International Journal of Entomology Research
www.entomologyjournals.com
ISSN: 2455-4758
Received: 08-09-2022, Accepted: 24-09-2022, Published: 10-10-2022
Volume 7, Issue 10, 2022, Page No. 82-94

Butterfly diversity of Janaki forest in Kozhikode district, Kerala

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Abstract
Janaki Forest is a known tourist place in Kozhikode District, Kerala. The area is protected by the Forest department of Kerala under the Kuttiyadi Forest range. The present study highlights the significant record of butterfly diversity of Janaki Forest. The study was conducted from January 2022 to April 2022 by applying transect count method. Butterfly species diversity was assessed quantitatively across the different habitats in the study area. The study site-1 represent riverine, the site-2 represent wet land, the site 3 represent evergreen forest and the site-4 represents mixed vegetation. The site-3 evergreen forest is observed as the area with maximum species diversity, followed by site-1 riverine and site-4 mixed vegetation. Site-2 wet land is observed as the area with less species diversity. The area known for riparian type of habitat that serves as a good host for various species of butterflies. During the study period, a total of 60 butterfly species belonging to 6 families were recorded with Nymphalidae as the dominant family with 24 species followed by Papilionoidea with 13 species, Pieridae with 11 species, Lycaenidae with 7 species, Hesperiidae with 4 species and Riodinidae with only one species. The difference in species diversity is because of differential distribution of various host plants, Availability of nectar resources and sunlight. Human activity also found to be a factor for the difference in diversity across various habitats.

Keywords: butterfly diversity, Janaki forest, riverine, wetland, forest, mixed vegetation

Introduction

Butterflies are always fascinated human beings. Probably among insects, they are the most attractive group of organisms in terms of coloration and beauty. And they are the most studied insect group (Kehimkar 2008) [11]. They are active most of the day time but the high activity observed at approximate 3 hours prior to sunset and 3 hours after to sunrise. The word Butterfly arises from two Greek words Lepis, which means scales and Pteron means wings. This is the idea behind the term Lepidoptera, which is the butterfly order. It is believed that the butterflies are evolved from moths and the evolution of butterflies is linked with the evolution of flowering plants.

Kerala is a southern state on tropical Malabar coast of India and the study area Janaki Forest is located at Maronthongara panchayat, Kozhikode district of Kerala. The study area comes under Kuttiyadi range of Kozhikode Forest division. The forest is a part of western ghat region of Kerala and it is highly diverse in terms of vegetation. More than 17,000 butterfly species are identified throughout the world, in which 1501 species are residents in India (Gupta *et al*. 2012) [6]. The Western Ghat region have more than 334 butterfly species precent, in which 37 species are endemic (Kunte 2000) [13]. Kerala has 322 butterfly species (Palote *et al*.2003) [15]. Butterflies are included in the largest phylum Arthropoda, Class Insecta and Order Lepidoptera. They are further classified in to two different superfamilies. The superfamily Papilionoidea contain six families (Varshney *et al*. 2015) [24], such as Papilionidae, Pieridae, Nymphalidae, Lycaenidae, Riodinidae, Hesperiidae and the second superfamily Hedyloidea, which include American moth butterflies contains only one family, Hedylidae. The butterflies are major pollinators of many crop plants and they are really helpful for the pollination of most of the flowering plants. So, the presence of butterflies is ecologically really important. The butterfly species depends own specific host plants for the creation of next generation, So the diversity of butterfly species is directly proportional to the diversity of vegetation in that area (Padhye *et al*. 2006) [14]. The study area is an unstudied site for butterfly diversity and it comes under the tourism department of Kerala. So, the survey is useful to understand how the butterflies are affected due to the increase in tourism activities.

Materials and Methods

Geologically Janaki Forest located at 11°37'28" N and 75°47'36" E and elevation is 40-50 m from the sea level. During this survey study, the study area divided into four different study sites.

Site-1 Riverine located at the banks of River Kuttiyadi, dominated by rocks and some mangroves. Some flowering plants also found. The area has wet land. Site-2 Wet land is a poor vegetation muddy area, some herbs are spotted. Site-3 evergreen forest represents an evergreen forest with open canopy. Some flowering plants are found. The area is not accessible for visitors. Site-4 mixed vegetation is also a low vegetation area in which the dry leaves and plant parts are found. This area will cover up by herbs and shrubs during rainy season. The sampling was carried out by Transect count method (Ernie Pollard, U.K in 1973). A one kilometre transect were created throughout the study area. The transect is then divided to 8 equal regions, in which every two regions represent a study site.

During every survey day, used to walk through the prescribed transect and the count of butterflies was taken. The butterflies were counted within 2.5 meters to the left and right side and five meters in front of the observer. Field

notes and butterfly checklist were used to mark the count. Clear photographs were taken by professional camera (Nikon D3500) and some small butterflies were caught by insect net. After identification they were released to their original habitats. The observed species was identified on the field with the help of resource persons and the identification was confirmed by field guides of Evans *et al*., IJ. Gupta *et al*. and Jaffer Palot *et al*. Statistical analysis was done based on the number of sightings in survey days.

The butterfly species were categorized into five groups.

Very rare (>2 sightings),

Rare (3-14 sightings),

Occasional (15-40 sightings),

Common (41-80 sightings),

Very common (<81 sightings).

The diversity of the study area is calculated by using diversity indices

Shannon-Wiener Index for Diversity: High values for the Shannon index reflects greater diversity.

Diversity $\boldsymbol{H'} = -\sum \boldsymbol{sPi} \ln \boldsymbol{Pi}$

Where, S = Number of species

Pi = Proportion of individuals of the abundance of the ith species expressed as a proportion of total cover.

ln = Natural logarithm

Simpson's Index for Species Richness: Zero Simpson's index results in infinite richness and 1 predicts no richness.

$\boldsymbol{D} = \sum(\boldsymbol{n}/\boldsymbol{N})\boldsymbol{2}$

Where, n = The total number of a particular species. N = The total number of all species.

Pielou's Index for Species evenness: Pielou's index value lies between 0 and 1. J value 1 shows similar proportion which means high evenness and less values indicate unequal proportion of all species which means less evenness.

Where, S = the number of species

Pi = the proportion of individuals of the ith species or the abundance of the nth species expressed as a proportion of total cover.

