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BUTTERFLY DIVERSITY OF WALAYAR VALLEY, THE WESTERN GHATS, INDIA AND ITS CONSERVATION

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ABSTRACT

The Walayar Valley is situated in the Palakkad Gap of the Western Ghats. A portion of the valley lies in the moist areas of Kerala and the other part in comparatively drier zone of Tamil Nadu and hence it is in the transition zone. The valley consists of a variety of landscape elements, which include various types of forests, forest plantations, rocky patches, barren areas, areas under mines, human habitations and agricultural areas, which form the habitats of different species of butterflies. No comprehensive studies have been conducted on the butterfly fauna of this valley and hence the present study was undertaken during 2012 to 2015. Altogether, 117 species of butterflies belonging to 5 families viz. Papilionidae (12 species), Pieridae (20 species), Lycaenidae (32 species), Nymphalidae (42 species) and Hesperiidae (11 species) were recorded from the study area. The maximum number of butterflies were recorded from the Thorn forests (70 species), followed by Moist deciduous forests (65 species) and Dry deciduous forests (59 species) while in the modified landscape elements like agricultural areas, monoculture forest plantations and mining areas, the diversity was low. The species diversity indices such as Shannon - Weiner Index, Simpson Index and Margalef's Index also followed a similar pattern. The tamarind plantations showed the highest Evenness or Equitability Index (0.9197), followed by mining areas (0.8967) and the Semi-evergreen forests (0.8033), while the Dry deciduous forests exhibited least evenness (0.7014). Sorenson's Similarity Coefficient was found to be maximum between Dry deciduous forests and Moist deciduous forests (79%), followed by agricultural areas and Teak plantations (77%) and Teak plantations and Dry deciduous forests (66%). The least Similarity Index of 33 percent was shown by Riparian forests and Thorn forests. Other combinations showed values of intermediate ranges. The study has revealed the presence of six endemic butterfly species viz. *Troides minos* Cramer (Southern birdwing), *Curetis siva* Evans (Shivas sunbeam), *Idea malabarica* Moore, (Malabar tree nymph), *Kallima horsfieldii* Kollar (South Indian blue oakleaf), *Cirrochroa thais* Fabricius (Tamil yeoman) and *Mycalesis patnia* Moore (Gladeye bush brown) in Walayar Valley, which shows the biodiversity richness of the area. Apart from this, the valley also shelters 10 species of butterflies falling under schedules I, II and IV of the Indian Wildlife (Protection) Act, 1972, which further adds to the conservation importance of the area. Management measures to arrest the habitat destruction / deterioration by identifying various threat factors has to be undertaken. Habitat improvement by afforesting the degraded areas with native species, especially the butterfly host plants will go a long way in ensuring *in-situ* conservation of endemic and rare butterflies. Establishing of a Butterfly Park in Walayar Valley, captive breeding of endemic and rare butterfly species and re-introduction of stock in the wild are also suggested as *ex-situ* conservation strategy.

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1. INTRODUCTION

Butterflies are a group of fascinating insects with an estimated number of about 20,000 species in the world. India is one of the 17 megadiverse countries in the world, with large chunk of tropical forests, sheltering rich butterfly fauna. The Indian butterfly fauna constitutes about 1501 species [1]. The Himalayan mountain range harbours the major share of Indian butterfly diversity [2]. Because of their dependence on climatic, vegetational and ecological characteristics of the environment, butterflies are employed by many authors as bioindicators [3,4,5]. Moreover, as many species are sensitive to anthropogenic disturbances, butterflies are largely considered as an indicator group for nature conservation purpose [5].

The Western Ghats is considered as one of the hotspots of butterfly diversity. Several studies have been made on the butterfly diversity of this important mountain system of Peninsular India. Larsen [6,7] carried out pioneering works on butterflies of the Nilgiri mountains of Southern India. Mathew and Rahamathulla [8] recorded about 100 species of butterflies from Silent Valley National Park in the Western Ghats. In another study, Mathew [9] reported 133 species of butterflies from New Amarambalam area of the Western Ghats. Mathew [10] summarised information pertaining to 282 species of butterflies found in the Nilgiri Biosphere Reserve based on a critical examination of available literature. Kehimkar [11] catalogued 734 species of butterflies occurring in Indian sub-continent.

Arun [12] reported 53 species of butterflies from the forests of Siruvani (Coimbatore), located in the Western Ghats. Easwaran and Pramod [13] recorded 75 species of butterflies from Anaikatti hills (Coimbatore) of the Western Ghats. Parandhaman et al. [14] assessed butterfly diversity in the Southern Western Ghats of Tamil Nadu and reported 92 species belonging to 65 genera and five families.

