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Research Article

Eco-contributory species composition of butterflies in Panchavati garden area, Aarey colony, Goregaon, Maharashtra, India

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ABSTRACT

The study area is a part of Aarey Milk Colony, located to the southern border of the Sanjay Gandhi National Park. The habitat is highly varied consisting of scrub forest, seasonal freshwater marshes, hillocks, rocky outcrops, grass, and scrub, inhabiting a variety of biodiversity, thus making this area a biodiversity hotspot in Mumbai. Aarey Milk Colony is established in 1949 and it is situated in Goregaon east; a suburb of Mumbai that covers an area of 16 sq. km. The study area inhabits diverse living forms which specifically have not yet been documented. This area is a grass and shrubs habitat with a few hillocks, possessing two perennial and one seasonal pond as well as many seasonal streams in the area. But apart from being an industrial establishment, it is blessed with diverse flora as well as abundant fauna. The present study comprises a survey of butterflies of Panchavati Garden (five-plant garden) in Aarey colony, Mumbai, which would provide baseline data, for planning an effective management study of butterfly diversity with respect to the sustainable development of the Aarey colony. The study area is home to diverse flora and fauna which has not yet been documented. Various anthropogenic activities are resulting in heavy loss to the biodiversity in the area. In the present study, a total of 95 individuals including both the resident and migratory ones belonging to 16 sub families were identified and recorded. Butterflies are often considered as vital indicators of a region's eco-health as is experienced in this green realm.

Key words: Aarey Colony, Butterfly, Species Composition, Sustainable Development, Panchavati Garden Area.

INTRODUCTION

An insect fauna represents more than 70% of the ecosystem and also plays a vital role in the food chain and acts as bio-indicators (Clark *et al*., 2007). Butterflies are beautifully coloured insects with scaled wings and belong to the order Lepidoptera under the class Insecta. Butterflies are vital part of any natural ecosystem and their adults act as a bio- pollinators and larvae feeds on crops and called as primary herbivores. They are the bio indicators species in urbanized area and are very sensitive to changes in the environment and the availability of host plants for egg laying and larval development (Nimbalkar *et al*., 2011; Fordyce *et al*., 2003). The construction of roads, buildings and green lawns are increased which ultimately affects the butterfly species diversity, abundance, and richness (Blair *et al*., 1997; Clark *et al*., 2007). Seasonal variations is fundamental process in butterfly population and the seasonal fluctuations including the temperature, light, rainfall, pH, variation in the availability of larval food resources and greeneries such as herb and shrubs can also affects the butterfly diversity (Rajagopal *et al*., 2011). The butterfly fauna is very rich and diverse in the surrounding areas of Panchavati garden and Aarey colony due to the accessibility of diversified habitats associated with microclimate regimes. The detailed study funded by MMR -EIS in two phases from 2009 to 2012, clearly expresses the ecological importance of the highly biodiverse Aarey Milk Colony (Anand Pendharkar *et al*., 2021; Anne Magurran, 1988). The awareness regarding butterfly conservation, sustainable development and its importance is lacking among the public in cities. There are several surveys done on butterfly diversity by many researchers in isolated pockets of Aarey colony related to diversity and population abundance. This is the first attempt was made to fulfil the lacuna in the area of butterfly diversity in the surrounding areas of Panchavati Garden.

MATERIALS AND METHODS

The butterflies were observed in the surrounding areas of Panchavati garden located in the Aarey colony (Figure 1) from various ecosystems viz., agricultural land, grassland, bushy areas etc. Survey for butterflies was made in all the four seasons namely, winter, summer, Monsoon and Post-monsoon from December 2019 to November 2021. The study areas were surveyed twice a week and the data were documented. The data on butterfly diversity and its relative abundance were recorded based on observation of the individual butterfly species and also by photographic documentation. The survey was made from morning 7.30 to 11.30 hr. Line transect count method according to Kunte (2000) were followed to find the butterfly abundance. The

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Figure 1. Map of the study area

transects were fixed in the routes along the paths once in a week covering an area of 50 meter around a radius of 5 meter front from the observer and 2.5m on either sides. All zoological names and identification used in the present study are in accordance with Varshney (1983), Kehimkar (2008) and common English names were used from Wynter-Blyth (1957). The observed butterflies were categorized into five groups on the basis of relative abundance in the study area as VC-very common (75-100 sightings), C-common (50-75 sightings), LC-less common (25-50 sightings), R-rare (5-25 sightings), VR-very rare (1-5 sightings). The diversity indices and evenness were worked out by following Shannon Wienner diversity index.

