BIOLOGY, MEDICINE, & NATURAL PRODUCT CHEMISTRY ISSN 2089-6514 (paper)
Volume 15, Number 1, April 2026 | Pages: 499-504 | DOI: 10.14421/biomedich.2026.151.499-504 ISSN 2540-9328 (online)

Butterfly Species (Lepidoptera) in Forest Area of Namo Village, Kulawi District, Sigi Regency

Uzaini Nur Rahma, Bustamin, Manap Trianto*, Fatma Dhafir, Raya Agni, Abd. Rauf
Department of Biology Education, Faculty of Teacher Training and Education, Tadulako University.
Jl. Soekarno Hatta No KM 9, 94148, Central Sulawesi, Tel./Fax. (0451)422611, Indonesia.

Corresponding author*
manaptrianto@untad.ac.id

Manuscript received: 04 January 2026. Revision accepted: 13 April 2026, Published: 12 May 2026.

Abstract

Butterflies (Lepidoptera) are one of the insect groups that play an important role in maintaining ecosystem balance, particularly as pollinators of various flowering plants and as indicators of environmental conditions. This study aimed to identify and describe butterfly species (order: Lepidoptera) found in the forest area of Namo Village, Kulawi District, Sigi Regency. The research employed a descriptive method with an exploratory (survey) technique. Sampling was conducted at three different observation stations. Field data were collected over three days, with two sampling periods per day, from 07:00 to 11:00 and 14:00 to 17:00 local time (WITA). Samples were collected using insect nets and subsequently identified based on morphological characteristics. The results of the study revealed 27 butterfly species belonging to four major families. These families are Nymphalidae (17 species), Papilionidae (6 species), Pieridae (3 species), and Lycaenidae (1 species). The diversity analysis indicated that the family Nymphalidae had the highest number of species. Environmental factors, such as the abundance of host plants in the genus Lantana and host plants of the genus Mangivera, as well as abiotic conditions including an average temperature of 27°C, humidity of 70.33%, and light intensity of 786 cd, were strongly suspected to support the high variation in butterfly species.

Keywords: Bioindicator; exploration; lepidoptera; Namo; species.

INTRODUCTION

Butterflies (Lepidoptera) play a crucial role in maintaining the balance of global ecosystems. These insects, known for the beauty of their wings, not only enhance the aesthetic value of a landscape but also perform vital functions, particularly as pollinators of a wide variety of flowering plants (Chowdhury et al., 2023). Through the pollination process, butterflies directly support the reproduction and survival of flora, which in turn sustains the entire food chain within a habitat. Beyond their role as pollinators, butterflies are widely recognized as sensitive environmental indicators or bioindicators. Their responsiveness to microclimatic changes and habitat degradation makes them an immediate reflection of an ecosystem's health. Butterfly survival is strongly influenced by specific environmental factors, such as the availability of host plants, microclimatic conditions (e.g., temperature and humidity), and the level of anthropogenic disturbances (Setiawan et al., 2018). Therefore, a significant decline or change in butterfly diversity and population can serve as an early warning of potential environmental damage, indicating that an ecosystem is under stress or instability (Pebrianti et al., 2025). Consequently, research focused on identifying and inventorying butterfly species is essential to support biodiversity conservation (Sandall et al., 2023).

Indonesia, recognized as one of the world's megadiverse countries, is blessed with abundant flora and fauna, including Lepidoptera. Among the Indonesian archipelago, Sulawesi occupies a highly strategic and unique position in terms of biodiversity. The island is part of the Wallacea region, a biogeographical transition zone renowned as a global biodiversity hotspot. Sulawesi's geological uniqueness and evolutionary history have resulted in a very high level of endemism, including among butterflies (Arof & Barbosa, 2024). The level of endemism in Sulawesi, particularly for butterfly fauna, is estimated to reach 40% of the total species present (Ismail et al., 2023). This figure emphasizes Sulawesi's ecological importance and its role as a center of butterfly diversity (Winarni et al., 2024). Therefore, every remaining natural forest in Sulawesi, even in regions relatively untouched by research, holds great potential for discovering new species or populations of vulnerable endemic species. Data on Lepidoptera fauna in this region are crucial for understanding biogeography, evolutionary processes, and for developing effective conservation strategies at both regional and national levels.

