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The Diversity of Butterflies (Lepidoptera): A case Study of Changes in Butterfly Habitat due to Swamp Land Conversion (SLC) in Palembang Indonesia

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Abstract: This study a specific case: whether alterations in butterfly habitats resulting from Swamp Land Conversion (SLC) impact the diversity, species count, and abundance of butterflies, which act as pollinating insects, within Palembang city. This study employs observational methods with a roaming technique, conducted five times at each research location. The research sites were determined using purposive sampling. The findings reveal a total of 230 individual butterflies from 19 species, distributed among five families: Hesperiidae, Lycaenidae, Nymphalidae, Papilionidae, and Pieridae. The highest butterfly diversity index value is recorded at the Alang-Alang Lebar SLC location, whereas the lowest butterfly diversity index value is observed at the swamp land (SL) location. The most recent findings from this study is SLC lead to an increase in the diversity index, species count, and individual butterfly numbers of the Lepidoptera order, particularly in Alang-Alang Lebar SLC and Jakabaring SLC, as compared to SL location on Sungai Ijuk SL. The results suggest that SLC can contribute to the conservation of butterfly species belonging to the Nymphalidae, Papilionidae, Hesperiidae, and Lycaenidae families except the Pieridae family.

Keywords: Butterfly; Diversity; Palembang; Indonesia; Swamp Land Conversion.

Introduction

Biodiversity can be understood through the study of bioindicators and ecosystem management in nature. Species that serve as suitable ecological indicators are those sensitive to environmental changes, such as butterflies (Gerlach et al., 2013). Species suitable as ecological indicators are those biologically sensitive to negative changes in ecosystem management and functioning in nature (Anderson et al., 2022; Braby & Williams, 2016; Kong et al., 2023; Smit et al., 2023). Among insects, butterflies stand out as prominent bioindicators due to their responsiveness to environmental factors that align with butterfly needs, rapid generational turnover, effective natural movement, and high sensitivity to environmental changes (Costache et al., 2021; Riva et al., 2023). Butterflies exhibit swift responses to climate change through shifts in distribution patterns owing to their short life spans, limited mobility, specialized larval diets, and reliance on weather and climate (Bond & Vardon, 2023; Habel et al., 2023; Kwon et al., 2021). According to Koneri & Nangoy (2019), butterflies play several crucial roles in ecosystems, including aiding in pollination, natural propagation, and serving as essential elements in the food chain, as they are prey for bats, birds, and other insectivorous animals.

Butterflies that act as pollinators in nature have morphological variations. The morphology of butterflies found in the highlands is different from the butterflies

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found in the lowlands (Harmonis et al., 2022). Butterflies are widely recognized insects, measuring 2.8 – 3.6 cm, adorned with vibrant hues, intricate wing patterns, functioning as pollinators, and exhibiting high attractiveness to surrounding plants, facilitating cross-pollination (Bibi et al., 2022). Shilpa et al. (2023) found that butterflies living in lowlands have broader wings, whereas butterflies living in the highlands have slender, longer, and more rounded wings. Morphologically, there is no significant difference in the variation of butterfly scales between butterflies in highlands and lowlands. The morphological variation in butterfly wings is mainly related to adaptive responses, such as migration, host searching, and flight energy management. Due to their diurnal nature, butterflies contribute to the daytime activities of foraging and pollination for plants (Balduci et al., 2019; Witek et al., 2023).