RESULTS AND DISCUSSIONS

The butterfly diversity and abundance were observed in the surrounding areas of Panchavati garden, Aarey colony, Goregaon, Mumbai from December 2020 to November 2021 is given in Table 1. There were 95 species of butterflies identified and segregated under five different families according to the Kehimkar I. classification (Kehimkar, 2011). The families namely, Hesperidae Papilionidae, Pieridae, Nymphalidae, and Lycaenidae. Among the butterflies recorded in the surrounding areas of the Panchavati garden, 12 of them were very common (Common Grass Yellow, Lemon Pansy, etc.) and they were recognized under Pieridae and Nymphalidae, 31 species were common (Common Wanderer, Common Crow, etc.) and they were recognized under Pieridae, Nymphalidae and Hesperiidae while 29 number of butterflies were categorized under rare and very rare (Crimson Tip, Yellow Orange Tip, etc.). 23 numbers of butterfly species belong to Lycaenidae, Blues (Apefly), and Hesperiidae (Tricolored Pied Flat) one each was found rare in the investigation areas based on their relative abundance. Regarding the abundance of the butterflies in the survey area, Psyche and Common Grass Yellow was found all over the year from December 2020 to November 2021 (Pendharkar *et al*., 1986-2021). Crop rotation pattern followed in the study areas, grassy and bushy vegetation in and around the field might be the reason for the common occurrences of the above butterflies. The results of the study coincided with the findings of (Aiswarya *et al*. 2014; Fergusson, 1891) who found that the status of butterflies in Sarojini Naidu college campus under various categories like very common (11%), common (31%), less common (14%), rare (6%), and very rare (2%). The results of the relative abundance of butterflies during the study period are furnished in Figure 2 and 3. It was observed that the maximum number of butterflies was observed during September and October 2021 due to the availability of host and nectar plants. Family -wise collection of butterflies revealed that Nymphalidae was witnessed with maximum individuals of butterflies (41) followed by Hesperidae (15) and Lycaenidae with (15) numbers from all the surrounding areas of Panchavati garden. Further, the reports it is confirmed with the findings of (Rajagopal *et al*. 2011; Ackery *et al*., 1988) who found that the temperature precipitation is two vital factors that directly influence the butterflies richness and population. Earlier studies by (Kunte, 2001; Chakaravarthy *et al*. 1997; Hussain *et al*., 2011) also indicated that temperature and rainfall are two important factors which directly influence the butterflies richness and population. The detailed study funded by MMR-EIS in two phases from 2009 to 2012 and covering every landscape in the MMR, clearly expresses the ecological importance of the highly biodiverse Aarey Milk Colony, the conservation status coincided with (Anand *et al*.1986-2021). In Mumbai suburban areas, the ultimate breeding season for most of the butterfly species is post Monsoon and it continues till winter. The results of the present study coincided with the butterfly movement from October to January/February at Nilgiri and Annamalai hills of southern Western Ghats (Kunte, 2005). The Shannon-Wiener diversity index of the butterfly families collected in the study area indicated that the Nymphalidae was rich in species diversity with 1.47 than other families. The evenness was also found more with Nymphalidae matched with the results of (Mirza, *et al*., 2010).

