Treubia, 50(2): 125–136, December 2023
DOI: 10.14203/treubia.v50i2.4688
https://e-journal.biologi.lipi.go.id/index.php/treubia

BAIT PREFERENCE AND BUTTERFLY DIVERSITY (LEPIDOPTERA: PAPILIONOIDEA) CAUGHT BY BAIT TRAP IN LANGSA URBAN FOREST, LANGSA, ACEH, INDONESIA

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Submitted: November 23, 2023; Accepted: December 20, 2023; Published: December 31, 2023

ABSTRACT

Butterflies are important for the ecosystem and human life. The presence of butterflies has also become an attraction for nature-based tourism. Langsa Urban Forest (LUF) is an ecotourism site in Langsa City with various biodiversity, including butterflies. For now, data on butterfly diversity in LUF is limited to the active collection using insect nets. This research aimed to complete the database of butterflies in LUF by passive collection to support conservation in LUF. Data was collected for 3 months in the early rainy season (from late August to October 2023), with 8 repetitions using the bait trap method. Results showed 13 species from 3 families with 37 individuals. There were 7 species newly recorded, making a total of 43 species in LUF. From 2 different traps used, 9 species preferred banana bait, 6 species preferred shrimp paste bait, and 2 species trapped in both baits. From 13 species collected by bait trap, 11 species are categorized as Not Evaluated and 2 species are Least Concern by the IUCN Red List.

Key words: banana, butterfly, ecosystem, ecotourism, shrimp paste

INTRODUCTION

Butterflies (Lepidoptera) become one of the most studied groups of insects because they play an important role in the ecosystem and human life, i.e., as a component of the food web, bioindicator, pollinator during the imago stage, or as pest during the larva stage (Peggie & Amir, 2006; Van-Swaay et al., 2012; Panjaitan et al., 2020). In addition, the presence of butterflies contributes to tourism development (Genç et al., 2021). The number of butterfly species in the world is 19,022 species, consisting of 7 families, i.e., Papilionidae, Nymphalidae, Riodinidae, Pieridae, Lycaenidae, Hedylidae, and Hesperiidae (EoL, 2023), with a distribution of 890 species in Sumatra, Indonesia (Widjaja et al., 2014).

The presence of butterflies in an ecosystem is inseparable from the presence of plants that are used as host plants for larvae and flowering plants as nectar sources for imago. Some butterfly species have a wide range of food choices, but some species have a specific range (Peggie & Amir, 2006). The more specific a butterfly's food is, the more susceptible it is to environmental fragmentation, so the butterfly can serve as a bioindicator (Van-Swaay et al., 2012). Butterfly diversity increases along with high plant diversity (Widhiono, 2015).

Butterfly monitoring plays a role in assessing the butterfly population that is related to biodiversity and environmental changes, thus contributing to the conservation of an area (Van-Swaay et al., 2012; Van-Swaay et al., 2015). Butterfly sampling to population monitoring can be done actively using insect nets or passively using traps (Gullan & Cranston, 2010). In the passive collection, the trap that is often used for butterfly diversity research is a bait trap.

Bait traps generally use a cylindrical piece of cloth with small holes. The trap is approximately 1 m in length and 25 cm in diameter to prevent the butterfly from escaping (Van-Swaay et al., 2015). The bait that can be used in the trap is various fruits, especially fermented fruits, including mango, pineapple, durian, and banana, as well as other rotten materials (Freitas et al., 2014). This trap has various advantages, such as being easy to use, cheap, and does not require long sampling time. Also, the caught butterfly individual can be evaluated with minimal handling thus reducing damage (Panjaitan et al., 2019). Another advantage of this method is that the researcher's sampling skills do not influence sampling, as sampling is done passively (Freitas et al., 2014), so there is no bias due to different efforts in sampling.