Butterflies inhabit tropical and subtropical regions (Henry et al., 2022; Pablos et al., 2021; Tseng et al., 2022), favoring habitats abundant in plant vegetation (Kozlov et al., 2022; Sushko, 2022). In Jambi Province's oil palm plantations and rubber forests, Siregar et al. (2016) documented 18 individuals spanning 6 species from the Nymphalidae and Lycaenidae families. In Battagam district, Pakistan, Bibi et al. (2022) identified 572 individuals encompassing 9 species and 7 genera from the Papilionidae, Nymphalidae, and Pieridae families. Miyashita et al. (2023) recorded an abundance of 259 individuals across several cities in Iijima, Japan, noting that butterflies remain unaffected by changes in sunlight duration. Rege & Lee (2023) explored butterfly species habitats within cashew plantations, secondary forests, polyculture plantations, and open forests in India. Butterfly habitats encompass highland and riverside vegetation, subtropical and tropical green deciduous forests, green plant pathways, and tropical moist deciduous forests (Tiple, 2011). Qodri et al. (2023) identified 59 species among 157 individual butterflies in the Padang Bindu Karst, South Sumatra. The presence of butterflies at the site is thought to be correlated with host plants, nectar plants, and abiotic factors in the Padang Bindu Karst National Cultural Heritage Park. Host plants, nectar plants, and abiotic factors are essential strategies for long-term butterfly conservation. Observations reveal the presence of butterflies in Palembang, South Sumatra, Indonesia, even within urban settings like SLC areas.

Swamp land Conversion (SLC) entails transforming swamps into public facilities, including housing, offices, stadiums, terminals, and playgrounds. This conversion can impact butterfly abundance and diversity by reducing plant vegetation, a crucial nectar and nutrient source for butterflies, in various natural swamp areas (Siregar et al., 2019). Ilhamdi et al. (2023) asserted that effective management for the conservation of insects, including butterflies, can only be achieved through a deep understanding of their biology and ecology Latumahina (2016) emphasizes that land conversion carries the potential for habitat destruction, alteration, and degradation, which can disrupt diversity, behavior, species composition, and ecosystem functioning (Lewis, 2014). Field observations confirm that SLC has altered butterfly habitats alongside the transformation of swamps into public facilities in Palembang City. This alteration is believed to influence butterfly diversity, species count, and abundance. While research on butterfly diversity, species count, and abundance as pollinators has been conducted across diverse ecosystems, studies analyzing the impact of SLC-induced habitat changes on butterflies are limited. This study aims to discuss whether SLC can have an impact on increasing butterfly diversity, number of species, and abundance in Palembang, South Sumatra, Indonesia.

Method

Research Location

The research was conducted in swamp lands located on the Sungai Ijuk SL (control or natural swamps) and swamp lands convertion located at Jakabaring SLC, Kertapati SLC, Alang-Alang Lebar SLC, Soekarno-Hatta SLC, and Gandus SLC (Figure 1). The samples were selected by purposive sampling (Nurliza et al., 2023). These SLC locations are natural swamps that have served various purposes such as stadiums, terminals, shophouses, office buildings, and housing (Table 1). The elevation of the research sites ranges from 4.5 to 15 meters above sea level (MASL). The temperature at the research sites varies between 28°C and 32°C, with air humidity ranging from 78% to 82%. Butterfly specimens collected during the study were subsequently identified at the Biology Education Laboratory, Faculty of Teacher Training and Education, Sriwijaya University.

Figure 1. Distribution of butterfly sampling locations in Palembang, South Sumatra, Indonesia

Table 1. Research location of butterfly diversity and abundance (Order: Lepidoptera) in Palembang, South Sumatra, Indonesia

Station	Research location	Coordinate point	MASL	Information
1	Sungai Ijuk SL	3°01′11.87″LS 104°43′6.52″BT	4.57	Activities of farmers and local residents. Predominantly herbaceous.
2	Alang-Alang Lebar SLC	2°55′58.47″LS 104°42′18.52″BT	14.93	Activities of office employees. Dominated by shrubs and tree vegetation.
3	Gandus SLC	2°59′43.64″LS 104°44′12.44″BT	5.18	Residential activities. Dominated by shrubs and trees.
4	Jakabaring SLC	3°01′20.88″LS 104°47′24.90″BT	5.18	Sport community activities.Dominated by shrubs and trees.
5	Kertapati SLC	3°03′54.45″LS 104°44′23.02″BT	5.79	Community activities at the bus terminal. Dominated by shrubs and trees.
6	Jalan Soekarno-Hatta SLC	2°57′59.27″LS 104°45′06.27″BT	7.92	Shophouse trading activity. Lack of tree and shrub vegetation