ln = Natural logarithm

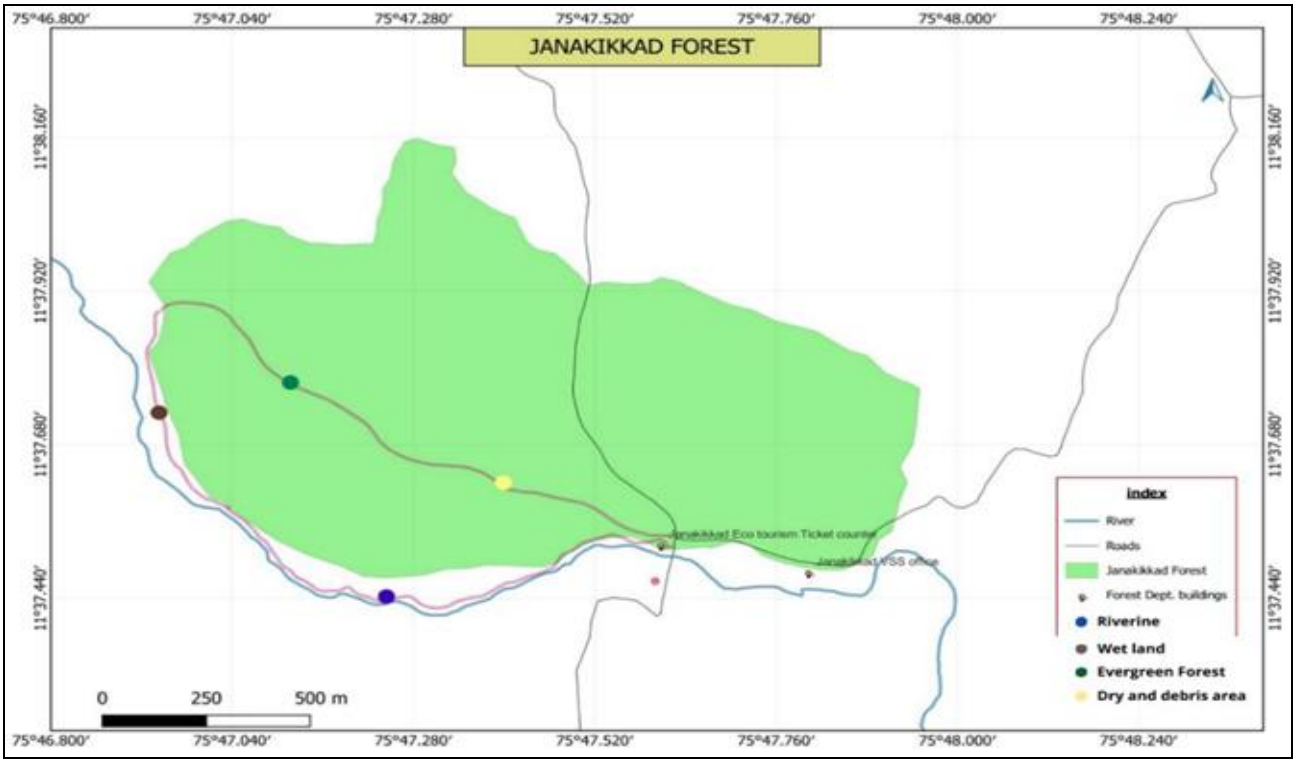

Fig 1: Transect showing various Habitats

Table 1: Observation Period

S.L. NO.	Study Sites	Date	Survey time
1	Site 1- riverine	26/01/22 to 12/04/22	7.30 AM –12.00 PM and 3.30 PM – 5.30 PM
2	Site 2- wet land	26/01/22 to 12/04/22	7.30 AM –12.00 PM and 3.30 PM – 5.30 PM
3	Site 3- evergreen forest	26/01/22 to 12/04/22	7.30 AM –12.00 PM and 3.30 PM – 5.30 PM
4	Site 4- mixed vegetation	26/01/22 to 12/04/22	7.30 AM –12.00 PM and 3.30 PM – 5.30 PM

Site 1- Riverine **Site 2- Wet Land**

Site 3- Evergreen Forest **Site 4- Mixed Vegetation**

Fig 2: Different study sites-1, 2, 3, 4

Instruments Used

Professional Camera (Nikon D3500), Insect Net, Field note, Pen, Walking stick.

Observation

A total of 60 species comes under 6 families are identified during the period of study.

Family Nymphalidae is the most dominated butterfly family of Janaki Forest with 24 species followed by Papilionidae with 13 species, Pieridae 11 species, Lycaenidae 7 species, Hesparidae 4 species and a single Riodinidae. Nymphalidae alone constitute 40% total number of species. From the present survey, *Euploea core* is the most abundant species of Janaki Forest with 97 citations. Followed by *Melanitis leda* with 87 citations.The study Site-1(riverine) reported 38 species of butterflies consist of 5 different families.

The study site-2 (wet land) reported 28 species with 5 families, and the site-3 (dens forest) reported 52 species with 6 different families and the study site-4 (mixed vegetation) reported 36 species with 6 different families.

List of Butterflies and Their Status in Janaki forest, Kozhikode, Kerala

Table 2

SI. NO.	Common Name	Vernacular Name	Scientific name	Family	Sub Family	Adbund Acne	Occura Nce status	WPA status
1.	Southern Birdwing	Gharuda Shalabham	*Troides minos*	Papilionidae	Papilioninae	2	VR	
2.	Common Rose	Naattu Rose	*Pachliopta aristolochiae*	Papilionidae	Papilioninae	48	C	
3.	Crimson Rose	Chakkara Shalabham	*Pachliopta hector*	Papilionidae	Papilioninae	12	R	Schedule 1
4.	Common Blue Bottle	Neela Kudukka	*Graphium sarpedon*	Papilionidae	Papilioninae	46	C	
5.	Common Jay	Naatu Kudukka	*Graphium doson*	Papilionidae	Papilioninae	8	R	
6.	Tailed Jay	Vira Vaalan	*Graphium agamemnon*	Papilionidae	Papilioninae	40	O	
7.	Common Mime	Vazhana Poombatta	*Papilio liomedon*	Papilionidae	Papilioninae	16	O	Schedule 1
8.	Lime Butterfly	Naaraka Shalabham	*Papilio demoleus*	Papilionidae	Papilioninae	22	O	
9.	Malabar Raven	Malabar Raven	*Papilio dravidarum*	Papilionidae	Papilioninae	4	R	
10.	Red Helen	Chuttikkaruppan	*Papilio helenus*	Papilionidae	Papilioninae	22	O	

11.	Common Mormon	Narakakkali	*Papilio polytes*	Papilionidae	Papilioninae	85	VC	
12.	Blue Mormon	Krishna Shalabham	*Papilio polymnestor*	Papilionidae	Papilioninae	40	O	
13.	Paris Peacock	Chutti Mayoori	*Papilio paris*	Papilionidae	Papilioninae	5	R	
14.	Common Emigrant	Manja Thakaramuthy	*Catopsilia pomona*	Pieridae	Coliadnae	82	VC	
15.	Common Grass Yellow	Manja Pappathy	*Eurema hecabe*	Pieridae	Coliadnae	50	C	
16.	Small grass yellow	Cheru Manja Pappathy	*Eurema brigitta Cramer*	Pieridae	Coliadnae	17	O	
17.	Three spot grass yellow	Muppottan Mnaja Pappathy	*Eurema blanda Boisduval*	Pieridae	Coliadnae	3	R	
18.	Common Jezebel	Vilasiny	*Delias eucharis*	Pieridae	pierinae	46	C	