Previous research on butterfly diversity in other regions of Aceh has been conducted (Alfida & Eliyanti, 2016; Yusuf et al., 2018; Akla et al., 2018; Suwarno et al., 2018). In Langsa, research on butterfly diversity has only been conducted in the LUF and recorded 36 species, but this research is limited to the active collection method using an insect net (Sari et al., 2019), so it does not cover all butterfly species. Based on this, research on butterfly diversity in LUF using the bait trap method is important, because several specialized butterfly species are difficult to catch using insect nets and are only trapped using bait traps (Graça et al., 2017). Therefore, two types of bait, banana and shrimp paste, were used in this study. Some studies showed that bananas are effective as bait (Freitas et al., 2014; Van Swaay, 2015). Freitas et al. (2014) also stated that rotten fish can be used as bait, and become an excellent bait to attract butterflies, for example, the genus *Adelpha* (Nymphalidae: Limenitidinae) and some Riodinidae. Thus, shrimp paste bait, which is assumed to be similar to rotten fish, can be used as a potential bait that attracts butterflies. The effectiveness of prawns as bait in bait traps has been shown (Holloway et al., 2013).

This research aimed to complement the database of butterfly diversity in LUF. The additional data on butterfly diversity in LUF can enrich the information on butterfly species in Aceh, especially in LUF, so it can be a reference in making butterfly conservation policies in the LUF area. This conservation effort is expected to support ecosystem improvement and ecotourism development in Langsa.

MATERIALS AND METHODS

Research conducted in Langsa Urban Forest (LUF), located in Paya Bujok Seulamak Village, Langsa Baro District, Langsa, Aceh, Indonesia (4°29'25" N, 97°56'44" E), and an altitude of 7 m asl (Fig. 1). Measured temperature dan humidity during data collection were 26-35°C and 58-98%. The research site is divided into two areas, a canopy-covered area and an open area (Fig. 2). The canopy-covered area is divided into a Mini Zoo area (Location 1) and a Forest area (Location 2), while the open area is divided into Field area (Location 3) and Flower Garden area (Location 4).

Figure 1. Map of Langsa Urban Forest. A: Aceh; B: Langsa (Google Map, 2023).

Figure 2. Research site. A: LUF Location (Loc a: Banana trap; Loc b: Shrimp paste trap); B: Location 1; C: Location 2; D: Location 3; E: Location 4 (photographed by Sari, 2023).

Butterfly sampling using bait trap with banana and shrimp paste bait, with 1 trap at each location, making a total of 8 traps installed. To reduce bias during sampling, all banana baits were of the same weight and the same type of banana (i.e., Barangan type), and were fermented for 2 days before being used. Similarly, the shrimp paste baits were obtained from a shrimp paste of the same quality and quantity. Traps were hung in a tree at a height of 1 – 1.5 m above the ground (Christharina & Abang, 2014; Van-Swaay, 2015) at each location from 09.00 in the morning and were collected the next day at the same time of installation. Data collection was conducted weekly for 3 months (from late August to early October 2023) in the early rainy season with 8 repetitions. The collected butterflies were preserved and identified using identification guidebooks (Peggie & Amir, 2006; Iqbal et al., 2021). All specimens were stored at the Biology Laboratory, Universitas Samudra, Aceh.

RESULTS

The butterflies obtained from LUF using bait trap were 13 species (Fig. 3) with a total of 37 individuals (Table 1), making a total of 43 species in LUF (Table 2), and expected to increase if the research is continued. Butterflies consisted of 3 families: Nymphalidae (84,61%), Lycaenidae (7,14%), and Hesperiidae (7,14%). At the subfamily level, there were 6 subfamilies obtained, i.e., Satyrinae (38,46%), Limenitidinae (30,77%), Charaxinae (7,69%), Nymphalinae (7,69%), Theclinae (7,69%), and Hesperiinae (7,69%). At the species level, *Melanitis leda* became the most abundant species (7 individuals), while *Athyma nefte, Euthalia adonia, Polyura schreiber,* and *Deudorix kessuma* became the lowest species found with only one individual for each species.

Based on the bait types, 9 species preferred banana traps, 6 species preferred shrimp paste, and 2 species chose both (Table 3). At the subfamily level, 3 subfamilies were trapped in the banana bait trap, 5 subfamilies were trapped in the shrimp paste trap, and 2 subfamilies were trapped in both bait (Fig. 4).