Butterfly sampling method

The research employed an observation method utilizing cruising techniques. with 5 survey rounds conducted at each research site. Butterfly samples were collected using the insect net collection method. butterfly traps and scan sampling methodology. spanning from 07:00 AM to 5:00 PM, encompassing morning till late afternoon. The collection process involved three distinct approaches: direct manual capture by hand or tweezers for passive butterfly species, the use of insect nets for actively flying species, and glue traps to capture butterflies on trees. Each species was sampled up to a maximum of 3 individuals. Any surplus live butterflies were recorded and then released back into their natural habitat. Preserving involved injecting butterfly samples with 70% alcohol into the mesothorax, followed by positioning on styrofoam with a dissecting needle.

Identification of butterfly samples (Order: Lepidoptera) from Palembang research location

Butterfly samples were identified through assessment of head, thoracic, and abdominal morphology. Identification references encompassed several books: "An Atlas and Guide to the Butterflies of the Arnside & Silverdale AONB" (Hancock, 2013), "Atlas of Butterflies and Diurnal Moths in the Monsoon Tropics of Northern Australia" (Braby et al., 2018), "Practical Guide to Butterflies of Bogor Botanic Garden" (Peggie & Amir, 2006), "The Butterflies of Jambi (Sumatra, Indonesia), An EFForTS Field Guide" (Panjaitan et al., 2021), and "Butterfly Field Guide" (Resasco, 2011).

Data analysis

The diversity and abundance of butterflies from the Palembang city's research site was analyzed using the Shannon-Wiener diversity index (H'). The Shannon-Wiener diversity index was calculated using the equation:

$$H' = -\sum_{i=1}^{s} pi \ln pi \quad (1)$$

Where *pi* signifies the proportion of individuals found in a given species, and lnrepresents the natural logarithm. Evenness (*E*) was calculated using the equation:

$$E = \frac{H\prime}{\ln S} \quad (2)$$

The Simpson dominance index was employed to gauge species dominance and determine frequently occurring species within the SLC area. The formula for the Simpson dominance index is:

$$D = \sum(pi)^2 = \sum(\frac{ni}{N})^2 \quad (3)$$

Description:
H' = Shannon-Wiener index, E = evenness index, D = dominance index, *pi* = proportion of individuals, S = number of species,*ni* = number of individuals species-i, N = total number of individuals

Result and Discussion

This research found 230 individual butterflies from 19 species belonging to 5 families. The five butterfly families are Hesperiidae, Lycaenidae, Nymphalidae, Papilionidae, and Pieridae. The percentage of the number of individuals based on families from the Lepidoptera Order in several SLC locations from the highest to the lowest respectively were Pieridae (34.78%), Nymphalidae (34.34%), Papilionidae (13.47%), Hesperiidae (11.30%), and Lycaenidae (6.08%). The highest species found was *Appias* sp. with 45 individuals, and the least species found were *Erionota thrax* and *Mycalesis* sp. with 1 individual each from Alang-Alang Lebar SLC and Gandus SLC. The butterflies from the family Hesperiidae were 3 species (*Borbo cinnara* (Wallace, 1886), *Erionota thrax* (Linnaeus, 1767) and *Telicota augias* (Linnaeus, 1763)), family Lycaenidae had 3 species (*Euchrysops cnejus* (Fabricius,

1798), *Zizina otis* (Fabricius, 1787) , and *Lycaenopsis haraldus* (Fabricius, 1787)), family Nymphalidae had 8 species (*Athyma asura* Moore, 1858), *Elymnias pananga* (Westwood, 1851), *Euthalia adonia* (Cramer, 1782), *Hypolimnas bolina* (Linnaeus, 1758), *Ideopsis juventa* (Cramer, 1777), *Junonia almanac* (Linnaeus, 1758), *Mycalesis dohertyi* Elwes, 1891, and *Neptis nata* Moore, 1857), family Papilionidae had 2 species (*Graphium doson* C. & R. Felder, 1864 and *Papilio demolion* Cramer, 1776), and the family Pieridae had 3 species (*Appias lyncida* (Cramer, 1777), *Eurema hecabe* (Linnaeus, 1758), and *Leptosia nina* (Fabricius, 1793) (Figure 2) (Table 2).