Even though several studies mentioned above have been carried out in different parts of the Western Ghats, no comprehensive studies have been conducted on the butterfly fauna of Walayar Valley, which is lying in the transition zone of the moist areas of Kerala and drier parts of Tamil Nadu. Further, the forest areas of the valley have also been subjected to lot of anthropogenic pressures over a period of time, resulting in degradation and fragmentation. Hence the present study was undertaken to create a baseline data on the butterfly diversity of one of this important gaps of the Western Ghats, so as to conserve the biodiversity.

2. MATERIALS AND METHODS

2.1 The Study Area

The Palakkad (Palghat) gap is a major break in the Western Ghats mountain range, in south-western India. It is located between the Nilgiri Hills to the north and the Anaimalai Hills to the south, and is about 32 km wide. The Walayar Valley (Lat: N 10°51'0"& Long: E 76°51'0") is situated in the Palakkad Gap of the Western Ghats. The western portion of the valley is situated in Kerala State, whereas the eastern portion is in Tamil Nadu (Fig. 1). A small river known as "Walayar River" flows through the boundary of Kerala and Tamil Nadu States. The total extent of the study area is about 121.22 km^2 with an altitude ranging from 200m to 1200m. The forest types occurring in the valley are: Moist deciduous forests, Dry deciduous forests, Thorn forests, Semi-evergreen forests, Riparian forests and Grasslands.

The Walayar Reserve Forest was purchased by the Government in 1873-74, to ensure permanent fuel supply to the Madras Railway. This reserve was brought under the operation of a working plan in 1885 [15]. The forests were mainly worked for Teak poles, fuel wood and bamboos.

The area receives rainfall from both the south-west and north-east monsoons; but the greater part of the precipitation experienced in Kerala part is from the south-west monsoon. The Walayar Valley is swept by strong winds during both the monsoons as well as in the months of January and February. The mean annual temperature of the valley is about 34°C and the mean annual rainfall of Kerala part of the valley is around 1400 mm. The mean annual rainfall of Tamil Nadu part of the valley is around 600mm, the major chunk of which is obtained from the north-east monsoon.

2.2 Survey and Sampling

The study was undertaken during 2012 to 2015. Different landscape elements were identified in the study area and as per the information on these elements obtained from the State Forest Departments, a sampling design based on probability proportional to size was worked out. The details are given in Table 1.