The forest area in Namo Village, Kulawi Subdistrict, Sigi Regency, central Sulawesi, is one of the regions that still retains significant natural vegetation. This area serves as a buffer zone for Lore Lindu National Park. Its role as a buffer gives it high potential as a habitat for butterfly species, which may migrate to or inhabit the park's ecological boundaries. Despite its high biodiversity, scientific information regarding butterfly species diversity in the Namo Village forest area remains very limited (Tjatjo et al., 2015). Most faunistic studies in Central Sulawesi have focused on main conservation areas such as Lore Lindu National Park. Unfortunately, the buffer zones often the first to be affected by human activity and habitat degradation have not received adequate attention. The lack of baseline data on butterfly species in Namo Village presents a serious challenge for monitoring environmental health and managing ecosystems sustainably. This study aimed to identify and describe the butterfly species (Order: Lepidoptera) found in the forest area of Namo Village, Kulawi District, Sigi Regency.

MATERIALS AND METHODS

Study area

The research was conducted in the forest area of Namo Village, Kulawi Subdistrict, Sigi Regency (Figure 1). The study area features diverse microhabitats, including flowering plants, shrubs, and forest trails, which provide suitable environments for butterfly activity. The geographic coordinates, elevation, and environmental conditions of the site were recorded to characterize the habitat and support subsequent ecological analysis.

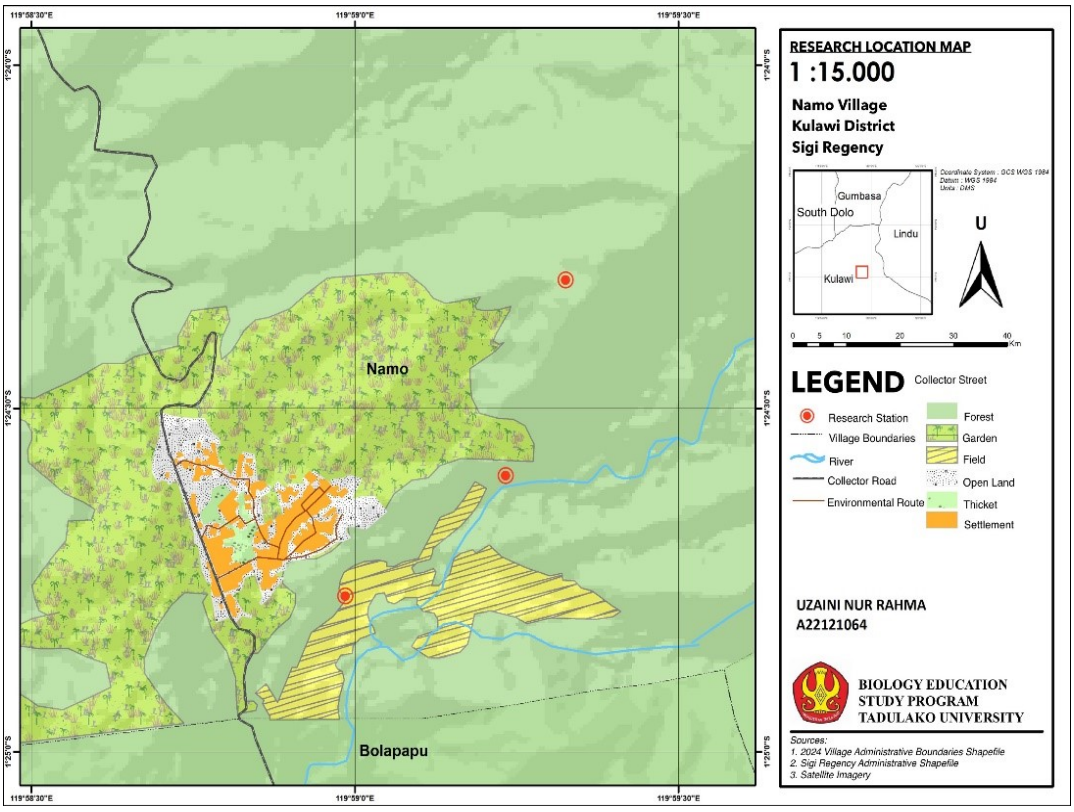

Figure 1. Map of the research location in the Forest Area of Namo Village, Kulawi Subdistrict, Sigi Regency.