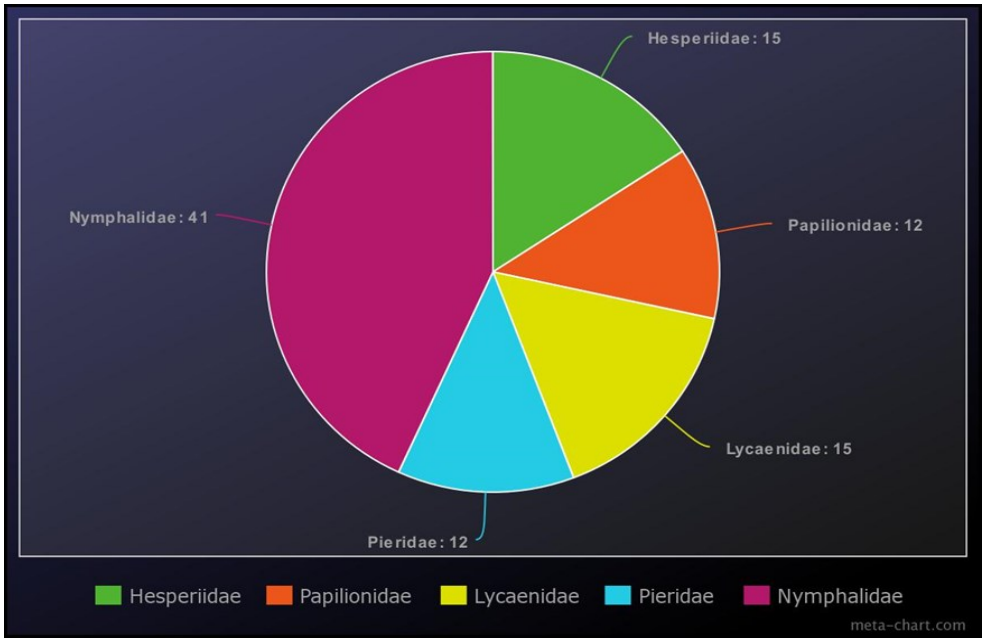

Figure 2. Family wise distribution of Butterflies in the surrounding areas of Panchavati garden, Aarey colony, Goregaon, Mumbai, Maharashtra.

Table 1. Butterflies of Family: Hesperiidae (Skippers) recorded at the surrounding areas of Panchavati garden, Aarey colony, Goregaon, Mumbai, Maharashtra.

Sl. No.	Common Name	Scientific Name	Relative Abundance
Subfamily: Pyrginae (Flats and Angles)			
01	Malabar Spotted Flat	*Celaenorrhinus ambareesa*	LC
02	Common Spotted Flat	*Celaenorrhinus leucocera (Kollar)*	C
03	Common Small Flat	*Sarangesa dasahara dasahara*	C
04	Spotted Small Flat	*Sarangesa purendra Moore*	R
05	Tricolour Pied Flat	*Coladenia indrani indra Moore*	LC
06	Common Snow Flat	*Tagiades japetus helferi*	R
07	Chestnut Angle	*Odontoptilum angulata (C. Felder, 1862)*	VR
08	Golden Angle	*Caprona ransonnettii*	LC
Subfamily: Hesperiinae (Darters, Darts, Dartlets, Swifts, Aces, Bobs, Redeyes, Demons.)			
09	Rice Swift	*Borbo cinnara (Wallace, 1866)*	R
10	Conjoined Swift	*Pelopidas conjuncta (Herrich-Schäffer, 1869)*	C
11	Common Redeye	*Matapa aria (Moore, [1866])*	R
12	Chestnut Bob	*Iambrix salsala (Moore, [1866])*	LC
13	Restricted Demon	*Notocrypta curvifascia (C. & R. Felder, 1862)*	R
14	Grass Demon	*Udaspes folus (Cramer, [1775])*	LC
15	Bush Hopper	*Ampittia dioscorides (Fabricius, 1793)*	C

VR=Very Rare, R= Rare, LC= Less Common, C=Common, VC=Very Common

Table 2. Butterflies of Family: Papilionidae (Swallowtails) recorded at the surrounding areas of Panchavati garden, Aarey colony, Goregaon, Mumbai, Maharashtra.