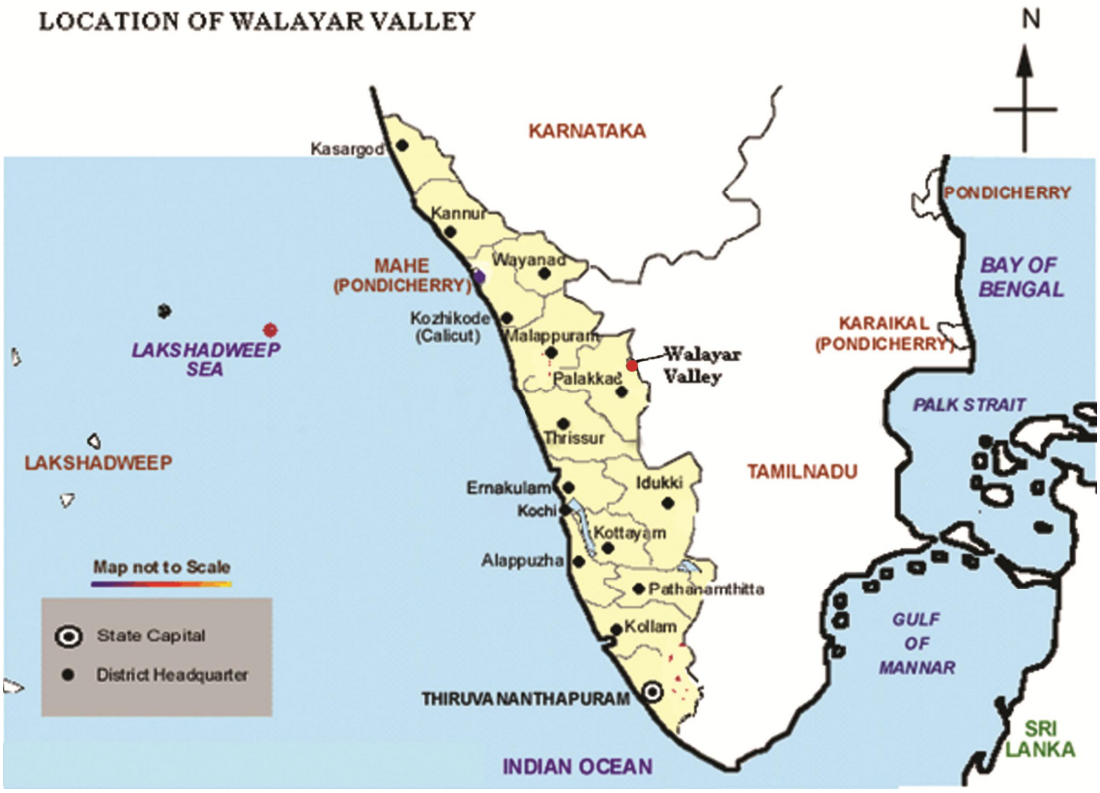

Fig 1. Location map of Walayar Valley

Table 1. Sampling design

S. No.	Forest/ vegetation / habitat	Area in ha (approx)	No. of belt transect units
1	Thorny scrubs	2561.00	26
2	Dry deciduous forests	1640.00	16
3	Moist deciduous forests	500.00	5
4	Semi - evergreen forests	200.00	2
5	Riparian forests	50.00	1
6	Grasslands	100.00	1
7	Mining areas	270.00	3
8	Teak plantations	714.00	7
9	Tamarind plantations	103.00	1
10	Agricultural areas	-	10

Butterflies were sampled in different seasons as given below:

Seasons: I June – November (Monsoon)
II December – January (Post monsoon / winter)
III February – May (Summer)

The methodology followed by Nayak et al. [16] was adopted for the butterfly sampling. Survey and documentation was carried out in different landscape elements, in a line transect of 500m length and 5 m width on either side, in an hour walking at a constant pace. All butterflies on the line as well as 5m on either side were recorded. Binoculars were used for close observation and identification of butterflies in the field. Specimens were collected only if it was absolutely essential for confirming their identity. Standard insect collection nets were used for sampling the insects. The digital photographs made /specimens collected were identified with the help of field guides and by referring to authentically identified reference collections and consulting the specialists on different groups.

2.3 Data Analysis

The following diversity indices were worked out:-

(i) Shannon-Weiner Index

The species diversity was worked out using Shannon – Weiner formula:

$$(H') = -\sum_{i=1}^{k} pi \ln(pi),$$

where, k is the number of categories and pi is the proportion of observations found in category i.

(ii) Simpson Index

The Simpson Index was worked out using the formula: $D = \sum (n / N)^2$, where n = the total number of organisms of a particular species and N = the total number of organisms of all species.

(iii) Species Richness Index

The number of species at a site, in a region or in a collection is called species richness, which is the simplest and most useful measure of diversity. Margalef's diversity index (D_{mg}) [17] was worked out using the following formula: $(D_{mg}) = (S-1)/ \ln N$, where 'S' is the number of species recorded and 'N' is the total number of individuals summed over all species.

(iv) Evenness or Equality Index

This index shows how the individuals of various species are distributed in community. The Shannon's evenness index (E) of community [18] was worked out, using the formula, $E=H/\log_e (S)$, where 'S' is the number of species recorded and 'H' is the Shannon-Weiner index.

(v) Similarity Index

Similarity of different habitats in terms of butterfly fauna was worked out by adopting Sorenson's Similarity Coefficient.

Sorenson's Similarity Coefficient $C_s = 2j / (a+b)$

Where,

a= Total number of species in habitat 1
b= Total number of species in habitat 2
j = Number of common species in the two habitats

3. RESULTS AND DISCUSSION

3.1 Species Richness and Diversity of Butterflies in Different Landscape Elements

Altogether, 117 species of butterflies belonging to five families have been recorded from the study area (Appendix-1). The family Nymphalidae consisted of the maximum number of 42 species, followed by Lycaenidae (32 species), Pieridae (20 species), Papilionidae (12 species) and Hesperiidae (11 species) in the decreasing order (Table 2). Among 10 different Forest / Vegetation type / Landscape elements studied, the maximum species diversity was found in Thorn forests (70 species) and the least in Mining areas (21 species). Other landscape elements had intermediate number of species (Table 3). The Thorn forests exhibited the highest values of Shannon-Weiner, Simpson and Margalef indices, whereas the Mining areas had the lowest values of these indices (Table 4 & Table 5). The diversity indices of butterflies were generally high during the monsoon and post monsoon / winter season and it was lowest during summer season.

3.2 Evenness / Equality Index

The Evenness or Equality Index shows how the individuals of various species are distributed in community. The Tamarind plantations showed the highest Evenness or Equality Index (0.9197), followed by mining areas (0.8967) and the Semi-evergreen forests (0.8033), while the Dry deciduous forests exhibited least evenness (0.7014) (Table 6).