Table 2. Number of species from each family (Order: Lepidoptera) from the research location Palembang, South Sumatra, Indonesia

Family	Spesies	Σ butterfly found*						Σ	Σ
		SI	AL	GD	JB	KP	SH	Individual	Family
Hesperiidae	Borbo cinnara (Wallace, 1886)	0	0	0	12	0	0	12	26
	Erionota thrax (Linnaeus, 1767)	0	1	0	0	0	0	1	
	Telicota augias (Linnaeus, 1763)	0	0	11	0	0	2	13	
Lycaenidae	Euchrysops cnejus (Fabricius, 1798)	0	10	0	0	0	0	10	14
	Lycaenopsis haraldus (Fabricius, 1787)	1	0	0	0	1	0	2	
	Zizina Otis (Fabricius, 1787)	0	0	0	0	0	2	2	
Nymphalidae	Athyma asura Moore, 1858	0	0	0	20	0	0	20	79
	Elymnias pananga (Westwood, 1851)	0	0	0	2	0	0	2	
	Euthalia adonia (Cramer, 1782)	0	0	0	4	0	0	4	
	Hypolimnas bolina (Linnaeus, 1758)	0	5	14	0	0	0	19	
	Ideopsis juventa (Cramer, 1777)	0	0	0	7	0	0	7	
	Junonia almanac (Linaeus, 1758)	0	1	5	8	0	6	20	
	Mycalesis dohertyi Elwes, 1891	0	0	1	0	0	0	1	
	Neptis nata Moore, 1857	0	5	0	1	0	0	6	
Papilionidae	Graphium doson C. & R. Felder, 1864	0	9	0	1	19	0	29	31
	Papilio demolion Cramer, 1776	0	2	0	0	0	0	2	
Pieridae	Appias lyncida (Cramer, 1777)	17	3	8	0	17	0	45	80
	Eurema hecabe (Linnaeus, 1758)	2	15	0	3	2	0	22	
	Leptosia nina (Fabricius, 1793)	0	11	0	2	0	0	13	
Number of Individuals		20	62	39	60	39	10		230
Number of species		3	10	5	10	4	3		

**Information: SI : Sungai Ijuk SL ; AL: Alang-Alang Lebar SLC; GD: Gandus SLC; JB: Jakabaring SLC; KP: Kertapati SLC; SH: Soekarno-Hatta SLC.*

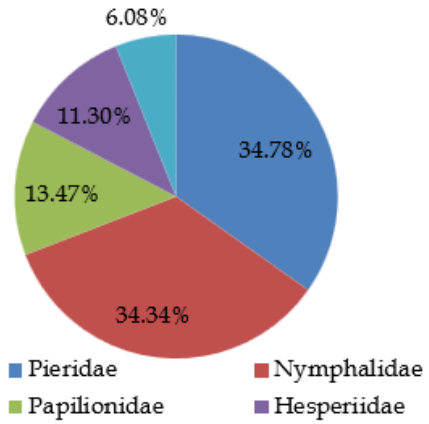

Figure 2. Percentage of the number of individuals from the butterfly family (Order: Lepidoptera) at the study site Palembang City, South Sumatra, Indonesia.

