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Changes in Butterfly Fauna at Different Altitudes in Central Jharkhand

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Abstract

This study investigates the changes in butterfly fauna across different altitudinal levels in Central Jharkhand. Butterflies, being sensitive bioindicators, provide valuable insights into the health and diversity of ecosystems. The research aimed to document the variations in species composition, abundance, and diversity of butterflies at varying altitudes, ranging from lowland forests to high-altitude regions. Field surveys were conducted over a year, covering three distinct altitudinal zones. Standardized methods, including transect walks and visual counts, were employed to record butterfly species and their abundance. The results revealed significant variations in butterfly diversity and composition across the different altitudes. Lowland areas exhibited higher species richness, with a dominance of generalist species, while mid-altitudinal regions showed a mix of both generalist and specialist species. High-altitude zones, characterized by harsher climatic conditions, had lower species diversity, with the presence of altitude-specialist species. Environmental factors such as temperature, humidity, and vegetation type were found to influence butterfly distribution and diversity. This study highlights the importance of altitudinal gradients in shaping butterfly communities and underscores the need for conservation efforts in diverse habitats.

Keywords: *Butterfly diversity, Altitudinal gradients, Ecosystem health, Species composition, Conservation strategies.*

1. Introduction

Butterflies are not only one of the most colorful and diverse groups of insects but also serve as crucial bioindicators of environmental health and biodiversity. Studying their distribution and diversity can provide valuable insights into the health of ecosystems, especially in regions experiencing significant environmental changes. Central Jharkhand, with its unique topographical and climatic variations, offers a rich tapestry of habitats that are home to diverse butterfly species. This region, characterized by a range of altitudinal zones from lowland forests to high-altitude areas, presents an ideal setting to study how altitude influences butterfly fauna. The intricate interplay of temperature, humidity, vegetation, and other environmental factors across these altitudinal gradients can lead to significant variations in butterfly species composition and abundance.

The primary objective of this study is to investigate the changes in butterfly fauna across different altitudinal levels in Central Jharkhand. By documenting the variations in species richness, composition, and diversity, this research aims to understand the impact of altitude on butterfly communities. The study area includes three distinct altitudinal zones: lowland forests, mid-altitude regions, and high-altitude zones. Each of these zones possesses

unique environmental conditions that are expected to influence the presence and distribution of butterfly species. Lowland forests, with their relatively stable and warm climate, are anticipated to host a higher number of generalist species. In contrast, mid-altitude regions may support a mix of generalist and specialist species due to the intermediate climatic conditions. High-altitude zones, often characterized by harsher and more variable climates, are expected to have lower species diversity with a predominance of altitude-specialist species.

Field surveys were meticulously conducted over a year, employing standardized methods such as transect walks and visual counts to record butterfly species and their abundance. These methods ensure a comprehensive and systematic collection of data, facilitating accurate comparisons across different altitudinal zones. Environmental parameters, including temperature, humidity, and vegetation type, were also recorded to understand their correlation with butterfly distribution and diversity. Preliminary observations indicate significant differences in butterfly fauna across the altitudinal gradient. The lowland areas, with their richer vegetation and milder climate, exhibit higher species richness. In contrast, the high-altitude zones, though less diverse, are home to unique species adapted to the colder and more rigorous environment. This pattern underscores the importance of altitude as a determinant of species distribution and highlights the need for targeted conservation efforts.