3.3 Similarity Index

The Sorenson's Similarity Coefficients of butterflies in different vegetation types are provided in Table 7. The highest level of similarity was exhibited between Dry deciduous forests and Moist deciduous forests (0.79), followed by agricultural areas and Teak plantations (0.77) and Teak plantations and Dry deciduous forests (0.66). The least Similarity Index of 0.33 was shown by Riparian forests and Thorn forests. Other combinations showed values of intermediate ranges.

The valley has about 63.16 percent of papilionid butterflies occurring in South India, followed by Pierids (58.82%), Nymphalids (43.30%), Lycaenids (31.68%) and hesperiids (13.58%). Overall, the Walayar Valley harbours around 35.24 percent butterfly species reported from South India (Table 8).

Table 2. Family-wise distribution of butterfly species in Walayar Valley

S. No.	Family	No. of species recorded from Walayar Valley
1	Papilionidae (Swallow tails)	12
2	Pieridae (Whites &Yellows)	20
3	Lycaenidae (Blues)	32
4	Nymphalidae (Brush-footed butterflies)	42
5	Hesperiidae (Skippers)	11
	Total	**117**

Table 3. Species diversity of butterflies in different landscape elements

S. No.	Forest/ Vegetation type / Landscape element	No. of butterfly species recorded
1	Moist deciduous forests	65
2	Dry deciduous forests	59
3	Thorn forests	70
4	Semi-evergreen forests	44
5	Riparian forests	28
6	Grasslands	24
7	Teak plantations	53
8	Tamarind plantations	35
9	Agricultural areas	46
10	Mining areas	21

Table 4. Diversity indices of butterflies in different landscape elements

S. No.	Vegetation / Habitat	Summer		Monsoon		Winter	
		Shannon Weiner Index(H')	Simpson Index	Shannon Weiner Index (H')	Simpson Index	Shannon Weiner Index (H')	Simpson Index
1	Moist deciduous forests	2.71	0.11	3.25	0.06	2.64	0.10
2	Dry deciduous forests	2.37	0.17	2.86	0.09	3.08	0.08
3	Thorn forests	2.67	0.11	3.38	0.05	3.13	0.07
4	Semi-evergreen forests	2.90	0.08	3.04	0.07	-	-
5	Riparian forests	-	-	2.56	0.12	-	-
6	Grasslands	-	-	2.43	0.16	-	-
7	Teak plantations	3.16	0.06	2.81	0.09	-	-
8	Tamarind plantations	-	-	-	-	3.27	0.05
9	Agricultural areas	2.13	0.24	2.94	0.08	2.58	0.12
10	Mining areas	2.73	0.08	-	-	2.00	0.14

"–"Indicates non-availability of information

Table 5. Species richness of butterflies across vegetation types

Vegetation type/ Code	No. of species (S)	No. of individuals (n)	(S-1)	lnN	Margalef's index(Dmg)
MDF	65	1071	64	6.98	9.17
DDF	59	728	58	6.59	8.80
THF	70	1361	69	7.22	9.56
SEF	44	254	43	5.54	7.77
RIF	28	123	27	4.81	5.61
GRL	24	143	23	4.96	4.63
TEP	53	1027	52	6.93	7.50
TAP	35	113	34	4.73	7.19
AGR	46	621	45	6.43	7.00
MNG	21	371	20	5.92	3.38

Abbreviations

MDF: Moist deciduous forests; GRL: Grasslands; DDF: Dry deciduous forests; TEP: Teak plantations; THF: Thorn forests; TAP: Tamarind plantations; SEF: Semi evergreen forests; AGR: Agricultural areas; RIF: Riparian forests; MNG: Mining areas

Table 6. Evenness / equality index of butterflies in different vegetation types

Vegetation type/Code	No. of species (S)	Shannon-Weiner Index(H')	Log (S)	Evenness / equality index(E)
MDF	65	3.25	4.1744	0.7786
DDF	59	2.86	4.0775	0.7014
THF	70	3.38	4.2485	0.7956
SEF	44	3.04	3.7842	0.8033
RIF	28	2.56	3.3322	0.7683
GRL	24	2.43	3.1781	0.7646
TEP	53	2.81	3.9703	0.7078
TAP	35	3.27	3.5553	0.9197
AGR	46	2.94	3.8286	0.7679
MNG	21	2.73	3.0445	0.8967

Table 7. Sorenson's similarity co-efficients of butterflies

Vegetation type/ code	MDF	DDF	THF	SEF	RIF	GRL	TEP	TAP	AGR
DDF	0.79								
THF	0.61	0.64							
SEF	0.55	0.60	0.48						
RIF	0.37	0.47	0.33	0.49					
GRL	0.40	0.47	0.34	0.49	0.58				
TEP	0.64	0.66	0.57	0.53	0.43	0.39			
TAP	0.54	0.62	0.57	0.45	0.41	0.40	0.65		
AGR	0.70	0.69	0.61	0.51	0.35	0.46	0.77	0.57	
MNG	0.55	0.56	0.46	0.57	0.49	0.42	0.53	0.53	0.57