Procedures

Materials and Equipment

The equipment used in this study included a digital camera or mobile phone camera, insect nets, pins, spreading boards/styrofoam, papilot papers, insect boxes, 1 ml disposable droppers, a lux meter, a thermometer, a hygrometer, and stationery. The materials used in this study consisted of all butterfly species collected in Namo Village, Kulawi Subdistrict, identification books, and alcohol.

Preparation Stage

The preparation stage of this study involved several key activities to ensure the systematic and ethical collection of butterfly specimens. Initial surveys were conducted to identify potential sampling sites within the forest area of Namo Village, Kulawi District, Sigi Regency, taking into account habitat diversity, accessibility, and the presence of flowering plants that attract butterflies. Field observations were carried out to gather preliminary data

on butterfly activity patterns, preferred microhabitats, and peak activity periods during daylight hours. In addition, all necessary administrative and ethical documents, including research permits, local approvals, and field data recording sheets, were prepared in advance to ensure compliance with institutional and regional regulations. These preparatory steps provided a structured framework for subsequent sampling and data collection, minimizing potential errors and ensuring the reliability of research outcomes.

Research Methodology

This study employed a descriptive research design (Noor, 2011) with an exploratory survey technique to systematically observe and document butterfly species in the study area (Mokodompit et al., 2022). Preliminary field observations were conducted to identify potential sampling locations, assess environmental conditions, and determine peak activity periods of butterflies. Field observations were carried out over three days, with two observation sessions each day from 07:00 to 11:00 and 14:00 to 17:00, totaling 10 hours, to ensure species active at different times were recorded.

Sample Collection Stage

At the sample collection stage, butterfly specimens (Lepidoptera) were systematically captured using insect nets, targeting active individuals on flowers, leaves, and along forest trails. Captured specimens were euthanized immediately to prevent damage, either by applying ethanol directly to the thorax for larger butterflies or by gently pressing the thorax for smaller, more delicate specimens. Each specimen was then carefully positioned on tracing paper and pinned with entomological pins to maintain wing posture and body integrity. Detailed data, including date, time, GPS coordinates, habitat type, and morphological observations, were recorded for each specimen. All specimens were labeled and documented to provide a comprehensive dataset for subsequent taxonomic identification, diversity analysis, and ecological assessment.

Data analysis

Data analysis was conducted using the digital guidebook Butterflies Class Insecta: Order Lepidoptera in Protected Forests, Wildlife Reserves, Ecotourism Areas, and Nature Parks in Angke, Kapuk, North Jakarta (Ruslan, 2021).

RESULTS AND DISCUSSION

Result

General Overview of the Research Location

Namo Village is one of the villages located in Kulawi District, Sigi Regency, Central Sulawesi. The village has unique characteristics, situated in a highland area with hilly topography and surrounded by mountains. The boundaries of Namo Village are as follows: to the west, it borders Salua Village; to the east, it borders the protected forest area of Kulawi at an altitude of 800–1,200 meters above sea level; to the south, it borders Omu Village; and to the north, it borders Bolapapu Village. The area is dominated by hills, valleys, and tropical forests. The average temperature in Namo Village ranges from 16°C to 28°C (Kaudern, 2022).

Environmental Physical Conditions Measurement

The measurements of environmental physical conditions conducted in this study included temperature, humidity, and light intensity, which were recorded during two observation periods. Based on the measurements, the average values at the research site are presented in Table 1.

Table 1. Results of physicochemical environmental measurements in the Forest Area of Namo Village, Kulawi District, Sigi Regency.

No	Parameters	Physical–Chemical Environmental Conditions			Average
		Stations 1	Stations 2	Stations 3	
1	Temperature	24˚C	27˚C	30˚C	27˚C
2	Humidity	73%	66%	72%	70,33%
3	Light Intensity	742	642	974	786

Butterfly Species

Observations conducted at three sampling stations in the forest area of Namo Village, Kulawi District, Sigi Regency, recorded 27 butterfly species belonging to 16 genera and 4 families (Table 2 and Figure 2).

