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Diversity of Butterflies (Lepidoptera) in the Bonsai Park, Tapan Village, Kedungwaru District, Tulungagung Regency

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Abstract: Butterflies are insects that can inhabit various types of habitats, but differences in habitat conditions may influence their abundance and species diversity. Bonsai Park, located in Tapan Village, Kedungwaru District, Tulungagung Regency, East Java, is a tourist area with vegetation that potentially supports butterfly populations. However, scientific information on butterfly diversity in this area remains limited. The lack of such data may hinder efforts to understand local biodiversity conditions and opportunities for pollinator conservation. Therefore, this study aimed to identify butterfly species and analyze their diversity and relative abundance in Bonsai Park, Tapan Village. This research employed a quantitative descriptive approach using the transect method. Sampling was conducted along three transect lines, each approximately 100 m in length, with an observation width of about 5 m on both sides of the transect. Sampling was carried out between 08.00–11.00 WIB using an insect net with the sweeping technique. Sampling was repeated four times at weekly intervals during the research period. Data analysis included the Shannon–Wiener diversity index (H') and relative abundance. The results showed that 7 butterfly species, totalling 21 individuals, were recorded, belonging to 4 families: Nymphalidae, Lycaenidae, Pieridae, and Papilionidae. The identified species were *Euploea crameri*, *Junonia atlites*, *Acraea terpsicore*, *Danaus chrysippus*, *Tajuria cippus*, *Leptosia nina*, and *Papilio demoleus*. The Shannon–Wiener diversity index (H') value of 1.746 indicates a moderate level of diversity, with the highest abundance found in *Junonia atlites*. These findings suggest that Bonsai Park can still support several butterfly species as part of local biodiversity. Ecological management strategies, such as planting host plants for larvae, increasing the number of flowering plants as nectar sources, and enhancing vegetation heterogeneity, are recommended to improve habitat quality and support butterfly conservation in the area.

Keywords: Abundance; Butterflies; Diversity; Tapan Village Bonsai Park.

Introduction

Indonesia is one of the countries with the highest levels of biodiversity in the world and is known as a megabiodiversity country [1]. Although its territory covers only about 1.3% of Earth's total surface area, Indonesia hosts about 10% of flowering plants, 12% of mammals, 17% of bird species, 25% of fish species, and 15% of insect species [2]. One group of insects that contributes significantly to this rich biodiversity is butterflies. Of the approximately 17,500 butterfly species worldwide, about 1,600 are found in Indonesia [3]. The high species richness makes butterflies an important component in the study of tropical biodiversity.

Taxonomically, butterflies belong to the order Lepidoptera, which is characterized by having two pairs of scaly wings. This order is divided into two suborders, namely Rhopalocera, known as butterflies, and Heterocera, known as moths [4]. The butterfly's body consists of three parts, namely the head (cephal), chest (thoracic), and abdomen [5]. Butterflies play an important ecological role. The presence of butterflies in a habitat can serve as an environmental quality indicator because this group is recognised as a bioindicator [6]. Butterflies have a relatively short life cycle, high mobility, and sensitivity to small environmental changes [7]. In addition, butterflies act as pollinators, helping plants that cannot pollinate themselves, and they are part of the food web, so their population dynamics reflect the balance of the ecosystem.

Butterflies can live in various habitats, but differences in habitat characteristics are important factors that affect species abundance and diversity. Habitat quality is largely determined by vegetation structure and the availability of host and food plants, which serve as sources of nutrition for both larval and adult stages [8]. Habitats with diverse vegetation tend to provide a wider ecological niche, thereby supporting more butterfly species [9]. Conversely, habitat degradation due to environmental modification and the loss of native vegetation can reduce the availability of host plants, ultimately affecting the abundance and diversity of butterflies [10]. In addition to biotic factors such as vegetation, abiotic factors, including temperature and humidity, also play an important role in influencing the activity and distribution of butterflies [11]. Butterflies are poikilothermic insects whose flight, feeding, and reproduction are strongly influenced by surrounding temperature and humidity [12]. Changes in temperature and humidity can affect the abundance and diversity of butterflies.

In community studies, diversity index analyses such as the Shannon-Wiener index (H') are used to describe the combination of species richness and evenness of individual distribution within a habitat. This index provides an overview of community stability and ecological pressure. In

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addition, relative abundance analysis is important for identifying dominant species that contribute significantly to community structure. Species with high relative abundance generally have broad ecological tolerance or good adaptation to specific microhabitat conditions.