19.	Psyche	Pottuvellatty	*Leptosia nina*	Pieridae	pierinae	5	R	
20.	Plain Puffin	Vella puffin	*Appias indra*	Pieridae	pierinae	3	R	Schedule 2
21.	Chocolate Albatross	Chocolate albatross	*Appias lyncida*	Pieridae	pierinae	32	O	Schedule 2
22.	Common Albatross	Albatross	*Appias albina*	Pieridae	pierinae	31	O	Schedule 2
23.	Plain Orange Tip	Chora Thunjan	*Colotis eucharis*	Pieridae	pierinae	47	C	
24.	Common Wanderer	Nadoodi	*Pareronia valeria*	Pieridae	pierinae	5	R	
25.	Common Evening brown	Kariyila Shalabham	*Melanitis leda*	Nymphalidae	Styrinae	87	VC	
26.	Common Palm fly	Oola Kkandan	*Elvmnias hypermnestra*	Nymphalidae	Styrinae	43	C	
27.	Common Four ring	Naalkanni	*Yothima huebneri*	Nymphalidae	Styrinae	24	O	
28.	Common Five ring	Ven Naalkanni	*Ypthima baldus*	Nymphalidae	Styrinae	10	R	
29.	Common Nawab	Nawab	*Polyura athamas*	Nymphalidae	Charaxinae	18	O	
30.	Tawny Coster	Thee Chirakan	*Acraea violae*	Nymphalidae	Charaxinae	8	R	
31.	Southern Rustic	Vayankathan	*Cupha erymanthis*	Nymphalidae	Charaxinae	81	VC	
32.	Leopard Butterfly	Puli Theyyan	*Phalantha phalanta*	Nymphalidae	Charaxinae	22	O	
33.	Common Sailor	Ponthachuttan	*Neptis hylas*	Nymphalidae	Limenitinae	83	VC	Schedule 2
34.	Common Lascar	Nari Varayan	*Pantoporia hordonia*	Nymphalidae	Limenitinae	50	C	
35.	Commander	Vellila Thozhi	*Moduza procris*	Nymphalidae	Limenitinae	21	O	
36.	Clipper	Clipper	*Parthenos sylvia*	Nymphalidae	Limenitinae	51	C	Schedule 2
37.	Angled Castor	Chithrakan	*Ariadne ariadne*	Nymphalidae	Limenitinae	3	R	
38.	Common Castor	Aavanachoppan	*Ariadne merione*	Nymphalidae	Limenitinae	49	C	
39.	Grey Pansy	Vayal Kotha	*Junonia atlites*	Nymphalidae	Limenitinae	50	C	
40.	Chocolate Pansy	Chocolate shalabham	*Junonia iphita*	Nymphalidae	Nymphalininae	69	C	
41.	Great Eggfly	Van Chotta Shalabham	*Hypolimnas bolina*	Nymphalidae	Nymphalininae	59	C	Schedule 1
42.	Danaid Eggfly	Chotta Shalabham	*Hypolimnas misippus*	Nymphalidae	Nymphalininae	5	R	
43.	Plain Tiger	Erikk Thappi	*Danaus chrysippus*	Nymphalidae	Nymphalininae	3	R	
44.	Glassy Blue Tiger	Theli Neela Kaduva	*Parantica aglea*	Nymphalidae	Danainae	21	O	
45.	Blue Tiger	Neela Kaduva	*Tirumala limniace*	Nymphalidae	Danainae	57	C	
46.	Dark Blue Tiger	Kari Neela Kaduva	*Tirumala septentrionis*	Nymphalidae	Danainae	22	O	
47.	Common Crow	Arali Shalabham	*Euploea core*	Nymphalidae	Danainae	97	VC	
48.	Malabar Tree Nymph	Vana Devatha	*Idea malabarica*	Nymphalidae	Danainae	21	O	
49.	Common Pierrot	Naattu Komali	*Castalius rosimon*	Lycaenidae	polyommatinae	17	O	
50.	Pea Blue	Pattani Neeli	*Lampides boeticus*	Lycaenidae	polyommatinae	31	O	Schedule 2
51.	Common Cerulean	Pottu Vaalatty	*Jamides celeno*	Lycaenidae	polyommatinae	45	C	
52.	Red Pierrot	Chenkomali	*Talicada nyseus*	Lycaenidae	polyommatinae	20	O	
53.	Yam fly	Kunju Vaalan	*Loxura atymnus*	Lycaenidae	Theclinae	53	C	
54.	Monkey Puzzle	Iru Thalachi	*Rathinda amor*	Lycaenidae	Theclinae	6	R	
55.	Indian Sunbeam	Soorya Shalabham	*Curetis thetis*	Lycaenidae	Theclinae	53	C	
56.	Brown Awl	Thavidan Aara	*Badamia exclamationis*	Hesperidae	coeliadinae	47	C	
57.	Common Small Flat	Kunji Parappan	*Sarangesa desahara*	Hesperidae	Pyrginae	13	R	
58.	Chestnut Bob	Chenkurumban	*lambrix salsala*	Hesperidae	hesperiinae	45	C	
59.	Coon	Cheera Chirakan	*Psolos fuligo*	Hesperidae	hesperiinae	8	R	
60.	Plum Judy	NA	*Abisara echerius*	Riodinidae	Nemeobiinae	24	O	

