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BUTTERFLY DIVERSITY IN THE ALAS RIVER OF SORAYA RESEARCH STATION, LEUSER ECOSYSTEM, ACEH PROVINCE

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Abstract: Butterflies are insects that live along riverbanks and belong to the Lepidoptera order. The Alas River is one of the longest rivers in Sumatra which passes through four districts in Aceh Province. Along the river banks, there are varied vegetation conditions such as secondary forests, shrubs, and sandy banks. This study aims to determine the diversity and composition of butterfly species in the Alas River, which is included in the Soraya Research Station area of the Leuser Ecosystem. The transect method was used to conduct butterfly diversity research from August to December 2020. A total of 75 species of butterflies were found in this study belonging to five families: Hesperidae, Lycaenidae, Pieridae, Papilionidae, and Nymphalidae. The butterfly compositions obtained were Nymphalidae (32 species and 134 individuals), Papilionidae (16 and 137), Pieridae (16 and 121), Lycaenidae (9 and 52), and Hesperidae (2 and 2). The butterfly species diversity index was categorized as high (H'= 3.763).

Keywords: Diversity; composition; butterfly; Alas River; Soraya Research Station

Abstrak: Kupu-kupu merupakan serangga yang tergolong ke dalam ordo Lepidoptera yang banyak hidup di aliran sungai. Penelitian tentang keanekaragaman kupu-kupu dilakukan pada bulan Agustus - Desember 2020, sampel dikoleksi dengan menggunakan metode transek. Sungai Alas merupakan salah satu sungai terpanjang di Sumatera yang melewati empat kabupaten di Provinsi Aceh. Sepanjang tepian sungai ditumbuhi oleh berbagai jenis vegetasi membentuk hutan dan semak serta daerah yang berpasir. Studi ini bertujuan untuk mengetahui keragaman dan komposisi jenis kupu-kupu di aliran Sungai Alas yang masuk dalam wilayah Stasiun Penelitian Soraya Kawasan Ekosistem Leuser. Hasil penelitian ditemukan 75 jenis kupu-kupu yang tergolong dalam lima family yaitu Hesperidae, Lycaenidae, Pieridae, Papilionidae dan Nymphalidae. Komposisi kupu-kupu yang didapatkan berturut-turut adalah Nymphalidae (32 spesies and 134 individu), Papilionidae (16 dan 137), Pieride (16 dan 121), Lycaenidae (9 dan 52), dan Hesperidae (2 dan 2). Indeks keanekaragaman jenis kupu-kupu dikategorikan tinggi (H'= 3.8).

Kata Kunci: Keanekaragaman; Komposisi; Kupu-kupu; Stasiun Penelitian Soraya.

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Introduction

Butterflies are one of the insect faunas with the greatest diversity in the world. There are around 4,000-5,000 species in Indonesia. Butterflies are daytime flying insects (diurnal). Butterfly existence is influenced by various biotic and abiotic factors. Butterflies prefer humid habitats. The butterflies exist in a variety of environments (Corbert & Pendlebury, 2020), including forests (Suwarno & Rasnovi, 2019; Salmah, Abbas, & Dahelmi, 2002), gardens (Suwarno, S., Hanum, I., Yasmin, Y., Rasnovi, S. and Dahelmi (2018), fields, shrubs, grasslands, residential areas (Ramesh, Hussain, Selvanayagam, Satpathy, & Prasad, 2012) and rivers (Herlina, 2017).

Butterflies prefer fresh, cool environments with plenty of light for their activities. The area around the river is one of the most popular butterfly habitats. Butterflies feed on the river's high humidity and many sorts of plants (Salmah, Abbas & Dahelmi, 2002). Male butterflies could obtain minerals from watersheds, particularly sandy, rocky, and wet riverbanks, which will be transmitted to females during copulation (Salmah, Abbas & Dahelmi, 2002). Male butterflies could obtain minerals from watersheds, particularly sandy, rocky, and wet riverbanks, which will be transmitted to females during copulation (Suwarno, Rasnovi, Utami, Rizki, & Dahelmi, 2019; Sharma & Sharma, 2017).