Several recent studies show that green open spaces and tourist areas can serve as alternative habitats for butterflies, providing vegetation structures and host plants that support butterfly diversity. Research conducted by Ruslan *et al.* shows that butterfly diversity in the Astra Honda Urban Forest, a green open space, reached an index of 2.92, classified as moderate [13]. Another study by Lestari *et al*. in the Bukit Gatan Waterfall tourist area also found butterfly diversity in the moderate category, with 21 species, supported by the area's vegetation diversity [14]. These studies were conducted in green open spaces and tourist areas with relatively natural or ecologically designed vegetation structures.

On the other hand, research on butterfly communities in tourist areas dominated by ornamental vegetation, such as a bonsai park, is still very limited. The vegetation structure in the bonsai park differs from that of green open spaces and tourist areas in general, as it is dominated by ornamental plants with relatively small crowns and more artistic vegetation arrangements. This condition can create distinct microhabitats for butterflies, both in terms of food availability and shelter. However, to date, no scientific research has examined butterfly diversity in the Bonsai Park in Tapan Village, Kedungwaru District, Tulungagung Regency, East Java. The lack of scientific data on the butterfly community in the area means that information on the condition of local biodiversity is still very limited.

Based on these conditions, there is a knowledge gap regarding how butterfly communities form in tourist areas with ornamental vegetation that differs from that of natural habitats and green open spaces. Therefore, this research is important to provide basic data on butterfly diversity in these habitats. This study aims to identify butterfly species and analyze the level of diversity and relative abundance of butterflies in the Bonsai Park of Tapan Village, Kedungwaru District, Tulungagung Regency. The results of this study are expected to provide scientific information on the butterfly community and serve as a basis for biodiversity management and conservation efforts in the Bonsai Park.

Research Methods

This research is a quantitative, descriptive study conducted at Bonsai Park, Tapan Village, Kedungwaru District, Tulungagung Regency (Figure 1).

Figure 1. Research Location Map

The tools used included insect nets, a thermo-hygrometer, envelopes, cameras, writing instruments, stretching boards, needles, plastic, and a butterfly identification guidebook from the Batang Toru Landscape Management Working Group Secretariat, "Types of Butterflies in Bulu Mario Village, South Tapanuli" [15], as well as the Malayan Forest Butterfly Guide. The material used was camphor.

Sampling was conducted in April 2023. Locations were determined using random sampling. Sampling was conducted using exploratory survey methods and transect tracing techniques. Transect locations were determined randomly (random sampling) to represent the vegetation variation found in the park area. Sampling was made on three transects, each ±100 m long and with an observation area width of approximately 5 m on the left and right sides of the transect path. Sampling was conducted by tracing the transect path while capturing butterflies encountered with an insect net using the sweeping net technique. Sampling was carried out from 8:00 a.m. to 11:00 a.m. Each transect was observed four times at weekly intervals during the research period to increase data representativeness. Butterflies collected using insect nets were then placed in envelopes as temporary storage so that their wings would not be damaged for further use in the insectarium.

The insectarium was made by breaking the butterfly's chest, spreading its wings on a stretching board coated with camphor and covered with plastic. Needles were inserted into the plastic, not covering the butterfly wings, and left to dry. The preserved butterfly samples were then further identified.

Butterfly identification was conducted at the Animal Taxonomy System Laboratory of the Biology Department at the State University of Surabaya. Butterfly identification is carried out by distinguishing the colors on the wings, both primary and secondary colors, as well as the patterns of the wing scales and the structure of the lines and veins on the wings. The colors and patterns of the wings are important characteristics for identifying butterflies [16]. The colors and patterns of butterfly wings are matched with the images in the butterfly identification guidebook. The recorded data include the species name, family, and number of individuals found. Based on this data, a quantitative analysis of butterfly species diversity is conducted.

The species diversity index (H') is a systematic representation that describes the structure of a community and facilitates the analysis of information regarding the types and numbers of organisms. Species diversity has two main components, namely richness and abundance [17]. Butterfly species diversity can be calculated using the Shannon-Wiener diversity index with following formula [18]:

$$H' = - \sum_{i=1}^{n} \left[\frac{ni}{N} \, x \, ln \left(\frac{ni}{N} \right) \right]$$

Description:
H' : Shannon-Wiener diversity index
ni : Number of species individual at-i
N : Total amount of species individual

The Shannon-Wiener diversity index obtained was then categorized with reference to the following criteria:

Table 1. Shannon-Wiener Diversity Index Criteria

Diversity Index	Category
H' < 1	Low diversity
1 < H' < 3	Medium diversity
H' > 3	High diversity

