Species Richness and Community Composition of Butterflies in the Coastal Habitat of Daman

Monika Dubey* and Rajpurohit Devika

Government College Daman - Kunta Rd, Dunetha, Daman-396210, India.

***Corresponding Author**l: monika_aqua12@yahoo.co.in

ABSTRACT

The present study assessed the species richness and community composition of butterflies in coastal habitat of Daman, documenting a total of 27 species belonging to five families, Nymphalidae, Pieridae, Papilionidae, Lycaenidae, and Hesperiidae. A total of 288 individuals were recorded, with Nymphalidae contributing the highest proportion (33%), followed by Pieridae (22%), Papilionidae and Lycaenidae (19% each), with Hesperiidae (7%). Species richness was highest in Nymphalidae (9 species) with highest abundance (89 individuals). The Shannon–Wiener diversity index (H') was calculated as 1.511, indicating a moderate level of diversity with fair species evenness and richness. This indicates that the butterfly community maintains a balanced composition with no single species predominating, reflecting moderately diverse habitat conditions and adequate resource availability. The results serve as a valuable baseline for future monitoring efforts and emphasize the need to conserve floral diversity and microhabitat complexity to support butterfly populations.

Keywords: *Butterfly diversity, Shannon–Wiener index, Species richness, Nymphalidae, habitat heterogeneity*.

INTRODUCTION

India is recognized as one of the world's mega-biodiverse nations (Venkataraman, 2012), encompassing ecosystems that range from the snow-clad temperate forests of the Himalayas to the tropical wet evergreen forests of the Western Ghats (Khara *et al.,* 2013). This vast environmental heterogeneity supports an extensive array of life forms across numerous taxa, including a particularly rich and diverse insect fauna, especially within the order Lepidoptera (Chandra, 2011; Pinkert *et al.,* 2022).

Approximately 18,000 to 20,000 butterfly species are known globally (Mathew, 2006; Kunte, 2000), recent comprehensive checklists identified around 19,327 accepted species worldwide, with nearly 1,500 to 1,504 of these species occurring in India (Pinkert *et al.,* 2022). The butterfly fauna of the southern Indian peninsula is particularly rich and diverse due to its variety of habitats, wide altitudinal gradients and associated microclimatic regimes (Lekshmi, 2017).

Butterflies, among the most colourful and visually striking insect groups (Medhi *et al.,* 2018), inhabit a diverse array of ecosystems including wetlands, grasslands, forests, deserts, alpine regions, and urban landscapes (Rani and Kashyap, 2024). They are closely related to moths, from which they diverged approximately 56 million years ago (DE Jong, 2016), and their unimodal activity pattern shows a peak around solar noon in a controlled environment condition (Riva *et al.,*2023).

Ecologically, butterflies play a vital role as pollinators, ranking second only to bees in their pollination efficiency (Barrios*et al.,* 2016). They also function as ecological indicators, reflecting habitat health and environmental changes such as climate variability and habitat degradation (Medhi

et al., 2018). Declines in butterfly diversity often signal loss of host plants or habitat degradation (Medhi *et al.,* 2018). Anthropogenic pressures including deforestation, urbanization, and infrastructure developmenthave been strongly linked to reductions in species richness, diversity, and abundance (Yadav and Kumar, 2024). Furthermore, ongoing climate change is altering butterfly life cycles and disrupting ecological balance (Shoucheand Ratnakar, 2018), underscoring the urgency for targeted conservation strategies.

Given their ecological importance and sensitivity to environmental changes, butterflies are ideal bioindicators for assessing habitat quality (Bhoye and Makode, 2025). This study aimed to conduct species richness and community composition of butterflies in coastal habitat of Daman, providing baseline data for conservation planning and biodiversity management in the region.

MATERIAL AND METHODS

Study area

The present study was carried out in Moti Daman Fort, located in Daman. The Fort covers an area of approximately 30,000 square meters and is situated at 20.42° N latitude and 72.85° E longitude (Figure 1).