An important habitat element for butterfly life is the availability of vegetation as a source of food, reproduction, and protection. If the habitat supports this, butterflies can survive to the next generation (Herlina, 2017). In addition, environmental factors such as temperature and humidity also affect butterfly reproduction (Dewi, Hamidah & Siburian, 2016). The diversity of vegetation along the river basin plays an important role as a food source for larvae and a source of nectar for adult butterflies (Suwarno & Rasnovi, 2019; Lodh & Agarwaa, 2016; Kitahara, Yumoto, & Kobayashi, 2008).

In Deudap Pulo Nasi Village, Pulo Aceh District (Darnilawati, Nurul, Hafiz & Samsul, 2018), 22 species belonging to six families were identified. In Pulau Raya, Aceh Jaya District (Darnilawati, Nurul, Hafiz & Samsul, 2018), 22 species belonging to six families were identified (Yusuf, Rasnovi, Fithri, Rizki, & Suwarno, 2018) In Banda Aceh's City Garden, 17 species from three families were discovered (Suwarno, Hanum, Yasmin, Rasnovi, & Dahelmi, 2018). found that 30 species from seven families in the Brayeun River in Aceh Besar District ('Akla, Rasnovi, Fithri, & Suwarno, 2018), 51 species from four families in the forest of Soraya Research Station (Suwarno & Rasnovi, 2019), and 25 species from four families in the forest of Soraya Research Station (Suwarno & Rasnovi,

2019). According to all the studies, butterflies were diverse in terms of species, composition, and population. There seem to be no reports of butterflies along the Alas River, meanwhile.

The Alas River is one of the longest rivers in Sumatra, which is located in Aceh Province. This river originates in Gayo Lues Regency and continues to flow to the Indian Ocean bypassing through four regencies/cities namely Gayo Lues Regency, Southeast Aceh, Aceh Singkil, and Subulussalam City. This river also crosses the Gunung Leuser National Park (TNGL) area and the Soraya Research Station (Hanafiah, 2021). The banks of the Alas River, which runs through the Soraya Research Station region, are in a variety of different places, including secondary forests, shrubs, and sand. In general, butterflies prefer high-humidity environments, such as riverbanks (Handayani, et al, 2012). As butterfly host plants and food sources, a variety of vegetation thrives. As a result, it is assumed that the diversity of butterfly species along this river is fairly great.

Methods

Study Site

The research was carried out in the Soraya Research Station's Alas River (Lae Soraya). The Leuser Ecosystem encompasses the area. The Soraya Research Station is located at 2°55'25" South Latitude (South Latitude) and 97°55'43" East Longitude (East Longitude), with a topography of 75-350 meters above sea level (Figure 1). The pedestal river is 366 kilometers long and has a river area of 13,466.41 km^2. The Alas River is about 579 kilometers southeast of Banda Aceh, the provincial capital of Aceh.

Data Collection

This study was carried out utilizing a transect survey method at six different locations (Figure 1). Butterfly habitat is suitable in the Alas River (Lae Soraya) area, and collection is carried out at various sites to fulfill their distribution. From each location point, a 500 m long and 10 m wide transect line was drawn (Pollard & Yates, 1995). From August to December 2020, butterflies were collected from 8 a.m. to 4 p.m. The thorax is squeezed, stored on papilot paper, labeled, and noted on the worksheet for the butterflies that have been caught. The butterflies were temporarily maintained at the camp by injecting 4 percent formalin into the mesothorax. Air temperature, humidity, and light intensity are used to measure environmental physical parameters. The appropriate environmental conditions for butterfly development are described by each measurement data obtained (Salmah, Abbas & Dahelmi 2002)

Butterfly Preservation and Identification

Preservation and identification of butterfly samples were carried out at the Ecology Laboratory, Department of Biology, Faculty of Mathematics and Natural

Sciences, Syiah Kuala University (USK). The preservation of butterfly specimens refers to Salmah, Abbas & Dahelmi (2002).

