International Journal of Entomology Research
www.entomologyjournals.com
ISSN: 2455-4758
Received: 10-12-2023, Accepted: 26-12-2023, Published: 11-01-2024
Volume 9, Issue 1, 2024, Page No. 46-50

Threats to butterfly fauna (Order: Lepidoptera) amidst rural and urban landscapes of Mysore district, Karnataka, India

Bhagya U, S Basavarajappa*
Department of Studies in Zoology, University of Mysore, Manasagangotri, Mysore, Karnataka, India

Abstract
Butterflies are indicators of quality of different types of agro-climatic landscapes and show altered dispersal ability and more sensitivity to changing environmental conditions as well. Under human modified habitats, butterfly species are facing various threats and necessitated their conservation to safeguard the local biodiversity. Published reports on threats and problems to butterfly fauna amidst modified and managed rural and urban landscapes are diffuse. In this regard, systematic field investigations were made using visual count, point count and photographic documentation methods by earmarking variable width line transects along with all out search methods at rural and urban human modified landscapes during 2022-23 at Mysore district. Results indicated interesting facts. In general, different species of butterflies are facing severe threat due to changing weather conditions, non-availability of suitable host plant species, inadequate foraging plants during larval stage, unwanted disturbances during breeding period and other man-made activities both at rural and urban human modified landscapes. However, agricultural intensification, livestock grazing, habitat destruction, habitat fragmentation, pesticide application, frequent weeding and disturbance during breeding period have impacted the butterfly population midst human managed and modified habitats at urban landscapes. Hence, it is high time to protect locally available butterfly fauna to restore local biodiversity, appropriate mitigation measures are necessitated. Since, butterflies help reveal the status of an ecosystem, act as useful links with various food chains, food web and many species act as important pollinators at different tropic levels of every ecosystem. Hence, their presence reveals the local diversity of plants and vegetation types. Therefore, care should be taken while doing habitat modification, alteration, host plant and food plants uprooting. All these practices are necessary both at rural and urban landscapes, suitable eco-friendly measures with minimum interference on local vegetation could be made at different agro-climatic landscapes both at rural and urban areas.

Keywords: Threats, butterfly species, modified and managed rural and urban landscapes

Introduction
Butterflies are considered as indicators of changes in different types of environments due to their high dispersal ability and sensitivity to changing environmental conditions (Podgorska *et al*., 2022; Sharma and Sharma, 2013) [2]. Hence, they are referred as flagship species for assessing different habitats under threat and thus helps in the conservation of local biodiversity (Braby, 2004) [3]. Moreover, butterflies show short life cycle, narrow niches and low mobility. These habits made them to exhibit more sensitivity to land-cover and land-use changes compared to long-lived animals (Munyuli, 2013) [4].

Habitat management practices midst agriculturally intensified areas are one of the challenging tasks in the present days. It involves the restoration of abandoned habitats which could help reduce the decline and extinction of specialist butterflies (Popovic and Nowicki, 2023). Moreover, in recent years human dominated landscapes are increasing day by day that amounts increased cover of human inhabitation (Yager *et al*., 2016) [6]. Human modified landscapes with more interference due to man-made activities that could hinder the vegetation cover by altering the structural complexity and habitat heterogeneity (Anand *et al*., 2010) [7]. Further, unplanned urbanization and more anthropogenic activities lead to local biodiversity decline (Thakur *et al*., 2017) [8]. Removal of native flora in the name of weeding, leaf litter removal for cleaning purpose, pruning for routine maintenance, pollution from residential activities, vehicular and industries exhaust causes more impact on the butterfly's biology (Prakash *et al*., 2020) [9]. In this regard, many authors (Kumar *et al*., 2011 [10]; Kumar, 2012 [11]; Sagwe *et al*., 2015) [12] have reported the habitat destruction for various purposes which ultimately reduce the food resources and negatively affect butterfly species richness and abundance. Mowing for habitat management and beautification is now common in urban areas that create negative effect on butterfly diversity (Guiliano *et al*., 2018; Popovic and Nowicki, 2023). Hence, there is an urgent need to encourage butterflies and to increase their numbers midst their natural habitat and to adopt suitable corrective measures for their conservation (Chitra, 2020) [14]. Any data on threat factors of butterflies across Mysore district is fragmentary. Thus, the present study was undertaken with aim to record threat factors affecting butterflies of Mysore district. Published reports on Mysore district is diffuse. Mysore district is one of the biologically diverse districts in Karnataka. It is located amidst eastern and western ghats and known for good vegetation with diversified habitats. Present study was conducted in Mysore district.