Table 2. Butterfly species obtained.

No	Ordo	Family	Species
1	Lepidoptera	Nymphalidae	*Charaxes affinis*
2			*Cyrestis paulinus*
3			*Danaus genutia*
4			*Dichorragia nesimachus*
5			*Euploea algea*
6			*Euploea hewitsoni*
7			*Euploea redtenbacheri*
8			*Euripus robustus*
9			*Hypolimnas bolina*
10			*Ideopsis juventa*
11			*Ideopsis vitrea*
12			*Libythea geoffroy*
13			*Lohora ophthalmica*
14			*Neptis ida*
15			*Parantica cleona*
16			*Symbrenthia lilaea*
17			*Ypthima nynias*
18		Lycaenidae	*Rapala dioetas*
19		Papilionidae	*Graphium meyeri*
20			*Graphium agamemnon*
21			*Graphium milon*
22			*Papilio ascalaphus*
23			*Papilio gigo*
24			*Papilio sataspe*
25		Pieridae	*Appias zarinda*
26			*Leptosia lignea*
27			*Pareronia tritaea*

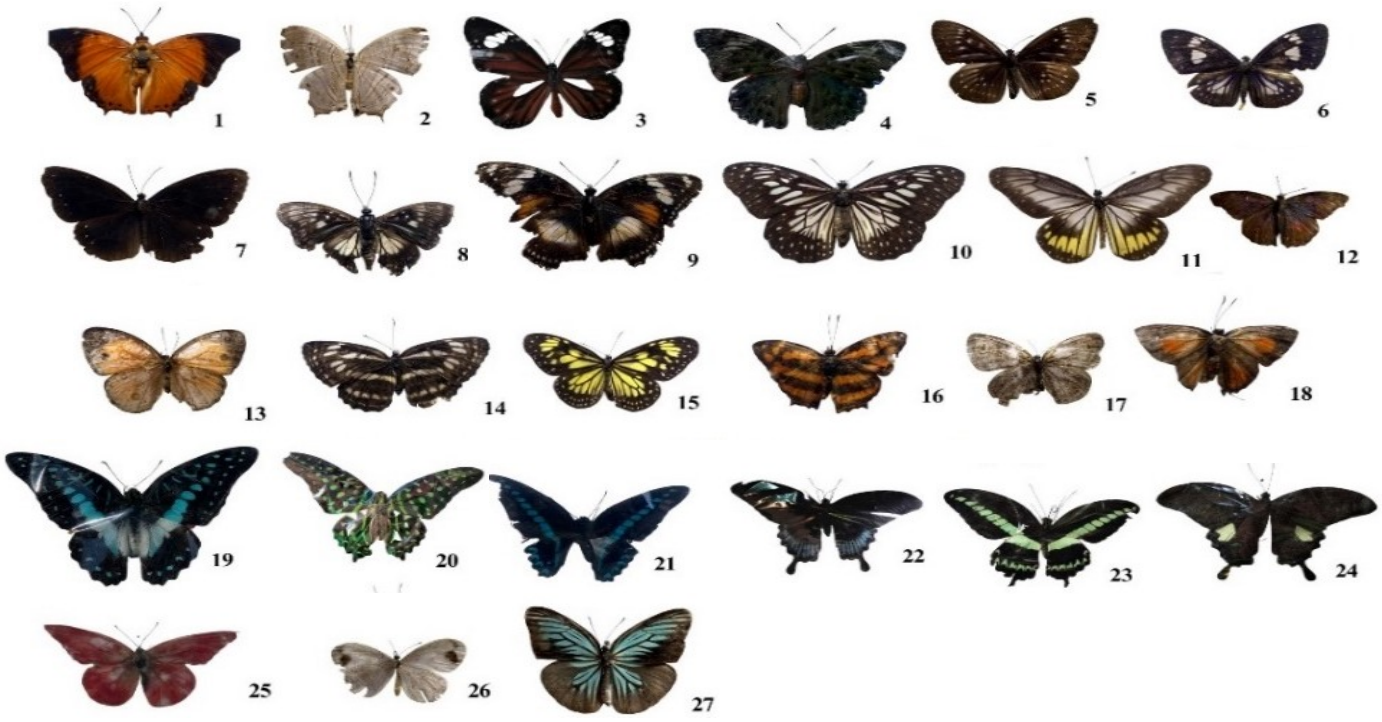

Figure 2. Identification Results of Butterfly (Lepidoptera). 1. *Charaxes affinis*, 2. *Cyrestis paulinus*, 3. *Danaus genutia*, 4. *Dichorragia nesimachus*, 5. *Euploea algea*, 6.*Euploea hewitsoni*, 7. *Euploea redtenbacheri*, 8. *Euripus robustus*, 9. *Hypolimnas bolina*, 10. *Ideopsis juventa*, 11. *Ideopsis vitrea*, 12. *Libythea geoffroy*, 13. *Lohora ophthalmica*, 14, *Neptis ida*, 15. *Parantica cleona*, 16. *Symbrenthia lilaea*, 17. *Ypthima nynias,* 18. *Rapala dioetas*, 19. *Graphium meyeri*, 20. *Graphium agamemnon*, 21. *Graphium milon*, 22. *Papilio ascalaphus*, 23. *Papilio gigon*, 24. *Papilio sataspe*, 2. *Appias zarinda*, 26. *Leptosia lignea*, 27. *Pareronia tritaea*

Discussion

The present study documented butterfly diversity in the forest area of Namo Village, Kulawi District, Sigi Regency, and recorded a total of 27 species belonging to four families: Nymphalidae, Papilionidae, Pieridae, and Lycaenidae. This result indicates that the forest ecosystem of Namo Village still supports a relatively high diversity of butterflies, particularly for a buffer zone area adjacent to a major conservation region. Similar findings have been reported in other tropical forest ecosystems, where butterfly diversity reflects habitat quality and ecosystem stability (Tukuboya et al., 2024).

The dominance of the family Nymphalidae in this study is consistent with previous research conducted in tropical and subtropical regions. Nymphalidae species generally exhibit broad ecological tolerance, diverse larval host plants, and strong adaptability to varying environmental conditions (Mega et al., 2020). Many species recorded in this study, such as *Danaus genutia*, *Euploea* spp., and *Hypolimnas bolina*, are known to utilize a wide range of nectar sources and host plants, allowing them to persist in both semi-open and forested habitats. This adaptability explains why Nymphalidae frequently dominates butterfly assemblages in natural and semi-natural landscapes.