Relative abundance is calculated using the following formula [19]:

$$KR\ (\%) = \frac{ni}{N} \text{ x } 100\%$$

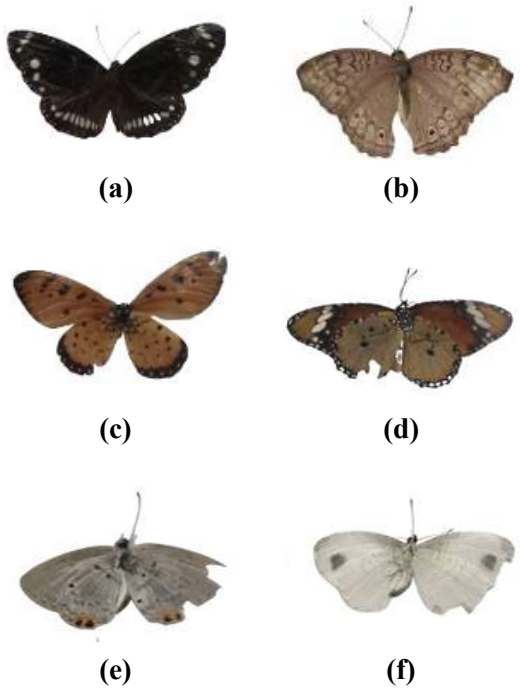
Description:
KR : Relative abundance
ni : Number of species individual at-i
N : Total amount of species individual

In addition to collecting butterfly samples, environmental parameters, such as temperature and humidity, were measured using a thermohygrometer. Furthermore, vegetation conditions at the research site were observed descriptively, particularly with respect to the presence of flowering plants that could serve as nectar sources and host plants for butterfly larvae.

Results and Discussion

Butterfly Specimen Identification

Research conducted at the Bonsai Park, Tapan Village, Kedungwaru District, Tulungagung Regency, in April 2023 successfully identified seven butterfly species, totalling 21 individuals, belonging to four families: Nymphalidae, Lycaenidae, Pieridae, and Papilionidae. The butterfly species found included *Euploea crameri*, *Junonia atlites*, *Acraea terpsicore*, *Danaus chrysippus*, *Tajuria cippus*, *Leptosia nina*, and *Papilio demoleus* (Figure 2).



(a) **(b)**

(c) **(d)**

(e) **(f)**

(g)

Figure 2. Butterfly Species Found (a) *Euploea crameri* (b) *Junonia atlites* (c) *Acraea terpsicore* (d) *Danaus chrysippus* (e) *Tajuria cippus* (f) *Leptosia nina* (g) *Papilio demoleus*

The Nymphalidae family has the most species [20]. Body size is small to medium, ranging from 25-100 mm. Their wings are white, black, and orange with varying color patterns. This family is known as brush-footed butterflies because they have a pair of front legs that are smaller and covered with dense scales resembling a brush. Butterflies belonging to the Nymphalidae family are cosmopolitan and widely distributed in open areas. This is because this family is polyphagous, meaning they feed on many plant species, making them more adaptable to various habitats [21]. Butterflies from the Nymphalidae family are more often found perching and sucking nectar from flowers in the shade [22]. Species of this family are active in flying around looking for nectar and mates from morning to evening.

Euploea crameri has a deep black color on the front wings with a few white spots at the tips, while the rear wings are brown with white spots at the tips. The abdomen has yellow hairs. *Junonia atlites* is also known as The Grey Pansy. It is medium in size, with a wingspan of 80 mm [23]. The wings are cream brown in color with a pattern of black, brown, and cream circles, bands, and lines.

Acraea terpsicore is commonly known as the Tawny Coster butterfly. *Acraea terpsicore* is commonly known as the Tawny Coster butterfly. Black thorax with white spots, white proboscis, brown abdomen with black stripes. Front wings dark orange, front marginal section at apex black, black spots scattered on disc, yellow spots on rear section, black band on anal section, rear wings orange and white, pattern similar to front wings, white spots lined up along margin to anal section following wing shape, black curved groove. Legs covered with long, fine hairs [24]. *Danaus chrysippus* is nicknamed the Plain Tiger because the scales on its wings are tiger-like in color. The main color pattern is a combination of black, orange, and white. There are several black spots on the underside of the hind wings. The wingspan is between 70-80 mm.