The study's findings revealed the presence of 230 individual butterflies, encompassing 19 species and 5 families within the order Lepidoptera, at the research site in Palembang city. The site, formerly Palembang's urban area, has undergone conversion into stadiums, terminals, housing, offices, and shophouses. The identified Lepidoptera families include Pieridae, Nymphalidae, Papilionidae, Hesperiidae, and Lycaenidae. Notably, the most prevalent species within the SLC areas belong to the Nymphalidae family, comprising 8 species. The highest number of individuals, however, belongs to the Pieridae family, with a count of 86 individuals. In a study by Zhang et al. (2023), the Pieridae family exhibited the highest number of butterfly individuals (N = 3,671), while the Nymphalidae family displayed the highest butterfly species count (N = 80). Rusman et al. (2016); Tamang et al. (2019) reported a similar trend, noting that Nymphalidae family members constituted the highest number of butterfly species compared to other families. The Nymphalidae family serves as an environmental bioindicator and engages in consuming fermented fruits, decaying plants, and animal carcass exudates (Graca et al., 2017; Sousa et al., 2019), suggesting their adaptability to the transformed Palembang environments. However, it's worth noting that Nymphalidae species were absent in marshlands (Table 2), likely due to the expansive nature of the Musi

watershed sampling location, which did not support Nymphalidae butterfly presence.

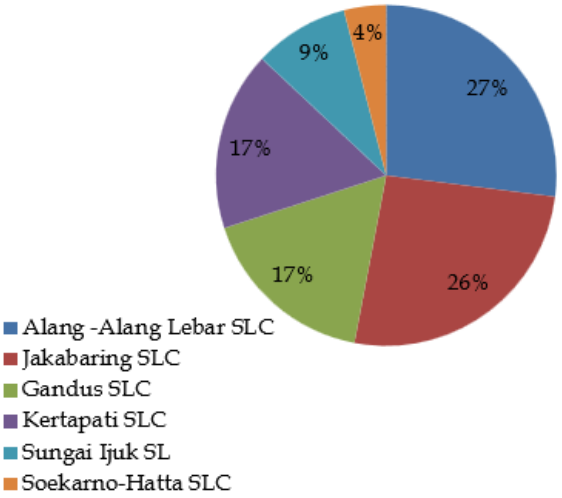

Figure 3. Percentage of individuals from several butterfly families found at the research location, Palembang, South Sumatra, Indonesia

The highest percentage of butterflies was found at the location of Alang-Alang Lebar (27%) SLC, then Jakabaring (26%) SLC, Gandus SLC and Kertapati (17%) SLC, Sungai Ijuk SL (9%), and Soekarno-Hatta (4%) SLC (Figure 3). The highest number of butterfly species was found in Alang-Alang Lebar SLC and Jakabaring SLC, with 10 species each, while Gandus SLC found 5 species, Kertapati SLC found 4 species, and Sungai Ijuk SL and Soekarno-Hatta SLC only found 3 species (Table 2).

The percentage of the number of individuals from the butterfly family found at the Palembang research site varied (Figure 4). Each study site showed differences in the number of species and the number of individuals found. The Sungai Ijuk SL location only had butterflies from the Pieridae (95%) and Lycaenidae (5%) families. Alang-Alang Lebar SLC had 5 families: Hesperiidae (1.61%), Lycaenidae (16.12%), Nymphalidae (17.74%), Papilionidae (17.74%), and Pieridae (46.77%). Gandus SLC had 3 families: Hesperiidae (28.20%), Nymphalidae (51.28%), and Pieridae (20.51%). Jakabaring SLC had 4 families: Hesperiidae (20%), Nymphalidae (70%), Papilionidae (1.66%), and Pieridae (8.33%). Kertapati SLC had 3 families: Lycaenidae (2.56%), Papilionidae (48.71%), and Pieridae (48.71%). Soekarno-Hatta SLC had 3 families: Hesperiidae (20%), Lycaenidae (20%), and Nymphalidae (60%).