The presence of Papilionidae as the second most abundant family further highlights the ecological value of the study area. Species of *Graphium* and *Papilio* are generally associated with relatively undisturbed habitats and are sensitive to habitat fragmentation and vegetation loss. According to Ghazanfar et al. (2016), Papilionidae butterflies rely heavily on specific host plants and stable microclimatic conditions. Therefore, their occurrence in Namo Village suggests that the forest environment still provides adequate food resources and suitable conditions for sustaining butterfly populations.

In contrast, Lycaenidae was represented by only one species (*Rapala dioetas*). This low species richness may be attributed to the specialized ecological requirements of Lycaenidae butterflies, which often depend on specific host plants and complex interactions with other organisms, such as ants. Similar patterns of low Lycaenidae representation have been reported in forest areas experiencing subtle habitat disturbances or limited sampling duration (Craioveanu et al., 2025). Additionally, the relatively small body size and cryptic behavior of Lycaenidae species may reduce detection probability during short-term surveys.

Environmental factors measured in this study strongly support the observed butterfly diversity. The average temperature (27°C), humidity (70.33%), and light intensity (786 cd) fall within the optimal range for butterfly activity and survival. Butterflies generally exhibit peak activity at temperatures between 20–40°C, as suitable thermal conditions are essential for flight, mating, and foraging behavior (Ruslan and Andayaningsi, 2021). Humidity levels below 85% help prevent dehydration and enhance flight efficiency, while adequate light intensity is required for thermoregulation and orientation (Kerr et al., 2025; Tobo et al., 2019).

Differences in species richness among observation stations further demonstrate the influence of habitat characteristics on butterfly distribution. Station 2, located near a river with relatively intact vegetation, recorded the highest species richness. Riparian zones typically provide abundant nectar sources, host plants, and favorable microclimatic conditions, making them ideal habitats for butterflies. Similar patterns have been observed in other tropical forest ecosystems, where areas with higher vegetation complexity support greater butterfly diversity (Craioveanu et al., 2025).