Materials and methods
Study area: Mysore district lies on the coordinates of 12°18' latitude and 76°12' longitude. Altitude of the study site is 770 meters above mean sea level (Gowda and Sridhara, 2014) [15]. The district experiences tropical monsoon type of climate. The average minimum and maximum temperatures range from 21.4-34°C in April to

16.4 to 28.5°C in January. Average annual rainfall is 850mm. Mysore district is spread across seven taluks namely: Mysore, Hunsur, Periyapatna, Tirumakudal Narsipur, Nanjangud, Krishnarajanagara and Heggadadevankote. The study was conducted across human-modified and managed habitats of rural and urban areas of Mysore district, Karnataka. Fifteen sites were chosen randomly from each taluk of Mysore district for the present study (Figure 1) during June, 2022 to May, 2023.

Methodology: Field survey was carried out from 8:00 am to 17:30 pm to record butterflies during their active period. Each study site was visited once in rainy, winter and summer seasons. Various methods were employed to record butterflies namely: variable width line transects method (Burnham *et al*., 1980) [16], all out search method as per Santhosh and Basavarajappa (2016) [17] and Point count method (Arjona *et al*., 2023) [18]. Photographic documentation of butterflies and human interferences across the habitats were made using Canon SX430 IS camera. Further, identification of butterflies was made using field guides as per Gunathilagaraj *et al*. (1998) [19] and Kehimkar (2016) [20]. Per cent occurrence was calculated as per Saha (1992) [21].

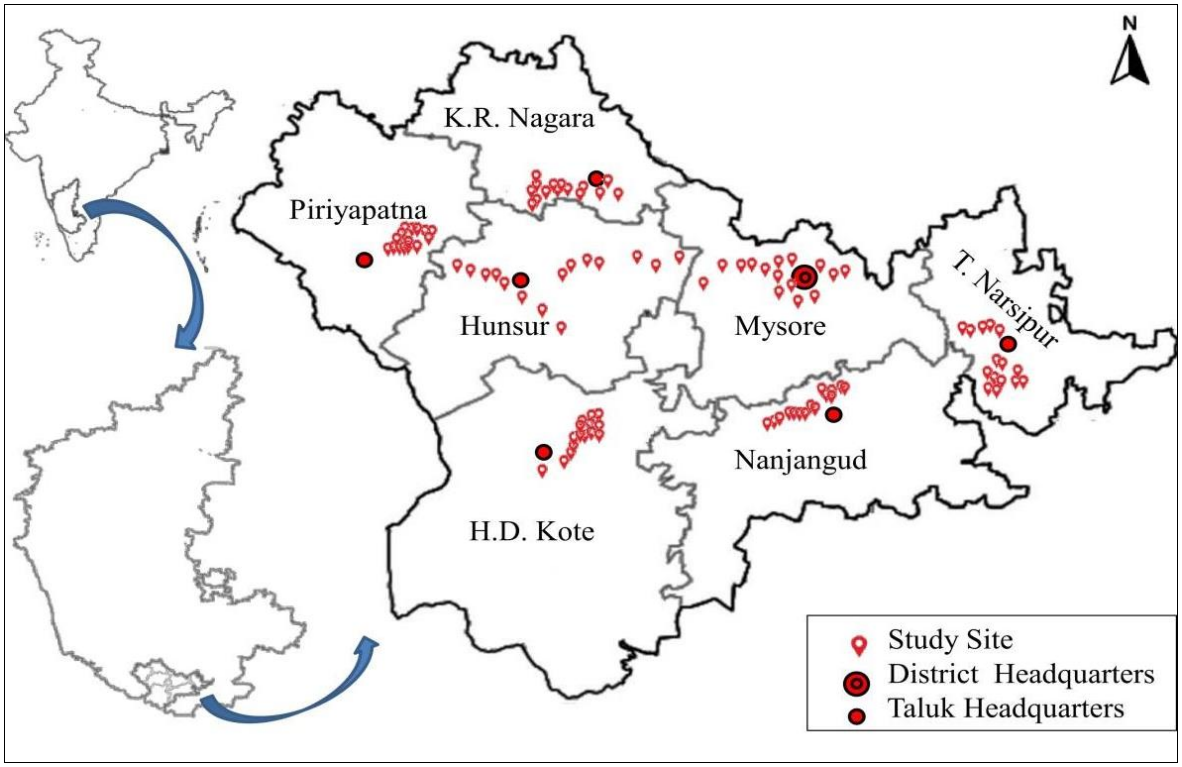

Fig 1: Map showing the study areas selected in different taluks of Mysore district