The Lycaenidae family is generally relatively small compared to other families. The color of the male butterfly's wings on the dorsal side is very attractive, while the wings of female butterflies are not very striking, generally brown in color. These butterflies are generally found on sunny days and in open areas [25]. In addition to having distinctive wing venation, this family also has other characteristics, namely, male butterflies have smaller front legs but they are still functional for walking, while female butterflies have normal front legs. Some species have eye spots and a pair or more of "tails" (hairstreaks) on their hind wings, which serve to deceive predators by creating a false head effect [26]. The eggs of Lycaenidae butterflies are generally semicircular in shape and are often laid on leaf buds or flowers. The larvae of the Lycaenidae family differ from those of other families, tending to be flattened in shape. The species found was *Tajuria cippus*, nicknamed The Peacock Royal. It has a small

body. Its wings are grey, and the tips of its wings have a pattern similar to peacock feathers.

The Pieridae family is medium-sized compared to other families. Butterflies in this family have brightly colored wings, predominantly white, yellow, and orange [27]. Almost all species in this family do not have wing extensions on the tornus of the hind wings, all legs are fully developed, and the tips of the legs have branched claws. Some species exhibit seasonal dimorphism, which is a difference in color patterns based on the season, and migrate. This family is often seen flying high and feeding in places exposed to direct sunlight.

The species found is *Leptosia nina*, also known as the Oriental Psyche. It has a small body. Its wings measure 20-30 mm. The wings are white with a slight black tinge on the upper wing edges. This species is commonly found in shrub-type vegetation. These butterflies fly slowly and weakly and close to the ground [28].

The Papilionidae family has a fairly large body size and wings longer than 50 mm [29]. In addition, they also have attractive color patterns dominated by black with combinations of white, yellow, green and blue. Papilionidae butterfly eggs are generally spherical with a smooth surface. Generally, eggs are laid singly on a leaf, but a small number are laid in groups. Papilionidae larvae or caterpillars have an osmeterium that protrudes from the upper part of the thorax when disturbed and emits a pungent odor. Papilionidae pupae usually attach themselves to the leaves or stems of host plants, with their heads at the top supported by silk threads on both lateral sides (girdle threads) and the tips of their abdomens attached to the substrate.

The species found is *Papilio demoleus*, also known as The Lime Butterflies. Medium-sized body. Head, lower thorax, and back are light brown with black stripes. Eyes are black. Wing size is approximately 60-80 mm. Wings are light brown with medium-sized circular patterns and black stripes.

Diversity and Relative Abundance of Butterfly Species

The butterfly species that were successfully found were then quantitatively analyzed using diversity indices, as shown in Table 2 below:

Table 2. Diversity and Relative Abundance of Butterflies in Bonsai Park, Tapan Village, Kedungwaru District, Tulungagung Regency

Family	Species	ni	H’	KR (%)
Nymphalidae	*Euploea crameri*	3	0.277	14.28
	Junonia atlites	7	0.366	33.34
	Acraea terpsicore	3	0.277	14.28
	Danaus chrysippus	1	0.144	4.76
Lycaenidae	*Tajuria cippus*	2	0.223	9.52
Pieridae	*Leptosia nina*	4	0.315	19.04
Papilionidae	*Papilio demoleus*	1	0.144	4.76
	N	21	1.746	100

Description:
ni : Number of species individual at-i
KR : Relative abundance
H’ : Shannon-Wiener diversity index
N : Total amount of species individual

Based on Table 2, the Shannon-Wiener diversity index (H’) for butterfly species in Bonsai Park, Tapan Village, Kedungwaru District, Tulungagung Regency is 1,746. According to Odum's diversity index criteria, the index is moderate, indicating that the butterfly community at the study site has sufficient diversity but does not yet exhibit a complex, stable community structure. Moderate diversity indicates that the number of species is relatively adequate, but the distribution of individuals among species is not yet evenly distributed.

The diversity index value is comparable to that of several studies on green open space habitats and tourist areas. A study in the Astra Honda Urban Forest reported a butterfly diversity index of 2.92, which is classified as moderate in habitats with a temperature of around 32.85 °C and humidity of 58.37%. The vegetation found in this habitat includes *Axonopus compressus*, *Cynodom dactylon*, *Synedrella nudiflora*, *Ruellia tuberose*, *Nephrolepis biserrata*, and *Pteris vittata* [13]. The diversity of vegetation provides food sources and microhabitats that support butterfly populations, thereby maintaining a relatively high level of diversity.

Similar diversity values were also reported in a study of the Bukit Gatan Waterfall tourist area, which found 21 butterfly species in a habitat with a temperature of around 30.1°C and humidity of 78%. The vegetation found in this habitat includes *Hevea brasiliensis*, *Syzygium malaccense*, *Baccaurea motleyana*, *Melastoma malabathricum*, *Durio zibethinus*, and *Coffea* sp., as well as several other flowering shrubs that serve as nectar sources for imago (adult butterflies [14]. This comparison shows that semi-natural habitats such as green open spaces and tourist areas are generally capable of supporting butterfly communities with moderate levels of diversity, especially when the constituent vegetation has sufficient variation.

