Butterflies of Amgaon Tehsil of Gondia District (Maharashtra), A Preliminary Survey of Their Community Structure, Taxonomic Diversity and Their Ecology

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ABSTRACT:

Butterflies are among the most beautiful of nature's creation and are members of order Lepidoptera, the literal meaning of which is 'scaled winged', and included with them are the moths. It is the wing scales which give the butterflies their beautiful colours and patterns and make them one of the most familiar of all insect groups. During present investigation 28 species belonging to 19 genera and 4 families were collected and identified of which 08 species belonged to family Papilionidae, 02 species to Pieridae, 12 to family Nymphalidae and 06 species to Lycaenidae. Relative diversity composition of each family revealed Nymphalidae (32.71%) was the most dominant while family Lycaenidae (30.26%) ranked second, followed by family Pieridae (22.19%) and Papilionidae (14.84%). Species diversity, evenness and species richness was calculated by Shannon-Weiner index, Evenness index and Margalef's index. Analysis of species diversity of butterfly fauna revealed that the family Nymphalidae (2.412) was the highest followed by the family Papilionidae (2.040), Lycaneidae (1.763) and lowest in Pieridae (0.666). The calculated values of species richness ranged from 0.199 (Pieridae) to 2.028 (Nymphalidae) and Evenness Index ranged from 0.964 (Pieridae) to 0.984 (Lycaneidae). Based on percentage composition on 28 species of butterflies, about 25% were Frequent, 21.43% were common,17.86% were Abundant and Occasional, 10.71% were rare and 7.14 % were reported Very Common Thus the present investigation is the first attempt to study butterfly diversity and distribution from the selected study area.

Keywords: Butterflies, Shannon-Weiner index, Evenness index and Margalef's index

Introduction

Butterflies are among the most beautiful of nature's creation. Their many hues and shapes have been a delight and inspiration to artists and nature lovers for generation. They are members of order Lepidoptera, the literal meaning of which is 'scaled winged', and included with them are the moths. It is the wing scales which give the butterflies their beautiful colours and patterns and make them one of the most familiar of all insect groups. In addition, the scientific importance of the Lepidoptera (butterflies and moths) has been recognized by entomologists because of their diverse behavior and habitats. This diversity is made possible, without the risk of unbridled wasteful competition; by the large number of ecological niches available within the complex jigsaw of the forest and variety of potential host-plant species typically present (Preston-Mafham and Preston-Mafham, 2004). Today several species of butterflies are used by conservation biologists as indicator species to identify habitats that are critical and need to be protected (Chakravarthy *et al.,* 1997). Butterflies are also monitored to indicate climate change and environment degradation (Preston-Mafham and Preston-Mafham, 2004).

Butterflies have been studied systematically since the early 18th century and 19,238 species had been documented worldwide (Heppner, 1998).This figure is not constant because of the continuous discovery of new butterflies (Lewis, 1973; Stokoe, 1974; Mani, 1986; Goodden, 1997; Green and Huang, 1998; Barua *et al.,*2004; Ambrose and Raj*,* 2005; Alphonsa, 2006; Chandra *et al.,* 2007; Parag and Omkar 2009) and also due to ongoing disagreements between taxonomists over the status of many species. About 1502 species have been described in India which includes 100 endemics and at least 26 taxa are today globally threatened as per the IUCN (1990) Red List of threaten animals and insects (Singh and Pandey, 2004). In central India the butterfly species diversity was reported earlier by D'Abreu (1931) and documented total 177 species occurring in the erstwhile Central Provinces (now Madhya Pradesh and Vidarbha).

It is essential that we document the butterfly fauna of certain regions so that steps may be taken to ensure the survival of these fascinating creatures for future generations. There is little that can be done to save our butterflies once their habitats are destroyed. Thus, it is important to environment and avoids further damaging the already fragile balance of nature (Whalley, 1988, 1992; Verma, 2009). Keeping this in view the present study was conducted to study the diversity, abundance and distribution of butterfly fauna from Mahadev Hills of Amgaon Tehsil of Maharashtra and is the first attempt to study butterfly diversity and distribution from the selected study area.