Sl. No.	Common Name	Scientific Name	Relative Abundance
Subfamily: Papilioninae			
01	Common Jay	*Graphium doson (C. & R. Felder, 1864)*	C
02	Tailed Jay	*Graphium agamemnon (Linnaeus, 1758)*	VC
03	Common Mime Male	*Papilio clytia Linnaeus, 1758*	C
04	Common Mime Female	*Papilio clytia Linnaeus, 1758*	VR
05	Common Mormon Male	*Papilio polytes Linnaeus, 1758*	VC
06	Common Mormon Female (Form romulus)	*Papilio polytes Linnaeus, 1758*	LC
07	Common Mormon Female (Form stichius)	*Papilio polytes Linnaeus, 1758*	LC
08	Blue Mormon	*Papilio polymnestor polymnestor*	R
09	Lime Butterfly	*Papilio demoleus Linnaeus, 1758*	C
10	Common Yellow Swallowtail	*Papilio machaon Linnaeus, 1758*	LC
11	Common Rose	*Pachliopta aristolochiae (Fabricius, 1775)*	C
12	Crimson Rose	*Pachliopta hector (Linnaeus, 1758)*	LC

Table 3. Butterflies of Family: Pieridae (Whites and Yellows) recorded at the surrounding areas of Panchavati garden, Aarey colony, Goregaon, Mumbai, Maharashtra.

Sl. No.	Common Name	Scientific Name	Relative Abundance
Subfamily: Coliadinae (Yellows)			
01	One Spot Grass Yellow	*Eurema andersonii (Moore, 1886)*	VC
02	Small Grass Yellow	*Eurema brigitta (Stoll, [1780])*	C
03	Common Grass Yellow	*Eurema hecabe (Linnaeus, 1758)*	VC
04	Common Emigrant	*Catopsilia pomona (Fabricius, 1775)*	R
05	Mottled Emigrant	*Catopsilia pyranthe (Linnaeus, 1758)*	VC
Subfamily: Pierinae (Whites)			
06	White Orange Tip	*Ixias marianne (Cramer, [1779])*	R
07	Yellow Orange Tip	*Ixias pyrene (Linnaeus, 1764)*	LC
08	Common/Indian Wanderer Male	*Pareronia hippia (Fabricius, 1787)*	C
09	Common Wanderer Female	*Pareronia hippia (Fabricius, 1787)*	VR
10	Common Gull	*Cepora nerissa (Fabricius, 1775)*	C
11	Common Jezebel	*Delias eucharis (Drury, 1773)*	LC
12	Psyche	*Leptosia nina (Fabricius, 1793)*	VC

Table 4. Butterflies of Family: Lycaenidae (Blues) recorded at the surrounding areas of Panchavati garden, Aarey colony, Goregaon, Mumbai, Maharashtra.

Sl. No.	Common Name	Scientific Name	Relative Abundance
Subfamily: Miletinae (Brownies, Mottles, Forest Pierrot and Apefly)			
01	Apefly	*Spalgis epius (Westwood, [1851])*	R
Subfamily: Theclinae (Strong Blues)			
02	Yamfly	*Loxura atymnus (Stoll, 1780)*	C
03	Monkey Puzzle	*Rathinda amor (Fabricius, 1775)*	R
04	Common Silverline	*Spindasis vulcanus (Fabricius, 1775)*	LC
Subfamily: Polymmatinae (Weak Blues)			
05	Angled Pierrot	*Caleta decidia (Hewitson, 1876)*	R
06	Common Pierrot	*Castalius rosimon (Fabricius, 1775)*	C
07	Common Cerulean	*Jamides celeno (Cramer, [1775])*	C
08	Forget-Me-Not	*Catochrysops strabo (Fabricius, 1793)*	C
09	Pea Blue	*Lampides boeticus (Linnaeus, 1767)*	LC
10	Grass Jewel	*Freyeria trochylus (Freyer, 1845)*	LC
11	Indian Cupid	*Everes lacturnus (Godart, [1824])*	R
12	Red Pierrot	*Talicada nyseus (Guérin-Méneville, 1843)*	C
13	Gram Blue	*Euchrysops cnejus (Fabricius, 1798)*	R
14	Plains Cupid	*Chilades pandava (Horsfield, [1829])*	C
Subfamily: Riodininae (Judies)			
15	Plum Judy	*Abisara echerius (Stoll, [1790])*	LC

VR=Very Rare, R= Rare, LC= Less Common, C=Common, VC=Very Common

Table 5. Butterflies of Family: Nymphalidae (Brush Footed Butterflies) recorded at the surrounding areas of Panchavati, Aarey colony, Goregaon, Mumbai, Maharashtra.