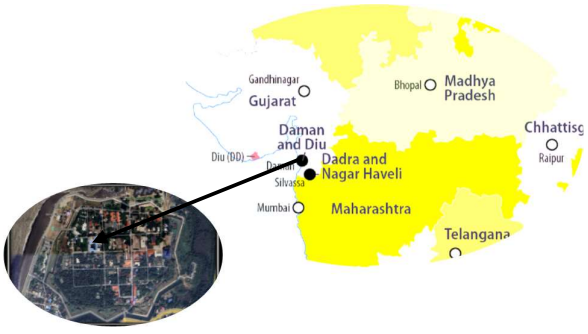


Fig. 1. Map of study area

Sample collection

The study was conducted from July 2024 to March 2025 in Moti Daman Fort area (Figure1). Butterfly diversity was assessed through an extensive field survey on regular interval, employing through the "Pollard Walk" method with few modifications in advanced statistical modelling and technological integration to improve data reliability (Pollard, 1977; Pollard and Yates, 1993) and photographs were taken using DSLR camera for the identification.

Identification

The identification of butterflies was carried out with the help of identification keys (Smetacek, 2017).

Statistical analysis

Diversity indices

Shannon - Wiener Index (H'): The Shannon index is a metric for determining the diversity and abundance of species. It's calculated using the following formula (Nolan and Callahan,2005).

$$H' = -\sum_{i=1}^{S} pi \ ln \ pi$$

Where:

H' = Shannon - Wiener index for species diversity,

S = Number of species,

Pi = Proportion of total sample belonging to the ith species, and

ln = Natural log.

In general, H' < 1: Low diversity (dominance by one or a few species), H' = 1–3: Moderate diversity (balanced community) and H' > 3: High diversity (many species with even distribution)

Species richness (S) Total number of distinct species recorded.

Diversity index, were calculated using PAST(version 4.03) software and for efficient statistical analysis (Hammer *et al.,* 2001).

RESULTS AND DISCUSSION

The results revealed a total 288 individuals of butterflies were recorded, belonging to 5 families (Table 1 and 2) and (Figure 3).

Species composition and percentage

A total number of 288 butterfly species belonging to five families - Papilionidae, Pieridae, Lycaenidae, Nymphalidae, Hesperiidae were recorded in the Daman Fort area, whereas Nymphalidae emerged as the most dominant family, contributing 89 species (33%), followed by Pieridae (84; 22%), Lycaenidae (49; 19%), Papilionidae (42; 19%), and Hesperiidae (24; 7%). The sequence of family dominance was: Nymphalidae>Pieridae>Lycaenidae = Papilionidae>Hesperiidae.

Table 1. Check list of butterflies from study area

Sr. No.	Scientific Name	Common Name	Individuals (Male & Female)
Family: Papilionidae			
1.	*Papilio polytes* Linnaeus, 1758	Common mormon	15
2.	*Papilio demoleus* Linnaeus, 1758	Lime	13
3.	*Garphium agamemnon* Linnaeus, 1758	Tailed Jay	4
4.	*Pachliopta aristolochiae* Fabricius, 1775	Common rose	3
5.	*Garphium sarpedon* Linnaeus, 1758	Common Bluebottle	7
Family: Pieridae			
6.	*Luthrodes pandava* Horsfield, 1829	Plains Cupid	14
7.	*Rathinda amor* Fabricius, 1775	Monkey Puzzel	2
8.	*Talicada nyseus* Guérin-Méneville, 1843	Red Pierrot	6
9.	*Catopsilia pyranthe* Linnaeus, 1758	Mottled Emigrant	17
10.	*Delias eucharis* Drury, 1773	Common Jezabel	20
11.	*Eurema hecabe* Linnaeus, 1758	Common Grass Yellow	25
Family: Lycaenidae			
12.	*Curetis thetis* Drury, 1773	Angled Sunbeam	3
13.	*Castalius rosimon* Fabricius, 1775	Common Pierrot	11
14.	*Euchrysops cnejus* Fabricius, 1798	Gram Blue	9
15.	*Pseudozizeeria maha* Kollar, 1844	Pale Grass Blue	13
16.	*Catochrysops strabo* Fabricius, 1793	Forgetmenot	13
Family: Nymphalidae			
17.	*Danaus genutia* Cramer, 1779	Common Tiger	10
18.	*Tirumala limniace* Cramer, 1775	Blue Tiger	12
19.	*Hypolimnas bolina* Linnaeus, 1758	Great Eggfly	19
20.	*Hypolimnas misippus* Linnaeus, 1764	Danaid Eggfly	4
21.	*Euploea core* Cramer, 1780	Common Crow	19
22.	*Junonia lemonias* Linnaeus, 1758	Lemon Pansy	7
23.	*Junonia iphita* Cramer, 1779	Chocolate Pansy	11
24.	*Elymnias hypermnestra* Linnaeus, 1763	Common Palmfly	1
25.	*Junonia almanac* Linnaeus, 1758	Peacock Pansy	6

Family: Hesperiidae			
26.	*Telicota colon colon* Fabricius, 1775	Pale Palm-Dart	4
27.	*Pelopidas subochraceas ubochracea* Moore, 1878	Large Branded Swift	20

The higher representation of Nymphalidae may be attributed to high richness and abundance (Figure 2) which was consistent with its preference for open sunny habitats and flowering plants common in the fort premises. Similar, observation was coined by Sharma and Joshi (2009) and Kumari *et al.* (2024).