Table 8. Comparison of butterfly species recorded from Walayar Valley under different families vis-a-vis that of South India

S.No.	Family	No. of species recorded from Walayar Valley	No. of species recorded from South India	Percentage of species occurring in Walayar Valley
1	Papilionidae (Swallow tails)	12	19	63.16
2	Pieridae (Whites &Yellows)	20	34	58.82
3	Lycaenidae (Blues)	32	101	31.68
4	Nymphalidae (Brush-footed butterflies)	42	97	43.30
5	Hesperiidae (Skippers)	11	81	13.58
	Total	**117**	**332**	**35.24**

Table 9. Butterflies coming under various schedules of the Indian Wildlife (Protection) Act, 1972

S. No.	Common name	Scientific name	WPA Schedule
1	Danaid eggfly	*Hypolimnas misippus* Linnaeus	I
2	Crimson rose	*Pachliopta hector* Linnaeus	I
3	Common baron	*Euthalia aconthea* Cramer	II
4	Grey count	*Tanaecia lepidea* Butler	II
5	Common albatross	*Appias albina* Boisduval	II
6	Chocolate albatross	*Appias lyncida* Cramer	II
7	Lesser gull	*Cepora nadina* Lucas	II
8	Common wanderer	*Pareronia valeria* Cramer	II
9	Gram blue	*Euchrysops cnejus* Fabricius	II
10	Striped albatross	*Appias libythea* Fabricius	IV

3.4 Protected Butterfly Species

Ten species of butterflies recorded from Walayar Valley come under various schedules of the Indian Wildlife (Protection) Act, 1972 - two species listed under Schedule-I; seven species under Schedule-II and one species under Schedule-IV (Table 9).

3.5 Endemic Butterfly Species

Altogether six endemic butterfly species were recorded from the study area (Table 10). Among them four species are endemic to the Western Ghats and two species are endemic to the Western Ghats and Sri Lanka (Plate 1).

Table 10. Endemic butterflies recorded from Walayar Valley

S. No.	Common name	Scientific name	Status
1	Southern birdwing	*Troides minos* Cramer	Endemic to Western Ghats
2	Shivas sunbeam	*Curetis siva* Evans	-do-
3	Malabar tree nymph	*Idea malabarica* Moore	-do-
4	South India blue oakleaf	*Kallima horsfieldi* Kollar	-do-
5	Tamil yeoman	*Cirrochroa thais* Fabricius	Endemic to Western Ghats & Sri Lanka
6	Gladeye bush brown	*Mycalesis patnia* Moore	-do-

***Idea malabarica* Moore (Malabar tree nymph)**

***Troides minos* Cramer (Southern birdwing)**

***Kallima horsfieldi* Kollar (Blue oakleaf)**

***Curetis siva* Evans (Shivas sunbeam)**

***Cirrochroa thais* Fabricius (Tamil yeoman)**

***Mycalesis patnia* Moore (Gladeye bush brown)**

Plate 1. Endemic butterflies recorded from Walayar Valley
Photos: K. R. Sasidharan & R. Ratheesh

The butterfly fauna of India consists of 1501 species. About 330 species of butterflies have been recorded from the entire Western Ghats [19]. The Indian butterfly fauna consists of 37 endemic species and another 23 species shared only with Sri Lanka [1]. Even though Walayar Valley is a very small area, compared to many study locations of the Western Ghats, occurrence of 117 species of butterflies, including six endemics and 10 species protected under the Wildlife (Protection) Act, 1972 is very interesting and highlights the importance of this area in terms of biodiversity conservation.

Arun [12] reported 53 species of butterflies from the forests of Siruvani (Coimbatore) and observed that, Nymphalids have the maximum species diversity in this area. Easwaran and Pramod [13] recorded 75 species of butterflies from Anaikatty hills (Coimbatore) of Western Ghats, in which Nymphalids was found to have the maximum species diversity. In the present study also, we have found that Nymphalidae is the dominant family with 42 species, which is in agreement with other recent studies carried out in the Western Ghats. As per Sterling [20] the values of the Shannon-Weiner index for natural communities are generally between 1.5 and 3.5. Padhye et al. [21] found that Shannon-Weiner index values of butterflies ranged from 2.33 to 3.13 in different landscape elements at Tamhini area of the Northern Western Ghats. The values of Shannon-Weiner index obtained in the present study are also more or less similar.