Material and Methods

Study sites

Mahadev Hills at Amgaon in Gondia district is situated in eastern region of Maharashtra state at the geographical coordinate of 20°39′0″N latitude and 79°57′0″E longitude at an elevation of 211 m (Fig. 1).

Butterfly Survey

Butterfly surveys were carried out in Mahadev Hill from January 2013 to December 2013 on a monthly basis covering a complete wet season (June to September) and dry season (March to June); rainy days were avoided because rain interfere with visibility (Ralph *et al*, 1993). Butterflies were identified by sight using binocular (Olympus 10×50) and digital camera (Nikon D 7200). Observations were made through walking transects (Pollard, 1993; Caldas and Robbins, 2003) of 0.5 km to 0.7 km length with 2 m to 5 m on either side. The present study is based on 4 line transects to study the butterfly population. The sites were visited in morning and evening hours to note maximum possible species of butterflies and record its activities. During field studies, guidebooks were used to identify the butterflies (Marshall and De Niceville, 1890, Evans, 1932, Wynter-Blyth, 1957 and Kehimkar, 2008).

Sampling Butterflies

Based on relative abundance estimates, the butterflies were categorized according to (Rajasekhar, 1991, 95) in five categories: - Abundant (>30%), Very Common (20-30%), Common (10-20%), Frequent (5-10%), Occasional (1-5%), and Rare (<1%).

Statistical Analyses

Diversity Index:

Shannon-Wiener diversity Index

The species diversity will be calculated following Shannon Wiener diversity Index (H) (Shannon and Wiener, 1949).

$$H = -\Sigma (N_i/N) \log_2 (N_i/N)$$

Where N_i = Number of individuals of species i and N= Total number of individuals of all the species.

Evenness index

Evenness Index was calculated as per Hill (1973).

$$E = H/\log_2 S$$

Where S= Total number of species, N= Total number of individuals of all the species, H = Index of diversity.

Margalef's Index

Margalef's index was used as a simple measure of species richness Margalef (1970).

$$\text{Margalef's index} = (S-1)/\log_2 N$$

S = Total number of species N = Total number of individual in sample ln = Natural logarithm

The relative diversity (RDi) of families was calculated by using following formula (Koli, 2014):

RDi = (No. of butterfly species in the family /Total no. of species)*100

Results and Discussion

A total of 694 butterflies in 28 species were recorded in Mahadev Hill at Amgaon in Gondia district during the study period. The species belong to 19 genera and 4 families. Out of 28 species recorded 12 species belonged to family Nymphalidae, 10 species from family Papilionidae, 6 species from Lycaenidae and 2 species from Pieridae (Table 1). As far as relative diversity is concerned family Nymphalidae (32.71%) was the most dominant while family Lycaenidae (27.27%) ranked second, followed by family Pieridae (22.19%) and Papilionidae (14.84%) (Fig. 2). This agreed with the finding of Kumar *et al.,* (2016), who reported that, Nymphalidae to be the most dominant family in Chansal valley in Shimla (Himachal Pradesh) and Nair *et al.,* (2014) according to them Nymphalidae to be the most dominant family followed by Lycaneidae, Pieridae, Papilionidae and Hesperiidae in Sarojini Naidu College campus, Kolkatta, West Bengal.