Table 1. Butterfly species obtained at LUF using bait trap

Family/Subfamily/Species	Location				Total	IUCN Conservation Status
	1	2	3	4		
NYMPHALIDAE						
Charaxinae						
Polyura schreiber (Godart, [1824])	-	-	-	1	1	NE
Limenitidinae						
Athyma nefte Cramer, 1782	-	1	-	-	1	NE
Athyma perius (Linnaeus, 1758)	-	1	-	1	2	NE
Euthalia adonia Cramer, 1782	-	-	-	1	1	NE
Phaedyma columella (Cramer, 1782)	-	4	1	-	5	NE
Nymphalinae						
Hypolimnas bolina (Linnaeus, 1758)	-	-	-	2	2	NE
Satyrinae						
Elymnias hypermnestra Linnaeus, 1763	-	1	-	1	2	NE
Melanitis leda Linnaeus, 1758	1	-	4	2	7	LC
Mycalesis janardana Moore, 1857	1	3	-	-	4	LC
Mycalesis mineus Linnaeus, 1858	-	1	1	1	3	NE
Mycalesis perseus Fabricius, 1775	-		2	1	3	NE
LYCAENIDAE						
Theclinae						
Deudorix kessuma (Horsfield, 1892)	-	-	1	-	1	NE
HESPERIIDAE						
Hesperiinae						
Telicota besta Evans, 1949	1	1	3	-	5	NE
Total number of individuals	3	12	12	10	37	
Total number of species	3	7	6	8		

