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Diversity of butterfly fauna in and around Gudavi bird sanctuary, Sorab, Karnataka.

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Abstract
The quantification of butterfly diversity and species richness is of core importance for evaluating the status of protected areas. Gudavi bird sanctuary is one of the well known bird sanctuaries of Karnataka and this area due to its geographical speciality evokes wide range of butterfly fauna, which plays a vital role in pollination of various flowering plants besides a key component of food chain. A total of 115 species representing 78 genera belonging to five families and 15 subfamilies were recorded in the present study. Of these, the family Nymphalidae was found to be the most dominant with 34.78% (40) species followed by Lycaenidae (25 species), Hesperiidae (18 species), Papilionidae and Pieridae (16 species). Large scale availability of larval hosts and adult nectar plants is the main reason for abundant diversity of butterflies in the region.

Keywords: Butterfly fauna, diversity, Gudavi bird sanctuary, Karnataka, Sorab.

1. Introduction
Butterflies are the potential umbrella group for biodiversity conservation. They are good subjects for dispersal studies and have enormous ecological importance. They serve as food for predators at various levels. The larvae, which feed on foliage, are primary herbivores in the ecosystem and are important in the transfer of energy fixed by plants, making them available to the other organisms in the ecosystem. After bees, butterflies are the second category of insects which are very specific to their food plants. The faunistic survey of butterflies, their occurrence and characteristics provide crucial information on the ecology of a particular region. Based on the flora of an area, one can easily predict the existing butterfly fauna of that region. The presence of grass butterflies indicates complete conversion of forests into an agricultural ecosystem. Butterflies are one of the most amazing and magnificent elements of biodiversity. They are popular because of their exquisitely colored and patterned wings [7]. They are valuable pollinators in the local environment and help in pollinating more than 50 economically important crops [2] and constitute one of the important food chain components of birds, reptiles, spiders and predatory insects. They are also good indicators of environmental quality and healthy ecosystems because they are sensitive to changes in the environment and the availability of host plants for oviposition and larval development [18].
The butterfly diversity is high in the tropics compared to temperate regions of the world. Their habitat ranges from Arctic to the great deserts of the world. The butterflies are divided into two super families viz. Papilionoidea constituting 11,100 species and Hesperioidea constituting 3,650 species [16]. The diversity and density of butterflies varies from region to region due to the typical eco-climatic and geographic features. Western Ghats are considered as one of the most diversified areas with a wide range of butterfly species. The Western Ghats section of Karnataka state, alone accounts for 331 species of butterflies, out of which 37 are endemic [12, 13]. India has a rich butterfly fauna, but due to various reasons such as increased urban features including roads and buildings, habitat destruction, fire, use of pesticides and illegal collection for trade, many species have become very rare and some are on the verge of extinction [5]. Due to this concern a periodic survey is a must to evaluate the status of butterflies, demography and predator parasite relationship for conservation of butterflies. The control of fire and grazing in green landscapes may be the best step to enhance or maintain butterfly diversity. Therefore, an attempt has been made to estimate the diversity and status of butterflies inhabiting in and around the Gudavi bird sanctuary, Sorab taluk, Karnataka.

2. Materials and Methods

2.1 Study Area

The study on diversity and status of butterfly species was carried out in and around Gudavi bird sanctuary (GBS). Gudavi bird sanctuary is one of the well known bird sanctuaries of Karnataka, with notification, AFLFF-262-fwl 86/ on 10:07:1989. It is located at a distance of 13 km from Sorab city and 0.5 km from Gudavi village. This sanctuary occupies the water spread area of about 33 ha, in rainy season, out of the total 73.68 ha. The sanctuary lies between latitude 14^0 25' 59" to $14^0$26' 41" and longitude $75^0$6' 43" to $75^0$25' 28". The entire area is covered with dense moist deciduous forest and due to intensive protection efforts by the Forest Department, the area maintains lush greenery throughout the year. Apart from this, Gudavi sanctuary embodies diversified vegetation comprising marshy plants, microphytes, trees and shrubs that provide food and shelter to the local and migratory butterflies (Fig. 1).