Table 2. Species richness and Shannon-Wiener diversity index (H') of butterflies

Sr. No.	Family	Number	
		Species	**Individual (Male & Female)**
1.	Papilionidae	5	42
2.	Pieridae	6	84
3.	Lycaenidae	5	49
4.	Nymphalidae	9	89
5.	Hesperiidae	2	24
Total		**27**	**288**
Shannon - Wiener index (H')		**1.511**	

Species Diversity Index

The Shannon Diversity Index (H') for butterfly species in the study area was calculated to be 1.511 (Table 2). The observed value reflects a moderate level of diversity, suggesting that the butterfly assemblage comprises a reasonably balanced mix of species without being overwhelmingly dominated by a single taxon.

This moderate diversity indicates both fair species richness a sufficient number of species present and fair species evenness, meaning that individuals are relatively evenly distributed among species (Hill, 1973). Such diversity levels are often characteristic of habitats that are moderately heterogeneous and offer a variety of resources such as nectar plants, larval host plants, and microhabitats (Kocher and Williams, 2000).

From a conservation perspective, moderate diversity suggests a somewhat stable but potentially vulnerable butterfly community. External pressures such as habitat degradation, pesticide use, or climatic variation could tip the balance toward lower diversity if resource availability or microhabitat structure is altered (Thomas, 2005). Therefore, ongoing monitoring and the preservation of nectar and larval host plant diversity remain essential for sustaining and potentially enhancing butterfly diversity in the region.

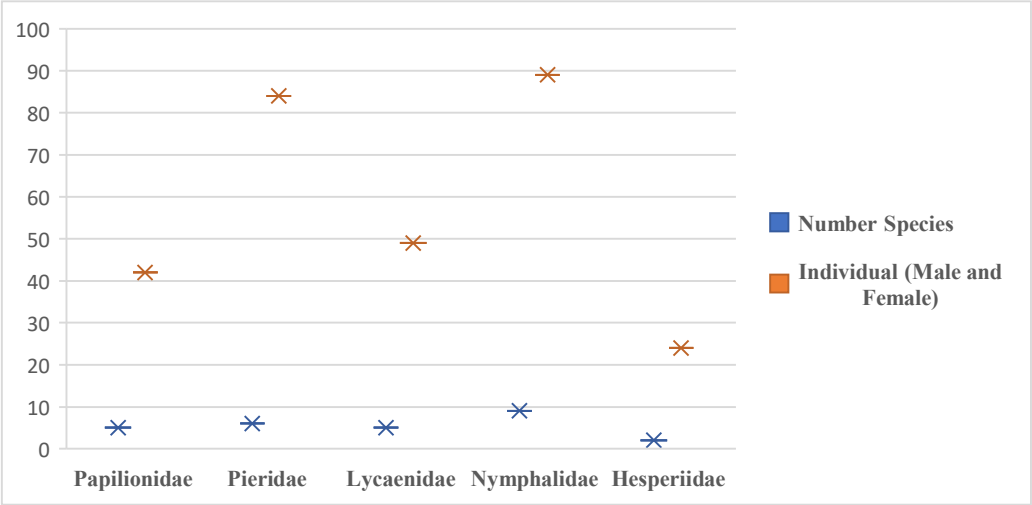
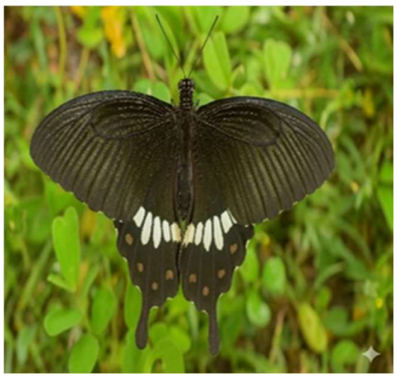