The Thorn forests had the maximum number (70) of butterfly species and highest diversity index, compared to other landscape elements, but most of the species of conservation concern were recorded from Semi-evergreen forests or Riparian forests. The impact of forest disturbances at four locations in the Western Ghats viz. Silent Valley, Nelliyampathy, Sholayar and Parambikulam have been studied by Mathew et al. [22]. They found that change in the vegetation has serious impact on fragile insect community, leading to the disappearance of arboreal feeding forms and colonization by herbaceous or weed feeding forms. Kunte [23] observed that the natural forests had higher butterfly species diversity, compared to human impacted areas like monoculture plantations, in the Western Ghats areas. But, Padhye et al. [21] shown that butterfly diversity was higher in human impacted landscapes like scrubland subjected to slash and burn activity and paddy fields with human habitation, compared to evergreen forests, in the northern Western Ghats. Croxton et al. [24] noticed that the species richness of butterflies was positively correlated with species richness of plants and with the number of larval food plants of the recorded butterflies. The highest species diversity noticed in the Thorn forest areas in the present study could be attributed to the presence of large number of larval and nectar host plants of butterflies in this forest type.

Nayak et al. [16] surveyed eight localities in various parts of the Western Ghats for pattern of butterfly diversity, distribution and abundance. Each site had heterogeneous habitat matrices, which varied from natural habitats to modified habitats like plantations and agricultural fields. A total of 168 species of butterflies were recorded in eight localities. It was found that the diversity of butterfly species was high in natural habitats than the modified ones. Further analysis on commonness and rarity of butterfly species showed that the rare butterflies were recorded only in natural habitats. The presence of natural habitats in the heterogeneous matrix influenced the species encountered in modified habitats. During the present study 53 species of butterflies were recorded from Teak plantations and 46 species from agricultural areas where many agricultural and horticultural crops are cultivated. Most of the butterfly species recorded from these areas is also common to Moist deciduous forests. Sayer and Whitemore [25], Verhaagh [26] and Perfecto et al. [27] indicated that tropical agroecosystems can have an impact on the biological diversity. This is possible because natural areas are usually embedded in a matrix of natural and managed lands [28].

The diversity of butterflies was generally high during the monosoon and post monsoon / winter season and it was low during summer season. Kunte [23] reported that the first peak of butterfly diversity in the Western Ghats forests occurs in late monsoon (August and September) and the second in winter (October to January). He observed that the diversity was low in summer season. The same trend was observed during the present study also.

Thomas [29] reviewed the status, ecology and conservation of butterflies in Europe and Britain and observed that Britain had a poor butterfly fauna. The main causes attributed for the decline of butterflies are biotope destruction, loss of habitats within surviving semi-natural biotopes due to changed land management and failure by several species to track the patches of their habitat that were generated in modern fragmented landscapes. The butterfly fauna of Walayar Valley may also encounter a similar situation in the near future, unless efforts are not taken to preserve the available forest patches intact, without any disturbances.

The maximum similarity was exhibited between dry deciduous forests and moist deciduous forests (79%),

followed by agricultural areas and Teak plantations (77%) and Teak plantations and dry deciduous forests (66%), since many species recorded in these vegetation types were common. The least Similarity of 30% was shown by riparian forests and thorn forests, due to very few numbers of butterfly species common to both. It could be due to entirely different floristic composition of these two forest types.

The studies have revealed that the landscape elements in Walayar Valley have generally high evenness or equality indices, with a maximum value of 0.9197 in Tamarind plantations and a minimum value of 0.7014 in dry deciduous forests. Species richness and evenness are components of biological diversity that may or may not be correlated with one another [30]. Sanderson [31] observed that evenness and species richness were not correlated within hemipteran communities on naturally vegetated land in NW England. Magurran [32] concluded that indices weighted towards species richness were more useful for detecting differences between sites than indices weighted towards evenness.

The present study has shown that the Walayar Valley is very rich in butterfly fauna, which shelters around 35.24 percent of the species found in South India. The maximum among them is the papilionids constituting about 63.16 percent, which is a sign of richness of the area. An analysis of the distribution pattern of different species recorded from Walayar Valley indicates that the valley has butterflies that are endemic to the Western Ghats, Western Ghats and Sri Lanka; species of Pan-Indian distribution, Himalayan species and those of N.E. India, S.E.Asian species as well as species having African distribution. As per Holloway [33], the butterfly fauna of Southern India is derived primarily by colonization of species from tropical South East Asian centres, with a few species derived from African regions via Arabia and Middle East, the latter being restricted to the arid habitats.