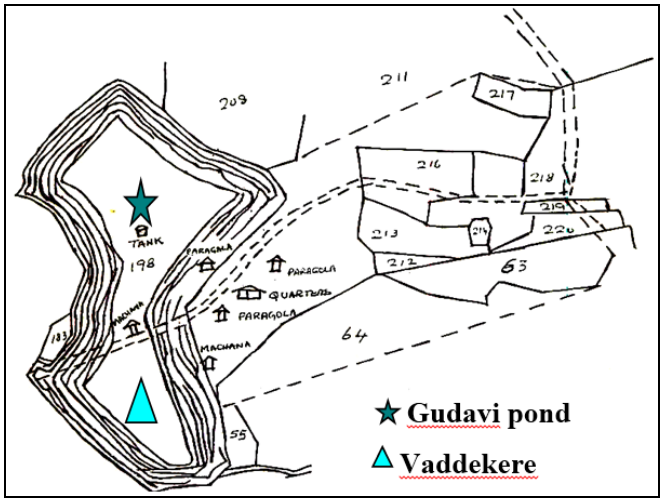

Fig 1: Gudavi bird sanctuary.

2.2 Sampling regime

The field survey was carried out from 2009 – 2011 of June to May in every year. The entire survey was conducted by walking both in morning (0700 am to 1000 am) and evening (1300 pm to 1800 pm). The butterflies were recorded by direct visual observations and photographic evidences. Some rare and small butterflies which are difficult to identify were caught with the help of insect net (7112 NA) and closely observed after placing them in clear glass bottle. Then they were released to the same habitat from where they were caught. However, enough precautions were taken, so that, the entire procedure did not cause any damage to the target specimens. The butterflies were broadly categorized into four groups: rare (1%), uncommon (1-5%), common (6-30%) and abundant (30%) depending on their relative abundance [5]. In the forest area different habitats were used as fixed transects each having 250m of length for this purpose.

The butterflies were identified by using standard literatures and field guides [6, 8, 12, 17, 3, 9]. The classification scheme followed here is based on [1].

3. Results and Discussion

During the systematic survey, a total of 115 species of butterflies belonging to 78 genera and 5 families were recorded from in and around the bird sanctuary. Out of these, Nymphalidae was dominant with 40 species followed by Lycaenidae (25 species), Hesperiidae (18 species) and Papilionidae and Pieridae (16 species, each) (Table 1). The abundance of butterfly species population in this area may be due to the availability of ample food, optimum climate and a serene atmosphere [15]. The relative abundance of butterflies was calculated and presented in Table 2. Among the 5 families, Nymphalidae was found to be the most dominant individuals with 34.78% followed by Lycaenidae (21.74%), Hesperiidae (15.65%), but the minimum number of species found in this sanctuary was from the families Papelionidae (13.91%) and Pieridae (13.91%). The predominance of Nyphalidae from Western Ghats has been reported by earlier workers [11, 10, 14, 5]. The reason for the increase in diversity may be due to the diverse serene habitats such as several small and large parks and gardens and forest areas with mixed deciduous and non-deciduous trees, shrubs, scrubs, bamboos, wild and ornamental flowering plants, streams and marshes, serving as ideal habitats for various types of butterflies.

This sanctuary is covered by moist deciduous forest and maintains lush greenery throughtout the year. The area comprising adequate source of water, unique climate and good floral diversity boast a rich diversity of butterflies and also provide food and shelter to the local and migratory butterflies. The study will be helpful for further research on status of the butterfly fauna and for planning conservation initiatives in Gudavi bird sanctuary.

4. Acknowledgement

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Table 1: Systematic list of butterflies and their status recorded in and around Gudavi bird sanctuary during the study period.