2. Study Area

Ghatsila, located in the Chota Nagpur Plateau (22.6°N- 86.48°E) at an elevation of 103 meters, is a region rich in diverse habitats. The southern side of this small town is bordered by the Subernarekha River. The terrain of Ghatsila includes a variety of landscapes such as the reservoir of a dam, small hillocks, valleys, rivulets, springs, and mining areas. The study area is notable for its lateritic plains and hillocks, which are covered with shrubby vegetation and forests that range from sparse to highly dense. The dominant vegetation includes trees like Shorea robusta, Azadirachta indica, Butea monosperma, and some plantations of eucalyptus and acacias. The region also experiences frequent visits from wild elephants,

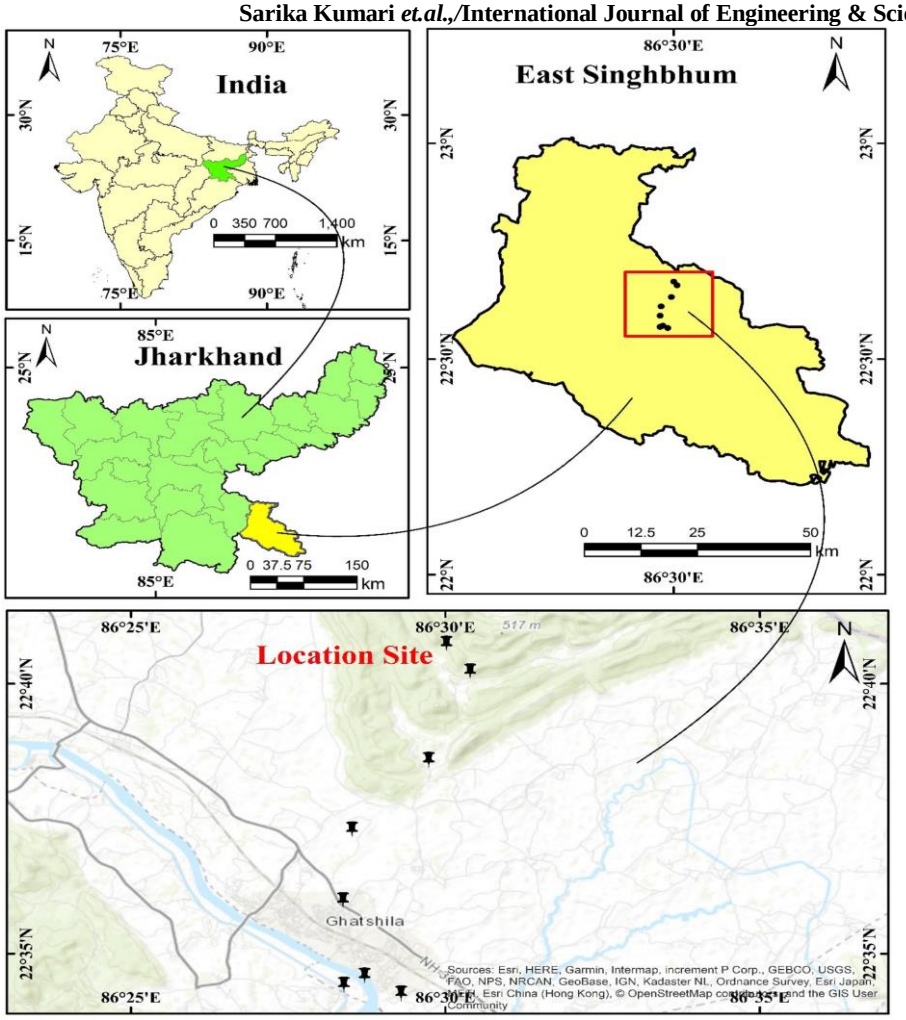

Fig. 1 Graphical drawing and satellite image the study area comprising of eight sites (S1-S8)

which often lead to the destruction of crops in human settlements, resulting in human-animal conflicts. These conflicts are a common occurrence in Ghatsila, highlighting the challenges of coexistence between the local wildlife and the human population.

3. Methods

The Pollard walk method (Pollard et al., 1975; Pollard, 1977) was employed to survey butterflies. Sampling was conducted on sunny days between 7 and 10 AM, without using insect nets. Eight sites, labeled S1 to S8, were sampled (Fig. 1, Table 1). Most species were identified through photographs taken from various angles using a Canon 600D with a 55–250 mm f/4–5.6 lens and a Nikon L820 point-and-shoot camera. Species identification followed the works of Evans (1932), Wynter-Blyth (1957), Kehimkar (2008), Kunte (2012), and the website 'ifoundbutterflies.org'. The identifications made in this study are tentative and aimed at describing the observed diversity; they may need authentication for taxonomic purposes, checklist preparation, and geographical distribution descriptions in future studies.