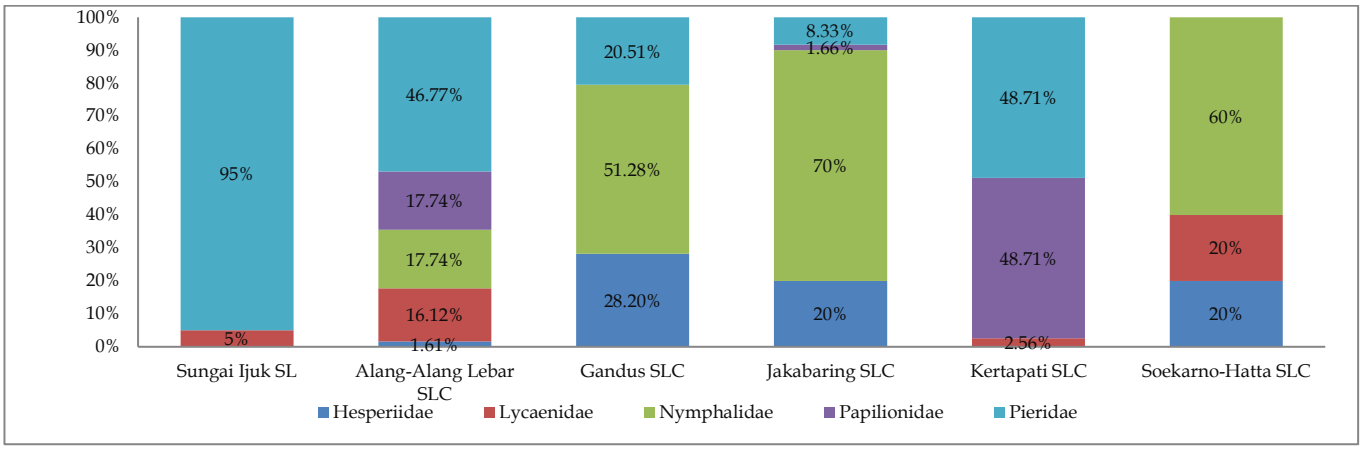

Figure 4. Percentage of the number of individuals from the butterfly family found at the research location Palembang, South Sumatra, Indonesia

The alteration of habitats resulting from the conversion of swamplands within Palembang has led to shifts in butterfly diversity, acting as a bioindicator of the effects of swampland conversion. Remarkably, the SLC at the Wide Reed location displayed higher butterfly abundance compared to other SLC areas, surpassing even the butterfly count in the Rawa land. This suggests the potential establishment of a stable and developed diversity within the Alang-Alang Lebar SLC. The results of field observations indicate that after swampland was converted into SLC areas or public facilities, more green vegetation and flowering plants were found, which serve as butterfly food sources. Koneri et al. (2019) reported higher butterfly diversity in forest edge habitats where numerous host plants, vegetation that serves as a food source, and shelter for butterflies were present. Rusman et al. (2016) stated that butterfly diversity is dependent on the availability of food sources and habitat quality. Additionally, Rusman et al. (2016) concluded that changes in butterfly habitat have a significant impact on butterfly composition and diversity. This stability could be attributed to significant environmental changes occurring in Alang-Alang Lebar SLC over a 22-year period (2000-2022) (Figure 5), while the Sungai Ijuk SL surrounding the Musi river in Palembang experienced less drastic land transformations (Figure 6).

(a) (b)

Figure 5. The condition of conversion of Alang-Alang Lebar swampland (a) Alang-Alang Lebar SLC in 2000; (b) Alang-alang Lebar SLC in 2023 (Google Earth, 2023).

(a) (b)

Figure 6. The conditions of conversion of Sungai Ijuk SL (a) Conditions of swampland in 2000; (b) Condition of swampland in 2023 (Google Earth, 2023).

In certain study locations, the butterfly population was primarily dominated by species from the Pieridae family, particularly in Sungai Ijuk SL (95%), Alang-Alang Lebar SLC (47%), and Kertapati SLC (49%). The Pieridae family is renowned for being a primary source of pteridin (Descimon, 2019; Wijnen et al., 2007), and globally, it encompasses around 83 genera and over 1,100 species (Braby, 2005). These butterflies have played a pivotal role in evolutionary biology, often displaying medium-sized features in shades of white, orange, or yellow. Additionally, many Pieridae species exhibit migratory behaviors and/or seasonal phenotypic variations (Courtney & P., 1986).