Analysis of species diversity of butterfly fauna revealed that the family Nymphalidae (2.412) was the highest followed by the family Papilionidae (2.040), Lycaneidae (1.763) and lowest in Pieridae (0.666)(Table-2). The species diversity pattern of Nymphalidae family agreed with the findings of Sreekumar and Balakrishanan (2001), Raut and Pandharkar (2010), Hussian *et al.*, (2011). Similar pattern was also recorded for species richness were Nymphalidae was most dominant family (2.028) followed by Papilionidae (1.510), Lycaneidae (0.935) and lowest in Pieridae (0.199) (Table-2). Such a richness of Nymphalidae family suggested their attribute to the polyphagous habit which helps them survive on varied food plants (Sreekumar and Balakrishanan, 2001). The second family in species richness was Papilionidae. Papilionidae are known to prefer tall trees providing moderate sunlight (Mathews and Anto, 2007) and Mahadev Hill vegetation is dominated by trees. The moderate richness of Lycaenidae can be attributed to regular presence of some of the species that were very common in the area. Pierids species richness was comparatively low in study area as they are sun lovers seen basking in sun with wings partially open and majority of them are seen in open country (Kehimkar, 2008). Species evenness showed a uniform range (0.960) in family Pieridae

to (0.984) in family Papilionidae (Table - 2). This reflects on the difference in the efficiency of different butterfly species to efficiently use the habitat.

Four species of butterflies are listed as endangered in Wildlife (Protection) Act, 1972. Among the four, one species of butterflies are listed under the schedule I (Crimson rose, *Atrophaneura hector*) and schedule IV (Common India crow, *Euploea core*) and two species are in schedule II (Gram blue, *Euchrysops cnejus* and Danaid Eggfly, *Hypolimnas misippus*). Based on percentage composition on 28 species of butterflies, about 25% were Frequent, 21.43% were common, 17.86% were Abundant and Occasional, 10.71% were rare and 7.14 % were reported Very Common (Fig. 3).

Several workers have previously recorded butterfly species in Nagpur city, *viz.* D'Abreeu (1931) recorded 91 butterfly species; Pandharipande (1990) examined 61 species of butterflies and recently Tiple and Khurad (2009) documented 145 species. In the opinion of Currie *et al.* (2004) patterns of species richness are strongly correlated with climatic variables that are related to productive or energy balance of an ecosystem. The richness – climate correlation explained by Wright (1983) and Currie (1991) may explain seasonal difference in species richness of butterfly at the Mahadev Hill located in Amgaon Tehsil, in eastern region of Maharashtra state. Since the richness – climate correlation in different areas have yet to be studied in Mahadev Hill, it is not possible to relate the distribution of butterflies to their habitat and climate.

Table 1. Systematic List of Butterfly Species at Mahadev Hill, Amgaon in Gondia district of Maharashtra (January, 2013 to December 2013)

S.N.	Family	Scientific name	Common name	Occurrence
1.	Papilionidae	*Papilio demoleus* Linnaeus, 1758	Lime butterfly	C
		Papilio polytes Linnaeus, 1758	Common Mormon	F
		Papilo polymenstor Cramer	Blue Mormon	O
		Atrophaneura aristolochiae (Fabricius, 1775)	Common rose	C
		Atrophaneura hector (Linnaeus, 1758)	Crimson rose	F
		Graphium Agamemnon (Linnaeus, 1758)	Tailed Jay	O
		Graphium doson (C. & R. Felder, 1864)	Common Jay	R
2.	Pieridae	*Pareronia valeria* (Cramer, 1776)	Common wanderer	F
		Eurema brigitta (Cramer, 1780)	Small grass yellow	A
		Eurema hecabe (Linnaeus, 1758)	Common grass yellow	VC
3.	Nymphalidae	*Danaus chrysippus* (Linnaeus, 1758)	Plain tiger	A
		Danaus genutia (Cramer, 1779)	Striped tiger	O
		Euploea core (Cramer, 1780)	Common Indian crow	A
		Hypolimnas bolina (Linnaeus, 1758)	Great eggfly	C
		Hypolimnas misippus (Linnaeus, 1764)	Danaid eggfly	VC
		Junonia lemonias (Linnaeus, 1758)	Lemon pansy	C
		Junonia orithya (Linnaeus, 1758)	Blue pansy	C
		Junionia atlites (Linnaeus, 1763)	Grey pansy	F
		Parantica aglea (Stoll)	Glassy tiger	O
		Tirumala limniace (Cramer, 1775)	Blue tiger	F
		*Moduza procris (*Cramer)	Commander	F
		Melantis leda (Linnaeus, 1758)	Common Evening Brown	R
4.	Lycaenidae	*Catochrysops panormus* (Fabricius, 1793)	Silver forget me not	O
		Euchrysops cnejus (Fabricius)	Gram blue	A
		Freyeria trochylus Freyer	Asian grass jewel	A
		Pseudozizeeria maha (Kollar)	Pale grass blue	R
		Azanus ubaldus (Stoll)	Bright babul blue	F
		Zizina Otis (Fabricius, 1787)	Lesser grass blue	C