Note: -: absent; NE: Not Evaluated; LC: Least Concern

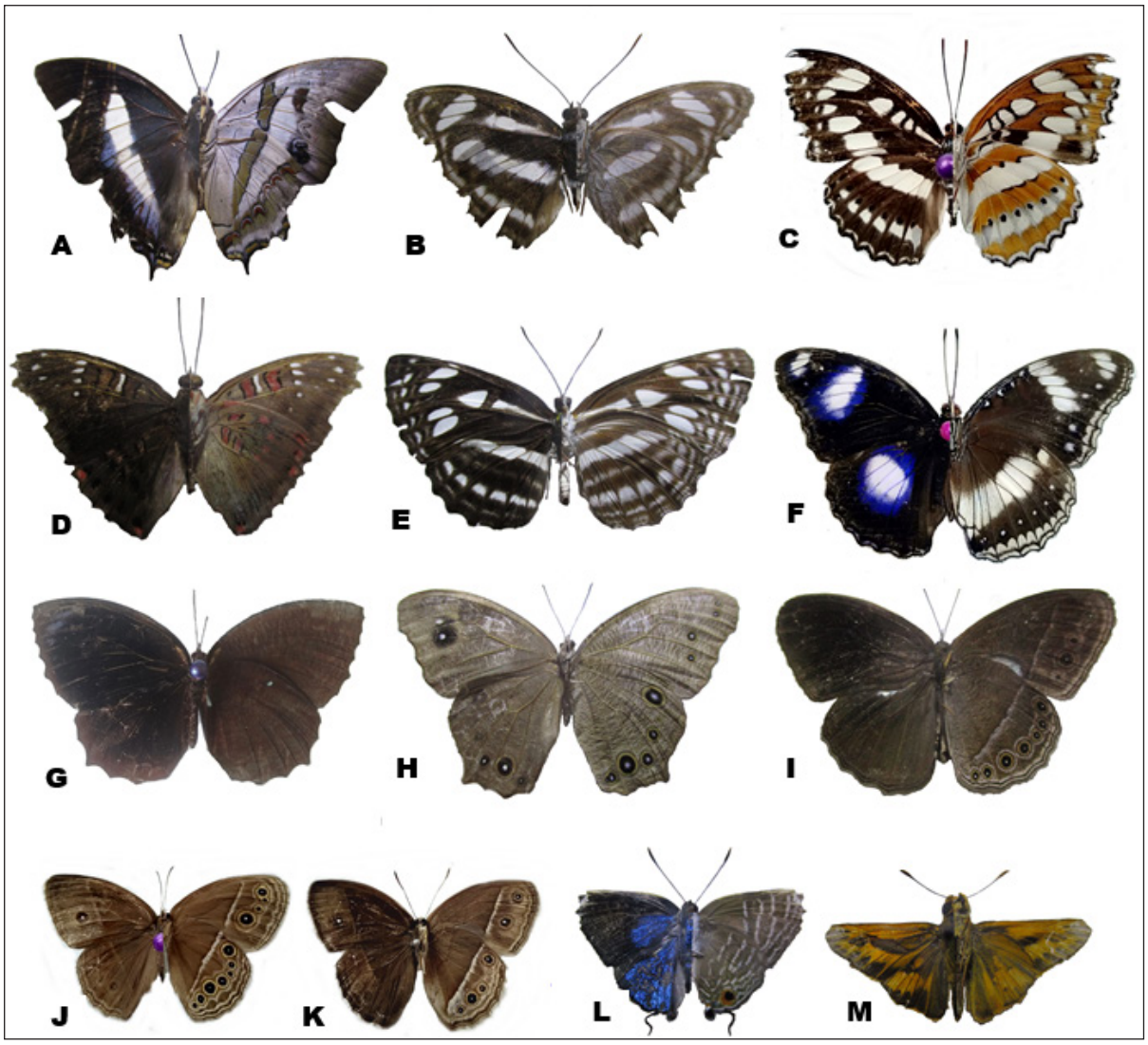

Figure 3. Butterfly species caught by bait trap in LUF. The uppersides of the wings are shown on the left and the undersides are on the right for each photo. A: *Polyura schreiber;* B: *Athyma nefte;* C: *Athyma perius;* D: *Euthalia adonia*; E: *Phaedyma columella*; F: *Hypolimnas bolina*; G: *Elymnias hypermnestra*; H: *Melanitis leda*; I: *Mycalesis janardana*; J: *Mycalesis mineus*; K: *Mycalesis perseus*; L: *Deudorix kessuma*; M: *Telicota besta*. (photographed by Sari, 2023).

Table 2. Butterfly species recorded in LUF by active and passive collection

Family/Subfamily/Species	Collected by	
	Insect net (Sari et al., 2023)	Bait Trap
PAPILIONIDAE		
Papilioninae		
Graphium agamemnon (Linnaeus, 1758)	√	-
Papilio polytes Linnaeus, 1758	√	-
Papilio demoleus Linnaeus, 1758	√	-
Papilio memnon Linnaeus, 1758	√	-
NYMPHALIDAE		
Charaxinae		
Polyura schreiber (Godart, 1824)	-	√

Family/Subfamily/Species	Collected by	
	Insect net (Sari et al., 2023)	Bait Trap
Danainae		
Euploea midamus (Linnaeus, 1758)	√	-
Ideopsis vulgaris (Butler, 1874)	√	-
Limenitidinae		
Athyma nefte Cramer, 1782	-	√
Athyma perius (Linnaeus, 1758)	√	√
Euthalia adonia Cramer, 1782	-	√
Lexias pardalis (Moore, 1878)	√	-
Neptis hylas (Linnaeus, 1758)	√	-
Neptis clinia Moore, 1872	√	-
Phaedyma columella (Cramer, 1782)	-	√
Nymphalinae		
Junonia atlites (Linnaeus, 1758)	√	-
Junonia almana (Linnaeus, 1758)	√	-
Junonia hedonia (Linnaeus, 1758)	√	-
Junonia orithya (Linnaeus, 1758)	√	-
Hypolimnas bolina (Linnaeus, 1758)	√	√
Satyrinae		
Elymnias hypermnestra Linnaeus, 1763	√	√
Melanitis leda Linnaeus, 1758	-	√
Melanitis phedima Cramer, 1782	√	-
Mycalesis janardana Moore, 1857	√	√
Mycalesis mineus Linnaeus, 1858	√	√
Mycalesis perseus Fabricius, 1775	√	√
Ypthima horsfieldi Moore, 1884	√	-
PIERIDAE		
Coliadinae		
Eurema hecabe (Linnaeus, 1758)	√	-
Eurema sp.	√	-
Pierinae		
Delias hyparete (Linnaeus, 1758)	√	-
Appias olferna Swinhoe, 1890	√	-
Leptosia nina (Fabricius, 1793)	√	-
LYCAENIDAE		
Theclinae		
Arhopala kinabala Druce, 1895	√	-
Flos apidanus (Cramer, 1779)	√	-
Rapala manea (Hewitson, 1863)	√	-
Deudorix kessuma (Horsfield, 1892)	-	√
Polyommatinae		
Catochrysops panormus (C. Felder, 1860)	√	-
Zizina otis (Fabricius, 1787)	√	-
Zizula hylax (Fabricius, 1775)	√	-
HESPERIIDAE		
Hesperiinae		
Caltoris bromus (Leech, 1844)	√	-
Cephrenes acalle (Höpffer, 1874)	√	-
Pelopidas conjuncta (Herrich-Schäffer, 1869)	√	-
Potanthus sp.	√	-
Telicota besta Evans, 1949	-	√
Total number of species	36	13

