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The butterfly community of an urban wetland system - a case study of Oussudu Bird Sanctuary, Puducherry, India

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Abstract: In a study on the butterfly community of the Oussudu (Ousteri) Bird Sanctuary and its environs at Puducherry, a total of 63 butterfly species belonging to 47 genera under five families were recorded which included two endemics and three Schedule I species. Nymphalidae was the most diverse and abundant butterfly family of the area followed by Pieridae. The paper also discusses the abundance and species assemblage pattern in the local butterfly fauna along with their legal/protection status and distribution patterns in the study area.

Keywords: Butterfly community, India, insects, Lepidoptera, Oussudu Bird Sanctuary, Oussuteri, Ousteri, Puducherry, urban wetland.

In recent times, biological diversity is increasingly being recognized as a vital parameter to assess global and local environmental changes and sustainability of developmental activities. Though the tropical region contains very rich and diverse butterfly fauna, the information on species found in different habitats is very poor particularly for the Indian region (Rajagopal et al. 2011). In Tamil Nadu, the systematic study of invertebrates particularly on butterflies has not been carried out in most of the protected areas. Oussudu is one of the unexplored inter-state protected areas shared between Tamil Nadu and Puducherry which is also an important bird area (IBA). Even though various aspects of studies on birds, fishes, plants have been conducted in this area, there is no previous study on butterflies. Therefore, an attempt was made to study the diversity and status of butterfly fauna in and around the Oussudu Bird Sanctuary, Puducherry, India.

Much of the Oussudu bank along the Tamil Nadu side consists of rural settlements, while the Puducherry side of the lake is predominantly urban or suburban (Abbasi & Chari 2008), which contributes to the severe anthropogenic stresses on the lake. Oussudu Lake has been facing serious threats from multiple fronts such as reclamation, agriculture, siltation, weed invasion, encroachments, runoff from agricultural fields, Illegal fishing and poaching. A medical college and an amusement park are operational on the banks of the lake. Apart from these, various industries are also present in the vicinity of the lake (Prusty et al. 2011).

In the recent past, Oussudu Lake has also been identified as a wetland of national importance under the National Wetland Conservation Programme of MoEF. The Bombay Natural History Society, has designated Oussudu as one of the Important Bird Areas (IBA) of India; as over 20,000 birds belonging to nearly 40 migratory species inhabit or winter at Oussudu (Chari et al. 2003). The Asian Wetland Bureau declared Oussudu lake as one of the 93 significant wetlands in Asia (Alexander

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& Pushparaj 2010) and has been identified as one of the heritage sites by IUCN and also ranked among the most important wetlands of Asia. The structure of the lake is complex, consisting of water, wetland/marsh and mudflats (Prusty et al. 2011).

The activities associated with agriculture and urban land use have brought about dramatic ecological changes affecting the quality of the Oussudu watershed in terms of direct destruction of natural habitat types, increased nutrient input to the watercourses and the lake through increased erosion, agriculture run-off and waste disposal as well as increased natural resource utilization such as gravel extraction, firewood harvest and fisheries. Considering the area has adequate ecological, faunal, floral, geomorphological, natural or zoological significance, it was declared as a bird sanctuary on 07 October 2008 for the purpose of protecting, propagating and developing wildlife and its environment (Prusty et al. 2011).

Study area

Oussudu Bird Sanctuary, located at 11^{0}56'19.51"–11^{0}58'38.89"N & 79^{0}44'07.27"–79^{0}45'30.26"E, is a large shallow wetland situated along the border of Puducherry (Fig. 1). The Oussudu Lake (Oussudu Eri in Tamil) is the largest freshwater lake in Puducherry region. It is an inter-state lake with the water-spread area almost equally shared between the states of Puducherry and Tamil Nadu. The lake situated at a distance of 12km from Puducherry town in the Western side on Puducherry-Villupuram-Valuthavur main road is a major wintering ground for a large number of migratory birds. The lake is rich in flora and fauna and is known to provide several ecological services and livelihood options for the local communities. The lake covers an area of about 800 ha (spread across both Tamil Nadu and Puducherry), of which 390 ha is in Puducherry and the rest in Tamil Nadu (Alexander & Pushparaj 2010).