Abbreviations- A- Abundant, VC- Very Common; C-Common; F-Frequent; O- Occasional; R-Rare

Table 2. Calculated values of Diversity indices different Habitats of Butterfly Species at Mahadev Hill, Amgaon in Gondia district of Maharashtra (January, 2013 to December2013)

Family	No. of species	Species Diversity	Species Eveness	Species richness
Papilionidae	8	2.040	0.981	1.510
Pieridae	2	0.666	0.960	0.199
Nymphalidae	12	2.412	0.971	2.028
Lycaenidae	6	1.763	0.984	0.935

Figure 1: A satellite view of Mahadev Hill, Amgaon in Gondia district of Maharashtra
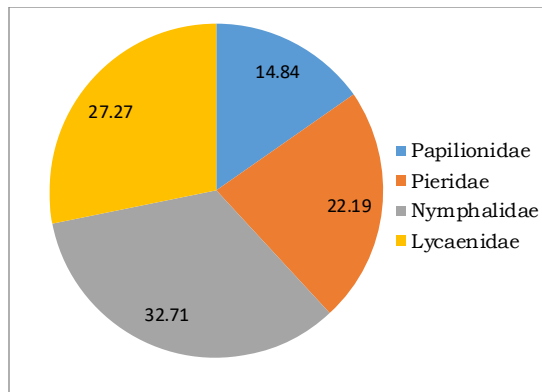
Figure 2: Relative diversity (RDi) of various families at Mahadev Hill, Amgaon in Gondia district of Maharashtra (January, 2013 to December, 2013)
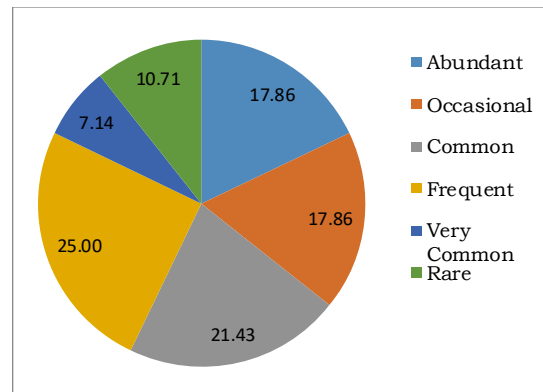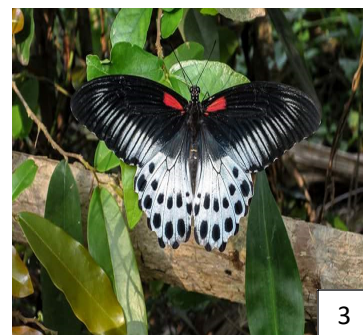

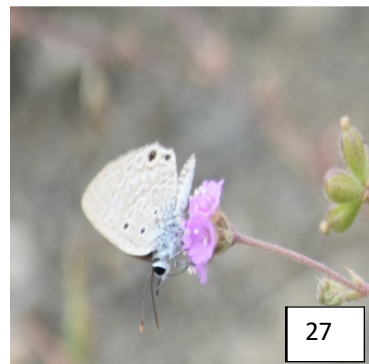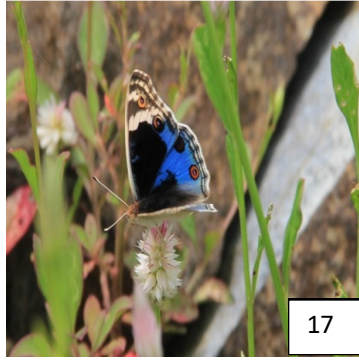**Figure 3.** Percentage composition of status of butterflies species