The butterfly specimens were then identified based on the main characteristics as shown in Figure 2 (Salmah, Abbas & Dahelmi, 2002). The references used for identification were Corbet & Pendlebury (2020) and Otsuka (2001) as well as butterfly specimens in the Ecology Laboratory of Biology Department.

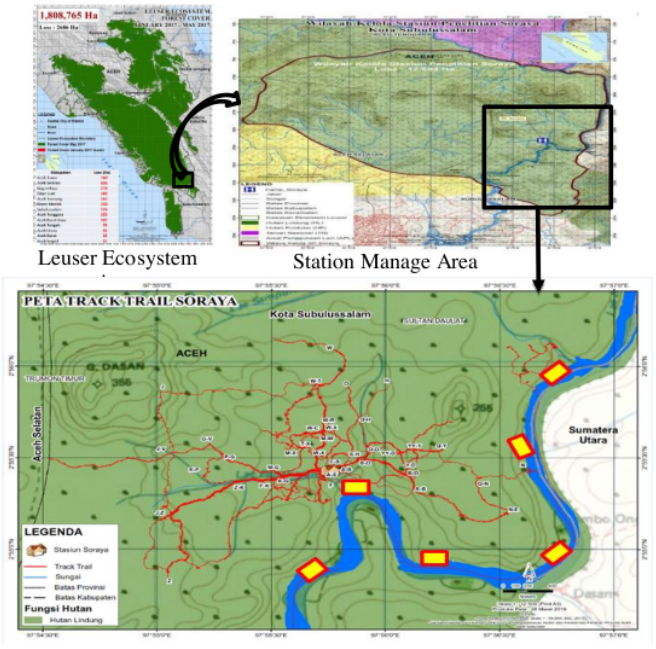


Figure 1. The point where the butterfly sample is taken

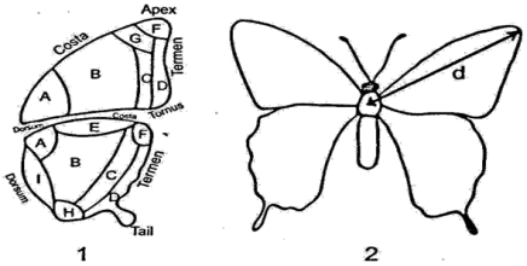


Figure 2. The wing parts that are considered in identification, A. Basal; B. Discal; C. Sub Marginal; D. Marginal; E. Costal; F. Apical; G. Sub Apical.; H. Tornus; I. Dorsal; J. Wing Length (Salmah, Abbas & Dahelmi, 2002).

Data Analysis

Data analysis was carried out on species composition in the community, Relative Density (RD), Relative Frequency (RF) and Diversity Index (H').

$$RD = \frac{\text{Number of individuals of a species}}{\text{Number of individuals of all species}} \times 100\%$$

$$RF = \frac{\text{Number of transects occupied by a species}}{\text{Total number of transects}} \times 100\%$$

The value of the Butterfly Diversity Index is calculated using the *Shannon-Wiener* formula (Odum, 1993), namely:

$$H' = -\sum P_i \ln P_i$$

Description :

H : Species diversity index

P*i* : n_i/ N

n_i : Number of individual butterfly species

N : Total number of individuals of all species

To determine the existence of diversity values, the Shannon-Wiener diversity index is categorized into three criteria as follows:

H'<1 = Diversity index is categorized as low.

H' 1-3 = Diversity index is categorized as medium.

H'>3 = Diversity index is categorized as high.

Results and Discussion

Butterfly Type Composition

Butterflies were found in the Alas River, Soraya Research Station as many as 447 individuals, belonging to 75 species and 5 families, namely Hesperidae, Pieridae, Lycaenidae, Papilionidae, and Nymphalidae. The composition of the number of species and the number of individuals for each family is shown in Figure 3.