To analyze the richness, diversity, and dominance of the recorded species, the Shannon index, species abundance ranking, and Simpson index were used. The Lorenz curve was drawn to illustrate inequality in population distribution among different species in the community (Damgaard and Weiner, 2000). Species evenness was assessed using Pielou's index. Additionally, a rank abundance curve was plotted to represent the relative abundance of species.

4. Result & Discussion

The study identified 72 butterfly species belonging to six families and 55 genera (Table 2). The family Nymphalidae had the highest number of specimens (n = 1577, 39.623%), followed by Lycaenidae (n = 1423, 35.73%), Pieridae (n = 485, 12.185%), Papilionidae (n = 308, 7.738%), Hesperiidae (n = 176, 4.422%), and Riodinidae (n = 11, 0.276%) of the total butterfly sample observed. The Shannon-Weiner diversity index value of 5.694 indicated high species richness and diversity in the study area. The Simpson's index value of 0.0269 and Berger Parker Dominance index value of 0.0989 suggested that a few species dominated the total abundance and observed diversities.

Table 1 Study locations in Ghatsila, Jharkahnd and their geo- coordinates

Study area	Name of the location	Coordinates
S1	Amainagar	22.5739°N-86.4731°E
S2	Harindungri	22.5712°N-86.4833°E
S3	Kandarbera Picnic Spot	22.5767°N-86.4786°E
S4	Phuldungri	22.5999°N-86.4729°E
S5	Jhaprisol	22.6217°N-86.4753°E
S6	Dharagiri	22.6791°N-86.5003°E
S7	Burundi	22.6432°N-86.4956°E
S8	Basadera	22.6705°N-86.5066°E

The Margalef Richness index value of 8.566 also indicated high species richness. The percentage distribution of butterflies among different families showed that the Riodinidae family had the lowest occurrence (0.276%) in the present survey, suggesting that the habitat is unfavorable for this family and requires further study. The Pielou's evenness index of 0.9199 suggested high evenness in the occurrence of butterflies within individual species at different sampling sites. The rank abundance curve of the recorded butterflies showed a steep initial inclination in the Whittaker Plot (Fig. 2), indicating that fewer species occurred in high abundance compared to many species that occurred in low abundance. The Lorenz curve (Fig. 3) showed an unequal distribution of different species in the community at different sites.

This study is the first account of butterfly diversity and abundance in the dry and scrub forests of Jharkhand state, India. Latitudinal variations in species richness and diversity of butterflies in the tropics, which have the highest diversity, have been previously described (Larsen 2005; Bonebrake et al., 2010). Anthropogenic activities such as pollution, and the indiscriminate use of pesticides, insecticides, and herbicides often lead to the depletion of butterfly populations. The present survey reveals higher species richness of butterflies in the study area compared to other insects (Jana et al., 2013; Samanta et al., 2017; Pahari et al., 2018). Higher species richness in an area

signifies higher genetic diversity, higher productivity, and stable ecosystems. Previous studies supported that Nymphalidae was the most dominant family in the semi-urban areas of Howrah and Haldia districts of West Bengal (Mandal, 2016; Pahari et al., 2018), whereas Lycaenidae was the most dominant family in the suburban areas of Kolkata, West Bengal (Mukherjee et al., 2015). The prevalence of the family Nymphalidae in terms of species diversity in the present investigation is consistent with the results of other studies (Singh, 2009, 2012; Sengupta et al., 2014; Agarwala and Majumder, 2015; Mandal, 2016).