Table 3. Bait preference by butterfly species

Family/Subfamily/Species	Bait	
	Banana	Shrimp Paste
NYMPHALIDAE		
Charaxinae		
Polyura schreiber (Godart, 1824)	-	√
Limenitidinae		
Athyma nefte Cramer, 1782	-	√
Athyma perius (Linnaeus, 1758)	√	-
Euthalia adonia Cramer, 1782	√	-
Phaedyma columella (Cramer, 1782)	√	√
Nymphalinae		
Hypolimnas bolina (Linnaeus, 1758)	√	-
Satyrinae		
Elymnias hypermnestra Linnaeus, 1763	√	-
Melanitis leda Linnaeus, 1758	√	-
Mycalesis janardana Moore, 1857	√	√
Mycalesis mineus Linnaeus, 1858	√	-
Mycalesis perseus Fabricius, 1775	√	-
LYCAENIDAE		
Theclinae		
Deudorix kessuma (Horsfield, 1892)	-	√
HESPERIIDAE		
Hesperiinae		
Telicota besta Evans, 1949	-	√
Total number of species	9	6

Note: √: present; -: absent

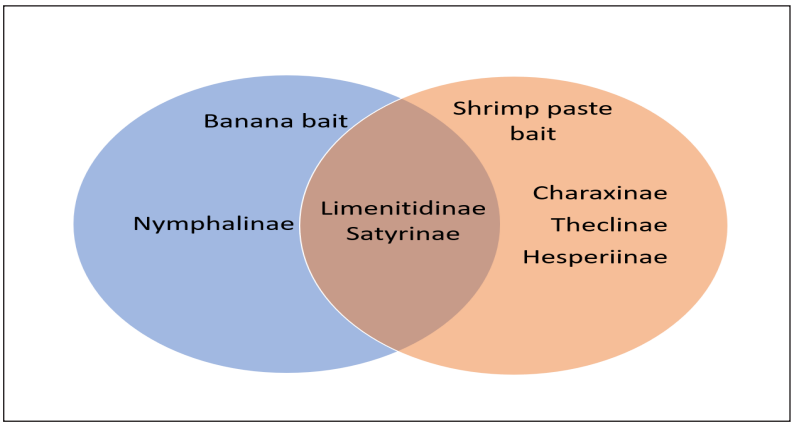

Fig 4. Bait preference by butterfly subfamily

DISCUSSION

There are 13 butterfly species obtained at LUF using bait trap, with 7 species newly recorded in LUF adding to the number reported using active method of sweep net (Sari et al., 2023), i.e., *Athyma nefte*, *Euthalia adonia*, *Phaedyma columella*, *Polyura schreiber*, *Melanitis leda,*

Deudorix kessuma, and *Telicota besta*. With 13 species obtained, the butterfly collected in LUF using bait trap was lower than the active collection using insect net at the same location (Sari et al., 2023). The result also has a lower number of butterfly species compared to other urban parks in Aceh using active collection; 18 species were collected from BNI Banda Aceh Urban Forest (Alfida & Eliyanti, 2016), and 30 species were collected from City Garden Banda Aceh (Suwarno et al., 2018).

In addition, the result was lower than the butterfly diversity collected using bait traps in Hutan Harapan and Bukit Duabelas (Panjaitan et al., 2019) but higher than the butterfly diversity collected using bait traps in Mount Ciremai National Park (Haryanto et al., 2020). The difference in results can be influenced by bait type. For example, research by Haryanto et al. (2020) used banana bait and collected 11 species. Meanwhile, research by Panjaitan et al. (2019) used various types of bait, bananas, and pineapples, and obtained more species (52 species). The results of those studies showed that the type of bait affects the butterflies obtained. Several other factors can also influence the different results, such as sampling size, data collection duration, as well as various other factors that need to be studied further.