However, the number of butterflies found in this study was relatively limited, namely 21 individuals. A small sample size can affect diversity index estimates because index values are greatly influenced by the number of individuals recorded during sampling. However, a low number of individuals does not always indicate low species diversity, because diversity indices are more influenced by the number of species found and the distribution of individuals among species [30]. In insect biodiversity studies in habitats with limited area, the small number of individuals can be influenced by the sampling period, weather conditions, and butterfly activity, which is highly dependent on light intensity and food availability. Therefore, the results of this study still provide an initial overview of the butterfly community structure in the bonsai garden area, although further research with broader area coverage and higher sampling intensity is needed to obtain a more representative estimate of diversity.

In addition to the number of individuals, butterfly diversity at the research site was also related to habitat structure and vegetation composition, namely the bonsai park, where vegetation heterogeneity tends to be limited to

certain types and is less complex than in natural habitats. As a result, the variety of ecological niches available to butterflies is also limited. According to Dewi *et al*., in communities that are developing at the succession level, interactions between species have not yet occurred optimally, so the number of species is lower than ini communities that have reached climax [31].

Butterflies usually live in terrestrial habitats, but the composition of species varies according to habitat conditions [32]. Habitats that allow butterflies to survive are identified by the availability of host plants used for larval food and nectar-producing plants for the imago [33]. Meanwhile, at the research site, bonsai plants were the main factor influencing the availability of food sources and shelter for butterflies. Bonsai plants are generally pruned and shaped regularly so that they have relatively small crowns and limited branching structures. These conditions can reduce the availability of young leaves as host plants for larvae and limit the shelter area for the imago. Thus, even though the garden appears green visually, its ecological complexity may not be high enough to support butterfly diversity.

In addition to biotic factors such as vegetation, abiotic factors such as temperature and humidity also play a role in determining the activity and presence of butterflies in a habitat. Measurements of environmental parameters in Bonsai Park show that the air temperature is around 31°C and the humidity is around 74%. These temperatures and humidity levels are suitable for butterfly survival. The effective temperature range for butterflies is 15-45°C, with an optimum temperature of 25.8°C [34]. Butterflies are poikilothermic animals whose body temperature depends on their surroundings. Relatively high temperatures can increase metabolism, making butterflies more active [35]. The optimal humidity for butterflies is around 60-75%. Habitats that are too humid can interfere with butterflies' ability to maintain body temperature and dry their wings. Meanwhile, low-humidity habitats can cause butterflies to lose excessive body fluids and experience dehydration [36].

In addition, the research site was dominated by asoka plants (Ixora sp.) from the Rubiaceae family, which also influenced butterfly abundance patterns. Asoka plants are known to produce brightly colored flowers with abundant nectar and a distinctive aroma, making them potential food plants for butterflies [37]. The relative concentration of nectar sources in certain plant species can cause butterfly species that are able to utilize these sources to become more dominant. In this study, the highest abundance was observed in Junonia atlites, a species from the Nymphalidae family. This is in line with the results of a study by Kurniawan et al., which found that 54% of the butterfly species in Merangin Garden, Bangko Jambi, belonged to the Nymphalidae family, including 24 specimens of *Junonia atlites* [38].

Most Nymphalidae families are polyphagous [39]. Polyphagy is a trait of butterflies that allows them to feed on other plants that are suitable for their larvae, even when their primary host is unavailable. *Junonia atlites* belongs to the Nymphalidae family and has a habit of sucking fluids with its long proboscis [40]. This habit allows *Junonia atlites* to adapt to the relatively small asoka flower petals, which can still be entered by the proboscis. This shows that *Junonia atlites* is adaptive and able to utilize open habitats and gardens with ornamental vegetation as a food source.

Thus, the composition of bonsai garden vegetation, which is dominated by ornamental plants such as bonsai and soka, tends to support generalist species tolerant of artificial habitat conditions, while species that require specific host plants or more complex habitat structures are less well developed. This condition leads to an uneven distribution of individuals among species and implies a moderate diversity index. Therefore, ecological management in the park area can be directed toward increasing vegetation diversity, especially by adding host plants for larvae and local flowering plants as nectar sources. The strategy of enriching the habitat by planting more diverse vegetation has the potential to improve habitat quality and increase butterfly diversity in Bonsai Park.