4. CONCLUSION

Due to contrasting ecological conditions prevailing in Walayar Valley as a result of different rainfall patterns, temperature regimes and topographical features, the butterfly fauna of the valley is rich, varied and diversified. In this context, the butterfly fauna of the valley is very unique and deserves all measures for its conservation. Management measures to arrest the habitat destruction / deterioration by identifying various threat factors have to be undertaken very urgently. Habitat improvement by afforesting the degraded areas with native species, especially the butterfly host plants will go a long way in ensuring *in-situ* conservation. Captive breeding of endemic and rare butterflies and re-introduction of stock in the wild is suggested as the *ex-situ* conservation strategy. Establishing of Butterfly Park at suitable location in the Walayar Valley to create awareness among the public, especially the students on the need for conservation of butterflies is also suggested.

DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Appendix-1

Checklist of butterflies recorded from Walayar Valley

S. No.	Family / Common name	Scientific name	Status
I	**Papilionidae (Swallowtails)**		
1.	Common rose	*Pachliopta aristolochiae* Fabricius	
2.	Crimson rose	*Pachliopta hector* Linnaeus	WPA Schedule-I
3.	Common mime	*Chilasa clytia* Linnaeus	
4.	Common jay	*Graphium doson* C.&R. Felder	
5.	Spot swordtail	*Graphium nomius* Esper	
6.	Common bluebottle	*Graphium sarpedon* Linnaeus	
7.	Common banded peacock	*Papilio crino* Fabricius	
8.	Lime butterfly	*Papilio demoleus* Linnaeus	
9.	Red helen	*Papilio helenus* Linnaeus	
10.	Blue mormon	*Papilio polymnestor* Cramer	
11.	Common mormon	*Papilio polytes* Linnaeus	
12.	Southern birdwing	*Troides minos* Cramer	Endemic to Western Ghats
II	**Pieridae (Whites &Yellows)**		
13.	Common albatross	*Appias albina* Boisduval	WPA Schedule-II
14.	Striped albatross	*Appias libythea* Fabricius	WPA Schedule-IV
15.	Chocolate albatross	*Appias lyncida* Cramer	WPA Schedule-II
16.	Pioneer	*Belenois aurota* Fabricius	
17.	Common emigrant	*Catopsilia pomona* Fabricius	
18.	Mottled emigrant	*Catopsilia pyranthe* Linnaeus	
19.	Lesser gull	*Cepora nadina* Lucas	WPA Schedule-II
20.	Common gull	*Cepora nerissa* Fabricius	
21.	Small salmon arab	*Colotis amata* Fabricius	
22.	Crimson tip	*Colotis danae* Fabricius	
23.	Small orange tip	*Colotis etrida* Boisduval	
24.	Large salmon arab	*Colotis fausta* Oliver	
25.	Common jezebel	*Delias eucharis* Drury	
26.	Small grass yellow	*Eurema brigitta* Cramer	
27.	Common grass yellow	*Eurema hecabe* Linnaeus	
28.	Great orange tip	*Hebomoia glaucippe* Linnaeus	
29.	White orange tip	*Ixias marianne* Cramer	
30.	Yellow orange tip	*Ixias pyrene* Linnaeus	
31.	Psyche	*Leptosia nina* Fabricius	
32.	Common wanderer	*Pareronia valeria* Cramer	WPA Schedule-II
III	**Lycaenidae (Blues)**		
33.	Common hedge blue	*Acytolepis puspa* Horsfield	
34.	Leaf blue	*Amblypodia anita* Hewitson	
35.	African babul blue	*Azanus jesous* Guerin-Meneville	
36.	Bright babul blue	*Azanus ubaldus* Stoll	
37.	Angled pierrot	*Caleta caleta* Hewitson	
38.	Common pierrot	*Castalius rosimon* Fabricius	
39.	Forget-me-not	*Catochrysops strabo* Fabricius	