Abbreviation: Verry rare (VR), Rare (R), Occasional (O), Common (C), Verry Common (VC).

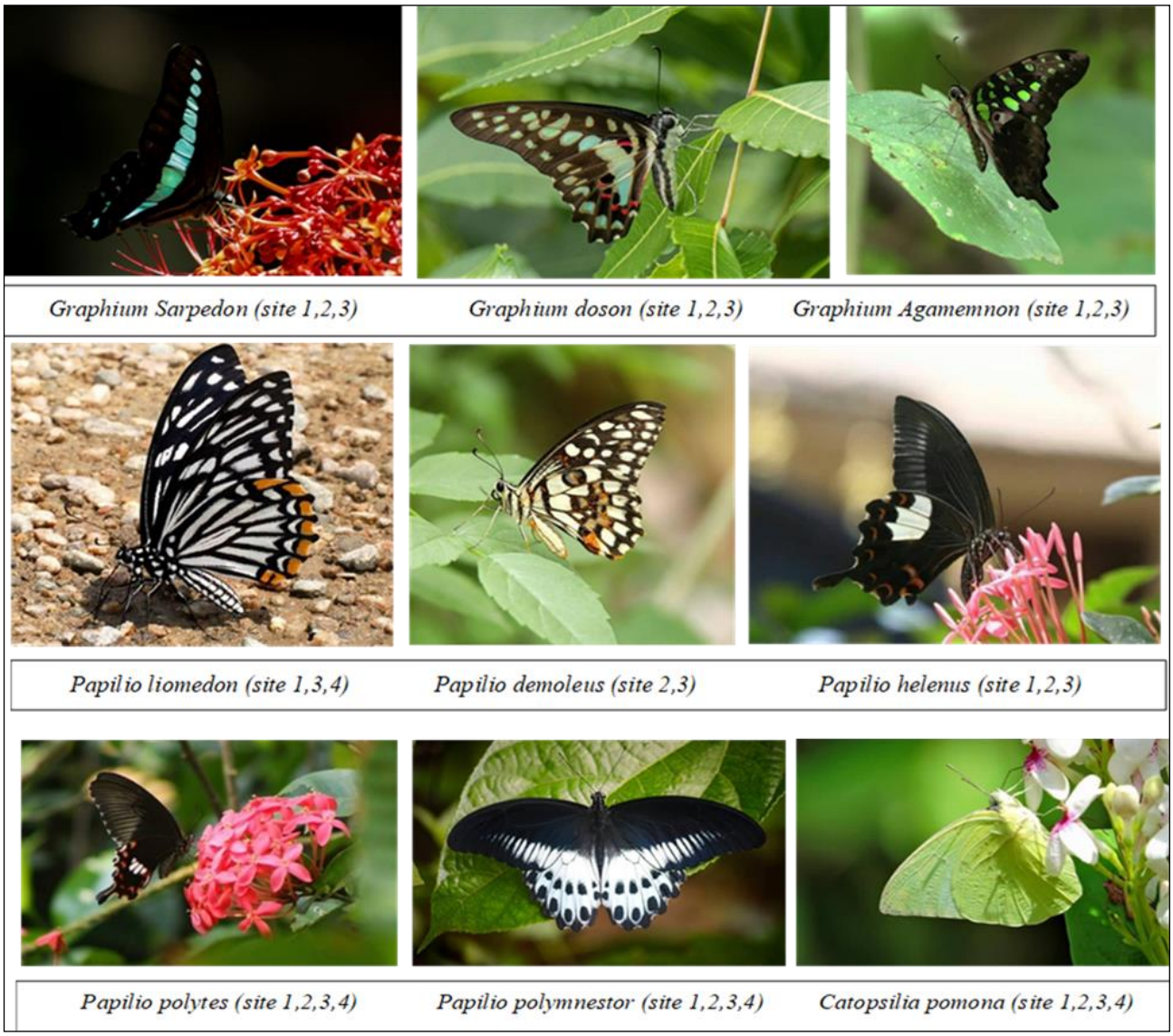

Fig 3

Butterflies of the Janaki Forest in Different Sites 1, 2, 3, 4

Fig 4

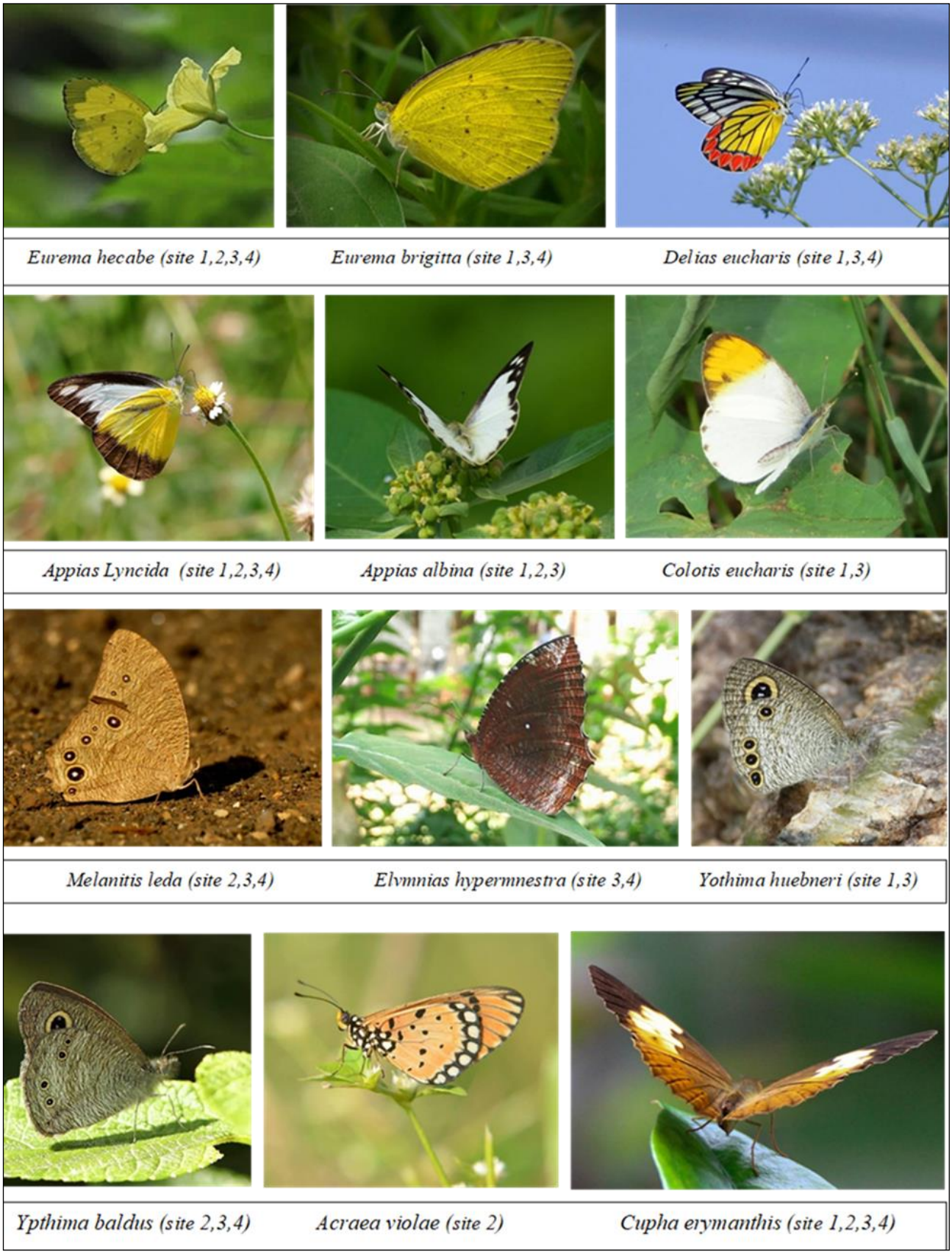
Eurema hecabe (site 1,2,3,4)
Eurema brigitta (site 1,3,4)
Delias eucharis (site 1,3,4)
Appias Lyncida (site 1,2,3,4)
Appias albina (site 1,2,3)
Colotis eucharis (site 1,3)
Melanitis leda (site 2,3,4)
Elymnias hypermnestra (site 3,4)
Yothima huebneri (site 1,3)
Ypthima baldus (site 2,3,4)
Acraea violae (site 2)
Cupha erymanthis (site 1,2,3,4)

Fig 5

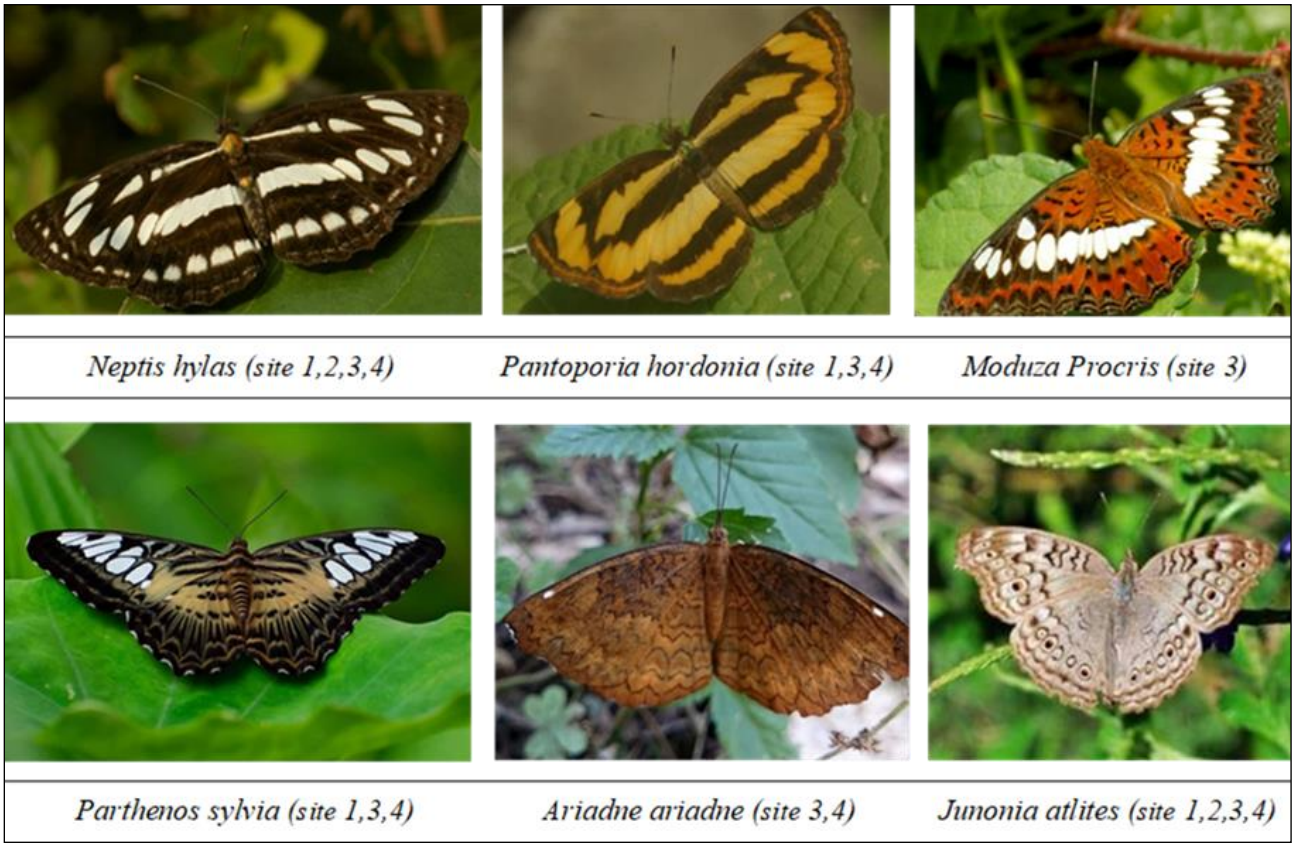
Neptis hylas (site 1,2,3,4)
Pantoporia hordonia (site 1,3,4)
Moduza Procris (site 3)
Parthenos sylvia (site 1,3,4)
Ariadne ariadne (site 3,4)
Junonia atlites (site 1,2,3,4)