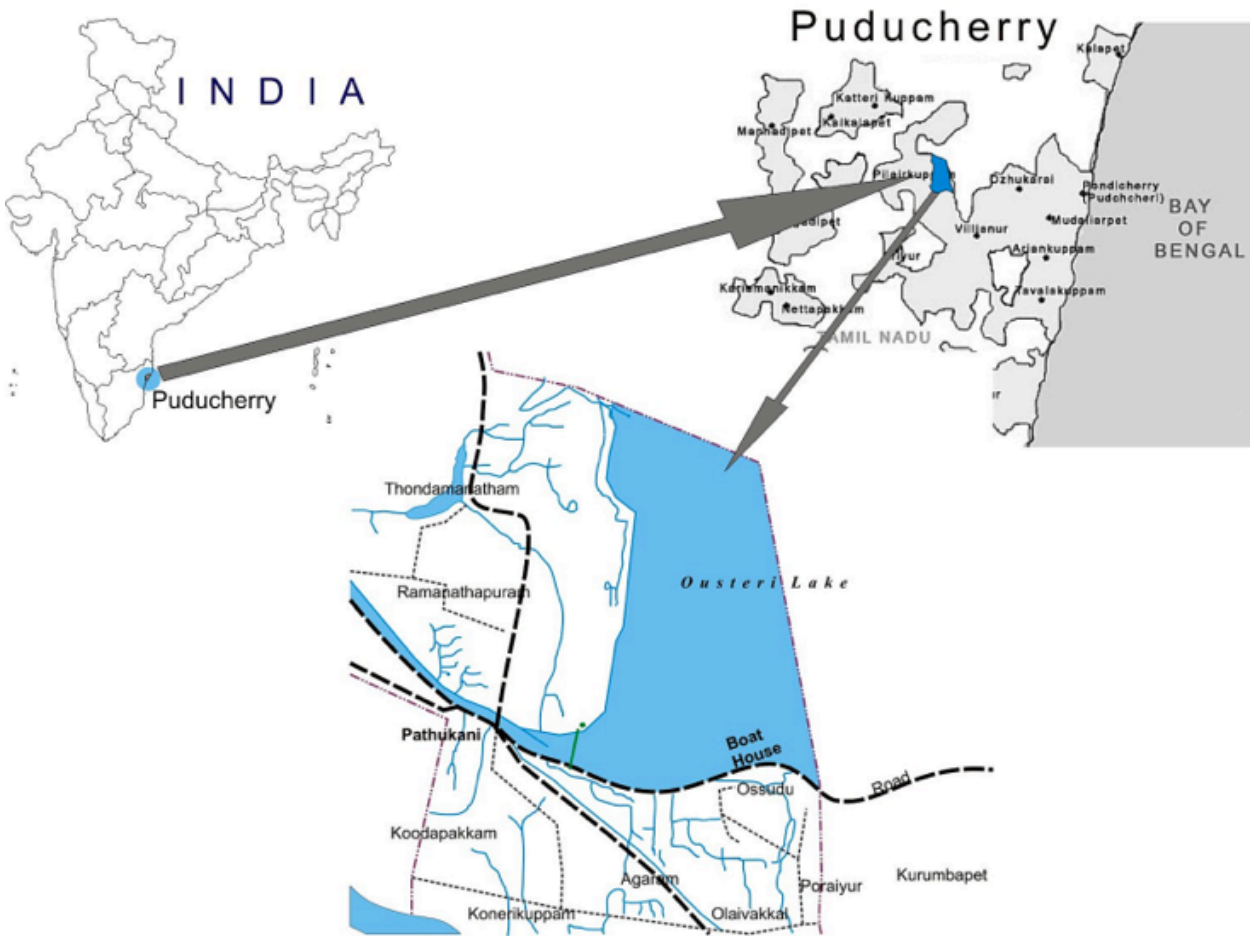

Figure 1. Location of Oussudu Lake and Bird Sanctuary, Puducherry part

Climate

The climate of Oussudu Lake is humid and the average annual rainfall of this region is 1300mm, of which around 63% occurs in north-east monsoon from October–December, while the remaining is scattered sporadically throughout the year. The climate is tropical dissymmetric with the bulk of the rainfall during northeast monsoon (October–December). The mean number of annual rainy days is 55 and the mean monthly temperature ranges from 21.3–30.2 ^{0}C.