Table 2 Butterfly species, their common names and records of abundance during the two- year study period

Sr. No.	Scientific Name	Common name	Nos. found
1	*Prosotas nora* (Felder, 1860)	Common Lineblue	394
2	*Catopsilia pomona* (Fabricius, 1775)	Common Emigrant	209
3	*Prosotas dubiosa* (Semper, 1879)	Tailless Lineblue	129
4	*Euthalia nais* (Forster, 1771)	Baronet	118
5	*Euploea core* (Cramer, 1780)	Common Crow	117
6	*Papilio polytes* (Linnaeus, 1758)	Common Mormon	116
7	*Mycalesis perseus* (Fabricius, 1775)	Common Bushbrown	112
8	*Phalanta phalantha* (Drury, 1773)	Common Leopard	103
9	*Danaus genutia* (Cramer 1779)	Common Tiger	96
10	*Eurema hecabe* (Linnaeus, 1758)	Common Grass Yellow	94
11	*Castalius rosimon* (Fabricius, 1775)	Common Pierrot	93
12	*Junonia hierta* (Fabricius, 1798)	Yellow Pansy	88
13	*Melanitis leda* (Linnaeus, 1758)	Common Evening Brown	83
14	*Arhopala amantes* (Hewitson, 1862)	Large Oakblue	81
15	*Junonia almana* (Linnaeus, 1758)	Peacock Pansy	79
16	*Acraea terpsicore* (Linnaeus, 1758)	Tawny Coster	73
17	*Euthalia aconthea* (Cramer, 1777)	Common Baron	72
18	*Amblypodia anita* (Hewitson, 1862)	Purple Leaf Blue	71
19	*Tirumala limniace* (Cramer, 1775	Blue Tiger	71
20	*Arhopala atrax* (Hewitson, 1862)	Indian Oakblue	68
21	*Delias eucharis* (Drury, 1773)	Common Jezebel	67
22	*Junonia iphita* (Cramer, 1779)	Chocolate Pansy	67
23	*Leptosia nina* (Fabricius, 1793)	Psyche	63
24	*Ariadne ariadne* (Linnaeus, 1763)	Angled Castor	62
25	*Anthene emolus* (Godart, 1823)	Common Ciliate Blue	57
26	*Matapa aria* (Moore, 1865)	Common Redeye	54
27	*Chilades lajus* (Stoll, 1780)	Lime Blue	54
28	*Caleta decidia* (Hewitson, 1876)	Angled Pierrot	53
29	*Acytolepis puspa* (Horsfield, 1828)	Common Hedge Blue	53
29	*Loxura atymnus* (Stoll, 1780)	Yamfly	52
30	*Polyura athamas (Drury, 1773)*	Common Nawab	52
31	*Zizeeria maha* (Kollar, 1844)	Pale Grass Blue	51
32	*Pareronia hippia* (Fabricius, 1787)	Common Wanderer	46
33	*Moduza procris* (Cramer, 1777)	Commander	46
34	*Ypthima huebneri* (Kirby, 1871)	Common Four-ring	46
35	*Chilades pandava* (Horsfield, 1829)	Plains Cupid	46
36	*Pachliopta aristolochiae* (Fabricius, 1775)	Common Rose	44