Sl. No.	Common Name	Scientific Name	Relative Abundance
Subfamily: Danainae (Milkweed Butterflies)			
01	Blue Tiger	*Tirumala limniace (Cramer,[1775])*	C
02	Striped Tiger	*Danaus genutia (Cramer, [1779])*	VC
03	Plain Tiger	*Danaus chrysippus (Linnaeus, 1758)*	C
04	Glassy Tiger	*Parantica aglea (Stoll, [1782])*	R
05	Dark Glassy Tiger	*Parantica agleoides (Stoll, [1782])*	R
06	Double Branded Crow	*Euploea sylvester (Fabricius, 1793)*	C
07	Brown King Crow	*Euploea klugii Moore, [1858]*	C
08	Common Crow	*Euploea core (Cramer, [1780])*	C
Subfamily: Charaxinae (Rajahs, Nawabs, and Begum)			
09	Common Nawab	*Charaxes bharata C. & R. Felder, [1867*]	VR
10	Black Rajah	*Charaxes solon (Fabricius, 1793)*	R
Subfamily: Satyrinae (Browns)			
11	Common Evening Brown	*Melanitis leda (Linnaeus, 1758)*	C
12	Dark Evening Brown	*Melanitis phedima (Cramer, [1780])*	C
13	Common Tree Brown	*Lethe rohria (Fabricius, 1787)*	VR
14	Common Palmfly	*Elymnias hypermnestra (Linnaeus, 1763)*	C
15	Common Bushbrown	*Mycalesis perseus (Fabricius, 1775)*	C
16	Dark Brand Bushbrown	*Mycalesis mineus (Linnaeus, 1758)*	C
17	Long Brand Bushbrown	*Mycalesis visala Moore, [1858]*	VR
18	Nigger	*Orsotriaena medus (Fabricius, 1775)*	R
19	Common Fivering	*Ypthima baldus (Fabricius, 1775)*	VC
20	Common Fourring	*Ypthima huebneri Kirby, 1871*	VC
Subfamily: Heliconinae (Costers)			
21	Tawny Coster	*Acraea terpsicore (Linnaeus, 1758)*	R
22	Small Leopard	*Phalanta alcippe (Stoll, [1782])*	LC
23	Common Leopard	*Phalanta phalantha (Drury, [1773])*	C
Subfamily: Limenitinae (Barons, Sailers and Others)			
24	Commander	*Moduza procris (Cramer, [1777])*	LC
25	Small Yellow Sailer	*Neptis miah Moore, [1858]*	R
26	Common Sailer	*Neptis hylas (Linnaeus, 1758)*	VC
27	Yellow Sailer	*Neptis ananta Moore, [1858]*	LC
28	Common Baron	*Euthalia aconthea (Cramer, [1777])*	VC
29	Gaudy Baron	*Euthalia lubentina (Cramer, [1777])*	R
30	Baronet	*Symphaedra nais (Forster, 1771)*	LC
31	Grey Count	*Tanaecia lepidea (Butler, 1868)*	R
Subfamily: Biblidinae			
32	Common Castor	*Ariadne merione (Cramer, [1777])*	LC
Subfamily: Nymphalinae (Painted Lady, Pansies, Eggflies, Oakleafs and Others)			
33	Blue Pansy	*Junonia orithya (Linnaeus, 1758)*	R
34	Yellow Pansy	*Junonia hierta (Fabricius, 1798)*	LC
35	Grey Pansy	*Junonia atlites (Linnaeus, 1763)*	C
36	Peacock Pansy	*Junonia almana (Linnaeus, 1758)*	LC
37	Lemon Pansy	*Junonia lemonias (Linnaeus, 1758)*	VC
38	Great eggfly	*Hypolimnas bolina (Linnaeus, 1758)*	C
39	Danaid Eggfly	*Hypolimnas misippus (Linnaeus, 1764)*	C
40	Orange Oakleaf	*Kallima inachus (Doyère, [1840])*	LC
41	Blue Oakleaf	*Kallima horsfieldii (Kollar, [1844])*	R