Methods

The present study was conducted between July 2010 and May 2011. The butterflies in and around Oussudu Lake were documented by direct observations, random walks and opportunistic observations mostly during the morning (07:00–11:00 hr) and in the evening (16:00–19:00 hr). These timings were found to be suitable since the maximum butterfly activity happened during these times. The butterfly survey was carried out by searching for a distance of 5m on either side of the transect. Gunathilagaraj et al. (1998), Kunte (2000) and Kehimkar (2008) were referred to for the identification of Butterflies. Larsen (1987a,b,c; 1988), Evans (1932) and Wynter-Blyth (1957) were also referred to for the scientific nomenclature of butterflies. To find out species diversity, density and richness of the butterfly species occurring in the study area, a line transect survey was also conducted, by covering three different sides of the lake. The transects representative of the area were selected considering topography, vegetation and habitat structure. A total of 15 transect counts were made from the three transects (five counts per transect during the study). Based on abundance figures (the number of individuals encountered per transect), the recorded butterfly species were classified into the following four broad categories: Common (more than 10 individuals per transect); fairly common (6–10 individuals per transect); uncommon (3–5 individuals per transect); and 'rare' (1–2 individuals per transect). Species diversity, species richness and Shannon-Wiener's index of diversity (H') were analyzed in the study by using the software 'Species diversity and richness (version 2.65, Colwell, 1994–2004).

Results

A total of 63 butterfly species falling under 47 genera and spread over five families were recorded during the present survey (Appendix 1). At family level, the family Nymphalidae was dominant with 21 species (34%) followed by Pieridae with 14 species (22%) and Lycaenidae with 10 species (16%). The least number of butterfly species were recorded in the families Papilionidae (14%) and Hesperiidae (14%) with nine species each (Table 1).

During the present study period, species such as Chocolate Pansy, Common Jezebel, Plain Tiger, Danaid Eggfly, Common Crow, Lime Butterfly and Common Grass Yellow were recorded as common around the lake. The butterflies such as Tailed Jay, Peacock Pansy, African Babul Blue, Banded Blue Pierrot were reported as rare. Three butterflies namely Common-banded Peacock, Southern Birdwing and Great Eggfly were reported only once during the entire study period with less than six individuals each.

Of the 63 species, Crimson Rose, Danaid Eggfly and Common Pierrot are protected under schedule - I of Indian Wildlife Protection Act 1972. Common Gull is included under Schedule - II. Species such as Blue Mormon, Crimson Rose and Common-banded Peacock are endemic to South India and Sri Lanka. Two species namely Southern Birdwing and Double-branded Crow are endemic to peninsular India (Kunte 2000).

Butterfly community structure

From 15 transect counts, 2693 individuals of butterflies belonging to 49 species and 37 genera, spread over five families were recorded (Appendix 1). The Shannon Index of diversity for the butterfly species was 3.40, Simpson Index 0.96 and Fisher Alpha was 8.51 (Table 2).

Among the 49 species, Chocolate Pansy was the dominant species with 306 individuals followed by Common Jezebel (n=188), Small Grass Yellow (n=169), Common Grass Yellow (n=169), Common Wanderer (n=150) and Common Crow (n=130) (Table 3).

Based on the observed abundance during the present study period, 14 of the total 49 butterfly species were rare in the area with less than two sightings per transect.

Table 1. Family-wise composition on number and percentage of species and genera recorded during the present study period.

Family	Number of species with %	Number of genera with %
Papilionidae	9 (14%)	5(11%)
Pieridae	14(22%)	9(19%)
Nymphalidae	21(34%)	15(32%)
Lycaenidae	10(16%)	9(19%)
Hesperiidae	9 (14%)	9(19%)
Total	**63**	**47**

Table 2. The structure of butterfly community in the Oussudu Bird Sanctuary

	Variables	Value
1	Total number of Individuals	2693
2	Number of Butterfly species	49
3	No. of genera	37
4	No. of families	5
5	Shannon index (H)	3.40
6	Simpson Index (D)	0.96
7	Fisher alpha	8.51

Table 3. Family-wise composition of butterflies.