37	*Mycalesis mineus* (Linnaeus, 1758)	Dark-banded Bushbrown	44
38	*Neopithecops zalmora* (Butler, 1870)	Common Quaker	41
39	*Charaxes bernardus* (Fabricius, 1793)	Tawny Rajah	39
40	*Danaus chrysippus* (Linnaeus, 1758)	Plain Tiger	39
41	*Badamia exclamationis* (Fabricius, 1775)	Brown Awl	37
42	*Neptis hylas* (Linnaeus, 1758)	Common Sailer	36
43	*Jamides celeno* (Cramer, 1775)	Common Cerulean	36
44	*Papilio demoleus* (Linnaeus, 1758)	Lime	34
45	*Hypolimnas bolina* (Linnaeus, 1758)	Great Eggfly	34
46	*Rapala manea* (Hewitson, 1863)	Slate Flash	33
47	*Graphium nomius* (Esper, 1799)	Spot Swordtail	27
48	*Zeltus amasa* (Hewitson, 1865)	Fluffy Tit	27
49	*Udaspes folus* (Cramer, 1775)	Grass Demon	26
50	*Kallima inachus* (Doyere, 1840)	Orange Oakleaf	25
51	*Graphium doson* (Felder & Felder, 1864)	Common Jay	24
52	*Catochrysops strabo* (Fabricius, 1793)	Forget-me-not	24
53	*Graphium antiphates* (Cramer, 1775)	Five bar swordtail	22
54	*Spialia galba* (Fabricius, 1793)	Indian Skipper	22
55	*Papilio clytia* (Linnaeus, 1758)	Common Mime	21
56	*Lasippa viraja* (Moore, 1872)	Yellow Jack Sailor	21
57	*Curetis thetis* (Drury, 1773)	Indian Sunbeam	19
58	*Tagiades japetus* (Stoll, 1781)	Common Snowflat	17
59	*Lampides boeticus* (Linnaeus, 1767)	Pea Blue	17
60	*Lethe europa* (Fabricius, 1775)	Bamboo Tree Brown	16
61	*Athyma perius* (Linnaeus, 1758)	Common Sergeant	16
62	*Caprona ransonnettii* (Felder, 1868)	Golden Angle	16
63	*Charaxes solon* (Fabricius, 1793)	Black Rajah	15
64	*Jamides bochus* (Stoll, 1782)	Dark Cerulean	12
65	*Spalgis epeus* (Westwood, 1851)	Apefly	12
66	*Papilio polymnestor* (Cramer, 1775)	Blue Mormon	11
67	*Abisara bifasciata* (Moore, 1877)	Double banded Judy	11
68	*Graphium agamemnon* (Linnaeus, 1758)	Tailed Jay	9
69	*Euthalia lubentina* (Cramer, 1777)	Gaudy Baron	7
70	*Ixias marianne* (Cramer, 1779)	White Orange Tip	6
71	*Taractrocera maevius* (Fabricius, 1793)	Oriental Grass Dart	4
	Total number of individuals observed		3980