SI No.	Common Name	Scientific Name	AS
A. Super-family: PAPILIONOIDEA I. Family: PAPILIONIDAE (Swallowtails) a. Sub-family: Papilioninae			
1	Common Birdwing	*Triodes helena* (Linnaeus, 1758)	R
2	Southern Birdwing	*Troides minos* (Cramer, 1775)	R
3	Spot Swordtail	*Graphium nomius* (Esper)	C
4	Common Bluebottle	*Graphium sarpedon* (Linnaeus, 1758)	R
5	Common Jay	*Graphium doson* (C. & R. Felder, 1864)	C
6	Tailed Jay	*Graphium agamemnon* (Linnacus, 1758)	C
7	Common Mormon	*Papilio polytes* (Linnaeus, 1758)	C
8	Blue Mormon	*Papilio polymnestor* (Cramer, 1777)	R
9	Red Helen	*Papillo helenus* (Linnaeus, 1758)	C
10	Paris Peacock	*Papilio paris* (Linnaeus, 1758)	R
11	Lime Butterfly	*Papilio demoleus* (Linnaeus, 1758)	VC

12	Common Mime	*Papilio clytia* (Linnaeus, 1758)	C
13	Malabar Banded Peacock	*Papilio buddha* (Westwood, 1851)	R
14	Crimson Rose	*Pachliopta hector* (Linnaeus,)	VC
15	Malabar Rose	*Pachliopta pandiyana* (Moore, 1886)	R
16	Common Rose	*Atrophaneura aristolochiae* (Fabricius, 1775)	R
II. Family: PIERIDAE (Whites and Yellows)			
a. Sub-family: Coliadinae			
17	Common Emigrant	*Gatopsilia pomona* (Fabricius, 1775)	C
18	Mottled Emigrant	*Catopsilia pyranthe* (Linnaeus, 1758)	VC
19	Common Grass Yellow	*Eurema hecabe* (Linnaeus, 1758)	VC
20	Spotless Grass Yellow	*Eurema laeta* (Boisduval, 1836)	R
b. Sub-family: Pierinae			
21	Yellow Orange-tip	*Ixias pyrene* (Linnaeus, 1764)	C
22	White Orange-tip	*Ixias marianne* (Cramer, 1777)	C
23	Great Orange-tip	*Hebomoia glaucippe* (Linnaeus, 1758)	R
24	Small or Little Orange-tip	*Colotis etrida (Boisduval, 1836)*	C
25	Crimson Tip	*Colotis danae* (Fabricius, 1787)	R
26	Chocolate Albtross	*Appias lyncida* (Cramer,1777)	R
27	Indian Cabbage White	*Pieris canidia* (Sparrman, 1768)	C
28	Common Gull	*Cepora nerissa* (Fabricius, 1775)	C
29	Common Jezebel	*Delias eucharis* (Drury, 1773)	R
30	Psyche	*Leptosia nina* (Fabricius, 1793)	C
31	Pioneer	*Anaphaeis aurota* (Fabricius, 1787)	VC
32	Common Wanderer	*Pareronia valeria* (Cramer, 1777)	C
III. Family: LYCAENIDAE (Blues)			
a. Sub-family: Theclinae			
33	Large Oakblue	*Arhopala amantes* (Hewitson, 1862)	R
34	Indian Oakblue	*Arhopala atrax* (Hewitson, 1862)	U