Fig. 2. Butterfly species richness and abundance across five families

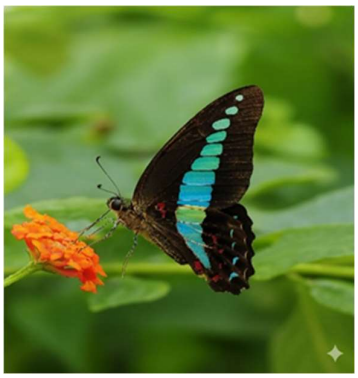
1.*Papilio polytes*

2.*Papilio demoleus*

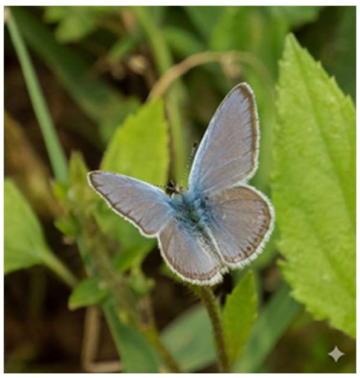
3.*Garphium agamemnon*



4.*Pachliopta aristolochiae*



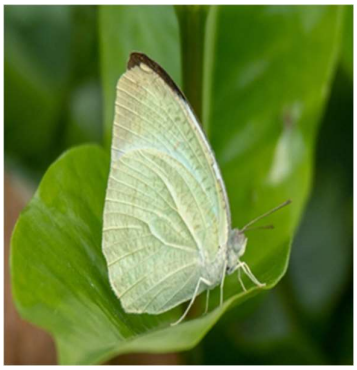
5. *Garphium Sarpedon*



6.*Luthrodes pandava*

7.*Rathinda amor*

8.*Talicada nyseus*



9.*Catopsilia pyranthe*

10.*Delias eucharis*

11.*Eurema hecabe*

12.*Curetis thetis*

13.*Castalius rosimon*

14.*Euchrysops cnejus*

15.*Pseudozizeeria* maha

Fig. 3. Diversity of butterflies in Daman

CONCLUSION

The study highlights a moderately diverse butterfly community in Daman, represented by 27 species across five families, with Nymphalidae showing the highest richness and abundance. The Shannon–Wiener index (H' = 1.511) reflects balanced species distribution and fair evenness, suggesting that the local habitats provide adequate resources and environmental stability. These findings serve as an important baseline for long-term biodiversity monitoring and emphasize the importance of conserving floral resources and habitat heterogeneity to sustain butterfly populations.

ACKNOWLEDGEMENT

The authors would like to thank Head, Department of Zoology, Government College, Daman for providing the laboratory facilities for conducting this research.

REFERENCES

Barrios, B., Pena, S. R., Salas, A. and Koptur, S. 2016. Butterflies visit more frequently, but bees are better pollinators: the importance of mouthpart dimensions in effective pollen removal and deposition.*AOB PLANTS*. **8**: plw001.10.1093/aobpla/plw001.

Bhoye, S. B. and Makode, P.M. 2025.The role of butterflies as bioindicators in ecosystem health in fragmented forest and agricultural landscapes.*Recent Trends in Science and Technology: A Proceedings of NCRTST-2025*. 665-667.

Chandra, K. 2011. Insect fauna of states and Union Territories in India. In: Uniyal, V. P. and Shrivastava, A. (Eds.), Arthropods and their conservation in India (Insects and Spiders). *ENVIS Bulletin.* **14**: 114–128.

DE Jong, R. 2016. Reconstructing a 55-million-year-old butterfly (Lepidoptera: Hesperiidae). *Eur. J. Entomol.***113**(1): 15-22.10.14411/eje.2016.055.

Hammer, O., Harper, D. A. T. and Ryan, P. D. 2001. PAST: Palaeontological statistics software package for education and data analysis. *Palaeontol. Electron*. **4**(1): 1-9.http://palaeo-electronica.org/2001_1/past/issue1_01.htm.

Hill, M.O. 1973. Diversity and evenness: A unifying notation and its consequences. *Eco.***54**(2): 427-432. https://doi.org/10.2307/1934352.

Khara, U., Das, B. and Bandyopadhyay, A. 2013. Impact of climate change on forest: A study of Western Himalayan regions in India. *Inter. J. Sci. & Tech.***1**(1):34-38. https://www.researchgate.net/publication/312045123_Impact_Of_Climate_Change_On_Forest_A_Study_Of_Western_Himalayan_Regions_In_India.