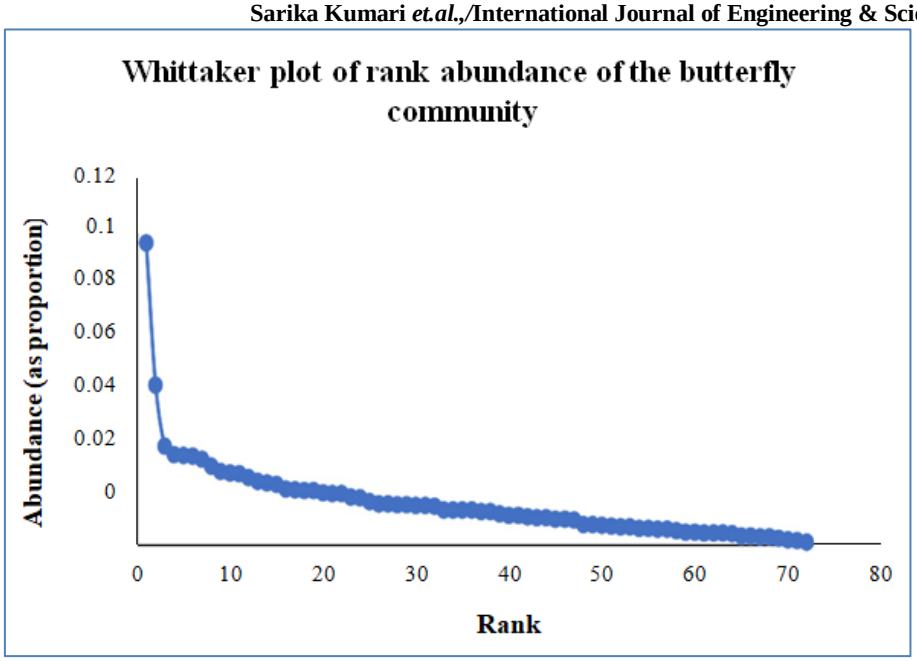

Fig. 2 Rank abundance of the butterfly species recorded in the study

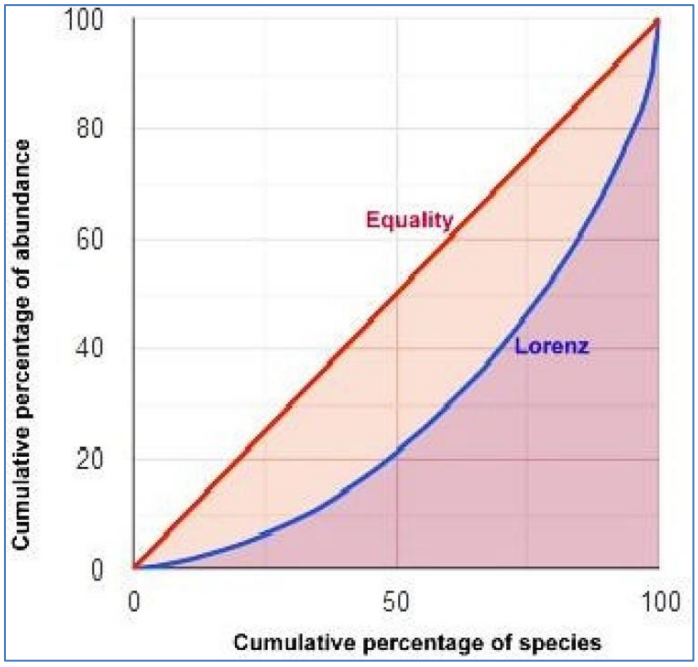

Fig. 3 Lorenz-curve showing inequality in species richness and abundance

The study site's significance extends beyond butterfly diversity, as it is also home to mammalian species such as Elephas maximus and Ursus thibetanus, leading to occasional human-animal conflicts. Butterfly diversity is closely linked to floral productivity, as these insects are highly dependent on specific host plants. Conservation efforts for butterfly populations can be effectively achieved by promoting vegetation growth in habitats favored by butterflies, thereby fostering sustainable environmental development (Lawton et al., 1988; Warren et al., 2021). The preliminary scientific data from Ghatsila presented in this study can be considered a reflection of the area's

ecological health, emphasizing the importance of conservation measures for maintaining biodiversity and ecological balance.

5. Conclusion

In conclusion, the study conducted in the dry and scrub forests of Jharkhand, India, identified a total of 72 butterfly species belonging to six families and 55 genera. The family Nymphalidae was the most abundant, followed by Lycaenidae, Pieridae, Papilionidae, Hesperiidae, and Riodinidae. The high Shannon-Weiner diversity index value of 5.694 indicated a rich diversity of butterfly species in the study area. However, the Simpson's index and Berger Parker Dominance index values suggested that a few species dominated the total abundance and observed diversities. The Margalef Richness index value of 8.566 also indicated high species richness. The percentage distribution of butterflies among different families showed that the Riodinidae family had the lowest occurrence, suggesting an unfavorable habitat for this family.

The study site's importance was highlighted by the presence of mammalian species such as Elephas maximus and Ursus thibetanus, leading to occasional human-animal conflicts. Butterfly diversity was found to be dependent on floral productivity, emphasizing the importance of conservation efforts to enhance vegetation in butterfly-favored habitats. The preliminary scientific data from Ghatsila presented in this study can be considered indicative of the area's ecological health. Overall, the study underscores the need for conservation measures to maintain the biodiversity and ecological balance of the region, especially in the face of anthropogenic activities such as pollution and the indiscriminate use of pesticides, insecticides, and herbicides, which can lead to the depletion of butterfly populations.

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