The values of diversity, evenness, and butterfly dominance index in Palembang showed varied results (Figure 5) (Table 3). The butterfly diversity index in the locations of Alang-Alang Lebar SLC, Gandus SLC, and Jakabaring SLC was in the medium category (H'1-3), while the butterfly diversity index in Sungai Ijuk SL, Kertapati SLC, and Soekarno-Hatta SLC was in the low category (H' < 1). The value of the butterfly diversity index in the Palembang research location from the highest value to the lowest value consecutively is Alang-Alang Lebar SLC (H'=2.02), Jakabaring SLC (H'=1.90), Gandus SLC (H'=1.40), Kertapati SLC (H'=0.96), Soekarno-Hatta SLC (H'=0.95), and Sungai Ijuk SL (H'=0.52). The evenness index (E) of butterflies at the location of Alang-Alang Lebar SLC and Jakabaring SLC was in the high category (EAL = 0.69 and EJB = 0.65), the medium category was at the location of Gandus SLC (EGD = 0.48), and the low category was found at the location of Kertapati SLC (EKP = 0.33), Soekarno-Hatta (ESH = 0.32), and Sungai Ijuk SL (ERA = 0.18). The dominance index in all research locations in Palembang is in the low to high category, namely approaching 0 for the low category and approaching 1 for the high category: Sungai Ijuk SL (DSI = 0.74), Soekarno-Hatta SLC (DSH = 0.44), Kertapati SLC (DKP = 0.43), Gandus SLC (DGD = 0.27), Jakabaring SLC (DJB = 0.19), and Alang-Alang Lebar SLC (DAL = 0.15).

Table 3. Parameters of diversity, evenness, and dominance of butterflies at the research location Palembang, South Sumatra, Indonesia

Parameters	SI	AL	GD	JB	KP	SH
Number of Individuals	20	62	39	60	39	10
Number of species	3	10	5	10	4	3
Diversity (H')	0.52	2.02	1.41	1.90	0.96	0.95
H' Max = Ln(19)	2.94	2.94	2.94	2.94	2.94	2.94
Evenness (E)	0.18	0.69	0.48	0.65	0.33	0.32
Dominance (D)	0.74	0.15	0.27	0.19	0.43	0.44

*Information: SI : Sungai Ijuk SL ; AL: Alang-Alang Lebar SLC; GD: Gandus SLC; JB: Jakabaring SLC; KP: Kertapati SLC; SH: Soekarno-Hatta SLC

The butterfly diversity index ranged from medium to low across the study locations, while evenness varied from high to low. Notably, all butterfly types across the research locations were categorized as highly dominant. Alang-Alang Lebar SLC (H'=2.02) and Jakabaring SLC (H'=1.90) fell within the medium category due to their diverse species count (N = 10 species). Conversely, Kertapati SLC (H'=0.96) and Soekarno-Hatta SLC (H'=0.95) demonstrated a low butterfly diversity index. Riva et al. (2023) postulate that land changes directly impact butterfly diversity, forcing them to adapt to new habitats. In the case of SLC Kertapati, the low butterfly diversity index observed was suspected to be caused by pollution from bus terminal vehicles. This low butterfly diversity demonstrates the role of butterflies as bioindicators and indicators of environmental quality. Sharma et al. (2020) emphasize butterflies' rapid and sensitive responses to environmental changes, making them valuable bioindicators for assessing ecosystem health. The low butterfly diversity index in Soekarno-Hatta SLC is attributed to inadequate plant vegetation, a primary source of nutrition for sustaining butterfly populations.