Results and discussion

Various threats under modified landscapes of Mysore district, Karnataka revealed that vegetation removal was most prominent across the study sites (Table 1). Vegetation removal and pesticide application followed by mowing, burning and finally road kills were the major threats to butterflies recorded. Pesticide application was very common in cultivated fields compared to other habitats (Table 1). Vegetation removal was done as a part of agriculture in rural landscapes whereas for habitat beautification in urban landscapes. Mowing and burning were common in urban landscape as a means of habitat management. Incidents of road kills were recorded from only four sites in urban landscape (Table 1).

Total 89 species of butterflies belonging to 59 genera and five families were recorded from various human modified habitats which were disturbed at some point of the study.

Nymphalidae family was dominant in the study followed by Lycaenidae, Pieridae, Hesperiidae and Papilionidae (Figure 2).

Species composition also varied between habitats with urban parks recording the highest number (61) of species and it was followed by cultivated lands with 56 species, institutional campus with 38 species, aquatic habitat (28 species), residential area (23 species), road verge (22 species), weed vegetation (6 species) and nursery (5 species) (Tables 2 and 3).

Table 3 shows the variation in diversity across different type of agro-climatic landscapes. Berger-Parker index (0-1) values are near to zero which represents that there is no clear dominance by any particular species. Simpson (0-1) and Shannon index (0-5) values from Table 3 indicates that species diversity was high in urban parks followed by cultivated lands, institutional campus, aquatic habitat, residential area, road verge, weed vegetation and nursery with least diversity compared to other habitats. Evenness was observed to be high in nursery and low in institutional campus (Table 3). Further, species richness was high in urban park and low in nursery as indicated by the Margalef index values (9.929 to 2.056) and Fisher-Alpha values (19.6 to 7.824) (Table 3).

As per Figure 2, abundance of butterflies followed the order of highest to lowest from park, cultivated land, institutional campus, road verge, aquatic habitat, residential area, weed vegetation and nursery respectively.

Malcolm *et al*. (2018) [22] have recorded that the primary threat to butterflies are loss of larval host plants and adult nectar plants. Tiple (2012) [23] have recorded reduction in

number of butterfly species due to constant disturbances in the study area like cutting of grasses, shrubs and trees for landscaping. Management practices across different land-use types were found to influence the species assemblage of butterflies in Tuczno Forest District, Poland as per Podgorska *et al*. (2022). Land-use intensity decreased the butterfly abundance in coffeebanana agroforests, Uganda (Munyuli 2013) [4]. After reducing the anthropogenic disturbances in an urban garden of Kolkata butterfly sighting was observed to increase (Thakur *et al*., 2017) [8]. Habitat destruction for developmental activities and cultivation caused decrease in availability of host plants and thereby butterfly species abundance in Eastern Ghats of Andhra Pradesh as per Kumar *et al*. (2011) [10]. Improper management practices in various land cover types negatively affect the diversity and abundance of butterflies (Sagwe *et al*., 2015) [12]. Abundance of butterflies was high in secondary forests and riverine ecosystem and was least in monoculture, human settlement and mining land covers (Sagwe *et al*., 2015) [12]. According to Feber *et al*. (2016) [24] spraying of herbicides and mowing had affected the abundance of nectar plants and larval host-plants commonly depended by butterflies. Removal of vegetation in paddy field banks was observed to decrease species richness and Abundance of butterflies (Giuliano *et al*., 2018) [13]. Intensive agricultural practices were attributed responsible for butterfly decline in farmland habitat of Netherlands (Strien *et al*., 2016) [25]. As per Popovic and Nowicki (2023) mowing negatively affected population size
and increased the dispersal of butterflies. Leaving an uncut refuge while mowing, had positive effects on butterfly abundance as per Bruppacher *et al*. (2016) [26]. Unburned clear-cuts were found to possess high species richness and abundance of butterflies than burned clear-cuts in a large wildfire area in Sweden according to Johannson *et al*. (2020). In urbanization zones of Lodz, Poland, Sobczyk *et al*. (2017) [28] recorded highest number of species in ruderal sites and parks and low species richness in cultivated lawns. Urban habitat use of butterfly species was found to be driven by shorter vegetation and exotic plants (Dexheimer and Despland, 2023) [29]. Total abundance of butterflies may not be less in disturbed landscapes like agricultural fields which provide resources for the survival of species which can adapt to such conditions Kocher and Williams (2008) [30]. But according to Li *et al*. (2011) [31] butterfly abundance was more where disturbance from human activity is relatively mild and the vegetation is less disturbed.