Based on food type, butterflies are generally divided into nectar-feeder and fruit-feeder. Nectar-feeding butterflies obtained their nutrients from flower nectar, while fruit-feeding butterflies obtained nutrients from rotten fruit, plant sap, and other rotten materials, such as animal feces of different types (DeVries, 1988; DeVries in Freitas et al., 2014). In this study, the butterflies trapped by banana bait are 9 species (69,23%), consisting of 3 subfamilies, Limenitidinae, Satyrinae, and Nymphalinae. The butterflies trapped from shrimp paste bait are 6 species (46,15%), consisting of 5 subfamilies: Limenitidinae, Satyrinae, Charaxinae, Theclinae, and Hesperiinae. The use of rotten bananas for the traps was also applied in the study by Panjaitan et al. (2019), but the use of banana bait obtained lower results than pineapple bait. This result was due to the more pungent aroma of pineapple bait than banana bait. In LUF, shrimp paste as bait is one type of bait that needs to be studied further, as it shows that shrimp paste bait captures more butterfly subfamilies than banana bait. Other research by Holloway et al. (2013), using prawns as bait showed good results with 42 butterfly species from 5 subfamilies. Freitas et al. (2014) also stated that rotten fish can be used as bait. Thus, shrimp paste bait, which is assumed to be similar to rotten fish or prawn, can be used as a potential bait that attracts butterflies. As we can see from the result, 6 species were trapped by shrimp paste bait.

The subfamilies of the trapped butterflies consist of Charaxinae, Limenitidinae, Nymphalinae, Satyrinae, Theclinae, and Hesperiinae. Some butterfly subfamilies collected are the same as those obtained from other studies, i.e., Charaxinae, Nymphalinae, Satyrinae, and Limenitidinae (Christharina & Abang, 2014; Haryanto et al. 2014; Panjaitan et al. 2015). Meanwhile, the subfamily Hesperiinae (family Hesperiidae) was only trapped in the shrimp paste trap. This result was corroborated by Holloway et al. (2013), who reported that the subfamily Hesperiinae was only trapped by prawn bait. Freitas et al. (2014) also reported that Pieridae, Riodinidae, Hesperiidae, and Nymphalidae (Limenitidinae, Cyrestinae, Apaturinae) are nectar-feeding butterflies that are usually caught in bait traps. Meanwhile, butterflies of the subfamily Theclinae have never been reported before being trapped in bait traps. The report of Lycaenidae trapped by bait trap was from the subfamily Miletinae and Lycaeninae, which were trapped by prawn

bait only (Holloway et al., 2013). In LUF, the butterfly from Lycaenidae obtained was subfamily Theclinae (only 1 species with 1 individual, *Deudorix kessuma*), which was only obtained from shrimp paste bait trap.

Although the quantitative data was insufficient to measure the Shannon-Wiener index diversity (less than 100 individuals), the result showed that Location 4 has the highest number of butterfly species while Location 1 has the lowest number of butterfly species. This result showed the same pattern as the previous study about butterfly diversity in LUF using the active collection. Location 4 has the highest diversity due to the presence of various flowering plants that can be the food sources for the imago butterflies (Sari et al., 2023). Meanwhile, Location 1 is a canopy-covered area with tall trees and a mini zoo with visitor activities. The placement of traps in Location 1 and Location 2, which are canopy-covered areas of tall trees needs to be studied further based on the height of the trap position because several specialized butterfly species are known to actively fly at a high position, between 21-27 meters above the ground (Christharina & Abang, 2014). The low number of butterfly species at Location 1 and Location 2 was also technically caused by the loss of bait, especially banana bait taken by monkeys roaming the canopy-covered sites.

Of the species recorded in LUF by bait traps, 11 species are categorized by IUCN as Not Evaluated and 2 species are Least Concern (IUCN, 2023). In addition, all species are not protected under the Minister of Environment and Forestry Regulation of the Republic of Indonesia P.106/MENLHK/SETJEN/KUM.2018. However, due to the large role of butterflies in the ecosystem and human life, conservation efforts must still be carried out to keep butterfly populations sustainable in nature. Butterfly conservation efforts can be carried out by providing plants as host plants and nectar plants. Larval host plants are the key resource for the population, also nectar and other adult food resources can form a vital part of the life history of butterflies (Dennis, 2010).

ACKNOWLEDGMENTS

The authors would like to thank Universitas Samudra and Lembaga Penelitian dan Pengabdian Masyarakat - Penjaminan Mutu (LPPM-PM) for providing the funding for this research. The authors would also like to thank the manager of LUF for permitting us to conduct research and collect specimens at LUF.

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