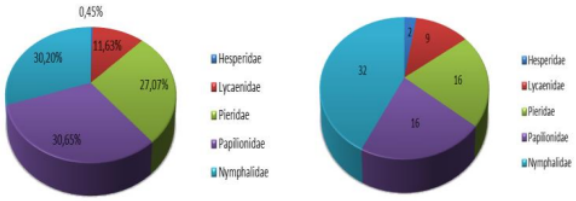


Figure 3. The composition of butterfly species and the number of individuals for each family, at Soraya Research Station, Leuser Ecosystem

The highest number of species was found in Nymphalidae, with as many as 32 species, followed by Papilionidae and Pieridae each with 16 species, while the Hesperidae only had 2 species (Figure 3). Furthermore, Figure 4 shows the highest number of individuals in the Papilionidae and Nymphalidae, respectively, as much as 30,.65% and 30,20%, while the lowest was in the Hesperidae, which was 0,45%. Nymphalidae butterflies had a higher number of species and individuals than the others due to the number of food plants and host plants along the river that were suitable for the butterfly's survival, both as a source of food and as a place to reside and shelter (Tatang, et al., 2018). The Nymphalid butterfly is a polyphagous insect and some of its host plant species were found in the location such as *Graptopilum pictum*, *Asystasia gangetica*, *Garcinia* sp. and *Ficus* sp. The host plants of Nymphalidae butterflies include Annonaceae, Asteraceae, Verbenaceae, Moraceae, Rubiaceae and Anacardiaceae (Lamatoa, Koneri, Siahaan, & Maabuat, 2013).

Nymphalid butterflies are also the most numerous in the Lepidoptera, with members distributed across a wide range of habitats and a high tolerance for environmental influences. Physical environmental factors such as temperature, humidity, and light intensity influence butterfly diversity. Butterflies are poikilothermic insects, which means their body temperature is highly influenced by their surroundings. As a result, butterflies' activities have a limited temperature tolerance range. However, the high number of Papilionidae species was due to this butterfly family's wide distribution and preference for riverbank environments, as water is one of the major aspects for butterflies to engage in puddling activities (Murwitaningsih, 2019).

Previous research observing the puddling behavior of butterflies in the Alas River by Suwarno *et al*. (2019), found as many as 25 species belonging to four families, namely Papilionidae, Nymphalidae, Lycaenidae, and Pieridae. The Nymphalid and Papilionid butterflies were most found. In addition, 'Akla *et al*. (2018), reported that as many as 51 species of butterflies belonging to four families namely Lycaenidae, Pieridae, Papilionidae and Nymphalidae were found in the Brayeun River. The most common butterflies found were the Nymphalidae 23 species (45.10%), followed by Papilionidae (12 species; 23.53%), Pieridae (14 species; 27.45%) and Lycaenidae only (2 species; 3.92%).

Diversity of Butterfly Species

All butterfly species found along the Alas River in the Soraya Research Station area are shown in Table 1. Three species of Lycaenidae butterflies that have the highest relative density and frequency were *Caleta roxus, Jamides zebra* and *Caleta elna*. These three butterfly species were very often found puddling on wet riverbanks and sucking the liquid nectar from flowers. The abundance of host plants and food plants of Lycaenid butterflies, such as *Asystacia gangetica* (Acanthaceae), *Eupatorium odoratum* (Asteraceae) and some species of

Leguminoceae, was one of the main factors for these three species of butterflies found in river flows. The Lycaenidae butterflies that often puddle in the Alas River were *Caleta elna*, *Caleta roxus*, *Jamides zebra* and *Jamides parasaturatus* (Suwarno *et al*., 2019).

Appias lybythea, Appias lyncida and *Eurema hecabe* are the dominant species in the family Pieridae (Table 1). The Pieridae butterfly above is a common species found in many locations. According to Suwarno et al. (2019), on the banks of the Alas River there are many Leguminoceae plants which are the host plants of Pieridae, and these three species also often puddle in the Alas River.