Conclusion

Based on the results and discussion, it can be concluded that in the Bonsai Park, Tapan Village, Kedungwaru District, Tulungagung Regency, seven butterfly species were found, totalling 21 individuals, belonging to four families: Nymphalidae, Lycaenidae, Pieridae, and Papilionidae. The species found were *Euploea crameri*, *Junonia atlites*, *Acraea terpsicore*, *Danaus chrysippus*, *Tajuria cippus*, *Leptosia nina*, and *Papilio demoleus,* with a Shannon-Wiener diversity index (H') of 1,746, which is classified as moderate, and the highest abundance was found in the *Junonia atlites* species. These results indicate that Bonsai Park is still capable of supporting several butterfly species, even though the community structure that has formed is not yet fully complex. The findings of this research contribute to the development of insect ecology, particularly in understanding the role of tourism-based green open spaces as alternative habitats for butterflies in non-natural areas. In addition, the results of this research can serve as a basis for the management of tourist areas, ensuring that biodiversity is taken into consideration. Efforts to increase butterfly diversity in Bonsai Park can be done by planting local host plants for larvae and flowering plants that produce nectar as a food source for imagoes, as well as by increasing vegetation heterogeneity to provide more diverse microhabitats for butterflies. This research has several limitations, including a relatively short sampling period, a limited number of participants, and a scope of research limited to one location. Therefore, further research is recommended to conduct long-term monitoring with higher sampling intensity and wider area coverage in order to obtain a more comprehensive picture of butterfly community dynamics and the effectiveness of habitat management strategies in increasing butterfly diversity.

Author's Contribution

U.Y. Nuraini: conceptualization of the research, data collection, and data analysis; H.S. Maharani: conceptualization of the research and data collection.

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References

[1] M. Abdillah, A. N. Arroyyan, and S. Anwar, "Keanekaragaman Arthropoda Tanah di Gunung Anjasmoro, Desa Carangwulung, Kecamatan Wonosalam, Kabupaten Jombang," *Bioma; Jurnal Biologi Makassar*, vol. 5, no. 2, pp. 144-150, Jun. 2020, doi: 10.20956/bioma.v5i2.10274.

[2] J. Supriatna, and C. Margules, *The National Parks of Indonesia*. Yayasan Pustaka Obor Indonesia, 2022.

[3] D. Peggie, and M. Amir, *Panduan Praktis Kupu-kupu di Kebun Raya Bogor*. Lembaga Ilmu Pengetahuan Indonesia, 2006.

[4] D. J. Borror, and D. M. DeLong, *An Introduction to The Study of Insects (3rd ed.)*. New York, USA, Holt, Rinehart & Winston, 1971.

[5] S. Zulaikha, and M. A. D. Susanto, M. A.D., "Diversity of Lepidoptera: Rhopalocera at Selorejo Waterfall Area, Ponorogo District, East Java, Indonesia," *Jurnal Riset Biologi dan Aplikasinya*, vol. 3, no. 2, pp. 68-72, Sep. 2021, doi: 10.26740/jrba.v3n2.

[6] S. D. Azahra, "Potensi Jenis Kupu-kupu sebagai Bioindikator Kondisi Lingkungan Kawasan Perkotaan," *In Gunung Djati Conference Series*, Pontianak, 2021, pp. 102-110.

[7] K. W. Sing, J. Luo, J., W. Wang *et al*., "Ring Roads and Urban Biodiversity: Distribution of Butterflies in Urban Parks in Beijing City and Correlations with Other Indicator Species," *Sci Rep*, vol. 9, no. 7653, pp. 1-9, May. 2019, doi: 10.1038/s41598-019-43997-8.

[8] R.A. Yuniartin, M. L. Ilhamdi, and G. Hadiprayitno, "Butterfly community (Lepidoptera) at Joben Tourism Park (Joben Eco Park) Regency of East Lombok," *Jurnal Pijar Mipa*, vol. 18, no. 1, pp. 105-111, Jan. 2023, doi: 10.29303/jpm.v18i1.3780.

[9] R. Y. Ashari, M. L. Ilhamdi, and D. Santoso, "The Diversity of Butterflies (Lepidoptera) in the Aik Bukak Tourism Park Area," *Jurnal Biologi Tropis*, vol. 22, no. 1, pp. 23-29, Jan. 2022, doi: 10.29303/jbt.v22i1.2850.