Plate 1: Photographs of the butterflies observed at different Habitats of Butterfly Species at Mahadev Hill, Amgaon in Gondia district of Maharashtra (January, 2013 to December2013). 1. *Papilio demoleus* 2. *Papilio polytes* 3. *Papilio polymenstor* 4. *Atrophaneura aristolochiae* 5. *Atrophaneura hector* 6. *Graphium Agamemnon* 7. *Graphium doson* 8. *Pareronia valeria* 9. *Eurema brigitta* 10. *Eurema hecabe* 11. *Danaus chrysippus* 12. *Danaus genutia* 13. *Euploea core* 14. *Hypolimnas bolina* 15. *Hypolimnas misippus* 16. *Junonia lemonias* 17. *Junonia orithya* 18. *Junonia atlites* 19. *Parantica aglea* 20.*Tirumala limniace* 21. *Moduza procris* 22. *Melantis leda* 23. *Catochrysops panormus* 24. *Euchrysops cnejus* 25. *Freyeria trochylus* 26. *Pseudozizeeria maha* 27. *Azanus ubaldus* 28. *Zizina Otis*

Conclusion:

       In conclusion it can be said that Mahadev Hill is a hilly undisturbed area with rich vegetation along with its water bodies is rich in availability of host and larval plant species. Availability of larval host plants and adult nector plants supports good diversity of Butterflies which need to be conserved by protecting the vegetation and water resources of the area.

References

Alphonsa, X. (2006). Butterfly fauna of Government arts & Science College campus, Kozhikode, Kerala. *Zoos'Print Journal*, 21 (3): 2263-2264.

Ambrose, P. D. and Raj, D. S. (2005). Butterflies of Kalakad- Mundanthurai tiger reserve, Tamilnadu. *Zoos'Print Journal*, 20 (12): 2100-2107.

Barua, K. K., Kakati D. and Kalita J. (2004). Present Status of Swallowtail butterflies in Garbhanga reserve forest, Assam, India. *Zoos'Print Journal*, 19 (4):1439-1441.

Chakravarthy, A. K., Rajagopal, D. and R. Jaganntha. (1997). Insect as bio indicators of conservation in the tropics. *Zoos' Print Journal*. 12: 21-25.

Chandra, K., Sharma R. M., Singh, A. and Singh R. K. (2007). A checklist of butterflies of Madhya Pradesh and Chhattisgarh States, India. *Zoos'Print Journal*, 22 (8):2790-2798.

Caldas, A. and Robbins, R. (2003). Modified Pollard transects for assessing tropical butterfly abundance and diversity. *Biological Conservation*, 110: 211-219.

Currie, D. J. (1991). Energy and large-scale patterns of animal and plant-species richness. *American Naturalist*, 137: 27−49.

Currie, D.J., Mittelbach, G.G., Cornell, H.V., Field, R., Guegan, J.F., Hawkins, B.A. et al. (2004). Predictions and tests of climate based hypotheses of broad-scale variation in taxonomic richness. *Ecol. Lett.*, 7: 1121–1134.

D'Abreu, E. A. (1931). The Central Provinces Butterfly List. Records of the Nagpur Museum Number VII, *Government Printing City Press*, 39.

Evans, W. H. (1932). Identification of Indian butterflies, Bombay Natural History Society, Bombay.

Godden, R. (1997). The Wonderful World of Butterflies and Moths. Hamlyn Pub. Group Ltd., London: 96

Green, J. and Huang, A. (1998). Butterflies of South Vancouver Island. Co-op resort. Royal British Columbia Museum. Available online at: http://rbcm.gov.bc.ca/nhpapers/ anneh/ text/coverpage.html

Heppner, J. (1998). Classification of Lepidoptera. *Holarctic. Lep.*, 5(1): 148

Hill, M. O. (1973). Diversity and its evenness, a unifying notation and its consequences. *Ecology*, 54: 427-432.