Table 1: Per cent occurrence of threats across different modified landscapes

Sl. No.	Type of threat	No. of incidence of threats								Total
		Aquatic habitat (Lake, Pond, Canal)	Park	Residential area	Institutional campus	Road verge	Nursery	Cultivated land	Weedy vegetation	
1	Mowing	-	5	-	1	-	-	-	-	6
2	Burning	-	1	1	-	3	-	1	-	6
3	Vegetation removal	2	-	1	-	4	1	25	1	34
4	Road kills	-	-	-	1	3	-	-	-	4
5	Pesticide application	-	1	-	-	-	-	33	-	34
	Total	2	7	2	2	10	1	59	60	84
	X^2 value				12.099*					-

Note: Each value is mean of three observations. *Value is significant at 5% level.

Table 2: Number of species across different disturbed habitats

Sl. No.	Family	Aquatic Habitat (Lake, Pond, Canal)	Park	Residential area	Institutional campus	Road verge	Nursery	Cultivated land	Weedy vegetation
1	Nymphalidae	10	21	9	15	10	2	22	3
2	Lycaenidae	6	20	6	11	5	0	12	0
3	Pieridae	6	9	4	7	5	2	13	2
4	Hesperiidae	1	5	0	1	0	0	4	0
5	Papilionidae	5	6	4	4	2	1	5	1
	Total	28	61	23	38	22	5	56	6
	X^2 value	225.885*							

Note: Each value is mean of three observations. *Value is significant at 0.001% level.

Table 3: Diversity indices of butterflies in different agro-climatic landscapes

Diversity index	Aquatic habitat (Lake, Pond, Canal)	Park	Residential area	Institutional campus	Road verge	Nursery	Cultivated land	Weedy vegetation
Taxa_S	28	61	23	38	22	5	56	6
Individuals	88	421	78	216	118	7	396	9
Simpson_1-D	0.9132	0.9555	0.9053	0.895	0.8437	0.7755	0.9413	0.7901
Shannon_H	2.815	3.523	2.664	2.845	2.306	1.55	3.27	1.677
Evenness_e^H/S	0.5963	0.5557	0.6239	0.4526	0.4561	0.9421	0.4696	0.8916
Margalef	6.03	9.929	5.05	6.883	4.402	2.056	9.195	2.276
Fisher_alpha	14.18	19.6	11	13.37	7.97	7.824	17.8	7.867
Berger-Parker	0.1818	0.1283	0.1795	0.2593	0.2797	0.2857	0.1313	0.3333