[10] A. F. Irsa, R. Rahadian, and M. Hadi, "Struktur Komunitas, Keragaman Tumbuhan Inang, dan Status Konservasi Kupu-Kupu di Desa Ngesrepbalong Kecamatan Limbangan Kabupaten Kendal," Jurnal Ilmu Lingkungan, vol. 20, no. 4, pp. 777-786, Oct. 2022, doi:10.14710/jil.20.4.777-786.

[11] T. F. Leonard, Y. Indrayani, and H. Prayogo, "Keanekaragaman Jenis Kupu-kupu pada Kawasan Taman Wisata Alam Baning Kecamatan Sintang Kabupaten Sintang Kalimantan Barat," *Jurnal Hutan Lestari*, vol. 10, no. 2, pp. 405-413, Jun. 2022, doi: 10.26418/jhl.v10i2.51064.

[12] U. Nuraini, I. Widhiono, and E. Riwidiharso, "Keanekaragaman dan Kelimpahan Kupu-Kupu (Lepidoptera: Rhopalocera) di Cagar Alam Bantarbolang, Jawa Tengah*," BioEksakta: Jurnal Ilmiah Biologi Unsoed*, vol. 2, no. 2, pp. 157-164, Jul. 2020, doi: 10.20884/1.bioe.2020.2.2.1756.

[13] H. Ruslan, I. SL. Tobing, and D. Andayaningsih, *Biodiversitas Kupu-Kupu (Lepidoptera: Papilionoidea) di Kawasan Hutan Kota Jakarta*. LPU-UNAS, 2020.

[14] A. Lestari, H. Harmoko, and I. Susanti, "Kupu-kupu (Lepidoptera) dari Air Terjun Bukit Gatan Kecamatan STL Ulu Terawas Kabupaten Musi Rawas Provinsi Sumatera Selatan," *Jurnal Biotik*, vol. 8, no. 2, pp. 126-134, Sep. 2020, doi: 10.22373/biotik.v8i2.7379.

[15] M. Andrianto and L. N Ginoga, *Jenis-jenis Kupu-kupu di Desa Bulu Mario Tapanuli Selatan.* Sekretariat Kelompok Kerja Pengelolaan Lansekap Batang Toru, 2020.

[16] D. Peggie, *Precious and Protected Indonesian Butterflies*. PT. Binamitra Megawarna, 2011.

[17] N. A. Campbell, J. B. Reece, and L. G. Mitchell, *Biologi Edisi 8*. Erlangga, 2010.

[18] E. P. Odum, *Dasar–Dasar Ekologi Edisi 3 Terjemahan Tjahjono Samingan*. Gadjah Mada University Press, 1998.

[19] E. P. Odum, *Dasar-dasar Ekologi (terjemahan)*. Gadjah Mada University Press, 1993.

[20] L. G. Kirton, *A Naturalist's Guide to the Butterflies of Peninsular Malaysia Singapore and Thailand (3rd ed.)*. John Beaufoy Publishing Limited*,* 2020.

[21] B. Dewi, A. Hamidah, and T Sukmono, *Keanekaragaman Kupu-kupu di Kabupaten Kerinci dan Sekitarnya*. 2023.

[22] A. Handayani, and M. Rahayuningsih, "Keanekaragaman Jenis Kupu-Kupu Di Taman Kota Semarang," *Jurnal Penelitian Ekosistem Dipterokarpa*, vol. 8, no. 1, pp. 43-52, Jun. 2022, doi: 10.20886/jped.2022.8.1.43-52.

[23] A. A. Kurniawan, and K. A. Samani, "Identifikasi Jenis Kupu-Kupu (Lepidoptera) di Taman Wisata Alam Baning Kabupaten Sintang," *Biocaster: Jurnal Kajian Biologi*, vol. 3, no. 2, pp. 73-85, April. 2023, doi: 10.36312/biocaster.v3i2.169.

[24] S. Sonia, Y. M. Jamilah, a. N. a. azzahra, R. K. Anissa, and D. A. Rahayu," Keanekaragaman dan Kelimpahan Kupu-kupu (Lepidoptera) di Lapangan Watu Gajah Tuban," *Jurnal Biologi Udayana*, vol. 26, no. 2, pp. 224-237, .2022.

[25] H. Ruslan, *Keanekaragaman Kupu-Kupu*. LPU-UNAS, 2015.

[26] H. Ruslan, and D. Andayaningsih, *Hutan Lindung, Suaka Margasatwa Ekowisata, dan Taman Wisata Alam Angke Kapuk Jakarta Utara*. LPU-UNAS, 2021.