Fig 6

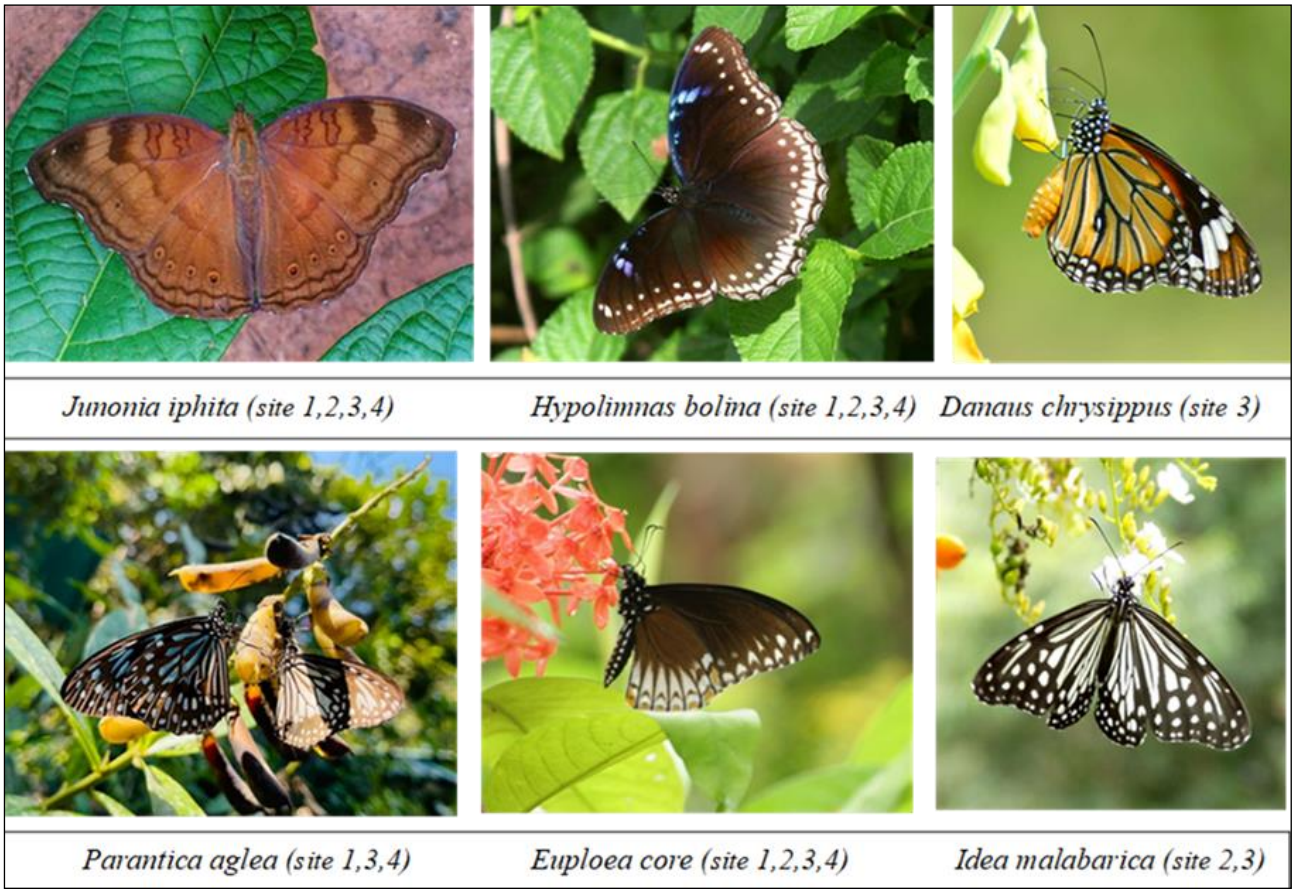
Junonia iphita (site 1,2,3,4)
Hypolimnas bolina (site 1,2,3,4)
Danaus chrysippus (site 3)
Parantica aglea (site 1,3,4)
Euploea core (site 1,2,3,4)
Idea malabarica (site 2,3)

Fig 7

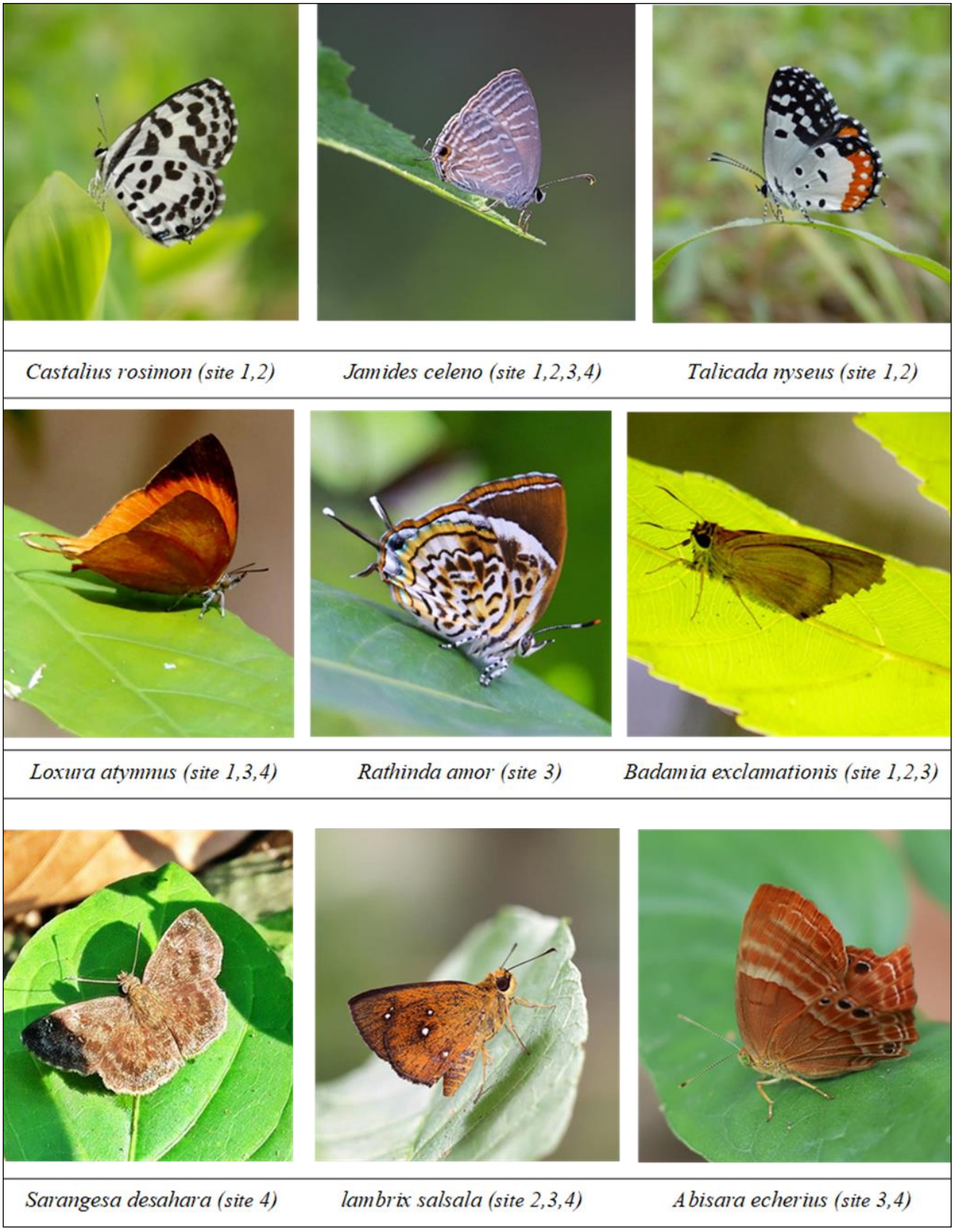

Fig 8

Among the four study sites, study site 3 evergreen forest is the most diverse habitat. This region has the higher shanon-weiner index value (3.6993) Followed by site-1 riverine got 3.4217, site-4 mixed vegetation got 3.2652 and site-2 wet land have the value 3.0529. All of the sites are less diverse when compared Janaki Forest as a whole. It has a shanon-weiner index value of 3.7959. Also, the Simpsons index for species richness show similar value, maximum richness is found on study site 3 (0.0281). The Pielou's evenness index also calculated. Here also the study site 3 got the highest value (0.9314), hence the study site.3 is more evenly distributed.