S. No.	Family / Common name	Scientific name	Status
40.	Plains cupid	*Chilades pandava* Horsefield	
41.	Lime blue	*Chilades lajus* Stoll	
42.	Small cupid	*Chilades parrhassius* Fabricius	
43.	Shivas sunbeam	*Curetis siva* Evans	Endemic to Western Ghats
44.	Cornelian	*Deudorix epijarbas* Moore	
45.	Large guava blue	*Deudorix perse* Hewitson	
46.	Banded blue pierrot	*Discolampa ethion* Westwood	
47.	Gram blue	*Euchrysops cnejus* Fabricius	WPA Schedule-II
48.	Indian cupid	*Everes lacturnus* Godart	
49.	Grass jewel	*Freyeria trochylus* Freyer	
50.	Dark cerulean	*Jamides bochus* Stoll	
51.	Common cerulean	*Jamides celeno* Cramer	
52.	Pea blue	*Lampides boeticus* Linnaeus	
53.	Zebra blue	*Leptote splenius* Fabricius	
54.	Yamfly	*Loxura atymnus* Stoll	
55.	Tailless lineblue	*Prosotas dubiosa indica* Evans	
56.	Common lineblue	*Prosotas nora* C.Felder	
57.	Pale grass blue	Pseudozizeeria maha Kollar	
58.	Monkey puzzle	*Rathinda camor* Fabricius	
59.	Common silverline	*Spindasis vulcanus* Fabricius	
60.	Common Acacia blue	*Surendra quercetorum* Moore	
61.	Red pierrot	*Talica danyseus* Guerin-Meneville	
62.	Striped pierrot	*Tarucus nara* Kollar	
63.	Lesser grass blue	*Zizina otis* Fabricius	
64.	Tiny grass blue	*Zizula hylax* Fabricius	
IV	**Nymphalidae (Brush-footed butterflies)**		
65.	Tawny coster	*Acraea violae* Fabricius	
66.	Angled castor	*Ariadne ariadne* Linnaeus	
67.	Common castor	*Ariadne merione* Cramer	
68.	Joker	*Byblia ilithyia* Drury	
69.	Tawny rajah	*Charaxes bernardus* Fabricius	
70.	Tamil yeoman	*Cirrochroa thais* Fabricius	Endemic to Western Ghats & Sri Lanka
71.	Rustic	*Cupha erymanthis* Drury	
72.	Common map	*Cyrestis thyodamas* Boisduval	
73.	Plain tiger	*Danaus chrysippus* Linnaeus	
74.	Striped tiger	*Danaus genutia* Cramer	
75.	Common crow	*Euploea core* Cramer	
76.	Common baron	*Euthalia aconthea* Cramer	WPA Schedule-II
77.	Great eggfly	*Hypolimnas bolina* Linnaeus	
78.	Danaid eggfly	*Hypolimnas misippus* Linnaeus	WPA Schedule-I
79.	Malabar tree nymph	*Idea malabarica* Moore	Endemic to Western Ghats
80.	Peacock pansy	*Junonia almana* Linnaeus	
81.	Grey pansy	*Junonia atlites* Linnaeus	
82.	Yellow pansy	*Junonia hierta* Fabricius	
83.	Chocolate pansy	*Junonia iphita* Cramer	
84.	Lemon pansy	*Junonia lemonias* Linnaeus	
85.	Blue pansy	*Junonia orithiya* Linnaeus	
86.	South India blue oakleaf	*Kallima horsfieldi* Kollar	Endemic to Western Ghats
87.	Bamboo tree brown	*Lethe europa* Fabricius	
88.	Common tree brown	*Lethe rohria* Fabricius	

S. No.	Family / Common name	Scientific name	Status
89.	Common evening brown	*Melanitis leda* Linnaeus	
90.	Commander	*Moduza procris* Cramer	
91.	Gladeye bush brown	*Mycaelesis patnia* Moore	Endemic to Western Ghats & Sri Lanka
92.	Dark- brand bush brown	*Mycalesis mineus* Linnaeus	
93.	Common bush brown	*Mycalesis perseus* Fabricius	
94.	Common sailer	*Neptis hylas* Linnaeus	
95.	Chestnut- streaked sailer	*Neptis jumbah* Moore	
96.	Common lascar	*Pantoporia hordonia* Stoll	
97.	Glassy tiger	*Parantica aglea* Stoll	
98.	Clipper	*Parthenos sylvia* Cramer	
99.	Common leopard	*Phalanta phalantha* Drury	
100.	Common nawab	*Polyura athamas* Drury	
101.	Grey count	*Tanaecia lepidea* Butler	WPA Schedule-II
102.	Blue tiger	*Tirumala limniace* Cramer	
103.	Dark blue tiger	*Tirumala septentrionis* Butler	
104.	Painted lady	*Vanessa cardui* Linnaeus	
105.	White fourring	*Ypthima ceylonica* Hewitson	
106.	Common fourring	*Ypthima huebneri* Kirby	
V	**Hesperiidae (Skippers)**		
107.	Bush hopper	*Ampittia dioscorides* Fabricius	
108.	Rice swift	*Borbo cinnara* Wallace	
109.	Golden angle	*Caprona ransonnetti* C. & R. Felder	
110.	Bispot banded ace (Moore's ace)	*Halpe porus* Mabille	
111.	Common banded awl	*Hasora chromus* Cramer	
112.	Chestnut bob	*Iambrix salsala* Moore	
113.	Small branded swift	*Pelopidas mathias* Fabricius	
114.	Fulvous pied flat	*Pseudocoladenia dan* Fabricius	
115.	Indian Grizzled skipper	*Spialia galba* Fabricius	
116.	Common grass dart	*Taractrocera maevius* Fabricius	
117.	Grass demon	*Udaspes folus* Cramer	