Furthermore, the Papilionidae butterflies were dominated by *Graphium* and *Papilio*. These two genera were always found at every sampling location because there are many plants in the Annonaceae, Lauraceae and Rutaceae families which are the host plants of the two genera. *Graphium agamemnon, G. antiphates* and *G. doson were* also found puddling on sandy riverbanks. Suwarno *et al*. (2019) reported that most of the Papilionidae that do puddle in the Alas River are *Graphium* and *Papilio*.

Two species of Papilionidae butterflies, *Trogoptera brookiana* and *Troides helena* which are protected species were also found with a high frequency of presence. The abundance of food impacts the existence of species which are restricted to habitats (Panjaitan *et al*., 2020). The results of the research by Suwarno and Rasnovi (2019) also found the dominance of the two genera (*Graphium* and *Papilio*) and three protected species, namely *T . brookiana, T. helena* and *T. amphrysus* in the forest habitat at Soraya Research Station

The Nymphalidae family is dominated by *Cupha erymanthis* and *Doleschallia bisaltidae* which are species that are commonly found in bush areas and along streams (Table 1). Both species were preferring the open areas. The host plants and food plants of *D. bisaltidae* were found along the banks of rivers such as *Asystacia longifolia*. The Nymphalidae family has a wide host range, allowing it to exist in a variety of different habitats. (Nuraini *et al*, 2020). This family is polyphagous. This means that this butterfly has more than one type of food. This is also supported by the number of plants that can be used as food sources so this family is often found in every research location (Hapsari *et al*, 2022)

Table 1. Species Composition, Relative Density, Relative Frequency and Butterfly Diversity Index in the Alas River in Soraya Research Station.

Species	Number of individuals	H'	RD	RF
Hesperidae				
Astictopterus jama	1	0,014	0,224	0,613
Lotongus calathus	1	0,014	0,224	0,613

Species	Number of individuals	H'	RD	RF
Lycaenidae				
Caleta elna	10	0,085	2,237	0,613
Caleta roxus	19	0,134	4,251	2,454
Cheritra freja	1	0,014	0,224	0,613
Curetis regula	1	0,014	0,224	0,613
Curetis santana	1	0,014	0,224	0,613
Druphadia teda	1	0,014	0,224	0,613
Jamides celeno	2	0,024	0,447	0,613
Jamides philatus	1	0,014	0,224	0,613
Jamides zebra	16	0,119	3,579	1,840
Pieridae				
Appias albina	3	0,034	0,671	0,613
Appias libythea	18	0,129	4,027	2,454
Appias lyncida	25	0,161	5,593	3,067
Appias nero	3	0,034	0,671	1,227
Catopsilia pomona	3	0,034	0,671	1,227
Catopsilia pyranthe	2	0,024	0,447	0,613
Eurema ada	1	0,014	0,224	0,613
Eurema andersonii	3	0,034	0,671	0,613
Eurema blanda	1	0,014	0,224	0,613
Eurema hecabe	28	0,174	6,264	3,681
Eurema lacteola	1	0,014	0,224	0,613
Eurema sari	15	0,114	3,356	2,454
Eurema simulatrix	7	0,065	1,566	1,840
Eurema sp.	8	0,072	1,790	0,613
Eurema tilaha	2	0,024	0,447	1,227
Gandaca harina	1	0,014	0,224	0,613
Papilionidae				
Graphium agamemnon	18	0,129	4,027	2,454
Graphium antiphates	10	0,085	2,237	3,067
Graphium doson	24	0,157	5,369	3,681
Graphium evemon	6	0,058	1,342	1,227
Graphium sarpedon	8	0,072	1,790	1,840
Lamproptera curius	9	0,079	2,013	2,454
Lamproptera meges	4	0,042	0,895	1,840
Papilio domeleon	4	0,042	0,895	1,840
Papilio domeleus	1	0,014	0,224	0,613
Papilio helenus	6	0,058	1,342	1,227
Papilio iswara	3	0,034	0,671	1,227
Papilio memnon	17	0,124	3,803	2,454
Papilio nephelus	1	0,014	0,224	0,613
Papilio polytes	3	0,034	0,671	1,227
Trogonoptera brookiana	19	0,134	4,251	3,067
Troides helena	4	0,042	0,895	2,454
Nymphalidae				
Cethochia hypsea	22	0,148	4,922	3,067
Charaxes bernardus	3	0,034	0,671	1,227
Chirrochroa malaya	1	0,014	0,224	0,613