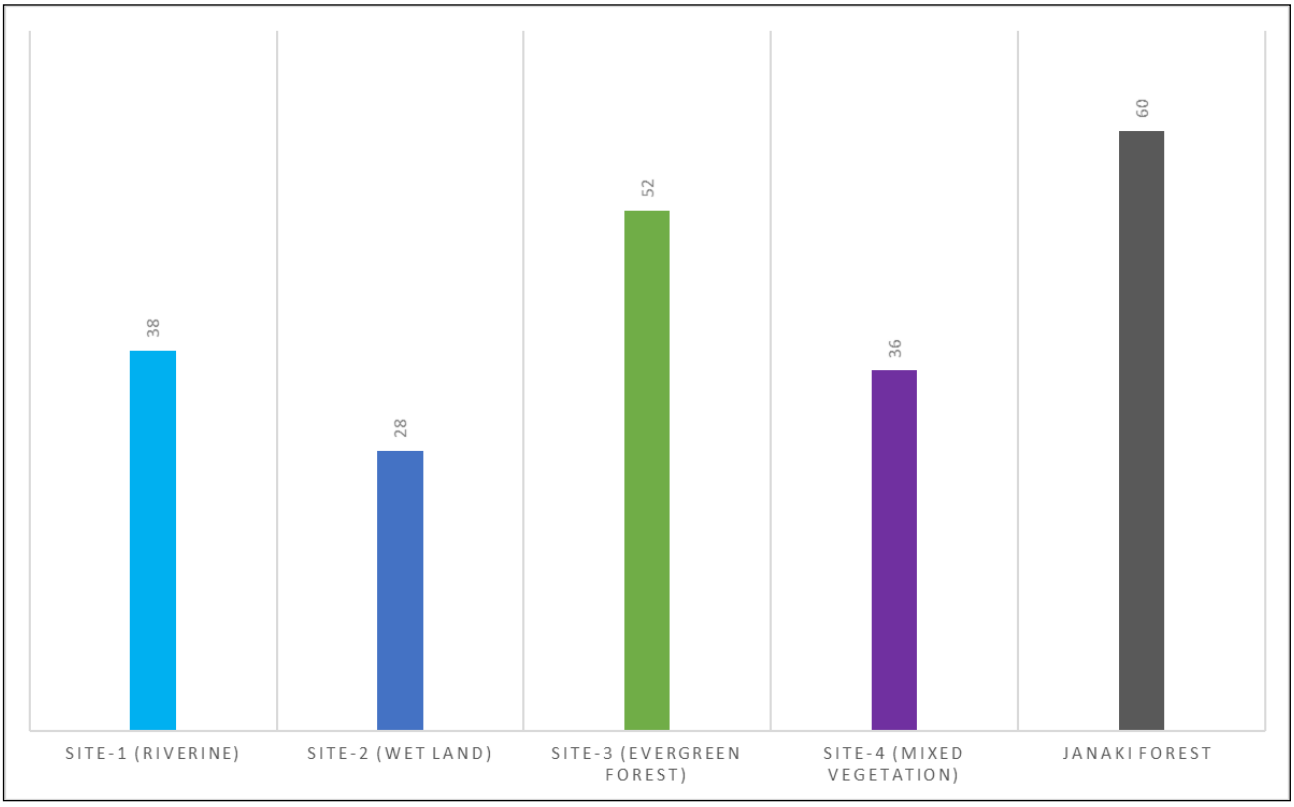

Fig 9: number of butterfly species found in different study sites

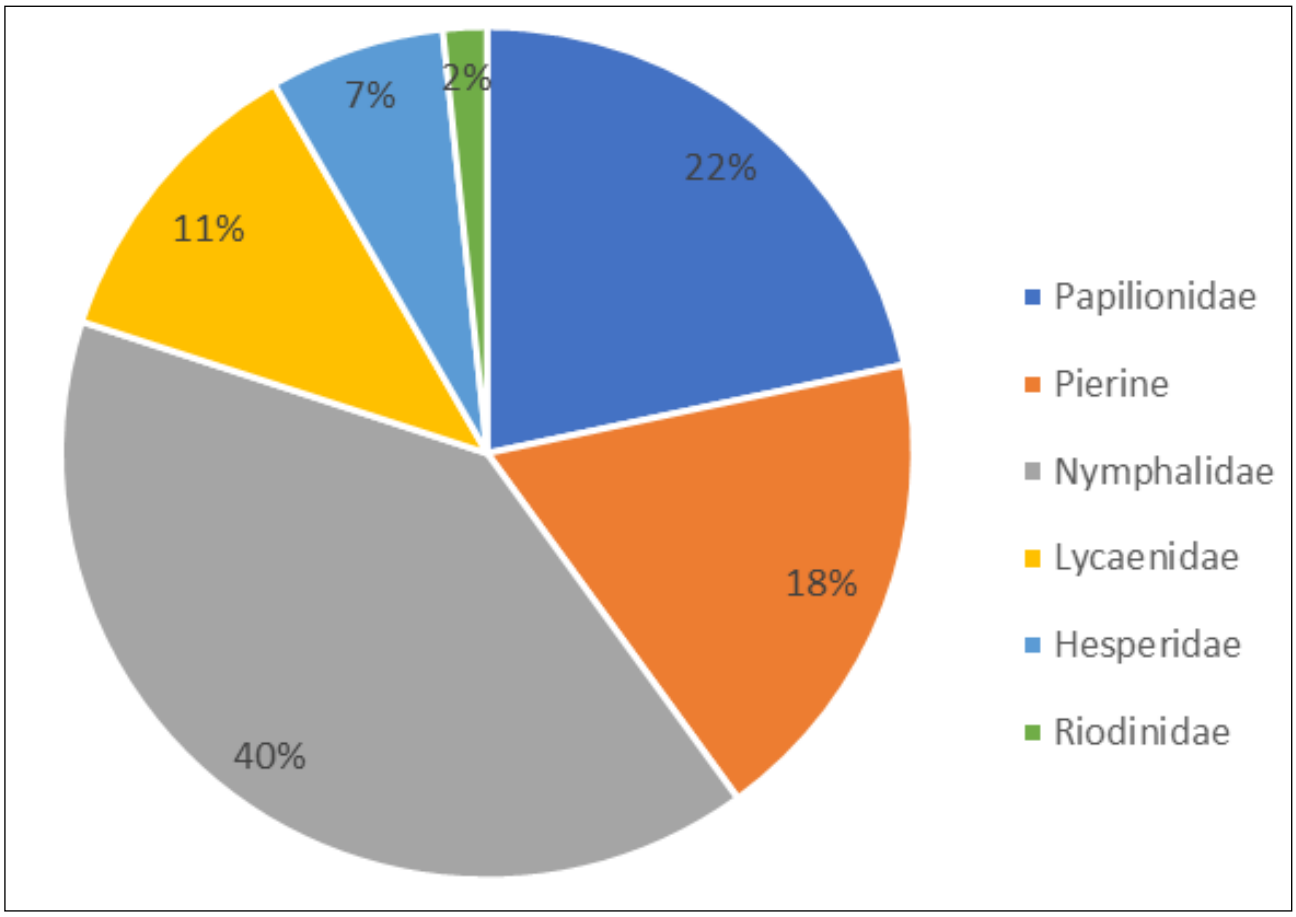

Fig 10: butterfly species distribution among families- Janaki Forest

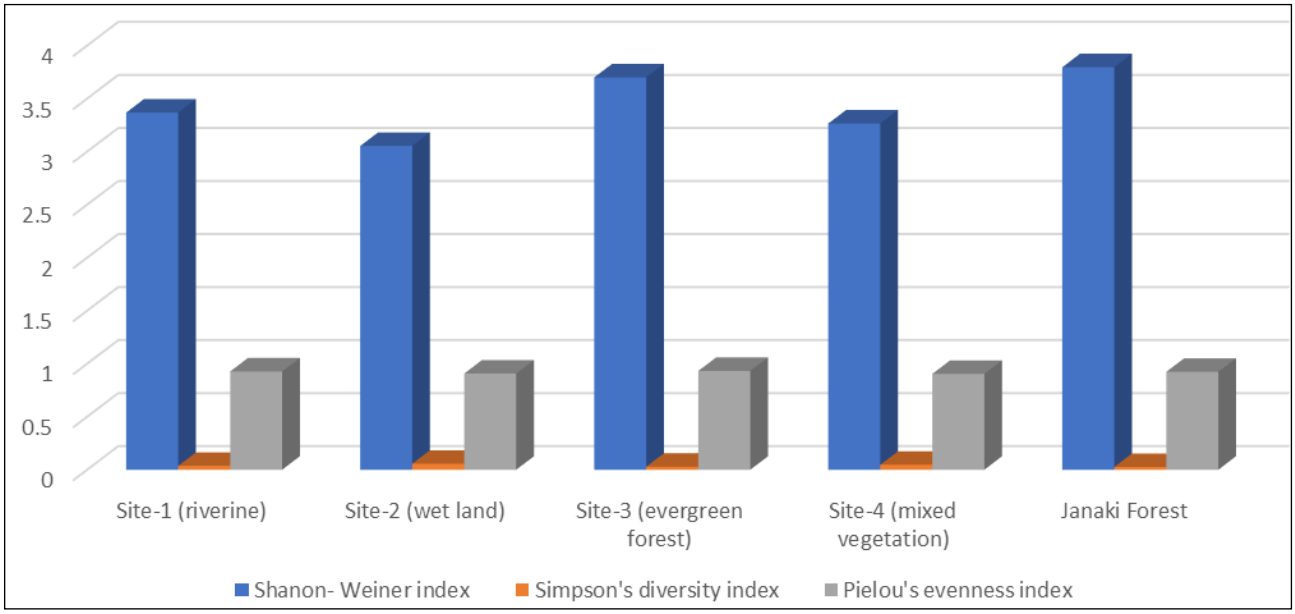

Fig 11: comparison of diversity indices

Table 2: diversity index of different study sites

SI. No.	Study sites	Shanon- Weiner index	Simpson's diversity index	Pielou's evenness index
1.	Site-1 (riverine)	3.3676	0.0367	0.9275
2.	Site-2 (wet land)	3.0529	0.0566	0.9066
3.	Site-3 (forest)	3.6993	0.0281	0.9317
4.	Site-4 (mixed vegetation)	3.2652	0.0469	0.9042
	Janaki Forest	3.7959	0.0262	0.9233

According to the present study *Appias indra* is an exclusive species in site-1, *Acraea violae* exclusive to site-2, five species (*Troides minos, Papilio dravidarum, Danaus chrysippus, Rathinda amor, Psolos fuligo*) are exclusive to site-3 and Two species (*Leptosia nina, Hypolimnas misippus*) are exclusive to site-4. Out of 60 species 12 were found common in four of the study sites.

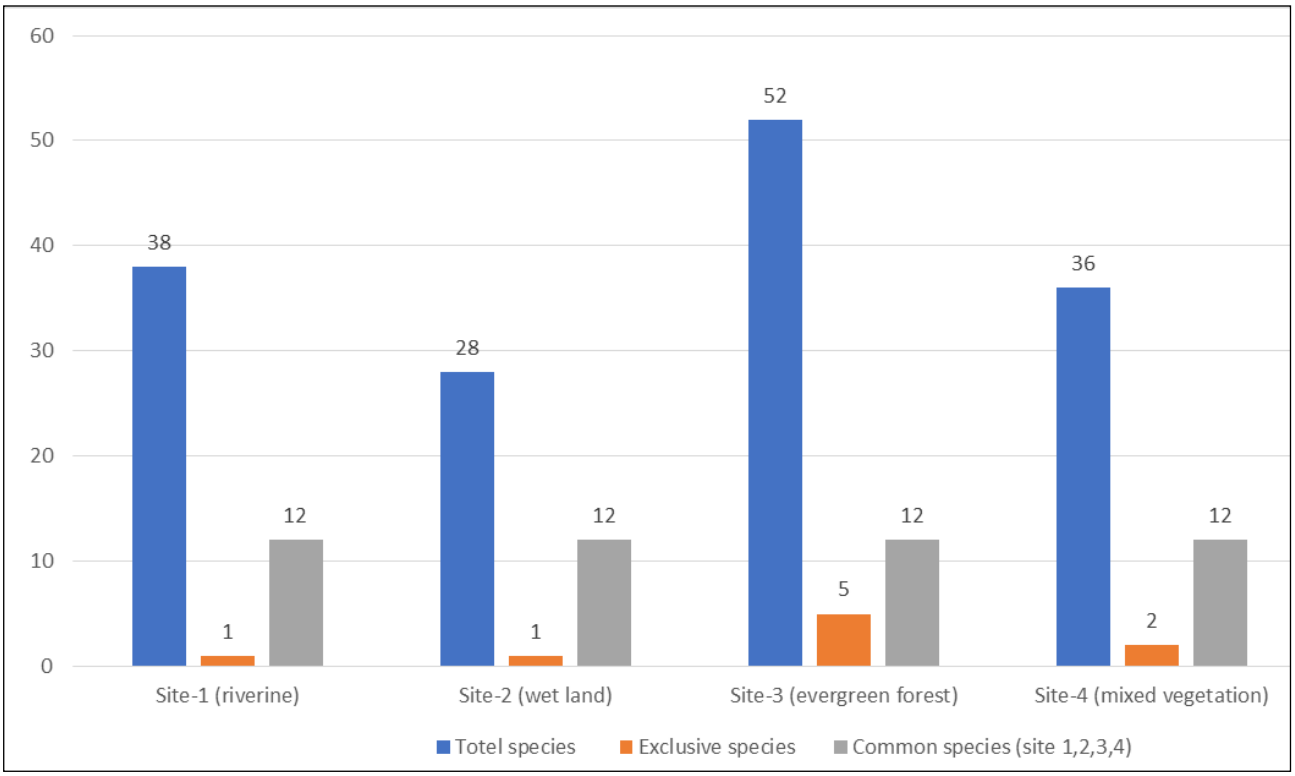

Fig 12: status of exclusive butterfly species in different study sites 1,2,3,4

Result and discussion

A total number of 60 species have been identified during the survey period of this study, which represent 6 families. Family Nymphalidae is the most dominated butterfly family of all the four sites. Family wise distribution of butterfly species is given in the fig.4. In site-1 riverine, 38 species were observed under 5 families, are mentioned in the table.2. In site-1, 5 species listed as verry common, 18 species listed as common, 10 species listed as occasional and 5 species are rare. 4 species listed under the schedule-1 and 6 species listed under schedule-2 of conservation by wild life protection act (1972). In site-2 wet