Hussain, K. J., Ramesh, T. , Satpathy, K. K. and Selvanayagam, M. (2011), Seasonal dynamic of butterflies population in DAE campus, Kalpakkam, Tamil Nadu, India. *J. Threat. Taxa*. 30(1):1401-1414.

Kehimkar, I., 2008, The Book of Indian Butterflies, Bombay Natural History Society Oxford University Press, Oxford, New York.

Koli, V. K. (2014). Diversity and status of avifauna in Todgarh-Raoli wildlife Sanctuary, Rajasthan, India. *J. of Asia-Pacific Biodiversity,* 7: 401-407.

Kumar, P., Devi, R. and Mattu, V. K. (2016). Diversity and abundance of Butterfly fauna (Insecta: Lepiddoptera) of subalpine area of Chansal valley of district Shimla (Himachal Prades). *Journal of Entomology and Zoology Studies,* 4(4): 243-247.

Lewis, H. I. (1973). Butterflies of the world. Harrap. London.

Margalef's, R. (1970). Temporal succession and spatial heterogeneity in phytoplankton. In: Perspectives in Marine biology, Buzzati-Traverso (ed.), Univ. Calif. Press, Berkeley. 323-347.

Marshall, G. F. L. and De Niceville L. (1890). The butterflies of India, Burma and Ceylon, Taylor and Francis Ltd., London, 3: 503.

Mathew, G. and Anto M. (2007). In situ conservation of butterflies through establishment of butterfly gardens: A case study at Peechi, Kerala, India. *Current Science*, 93(3): 337-347.

Nair, A.V., Mitra, P. and Aditya S. (2014). Studies on the diversity and abundance of butterfly (Lepidoptera: Rhopalocera) fauna in and around Sarojini Naidu College Campus, Kolkata, West Bengal, India, *Journal of Entomology and Zoology Studies*. 2 (4): 129-134

Parag, E. and Omkar, D. (2009). Three additions to the known butterfly (Lepidotera: Rhopalocera and Grypocera) fauna of Goa, India. *Journal of Threatened Taxa*, 1(5): 298-299.

Pollard, E. and Yates, T. J. (1993). Monitoring Butterflies for Ecology and Conservation. Chapman & Hall, London, UK

Preston-Mafhan, R. and Preston-Mafhan, K. (2004). Butterflies of the world. Octopus Publishing Groups. London.

Rajasekhar, B. (1991). Butterflies of Loyola College Campus. Blackbuck, 7: 3-4.

Rajasekhar, B. (1995). A study on butterfly populations at Guindy national park, Madras. *Journal Bombay Natural Hist. Society*., 92: 275-276.

Raut, N. B. and Pendharkar, A. (2010). Butterfly (Rhopalocera) fauna of Maharashtra Nature Park, Mumbai, Maharashtra, India. *Journal of Species Lists and Distribution*, 6(1) 22-25.

Shannon, C. E. and Wiener, W. (1949). The Mathematical Theory of Communication. Univ. of Illinois Press. Urbana, U.S.A.

Singh, A. P. and Pandey, R. (2004). A model for estimating butterfly species richness of areas across the Indian sub- continent: species proportion of Papilionidae as an Indicator. *Jour. Bombay Nat. Hist. Soc.*, Bombay, 101: 79-89.

Sreekumar, P. G. and Balakrishnan, M. (2001). Habitat and altitude preferences of butterflies in Aralam Wildlife Sanctuary, Kerala. *Tropical Ecology*, 42(2): 277-281.

Stokoe, W. J. (1974). The Observer's Book of Butterflies. W.J. Frederick Warne and Co., London: 191

Wright, D. H. (1983). Species–energy theory: an extension of species–area theory. *Oikos*, 41: 496–506.

Wynter-Blyth, M. A. (1957). Butterflies of the Indian region. *Journal of Bombay Natural History Society*, 523.