Family	Number of species & %	Number of individuals & %
Papilionidae	8 (16%)	463 (17%)
Pieridae	12 (25%)	929 (35%)
Nymphalidae	18 (37%)	847 (31%)
Lycaenidae	8 (16%)	400 (15%)
Hesperiidae	3 (06%)	54 (02%)
Total	49	2693

Table 4. Composition, abundance and status of butterflies in the Oussudu Bird Sanctuary and its environs.

	Family	No. of genus	No. of species	Occurrence				
				Abundant	Common	Fairly common	Uncommon	Rare
1	Papilionidae	4	8	2	2	1	1	2
2	Pieridae	9	12	2	3	2	2	3
3	Nymphalidae	14	18	4	5	2	3	4
4	Lycaenidae	7	8	0	2	1	2	3
5	Hesperiidae	3	3	0	0	0	1	2
Total		**37**	**49**	**8**	**12**	**6**	**9**	**14**

While nine species were uncommon (3–5 sightings), 6 species were fairly common (6–7 sightings), 12 were common (8–10 sightings) and 8 were abundant (>10 sightings) per transect (Table 4).

Discussion

The present study indicates that the family Nymphalidae is the dominant family in the study area. Recently, Ramesh et al. (2010) reported a similar pattern of dominance in the Eastern plains of the Coromandel coast. A similar pattern of predominance of Nymphalidae was also reported by different researchers from the different ecosystems of Western Ghats (Mathew & Rahamathulla 1993; Kunte 1997; Kunte et al. 1999; Arun 2000; Devi & Davidar 2001; Eswaran & Pramod 2005; Kumar et al. 2007; Dolia et al. 2008; Krishnakumar et al. 2008). However, the species richness of Nymphalidae recorded in Aringnar Anna Zoological Park, Chennai, Tamil Nadu differs from this general pattern and Pieridae was the dominant butterfly family in this region according to Rajagopal et al. (2011).

But in the case of abundance, the most abundant butterfly family in the present study area was Pieridae. A similar pattern of abundance is also reported from various locations in Western Ghats (Ramesh et al. 2010; Rajagopal et al. 2011; Eswaran & Pramod 2005), Vikhroli, Mumbai (Arun 2009) and Siruvani Hills (Arun 2000, 2002). One of the reasons for the higher abundance of Pieridae butterflies in the Oussudu area might be the higher availability of their larval food plants such as *Capparis* sp. around the lake.

The representation from the family Hesperiidae was very low when compared to the proportion of other families in the study area. The same kind of low species richness was recorded in the Eastern Plains of southern India (Ramesh et al. 2010; Rajagopal et al. 2011) and in the Western Ghats (Eswaran & Pramod 2005) also. It might partly be attributed to the sampling/observer bias, since Hesperiids are generally crepuscular in nature, and are small and cryptically coloured.

We conclude that the Oussudu Bird Sanctuary area supports a rich butterfly community dominated by the nymphalids and pierids. The present visitors' areas of the sanctuary such as the boat house and surroundings have very poor butterfly activity because of the absence of suitable plant species, and wind breaks coupled with vehicular movements and human disturbances. Butterfly activity is higher in the relatively undisturbed areas around the banks of the lake with ample nectar and food plants. The butterfly diversity and abundance is comparable to the other parts of the eastern plains and Western Ghats also. The area may be given importance

while planning conservation programmes. Since the study area harbours some of the endemic and protected species, it highlights the conservation importance of the butterfly fauna of this area. From the conservation point of view, butterflies play a very important role in plant propagation through facilitating cross-pollination and are major ecological indicators. Part of the area may be developed into a butterfly garden by appropriate habitat management that can improve the habitat quality and aesthetic beauty of the sanctuary thus attracting more visitors. Further, long term research and monitoring on the diversity of butterflies with special reference to their host plants and factors that affect their distribution, diversity and abundance may be taken up in the area. It may be taken up by utilizing the rich and diverse butterfly community of the area more effectively for conservation and education purposes.