land, 28 species were observed under 5 families, in which 6 species are verry common, 12 were common,8 were occasional and 2 are rare. In site-2, 2 species listed under the schedule1 and 3 on schedule-2 of wild life protection act. In site-3 forest,52 number of species were found under 6 families. Out of 52 species, 6 species are verry common, 19 were common, 16 were occasional, 10 were rare and only 1 is verry rare. In site-3, 3 species belong to schedule 1 and 5 belong to schedule-2 of wild life protection act. In site-4 mixed-vegetation,36 species found under 6 families., where 6 species were verry common, 15 common, 8 were occasional and 6 were rare. Out of these 3 species belongs to schedule 1 and 3 belongs to schedule-2 of wild life protection act. According to the present study family Nymphalidae is the dominant family of Janaki Forest, also *Euploea core* is observed as the most abundant species followed by *Melanitis leda*. also,

During the survey, the study area is differentiated into 4 different study sites. And the Shanon-Weiner index, Simpson's index for species richness and Pielou's evenness index were calculated. The Janaki Forest as a whole have a Simpson's index value of 0.0262. Higher species richness is obtained from site-3 (0.0281) Followed by site-1 (0. 0367), site-4 (0. 0469) and least on site-2 (0.0566). Also, the Shanon-Weiner index provide almost similar data. The index is based on information theory gives Janaki Forest, an index value of 3.7959. Among study sites, site-3 got the highest diversity (3.6993) followed by site-1 (3.4217), site-4 (3.2652) and like in Simpsons index, site-2 placed at the last with an index value of 3.0529. The Pielou's evenness show that the site-3 is highly even (0.9317) followed by site-1 (0.9275), site-2 (0.9066) and site-4 (0.9042).