35	Common Acacia Blue	*Surendra quercetoram* (Moore, 1858)	U
36	Common Silverline	*Spindasis vulcanus* (Fabricius, 1775)	R
37	Indian Red Flash	*Rapala iarbus* (Fabricius, 1787)	C
38	Slate Flash	*Rapala manea* (Hewitson, 1863)	C
39	Indigo Flash	*Rapala varuna* (Horsfleld, 1829)	C
40	Common Flash	*Rapala nissa* (Kollar, 1844)	R
b. Sub-family: Polyommatinae			
41	Common Pierrot	*Castalius rosimon* (Fabricius, 1775)	VC
42	Banded Blue Pierrot	*Discolampa ethion* (Westwood, 1851)	C
43	Red Pierrot	*Talicda nyseus* (Guerin-Meneville,1843)	C
44	Rounded Pierrot	*Tarucus nara* (Kollar, 1844)	C
45	Common Lineblue	*Prosotas nora* (C. & R. Felder, 1860)	C
46	Dark Cerulean	*Jamides bochus* (Stoll,1782)	C
47	Common Cerulean	*Jamides celeno* (Cramer, 1779)	R
48	Grass Jewel	*Freyeria trochylus* (Freyer,)	C
49	Zebra Blue	*Leptotes plinius* (Fabricius, 1793)	R
50	Pea Blue	*Lampides boeticus* (Linnaeus, 1767)	C
51	Dark Grass Blue	*Zizeeria karsandra* (Moore, 1865)	VC
52	Pale Grass Blue	*Pseudozizeeria maha* (Kollar, 1844)	C
53	Tiny Grass Blue	*Zizula hylax* (Fabricius, 1775)	U
54	Lesser Grass Blue	*Zizinia otis* (Fabricius, 1787)	C
55	Common Hedge Blue	*Acytolepis puspa* (Horsfield,1828)	C
56	Lime Blue	*Chilades lajus* (Stoll, 1780)	R
57	Plains Cupid	*Chilades pandava* (Horsfield,1829)	C
IV. Family: NYMPHALIDAE (Brush-Footed Butterflies)			
a.Sub-family: Danainae			
58	Blue Tiger	*Tirumala limniace* (Cramer, 1775)	VC
59	Dark Blue Tiger	*Tirumala septentrionis* (Butler, 1874)	C
60	Striped Tiger	*Danaus genutia* (Cramer, 1779)	VC
61	Plain Tiger	*Danaus chrysippus* (Linnaeus, 1758)	C
62	Glassy Tiger	*Parantica aglea* (Stoll,1782)	C
63	Common Indian Crow	*Euploea core* (Cramer, 1780)	VC
64	Danaid Eggfly	*Hypolimnas misippus* (Linnaeus, 1758)	C
65	Great Eggfly	*Hypolimnas bolina* (Linnaeus, 1758)	R
b. Sub-family: Satyrinae			
66	Common Evening Brown	*Melanitis leda* (Linnaeus, 1758)	VC
67	Glade eye Bushbrown	*Mycalesis patnia* (Moore, 1865)	R
68	White-bar Bushbrown	*Mycalesis anxias* (Hewitson, 1862)	U
69	Common Bushbrown	*Mycalesis perseus* (Fabricius, 1775)	C
70	Nigger	*Orsotrioena medus* (Fabricius, 1775)	C
71	Common Five-ring	*Ypthima baldus* (Fabricius, 1775)	VC
72	Common Four-ring	*Ypthima huebneri* (Kirby, 1871)	VC