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Appendix 1. List of butterflies recorded during the present study period

	Common name	Scientific name	Endemic to	Legal status (IWPA, 1972)	Observed months	Abundance **
Family I. Papilionidae						
1	Blue Mormon	*Papilio polymnestor*	SL & PI		All	Uncommon
2	*Common Banded Peacock	*Papilio crino*	SL & PI		November	Rare
3	Common Jay	*Graphium doson*			December	Fairly common
4	Common Mormon	*Papilio polytes*			All	Common
5	Common Rose	*Pachliopta aristolochiae*			All	Abundant
6	Crimson Rose	*Pachliopta hector*	SI & SL	Schedule I	All	Common
7	Lime Butterfly	*Papilio demoleus*			All	Abundant
8	Southern Birdwing	*Troides minos*	SI & WG		January	Rare
9	Tailed Jay	*Graphium agamemnon*			February	Rare
Family II. Pieridae						
10	Common Emigrant	*Catopsilia pomona*			All	Abundant
11	Common Jezebel	*Delias eucharis*			All	Rare
12	Common Grass yellow	*Eurema hecabe*			All	Abundant
13	Common Gull	*Cepora nerissa*		Schedule II	All	Common
14	Common Wanderer	*Pareronia valeria*			All	Rare
15	Crimson Tip	*Colotis danae*			February	Fairly common
16	Great Orange Tip	*Hebomoea glaucippe*			All	Uncommon
17	Mottled Emigrant	*Catopsilia pyranthe*			All	Rare
18	Psyche	*Leptosia nina*			November	Common
19	Small Grass Yellow	*Eurema brigitta*			All	Abundant
20	Small Orange Tip	*Colotis etrida*			Dec-Jan	Common
21	*Spotless Grass Yellow	*Eurema laeta*			All	Rare
22	*White Orange Tip	*Ixias marianne*			Nov-Dec	Fairly common
23	Yellow Orange Tip	*Ixias pyrene*			Nov-Dec	Uncommon
Family III. Nymphalidae						
24	Angled Castor	*Ariadne ariadne*			January	Uncommon
25	*Baronet	*Euthalia nais*			November	Uncommon
26	Chocolate Pansy	*Precis iphita*			All	Abundant
27	Common Bush Brown	*Mycalesis perseus*			All	Common
28	Common Castor	*Ariadne merione*			All	Common
29	Common Crow	*Euploea core*			All	Abundant
30	Common Evening Brown	*Melanitis leda*			All	Common
31	Common Leopard	*Phalanta phalantha*			Nov-Jan	Uncommon
32	Common Sailer	*Neptis hylas*			All	Fairly common
33	Common Sergeant	*Athyma perius*			December	Common
34	Danaid Eggfly	*Hypolimnas misippus*		Schedule I	All	Uncommon
35	Dark Blue Tiger	*Tirumala septentrionis*			All	Common
36	*Double-branded Crow	*Euploea sylvester*	SI & PI		November	Rare
37	Glassy Tiger	*Parantica aglea*			All	Fairly common
38	Great Eggfly	*Hypolimnas bolina*			January	Rare
39	Lemon Pansy	*Junonia lemonias*			All	Fairly common
40	Peacock Pansy	*Junonia almana*			January	Rare
41	Plain Tiger	*Danaus chrysippus*			All	Abundant
42	Striped Tiger	*Danaus genutia*			All	Abundant
43	Tawny Coster	*Acraea violae*			Nov-Jan	Abundant
44	*Yellow Pansy	*Junonia hierta*			Dec-Jan	Rare
Family IV. Lycaenidae						
45	African Babul Blue	*Azanus jesous*			February	Rare
46	Banded Blue Pierrot	*Discolampa ethion*			Dec-Jan	Rare
47	Common Cerulean	*Jamides celeno*			All	Common
48	Common Pierrot	*Castalius rosimon*		Schedule I	All	Common