The study area Janaki Forest observed high species richness and species abundance during the study period (January - April 2022). It may be because of the riparian nature of the study area. The riparian habit consists of riverine, wetland, grassland and woods. These habitats are rich in wet areas and vegetations that help the butterfly to feed nectar and larval food. Most butterflies here are more or less depend on riparian forest (Kunte, K., 2000. Butterflies of Peninsular India) [13]. Jeongseop An et. al (2020) observed that butterfly species use riparian habitats effectively for nectar and larval food and Hardy *et al*., (2007) [8] mentioned that adult butterflies need water, pollen, mud, wet sand, carrion, animal waste and other substrates for survival and reproduction, of which most are available in riparian ecosystems. Also, during the study time, the study area received good amount of summer rain which also help to increase the vegetation. Bhusal and Khanal (2008) [4] reported that there is a positive correlation between abundance of diverse species and high relative humidity with high rainfall. This relation may be because of the emergence of good amount of vegetation after rainfall. Also, the climatic condition, vegetation and availability of host plant helped for the increased species richness and abundance of the study area. Since it's a reserved forest, the diversity of plantations and vegetations are much higher than normal habitats. Jos Barlow (2007) [3] also mentioned that the abundance of butterflies is due to favorable climatic conditions, availability of host plants, food and vegetation, also T. Ramesh et. al (2010) [20] mentioned that the butterfly population of that area was correlated negatively with temperature and positively with relative humidity. In light of the present study, family Nymphalidae is the dominant family of Janaki Forest. It is because of polyphagous habit of Nymphalidee and the presence of flowers belongs Families Euphorbaceae, Rubiaceae. Similar observations are made by Lekshmi Priya et.al (2007), Gupta et. al (2012) [6]. The higher abundance of *Euploea core* and *Melanitis leda* is because of the presence of *Ficus sp., Hemidesmus indicus, Tylophora indica, Streblus asper* and Grasses which are the host plants for *Euploea core* and *Melanitis leda* respectively. The host plants help the fly to lay egg on it. J.A. Thomson (1995) mentioned that Habitat selection of a butterfly is directly proportional to availability of preferred food plants for larva and adult (Host plant).

The high diversity of site-3 is due to the availability of variety of host plants. Similar observations are made by Jaffer Palot (Butterflies of Kerala, 2003) That butterfly species are host dependent and they depend host plant for food and completion of their life cycle. Gutierrez and Mendez (1995) [7] suggested that the abundance of butterflies is mostly affected by the availability of food plants. Nazim Ahmad Ansari et.al (2015) [2] had a similar observation that forest showed higher species richness due to rich floral assemblage in the study area. Also, A. M Khurad et. al (2007) [12] reported approximately two thirds of the butterfly species were from the forest area of the campus, six of which were unique and not recorded in other biotopes. Durairaj Parandhaman et. al (2012) [16] observed the higher species richness in forest area. Butterfly diversity in the tropics is more endemic and mostly depend on forest vegetation.

The study area is a leading tourist attraction in Kozhikode district, The portion of study area was accessible to all before Covid pandemic. Because of that there is a walk path through the habitat. The canopy is open and optimum sunlight will receive to the ground. But now, visitors can't access to the habitat due to regulations of Covid pandemic. So, it's less disturbed from human activities. Sprih Harsh (2014) [9] also found higher diversity in forest habitat because its less disturbed. He also mentioned that human interferences result in more gaps, edges which provide more light and space, and more diversity in plant structure than natural dense forests to support more butterfly species. Which is relevant in Janaki Forest also. The site-1 is also showing higher diversity according to the study. It's may be because of the presence of flowering plants in that region. Also, butterflies are more effected to watery area. Many species participating mud-puddling observed during the course of survey. Similar observations were made by Janzen et. al (1968) [10] that the living environment of the river bank habitat is diversified with vegetation, rocks, sand, animal dung, mud, with water that attracts more butterflies. Also,

the open canopy helps to receive maximum sunlight to those participating Basking.

Site-4 and the site-2 habitat is the two low diversity regions. In site-4 there is a walking path way going through the center of the habitat. The area before rain filled with dry and debris matter. Brown colored species like *Melanitis leda* were found verry common during that time in that location. The cryptic coloration with dried leaves helps them to survive from predators. Later (after raining) the region converts to mixed vegetation with the dominance of grass species. The area is rich in host plant diversity but observed high human activity. This may be the reason with low species diversity. Ashish D Tiple et. al (2009) [22] observed the negative effect on human activity on the diversity of butterflies. He observed the absence of many species from the disturbed areas (gardens, plantation, etc.) when compared to undisturbed wild areas. Arun M. Khurad et. al (2007) [12] also observed the same about human activity. He observed lesser diversity in impacted area. In case of site-2, their less diversity due to absence of host plants and nectar resources. Some butterflies those who participating mud-puddling were observed at this habitat but the region have relatively lesser species richness and diversity. The similar observation was made by Soumyajit Chowdhury et. al (2011) [5]. He confirms that the absence of preferred nectar sources and host plants in wet lands lead to low species richness. Also, the Composition and availability of nectar can cause changes in butterfly populations.

Conclusion

According to the present study, a total of 60 butterfly species were observed from Janaki Forest. They belonging to 6 families with Nymphalidae as the dominant family with 24 species followed by Papilionoidea 13, Pieridae 11, Lycaenidae 7, Hesperidae 4 and Riodinidae with only one species. Among the different study sites, site-3 forest is observed as the area with maximum species diversity, richness and evenness followed by site-1 riverine and site-4 mixed vegetation. Site-2 wet land is observed as the area with less species diversity, less species richness but show comparatively high evenness. From the observed data the site-3 is more suitable for butterflies. The area is less disturbed by human beings and preserved many host plants. Also, the Site-1 have lots of favourable condition for the higher diversity. But the tourism has a negative impact on the diversity of that region. The diversity on afternoon session of survey days is found to be very less when compared to morning session of the survey days. This may because of the less human interference in morning time when compared to afternoon. Similar observations were got in the site-4 also. Four species, Troides minos, Pachliopta hector, Papilio dravidarum, Idea malabarica are endemic to Western Ghats observed from study site-3 evergreen forest and one species Troides minos, endemic to Western Ghats found from study site-1 riverine and one species Pachliopta hector, endemic to Western Ghats observed from study site-2 wet land.

In site 1 riverine, 10 species *Pachliopta hector, Papilio clytia, Neptis hylas, Parthenos sylvia, Hypolimnas bolina, Castalius rosimon, Lampides boeticus, Appias indra, Appias albina, Appias lyncida* included in the WPA conservation list (1972) were identified. Also from site 2 wet land, 5 *species Neptis hylas, Hypolimnas bolina, Castalius rosimon, Appias albino, Appias lyncida* included in the WPA conservation list (1972) were identified. 8 species *Pachliopta hector, Papilio clytia, Neptis hylas, Parthenos sylvia, Hypolimnas bolina, Lampides boeticus, Appias lyncida, Delias eucharis* included in the WPA conservation list (1972) from the study site 3 evergreen forest and 6 species *Papilio clytia, Neptis hylas, Parthenos sylvia, Hypolimnas misippus, Hypolimnas bolina, Lampides boeticus* included in the WPA conservation list (1972) from the study site 4 mixed vegetation. It's really important to conserve them to prevent their extinction. For the conservation, it's essential to identify and preserve the host plant of such species. Also, it's important to prevent the visitors from disturbing their wellbeing. It's need to ensure that the visitors only walk through the prescribed walk path ways. So that the habitats will be less distracted. To save the butterflies, because this is nature beauty created by God it is recommended to implant a butterfly garden with their particular habitat. Because they hold a major role in the pollination of many flowering plants and important pollinators to most agriculture crops. This is only a short duration study on the butterfly diversity of Janaki Forest, more surveys and analysis are definitely help to conserve the diversity.

Acknowledgment

Author greatly indebted to Dr. Jobi Raj T. (Assistant Professor, Dept. of Zoology, Govt. College Kodanchery, Kozhikode, Kerala) for offering his valuable time.I would like to thank Mr. Depeesh (Beat Forest officer, Kuttiyadi forest Range, Department of Forest, Kerala) for creating a map of the study area, sincere gratitude to Forest department of Kerala and to the Janaki Forest conservation committee. I would like to thank all the staffs in Janaki Forest for their immense support.

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