73	Common Three-ring	*Ypthima asterope* (KIug, 1832)	U
c. Sub-family: Heliconiinae			
74	Tawny coster	*Acraea violae* (Fabricius, 1775)	VC
75	Rustic	*Cupha erymanthis* (Drury, 1773)	C
76	Common Leopard	*Phalanta phalanta* (Drury, 1773)	VC
77	Baronet	*Symphaedta nais* (Forster,)	VC
78	Cruiser	*Vindula erota* (Fabricius,1775)	C
d. Sub-family: Limenitinae			
79	Commander	*Moduza procris* (Cramer, 1777)	U
80	Common Sergeant	*Athyma perius* (Linnaeus, 1758)	C
81	Common Lascar	*Pantoporia hordonia* (Stoll, 1790)	C
82	Common Sailer	*Neptis hylas* (Linnaeus, 1758)	VC
83	Grey Count	*Tanaecia lepidea* (Butler, 1868)	R
84	Common Baron	*Euthalia aconthea* (Cramer, 1777)	C
e. Sub-family: Biblidinae			
85	Angled Castor	*Ariadne ariadne* (Linnaeus, 1763)	C
86	Common Castor	*Ariadne merione* (Cramer, 1777)	C
f. Sub-family: Nymphalinae			
87	Indian Fritillary	*Argyreus hyperbius* (Linnaeus, 1758)	U
88	Painted Lady	*Vanessa cardui* (Linnaeus, 1758)	U
89	Blue Pansy	*Junonia orithiya* (Linnaeus, 1758)	C
90	Yellow Pansy	*Junonia hierta* (Fabricius, 1798)	C
91	Chocolate Pansy	*Junonia iphita* (Cramer,1779)	C
92	Grey Pansy	*Junonia atlites* (Linnaeus, 1763)	R
93	Peacock Pansy	*Junonia almana* (Linnaeus, 1758)	C
94	Lemon Pansy	*Junonia lemonias* (Linnaeus, 1758)	VC
95	Great Eggfly	*Hypolimnas bolina* (Linnaeus, 1758)	VC
96	Danaid Eggfly	*Hypolimnas misippus* (Linnaeus, 1758)	VC
g. Sub-family: Charaxinae			
97	Common Nawab	*Polyura athamas* (Drury, 1773)	R
B. Super-family: HESPERIOIDEA **V. Family: HESPERIIDAE (SKIPPERS)** **a. Sub-family: Coeliadinae**			
98	Common Awl	*Hasora badra* (Moore, 1858)	C
99	Common Banded Awl	*Hasora chromus* (Cramer, 1780)	C
100	Brown Awl	*Badamia exclamationis* (Fabricius, 1775)	C
b. Sub-family: Pyrginae			
101	Common Spotted Flat	*Celaenorrhinus leucocera* (Kollar, 1844)	U
102	Indian Skipper	*Spialia galba* (Fabricius, 1793)	R
103	Common Small Flat	*Sarangesa dasahara* (Moore, 1866)	C
104	Fulvous Pied Flat	*Pseudocoladenia dan* (Fabricius, 1787)	C
105	Suffused Snow Flat	*Tagiades gana* (Moore, 1866)	U
106	Common Snow Flat	*Tagiades japetus* (Stoll, 1781)	C
c. Sub-family: Hesperiinae			
107	Common Dartlet	*Oriens goloides* (Moore, 1881)	U
108	Pale Palm Dart	*Telicota colon* (Fabricius, 1775)	C
109	Dark Palm Dart	*Telicota ancilla* (Herrich-Schaffer, 1869)	U
110	Rice Swift	*Borbo cinnara* (Wallace, 1866)	C
111	Common Red-eye	*Matapa aria* (Moore, 1866)	R
112	Gaint Red-eye	*Gangara thyrsid* (Fabricius, 1775)	R
113	Chestnut Bob	*Iambrix salsala* (Moore, 1866)	C
114	Restricted Demon	*Notocrypta curvifascia* (C. & R. Felder,1862)	U
115	Grass Demon	*Udaspes folus* (Cramer, 1775)	U

AS= Abundance Status; **VC**= Very Common; **C**= Common; **U**= Un Common; **R**= Rare.

Table 2: Relative abundance of butterflies at GBS during study period.

S. No.	Family	No. of Genera	Relative Abundance (%)	No. of Species	Relative Abundance (%)
1.	**Papilionidae**	6	7.69	16	13.91
2.	**Pieridae**	13	16.67	16	13.91
3.	**Lycaenidae**	19	24.36	25	21.74
4.	**Nymphalidae**	25	32.05	40	34.78
5.	**Hesperiidae**	15	19.23	18	15.65
	Total	**78**	**100.00**	**115**	**100.00**

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