VR=Very Rare, R= Rare, LC= Less Common, C=Common, VC=Very Common

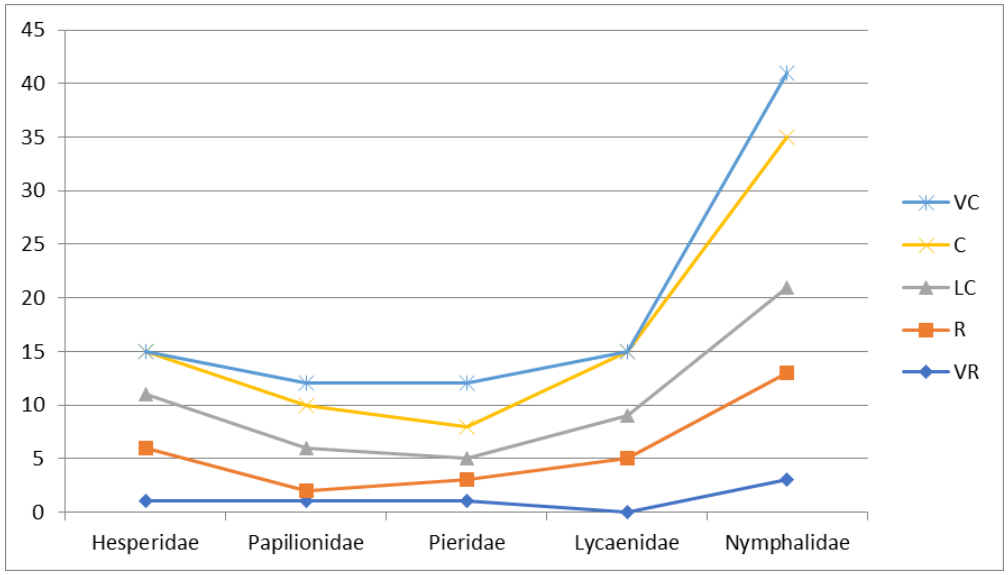

Figure 3. Relative abundance of butterflies observed in the surrounding areas of Panchavati garden, Aarey colony, Goregaon, Mumbai, Maharashtra.

Table 6. Relative abundance of butterflies observed in the surrounding areas of Panchavati garden, Aarey colony, Goregaon, Mumbai, Maharashtra.

Sl.No.	Family	VR	R	LC	C	VC	Total
01	Hesperidae	01	05	05	04	00	**15**
02	Papilionidae	01	01	04	04	02	**12**
03	Pieridae	01	02	02	03	04	**12**
04	Lycaenidae	00	05	04	06	00	**15**
05	Nymphalidae	03	10	08	14	06	**41**
Total		**06**	**23**	**23**	**31**	**12**	**95**

VR=Very Rare, R= Rare, LC= Less Common, C=Common, VC=Very Common

One of the observed threat to the butterfly diversity in Panchavati Garden and the adjacent areas is caused by anthropogenic disturbances, such as the building of roads and their development, a rise in traffic and air pollution, over-exploitation of the forest resources in the area surrounding the garden, and cutting down and logging of plants that provide nectar and food for butterflies, which results in the destruction of habitat. The relative abundance and diversity of butterflies in the study region can be affected of habitat degradation and fragmentation. These interferences are degrading the habitat quality and negatively harming the host and nectar plant supplies of butterflies, which in turn is reducing the taxonomic diversity of those species. It is crucial to conserve the diversity of butterflies in the study area since they are an integral part of the ecology. The Panchavati Garden in the Aarey Milk colony also has the potential to be a butterfly eco-tourism destination and presents a chance to raise awareness of conservation efforts among the local population. Also the butterfly species composition in Panchavati Garden and nearby areas will need to be monitored and studied in the future for any changes in their population.

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