	Common name	Scientific name	Endemic to	Legal status (IWPA, 1972)	Observed months	Abundance **
49	*Common Silverline	*Spindasis vulcanus*	IS		November	Rare
50	Dark Cerulean	*Jamides bochus*			December	Rare
51	Plains Cupid	*Chilades pandava*			November	Uncommon
52	*Slate Flash	*Rapala manea*			November	Rare
53	Tiny Grass Blue	*Zizula hylax*			Nov-Jan	Fairly common
54	Zebra Blue	*Lepotes plinius*			Nov-Jan	Uncommon
Family V. Hesperiidae						
55	*Brown Awl	*Badamia exclamationis*			November	Fairly common
56	*Bush Hopper	*Ampittia dioscorides*			February	Uncommon
57	Chestnut Bob	*Iambrix salsala*			January	Rare
58	*Common Banded Owl	*Hasora chromus*			Nov-Dec	Uncommon
59	Common Grass Dart	*Taractrocera maevius*			All	Fairly common
60	*Dark Palm Dart	*Telicota ancilla*			December	Fairly common
61	*Indian Palm Bob	*Suastus gremius*			January	Rare
62	*Indian Skipper	*Spialia galba*			All	Uncommon
63	Rice Swift	*Borbo cinnara*			All	Fairly common

*Species not recorded in transect; IWPA-Indian Wildlife Protection Act 1972; SI-Southern India; PI-Peninsular India; WG-Western Ghats; IS-Indian Subcontinent; SL-Sri Lanka; All-All months. ** Abundace: Common - more than 10 individuals per visit; fairly common - 6–10 individuals per visit; uncommon - 3–5 individuals per visit; rare - 1–2 individuals per visit.

Appendix 2. Species-wise Cumulative Butterfly counts during the present study period

	Common name	Scientific name	No. of individuals
1	African Babul Blue	*Azanus jesous*	3
2	Angled Castor	*Ariadne ariadne*	10
3	Banded Blue Pierrot	*Discolampa ethion*	3
4	Blue Mormon	*Papilio polymnestor*	40
5	Chestnut Bob	*Iambrix salsala*	14
6	Chocolate Pansy	*Precis iphita*	306
7	Common Bush Brown	*Mycalesis perseus*	34
8	Common Castor	*Ariadne merione*	53
9	Common Cerulean	*Jamides celeno*	10
10	Common Crow	*Euploea core*	130
11	Common Emigrant	*Catopsilia pomona*	68
12	Common Evening Brown	*Melanitis leda*	22
13	Common Grass Dart	*Taractrocera maevius*	59
14	Common Grass Yellow	*Eurema hecabe*	169
15	Common Gull	*Cepora nerissa*	46
16	Common Jay	*Graphium doson*	17
17	Common Jezebel	*Delias eucharis*	188
18	Common Leopard	*Phalanta phalantha*	32
19	Common Mormon	*Papilio polytes*	94
20	Common Pierrot	*Castalius rosimon*	94
21	Common Rose	*Pachliopta aristolochiae*	58
22	Common Sailer	*Neptis hylas*	118
23	Common Sergeant	*Athyma perius*	7
24	Common Wanderer	*Pareronia valeria*	150

	Common name	Scientific name	No. of individuals
25	Crimson Rose	*Pachliopta hector*	54
26	Crimson Tip	*Colotis danae*	19
27	Danaid Eggfly	*Hypolimnas misippus*	83
28	Dark Blue Tiger	*Tirumala septentrionis*	46
29	Dark Cerulean	*Jamides bochus*	12
30	Glassy Tiger	*Parantica aglea*	16
31	Great Eggfly	*Hypolimnas bolina*	4
32	Great Orange Tip	*Hebomoea glaucippe*	20
33	Lemon Pansy	*Junonia lemonias*	41
34	Lime Butterfly	*Papilio demoleus*	52
35	Mottled Emigrant	*Catopsilia pyranthe*	83
36	Peacock Pansy	*Junonia almanac*	3
37	Plain Tiger	*Danaus chrysippus*	70
38	Plains Cupid	*Chilades pandava*	11
39	Psyche	*Leptosia nina*	86
40	Rice Swift	*Borbo cinnara*	9
41	Small Grass Yellow	*Eurema brigitta*	169
42	Small Orange Tip	*Colotis etrida*	13
43	Southern Birdwing	*Troides minos*	6
44	Striped Tiger	*Danaus genutia*	62
45	Tailed Jay	*Graphium agamemnon*	2
46	Tawny Coster	*Acraea violae*	53
47	Tiny Grass Blue	*Zizula hylax*	8
48	Yellow Orange Tip	*Ixias pyrene*	31
49	Zebra Blue	*Lepotes plinius*	15