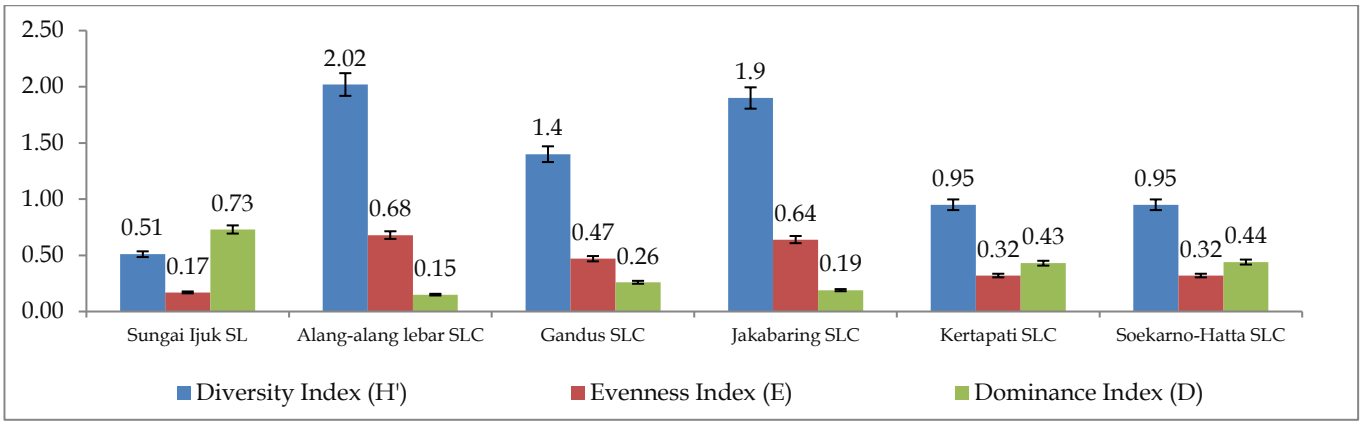

Figure 7. Shannon-Wiener index (H'), evenness index (E), and dominance index (D)

The diversity of butterflies (Order: Lepidoptera) in the Palembang City research location is in the medium-low category. The highest number of individual butterflies found at the study site was from the family Pieridae, and the least number of butterflies found were from the family Lycaenidae. The largest number of species belongs to the family Nymphalidae, and the fewest species belong to the family Lycaenidae. The diversity of butterflies in the SLC location of Palembang City is in the medium to low category due to the conversion of swamp land into public facilities in several areas of Palembang. Stable and established diversity is found in the location of Alang-Alang Lebar SLC. Butterflies respond to environmental changes, marked by differences in butterfly diversity in each research location in Palembang City. The latest information from this study, in general, shows that case studies of butterfly habitat changes due to SLC can increase the diversity index, species diversity, and the number of individual butterflies of the order Lepidoptera as pollinator insects, rather than in natural swamps. We believe that changing the butterfly habitat from natural swamps to land SLCs can support the conservation of butterfly species as special pollinator insects of the families Nymphalidae, Papilionidae, Hesperiidae, and Lycaenidae, but it is less supportive for the conservation of butterfly species of the family Pieridae in the city of Palembang, South Sumatra, Indonesia.

Conclusion

The diversity of butterflies (Order: Lepidoptera) in the Palembang City research location is in the medium-low category. The diversity of butterflies in the SLC location of Palembang City is in the medium to low category due to the conversion of swamp land into public facilities in several areas of Palembang. The butterflies respond to environmental changes, marked by differences in butterfly diversity in each research location in Palembang City. The highest butterfly diversity index value is recorded at the Alang-Alang Lebar SLC , whereas the lowest butterfly diversity index value is observed at the Sungai Ijuk SL. The latest information from this study, in general, shows that case studies of butterfly habitat changes due to SLC can increase the diversity index, species diversity, and the number of individual butterflies of the order Lepidoptera as pollinator insects, rather than in swamp land. The results suggest that SLC can contribute to the conservation of butterfly species belonging to the Nymphalidae, Papilionidae, Hesperiidae, and Lycaenidae families except the Pieridae family.

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Author Contributions

Writing proposals, concepts, research, sample collection, data analysis, and interpretation of findings, article writing, and revision were carried out by the research team in writing this scientific paper. Conceptualization, R. and R.R.; methodology and conductor of experiment, M.A.F..; data analyzer and data visualization, Y.R.

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Conflicts of Interest

This paper also describes our original work and is not under consideration by any other journal. All authors approved the manuscript and this submission. The three co-authors do not have any conflict of interest regarding this manuscript. This document was reported as the result of the research we conducted as one of the requirements of our responsibility as a researcher in our university.

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