Hesperiidae with only 0.64% in the study area. All the research reports show that the Nymphalidae family is dominant with the highest number of butterfly species and fewest butterfly species were found under Hesperidae family compared to other families.

Simpson's diversity Index showed the highest number of butterflies and Species richness (S) were observed in forest site (54 and 17), followed by mixed vegetation (34 and 14) and water bodies sites (14 and 6).

The butterflies are most sensitive to the habitat disturbance and environment alternation. A little change in the environment or habitat affect the distribution pattern of the species.

The study shows the loss of suitable habitat (forest, water bodies, mixed vegetation) due to increased movement of vehicles, industrial activities and other sources of pollution which strongly affect the numerical strength as well as diversity of species. Also, Vehicle emissions, fuel oils and natural gas to heat homes, by-products of manufacturing and power generation, particularly coal-fuelled power plants, and fumes from chemical production are the primary sources of human-made air pollution that cause disturbance in these habitats.

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