Despite the relatively high diversity recorded, several limitations should be considered. Weather conditions, limited sampling duration, and the high mobility of butterflies may have influenced species detection. Some species may have been present but not recorded due to seasonal variation or behavioral factors. Long-term and seasonal monitoring is therefore recommended to obtain a more comprehensive understanding of butterfly diversity and population dynamics in the area.

Butterflies play a crucial ecological role as pollinators and as bioindicators of environmental quality. Declines in butterfly populations have been widely associated with habitat degradation, climate change, and land-use intensification (Warren et al., 2021). The diversity recorded in this study suggests that the forest area of Namo Village remains ecologically functional. Consequently, the butterfly assemblage documented here can serve as an important bioindicator for monitoring environmental changes and supporting conservation strategies in buffer zones surrounding protected areas (Tukuboya et al., 2024).

CONCLUSIONS

Identification of butterflies (Lepidoptera) in the forest area of Namo Village, Kulawi Subdistrict, Sigi Regency, recorded a total of 27 species across four families: Nymphalidae, Papilionidae, Pieridae, and Lycaenidae. The family Nymphalidae was the most dominant, comprising 17 species, whereas Lycaenidae was the least represented, with only a single species.

Acknowledgements: The authors would like to express their sincere gratitude to Tadulako University for the institutional support and facilities provided during the conduct of this research.

Authors' Contributions: Uzaini Nur Rahma and Manap Trianto designed the research study. Fatmah Dhafir conducted the fieldwork and performed the identification of the specimens. Bustamin, Raya Agni, and Abd Rauf analyzed the data and wrote the manuscript. All authors read and approved the final version of the manuscript.

Competing Interests: The authors declare that there is no conflict of interest.

REFERENCES

Chowdhury, S., Dubey, VK, Choudhury, S., Das, A., Jeengar, D., Sujatha, B., & Kumar, V. (2023). Serangga sebagai bioindikator: Permata tersembunyi untuk pemantauan lingkungan. *Frontiers in Environmental Science*, 11, 1146052.

Craioveanu, C., Muntean, I., Ruprecht, E., Băncilă, RI, Crișan, A., & Rákosy, L. (2021). Faktor-faktor yang mempengaruhi keanekaragaman kupu-kupu dan tumbuhan di padang rumput kering basifil di Transylvania, Rumania. Ekologi Komunitas, 22 (3), 295-308.

Ghazanfar, M., Malik, MF, Hussain, M., Iqbal, R., & Younas, M. (2016). Kupu-kupu dan kontribusinya dalam ekosistem: Sebuah tinjauan. *Jurnal Studi Entomologi dan Zoologi*, 4 (2), 115-118.

Imran, A. (2019). Hubungan Kekerabatan Kupu-Kupu (Ordo Lepidoptera) Berdasarkan Ciri Morfologi Di Taman Wisata Alam Kerandangan. *Jurnal Ilmu Sosial Dan Pendidikan*, 3(3), 1-11.

Ismail, T., Maulany, R. I., & Ngakan, P. O. (2024). Abundance assessment of Sulawesi Banded Swallowtail, Papilio gigon gigon and availability of resource plants in Bantimurung Bulusaraung National Park, South Sulawesi, Indonesia. *Biodiversitas Journal of Biological Diversity*, 25(2).

Kaudern, W. (2022). Di Pedalaman Sulawesi: Jilid II: Pipikoro, Kantewu, Peana, Benahu, Tobaku, Bada, Behoa Lindu. *LOBO*: *Annals of Sulawesi Research*, 6(S4).

Kerr, JT, Gordon, SC, Chen, IC, Ednie, G., Foden, W., Newbold, T., & Watson, MJ (2025). Pengaruh variasi iklim mikro terhadap persistensi serangga dalam perubahan global. *Nature Reviews Biodiversity*, 1-11.

Mega, NO, Guimarães, M., Costa, MC, Caporale, A., Paesi, RA, Fucilini, LL, & Romanowski, HP (2020). Biologi populasi dan sejarah alam kupu-kupu padang rumput Euryades corethrus (Papilionidae: Troidini), spesies terancam punah dari Campos, Amerika Selatan. *Jurnal Konservasi Serangga* , 24 (5), 853-865.