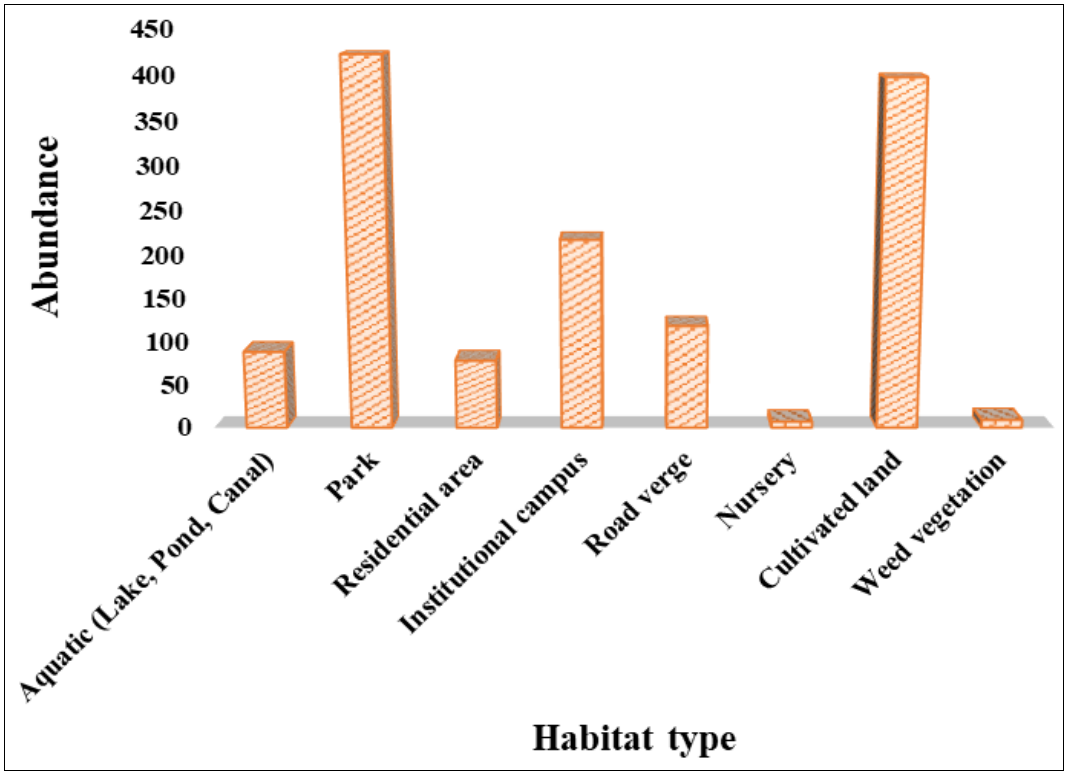

Figure 2. Abundance of butterfly species at different agro-climatic landscapes of Mysore district

Conclusion

Various threats to butterflies like vegetation removal, pesticide application, mowing, burning and road kills were recorded from different rural and urban landscapes of Mysore district. Modified landscapes like parks and cultivated lands possessed high species diversity compared to other landscapes. Frequent monitoring of threats to butterfly population helps in suggesting proper mitigation measures and thereby aids in its conservation.

Acknowledgement

The author (BU) thankful to the Council of Scientific and Industrial Research, New Delhi for granting fellowship and thankful to the Chairman, DOS in Zoology, University of Mysore, Manasagangotri, Mysore for constant support and encouragement.

Conflict of interest

There is no conflict of interest associated with this research.

References

1. Szyszko-Podgórska K, Dymitryszyn I, Jankiewicz U, Kondras M, ŻyfkaZagrodzińska E, Schwerk A. Assemblage Characteristics of Butterflies and Carabid Beetles as a Function of Soil Characteristics and Plant Diversity in Differently Managed Fields, Forests and Ecotones:A Case Study in Tuczno Forest District, Poland. Land,2022:11(1):1-20.
2. Sharma M, Sharma N. Nectar resource use by Butterflies in Gir Wildlife Sanctuary, Sasan, Gujarat. In Biological Forum Journal,2013:5(2):56-63.
3. Braby MF. The complete field guide to butterflies of Australia. 2004. Csiro Publishing. Pp. 2.
4. Munyuli MT. Drivers of species richness and abundance of butterflies in coffee– banana agroforests in Uganda. International Journal of Biodiversity Science, Ecosystem Services & Management, 2013:9(4):298-310.
5. Popović M, Nowicki P. Movements of a Specialist Butterfly in Relation to Mowing Management of Its Habitat Patches. Biology,2023:12(3):1-14.
6. Yager GO, Agbidye FS. Okoh AO. Diversity and Abundance of butterfly species (Lepidoptera) fauna in federal university of agriculture, Makurdi forestry nursery, Benue state, Nigeria. Journal of Research in Forestry, Wildlife and Environment,2016:8(3):83-89.
7. Anand MO, Krishnaswamy J, Kumar A, Bali A. Sustaining biodiversity conservation in human-modified landscapes in the Western Ghats:remnant forests matter. Biological Conservation,2010:143(10):2363-2374.
8. Thakur DC, Chakrabarti P, Chaudhuri AC. An approach for butterfly conservation through setting up a garden in an urban area, Kolkata, India. World Scientific News,2017:61(2):69-85.
9. Prakash S, Susarla S, Komath SS, Singh D, Maurya CB, Chaudhary R. Reduced 'Anthropogenic load'during 'lockdown', helped uncommon butterflies to resurface in Delhi-NCT. ENVIS RP:Geodiversity & Impact on Environment,2020:25(1):50-57.
10. Kumar VP, Reddy PH, Ramana SV. Climate effects and habitat destruction on butterfly diversity in the Eastern Ghats of southern Andhra Pradesh. Ecoscan Spec Issue,2011:1:139-143.
11. Kumar A. A report on the butterflies in Jhansi (UP) India. Journal of applied and Natural Science,2012:4(1):51-55.
12. Sagwe RN, Muya SM, Maranga R. Effects of land use patterns on the diversity and conservation status of butterflies in Kisii highlands, Kenya. Journal of insect conservation,2015:19:1119-1127.