[27] R. Krismawati, T. Rostikawati, and D. Prasaja, "Keanekaragaman Insekta (Ordo Lepidoptera) di Pusat Suaka Satwa Elang Jawa Bogor," *Ekologia: Jurnal Ilmiah Ilmu Dasar dan Lingkungan Hidup*, vol. 21, no. 2, pp. 54-63, Oct. 2021, doi: 10.33751/ekologia.v21i2.3893.

[28] F. Rahmawati, and B. Prakoso, "Data Jenis-jenis Kupu-kupu Di Lingkungan Perumahan Bukit Kalibagor," *Jurnal Kridatama Sains dan Teknologi*, vol. 3, no. 2, Des. 2021, doi: 10.53863/kst.v3i02.176.

[29] M. Triyanti, and D. A. Arisandy, "Keanekaragaman Kupu-Kupu di Bukit Cogong Kabupaten Musi Rawas Propinsi Sumatera Selatan," *Bioma: Jurnal Biologi dan Pembelajaran Biologi,* vo. 5, no. 2, pp. 94-105, Oct. 2020, doi: 10.32528/bioma.v5i2.2664.

[30] I. SL. Tobing, H. Ruslan, and D. Andayaningsih, "Diversitas Kupu-kupu di Kawasan Terbuka dan Tertutup Hutan Kota Tebet, Jakarta Selatan," *Bioma*, vol. 17, no. 1, pp., 28-36, Jun. 2022, doi: 10.21009/Bioma17(1).4.

[31] B. Dewi, A. Hamidah, and J. Siburian, "Keanekaragaman dan Kelimpahan Jenis Kupu-kupu (Lepidoptera; Rhopalocera) di Sekitar Kampus Pinang Masak Universitas Jambi," *Biospecies*, vol. 9, no. 2, pp. 32-38, Jul. 2016, doi: 10.22437/biospecies.v9i2.3160.
[32] D. T. H. Sihombing. *Satwa Harapan I: Pengantar Ilmu dan Teknologi Budidaya*. Pustaka Wirausaha Muda, 2002.
[33] M. L. Ilhamdi, A. Al Idrus, and D. Santoso, "Struktur Komunitas Kupu-Kupu di Taman Wisata Alam Suranadi, Lombok Barat," *JBT*, vol. 19, no. 2, pp. 147–153, Aug. 2019, doi: 10.29303/jbt.v19i2.880.
[34] Jumar, *Entomologi Serangga*. Rineka Cipta, 2000.
[35] N. Nelyzza, and I. K. Ningsih, "Keanekaragaman Kupu-Kupu (Lepidoptera) di Ruang Terbuka Hijau Taman Abhirama, Kabupaten Sidoarjo," *Sains dan Matematika*, vol. 8, no. 2, pp. 62-68, Oct. 2023, doi: 10.26740/sainsmat.v8n2.p62-68.
[36] I. Pahman, D. Hernawati, and D. M. Chaidir, "Studi Keanekaragaman Kupu-kupu (Papilionoidea) Berdasarkan Ketinggian di Kawasan Gunung Galunggung Kabupaten Tasikmalaya", *Bioscientist: Jurnal Ilmiah Biologi*, vol. 10, no. 2, pp. 818–836, Dec. 2022, doi: https://doi.org/10.33394/bioscientist.v10i2.5742.
[37] A. Mas'ud, A. Corebima, A. Haerullah, S. Hasan, and A. Alisi, "Jenis Kupu-kupu Pengunjung Bunga Mussaenda dan Asoka di Kawasan Cagar Alam Gunung Sibela Pulau Bacan," *JBT*, vol. 19, no. 2, pp. 189-196, Oct. 2019, doi: 10.29303/jbt.v19i2.1108.
[38] B. Kurniawan, R. R. Apriani, and S. Cahayu, "Keanekaragaman Spesies Kupu-Kupu (Lepidoptera) pada Habitat Ekowisata Taman Bunga Merangin Garden Bangko Jambi," *Al-Hayat: Journal of Biology and Applied Biology*, vol. 3, no. 1, pp. 1-7, May. 2020, doi: 10.21580/ah.v3i1.6064.
[39] M. Nikmah, Z. Hanafiah, and I. Yusttian, "Keanekaragaman Kupu-kupu (Lepidoptera: Rhopalocera) di Desa Pulau Panas Kecamatan Tanjung Sakti Pumi, Lahat, Sumatera Selatan," *Sainmatika*, vol. 18, no. 1, pp. 76–87, Jun. 2021, doi: 10.31851/sainmatika.v17i3.5615.
[40] M. F. Braby, *Butterflies of Australia: Their Identification, Biology, and Distribution*. CSIRO Publishing, 2000.