Mokodompit, R., Kandowangko, N. Y., & Hamidun, M. S. (2022). Keanekaragaman Tumbuhan di Kampus Universitas Negeri Gorontalo Kecamatan Tilong Kabila Kabupaten Bone Bolango. BIOSFER: *Jurnal Biologi Dan Pendidikan Biologi*, 7(1), 75-80.

Ngatimin, S. N. A., Nasruddin, A., Gassa, A., & Abdullah, T. (2019). Keanekaragaman Hayati Kupu-kupu Berbasis Pelestarian Lingkungan di Taman Nasional Bantimurung-Bulusaraung. *BIOMA*: *Jurnal Biologi Makassar*, 4(2), 145-152.

Noor, I. H. (2011). Pemanfaatan Ilmu Pengetahuan dan Teknologi Dalam Kegiatan Pengabdian Masyarakat di Perguruan Tinggi. *Jurnal Pendidikan dan Kebudayaan*, 17(3): 306-315.

Pebrianti, H., Naunik, H., Agustini, P. L., Hidayat, X. Z. A., Manisa, S., Larasati, S. A. N., & Umami, L. (2025). Butterfly Diversity (Lepidoptera) in The Kerandangan Nature Tourism Park Area. *Indonesian Journal of Tropical Biology*, 1(1), 1-8.

Ruslan, H., Andayaningsih, D., & Wahyuningsih, E. (2019). Biodiversitas Kupu-kupu (Lepidoptera) di Kawasan Cilintang, Taman Nasional Ujung Kulon Banten. *Bioma*, 15(1): 1-10.

Sandall, EL, Maureaud, AA, Guralnick, R., McGeoch, MA, Sica, YV, Rogan, MS, & Jetz, W. (2023). Struktur taksonomi terintegrasi global untuk mendukung ilmu keanekaragaman hayati dan konservasi. *Tren dalam Ekologi & Evolusi* , 38 (12), 1143-1153.

Setiawan, R., Wimbaningrum, R., & Fatimah, S. (2018). Keanekaragaman Jenis Kupu-Kupu (Lepidoptera: Rhopalocera) di Zona Rehabilitasi Blok Curah Malang Resort Wonoasri Taman Nasional Meru Betiri. Natural Science: *Journal of Science and Technology*, 7(2).

Tjatjo, N. T., Basir, M., & Umar, H. (2015). Karakteristik Pola Agroforestri Masyarakat Di Sekitar Hutan Desa Namo Kecamatan Kulawi Kabupaten Sigi. *Jurnal Sains dan Teknologi Tadulako*, 4(3), 55-64.

Tobo, T. S., Pollo, H. N., & Tasirin, J. S. (2024). Kupu-kupu sebagai Bioindikator Kesehatan Ekosistem di Hutan Tampusu, Areal Pertanian sekitarnya dan Areal Wisata Danau Linow. *Silvarum*, 3(3), 154-162.

Tukuboya, E., Kurniawan, A., & Fatrawana, A. (2024). Keanekaragaman Jenis Kupu-Kupu (*Rhopalocera*) Di Sungai Oba Kecamatan Oba Utara Kota Tidore KepulauanKeanekaragaman Jenis Kupu-Kupu (*Rhopalocera*) Di Sungai Oba Kecamatan Oba Utara Kota Tidore Kepulauan. *Jurnal Forest Island*, 2(2), 6-13.

Warren, MS, Maes, D., van Swaay, CA, Goffart, P., Van Dyck, H., Bourn, NA, & Ellis, S. (2021). Penurunan populasi kupu-kupu di Eropa: Masalah, signifikansi, dan kemungkinan solusi. *Prosiding National Academy of Sciences*, 118 (2), e2002551117.

Winarni, NL, Mitchell, SL, Anugra, BG, Deere, NJ, Yordan, K., Immanuel, B., & Struebig, MJ (2024). Keanekaragaman burung di hutan dan perkebunan kelapa Sulawesi, Indonesia. *Oryx*, 58 (4), 427-436.