13. Giuliano D, Cardarelli E, Bogliani G. Grass management intensity affects butterfly and orthopteran diversity on rice field banks. Agriculture, Ecosystems & Environment,2018:267:147-155.
14. Chitra KY. In-situ Conservation of Some Butterfly Species Population of Koti Women's College Campus, Hyderabad (Telangana) India. Bulletin of Pure & Applied Sciences-Zoology,2020:39(2):299-306.
15. Gowda K, Sridhara M. The greens of Mysore:An Appraisal of Their Contribution to Environment. International Journal of Innovative Technology and Research,2014:2(4):1023 – 1039.
16. Burnham KP, Anderson DR, Laake JL. Estimation of density from line transect sampling of biological populations. Wildlife monographs,1980:(72):3-202.
17. Santhosh S, Basavarajappa S. Study on nectar plants of few butterfly species at agriculture ecosystems of Chamarajanagar District, Karnataka, India. International Journal of Entomology Research, 2016:1(5):40-48.
18. Arjona JM, Ibáñez Álamo JD, Sanllorente Bolinches OM. Mediterranean university campuses enhance butterfly (Lepidoptera) and beetle (Coleoptera) diversity,2023:11:1-13.
19. Gunathilagaraj K, Perumal TNA, Jayramm K, Kumar MG. Some south Indian butterflies. Resources Communications Pvt. Ltd., Bangalore. 1988, 1-50.
20. Kehimkar I. BNHS field guides, butterflies of India. Bombay Natural History Society, 2016, 800.
21. Saha TK. Biostatistics in Theory and Practice. Emkay Publications in Delhi, India. 1992.
22. Malcolm SB. Anthropogenic impacts on mortality and population viability of the monarch butterfly. Annual Review of Entomology,2018:*63*:277-302.
23. Tiple AD. Butterfly species diversity, relative abundance and status in tropical forest research institute, Jabalpur, Madhya Pradesh, Central India. Journal of threatened Taxa,2012:4(7):2713-2717.
24. Feber RE, Smith H, Macdonald DW. The effects on butterfly abundance of the management of uncropped edges of arable fields. Journal of applied ecology,1996:33:1191-1205.
25. Van Strien AJ, Meyling AWG, Herder JE, Hollander H, Kalkman VJ, Poot MJ, Turnhout SF, van der Hoorn BG, Willy TFH, van Strien-van Liempt H, Chris AM, van Swaay I, Chris AM, van Turnhout Jk, Richard JT, Verweij A, Oerlemans NJ. Modest recovery of biodiversity in a western European country:The Living Planet Index for the Netherlands. Biological Conservation,2016:200:44-50.
26. Bruppacher L, Pellet J, Arlettaz R, Humbert JY. Simple modifications of mowing regime promote butterflies in extensively managed meadows:evidence from fieldscale experiments. Biological Conservation, 2016:196:196-202.
27. Johansson V, Gustafsson L, Andersson P, Hylander K. Fewer butterflies and a different composition of bees, wasps and hoverflies on recently burned compared to unburned clear-cuts, regardless of burn severity. Forest Ecology and Management,2020:463:1-15.
28. Sobczyk R, Pabis K, Wieczorek G, Salamacha A. Distribution and diversity of butterflies (Lepidoptera, Rhopalocera) in the urbanization zones of the Central European city (Lodz, Poland). North-Western Journal of Zoology,2017:13(2):337340.
29. Dexheimer E, Despland E. Newly introduced butterfly species' urban habitat use driven by shorter vegetation and exotic plants. Biological Invasions,2023:25:1767–1777.
30. Kocher SD, Williams EH. The diversity and abundance of North American butterflies vary with habitat disturbance and geography. Journal of biogeography, 2000:27(4):785-794.
31. Li XS, Zhang YL, Fang JH, Schweiger O, Settele J. A butterfly hotspot in western China, its environmental threats and conservation. Journal of Insect Conservation,2011:15:617-632.