Species	Number of individuals	H'	RD	RF
Chirrochroa orissa	3	0,034	0,671	1,227
Chressonesia rahria	1	0,014	0,224	0,613
Captcha erymanthis	14	0,108	3,132	3,067
Cyretis themire	2	0,024	0,447	1,227
Danaus melanipus	1	0,014	0,224	0,613
Doleschallia bisaltide	14	0,108	3,132	2,454
Elymnias hypermnestra	1	0,014	0,224	0,613
Euploea camaralzaman	5	0,050	1,119	1,840
Euploea diocletianus	3	0,034	0,671	0,613
Euploea mulciber	6	0,058	1,342	1,840
Euploea radamanthus	4	0,042	0,895	1,227
Faunis canens	1	0,014	0,224	0,613
Hypolimnas bolina	10	0,085	2,237	1,227
Ideopsis vulgaris	1	0,014	0,224	0,613
Junonia atlites	1	0,014	0,224	0,613
Kalima limborgii	1	0,014	0,224	0,613
Moduza procris	4	0,042	0,895	1,840
Neptis hylas	6	0,058	1,342	1,227
Neptis clinioides	5	0,050	1,119	1,227
Phaedyma cf columella	1	0,014	0,224	0,613
Polyura athamas	1	0,014	0,224	0,613
Polyura delphis	1	0,014	0,224	0,613
Polyura hebe	1	0,014	0,224	0,613
Tanaesia palguna	5	0,050	1,119	0,613
Terinos clarissa	1	0,014	0,224	0,613
Thaumanthis noureddin	2	0,024	0,447	1,227
Vindula dejone	7	0,065	1,566	1,840
Vindula erota	3	0,034	0,671	1,227
Ypthima baldus	4	0,042	0,895	0,613
Total	447	3,763	100	100

RD = Relative Density; RF = Relative Freuency;
Source: Research Result Data 2021

The diversity index of butterflies in the Alas River was high category (H' = 3,763). This is due to the abundance of host plants and food plants of butterflies along the Alas River. The presence and number of butterflies in an area is closely related to the presence of forage plants, and hosts, in the form of flowering plants that provide a source of nectar for imago and feed for their larvae (Setiawan *et al*. 2020). The existence of factors that encourage butterfly reproduction and development had an impact on the diversity of butterfly species. These include a variety of host plants that are beneficial to butterflies as well as outside conditions like humidity and temperature. These elements are more pronounced in daylight since they are diurnal organisms that are active during the day, and as a result, they have a big impact on butterfly survival (Bibas *et al*., 2021). In addition,

abiotic factors such as temperature, air humidity, and light intensity are suitable for the butterfly's life. Based on this diversity index value, it can be stated that the habitat conditions along the pedestal river are still very suitable for the life of butterflies.

Conclusion

Based on the research data, found 75 species from 5 families (Hesperidae, Lycaenidae, Pieridae, Papilionidae, and Nymphalidae) with a total of 477 individuals. The index value of butterfly diversity found in river habitats at the location of the Soraya Research Station is categorized as high H'=3.763. From the total diversity index value, it can be concluded that the river habitat in the Soraya Research Site is still in nature.

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GRADEMARK REPORT

FINAL GRADE

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GENERAL COMMENTS

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