Kocher, S.D. and Williams, E.H. 2000. The diversity and abundance of North American butterflies, vary with habitat disturbance and geography. *J. Lepid. Soc.* **54**(1): 37-46.10.1046/j.1365-2699.2000.00454.x

Kumari, N., Prakash, S., Ranjan, R., Mahto, S. and Jain, A. 2024. A study on species diversity of butterfly in selected area of Ranchi District, Jharkhand, India. *IJSR.* **13**(5):99-104.https://dx.doi.org/10.21275/SR24501165846.

Kunte, K.2000. Butterflies of peninsular India. Universities Press, Hyderabad.https://www.biodiversitylab.org/butterflies-of-peninsular-india.

Lekshmi, P., Krishnaraj, V., Janaranjini, S. and Lakeshmanaswamy. 2017. Studies on butterfly diversity in Adichanalloor Village, Kollam District, Kerala.*J. Entomol. Zool. Stud.***5**(5): 73-81.

Magurran, A.E. 2004. Measuring biological diversity. Blackwell Publishing, Oxford.

Mathew, G. 2006. Development of butterfly farming enterprises vis-à-vis conservation and sustainable utilization of biodiversity no. 286. KFRI Research Report.50.

Medhi, J., Barman, J. and Sharma, S. 2018. Assessment on butterfly and its diversity in Tegheria (Waterfall), Dimoria development Block, Kamrup (M) district of Assam, India. *J. Entomol. Zool. Stud.***6**(3): 1746-1750.

Nolan, K. A. and Callahan, J. E. 2005.Beachcomber Biology: The Shannon–Wiener species diversity index. *ABLE 2005 Proc.* **27**:334-338.

Pinkert, S., Barve V., Guralnick, R. and Jetz, W. 2022. Global geographical and latitudinal variation inbutterfly species richness captured through a comprehensive country-level occurrence database. *Global Eco. and Biogeo.***31**(5): 830-839. https://doi.org/10.1111/geb.13475.

Pinkert, S., Marcer, A. and Brandl, R. 2022. Country-level checklists and occurrences for the world's butterflies. *J. Bioge.* **49**(8):1459-1471.

Pollard, E. 1977. A Method for assessing changes in abundance of butterflies. *Biol. Conser.* **12**:116–134.

Pollard, E. and Yates, T.J. 1993. Monitoring butterflies for ecology and conservation. London: Chapman and Hall. 292.

Rani, R., and Kashyap, H. 2024. A study on butterfly diversity and abundance in vicinity of Indira Gandhi National Tribal University campus, Amarkantak (M.P.). India.*Int. J. Entomol. Res.***9**(4): 19-26.

Riva, F., Picard, A.P. D.and Larrivée, M. 2023. Butterfly foraging is remarkably synchronous in an experimental tropical macrocosm. *Biol. Lett.* **19**(3): 20220555. https://doi.org/10.1098/rsbl.2022.0555.

Sawant, P.P. 2019. Understanding of Insects and Their Ecological Roles. *IJARSCT*. **5**(1): 79-87.10.48175/568.

Sharma, K. and Joshi, P. C. 2009. Diversity of butterflies (Lepidoptera: Rhopalocera) from Dholbaha Dam, District Hoshiarpur, Punjab, India. *Biol. Forum*.**1**(2): 11-14.

Shouche, S. and Ratnakar, S.S. 2018. Diversity and richness of butterflies from Government Madhav Science College campus, Ujjain, Madhya Pradesh, India. *J. Entomol. Zool. Stud.***6**(2): 939-942.10.13140/RG.2.2.19123.73767.

Smetacek, P. 2017. A naturalist's guide to the butterflies of India, Pakistan, Nepal, Bhutan, Bangladesh and Sri Lanka. John Beaufoy Publishing Ltd., United Kingdom. 176.

Thomas, J.A. 2005. Monitoring change in the abundance and distribution of insects using butterflies and other indicator groups.*Phil. Trans. R. Soc. B or Phil. Trans. B.* **360** (1454): 339-357. https://doi.org/10.1098/rstb.2004.1585.

Venkataraman, K. 2012. Biodiversity and its conservation. *Proc. Natl. Acad. Sci., India, Sect. B. Biol. Sci.***82** (2): 271–282 (2012). https://doi.org/10.1007/s40011-012-0096-z.

Yadav, N. and Kumar, A. 2024. Effect of anthropogenic activity on butterfly population at sanjay gandhi postgraduate institute of medical sciences, Lucknow, UP. *IJCRT*. **12**(5): k192-k201.