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Study of Butterfly Diversity (Subordo Rhopalocera) Based on Altitude in the Pranji Hill Kebumen Area

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ABSTRACT

This study aimed to determine the composition of butterfly species and analyze the diversity index, uniformity index, and dominance index of butterflies found based on height in the Pranji Hill area. The research method used is exploratory descriptive research using the VES (*Visual Encounter Survey*) method. The observation transect used is point transect with a transect length of 800 meters. In this study, sampling points are divided into 3 stations (I, II, and III), each station size is made 200 x 50 meters with altitude variations of 300 meters above sea level, 400 meters above sea level, and 500 meters above sea level. The identification method used is *Merfometric*, where researchers make identification by observing the morphological structure in shape, size, color and pattern which is then compared with the butterfly identification key. Data analysis techniques using diversity index data analysis (H'), uniformity index analysis (E), and dominance index analysis (C). The results of the study are the types of butterflies found in the Pranji Hill area on the basis height totaling 25 species from 4 families, namely 14 species from the famuly Nymphalidae 5 species from the family Pieridae, 4 species from the family Papilionidae, and 2 species from the family Lycaenidae. Based on the criteria for assessing the weighting of the environmental quality the diversity index value (H'), is moderate, the uniformity index value (E) is high, and the dominance index value (C) is low.

Keywords: butterfly diversity, altitude, pranji hill

INTRODUCTION

Lepidoptera is an order of the phylum Arthropoda in the class insects which is characterized by two pairs of membranous wings covered by with scales. The name Lepidoptera comes from a combination of the Latin word "lepido" meaning scales, and the Greek word "pteron" (plural: ptera) meaning wing (Peggie, 2014). The order Lepidoptera has a chiffon-shaped mouth type that coils under the head, large compound eyes, and long limbs (Jumrodah *et al*., 2023). The order Lepidoptera is divided into two suborders, namely moths (Heterocera) and butterflies (Rhopalocera).

Butterflies are a type of insect in the order Lepidoptera. Their main characteristics are enlarged antennae tips and wings covered with pigmented scales that produce different colors on butterfly wings (Najah, 2023). Butterflies have important values for humans and the

environment, including economic, ecological, aesthetic, educational, conservation, and cultural values (Ardianto *et al*., 2023). Butterflies can be found in various types of habitats including forests, shrubs, gardens or fields, near streams, and in residential areas (Aspita, 2020).

Butterfly diversity varies from place to place because the presence of butterflies in a habitat is closely related to environmental factors both abiotic and biotic (Hengkengbala *et al*., 2020). The presence of butterflies is also influenced by biotic factors such as vegetation and other animals and abiotic factors such as temperature, air and water humidity, and sunlight intensity. In addition, butterfly diversity is influenced by the elevation of an area, because elevation is closely related to environmental factors. Differences in altitude affect microclimate, humidity, air temperature, soil temperature, and soil moisture content (Istiawan & Kastono, 2019). As altitude increases, the availability of host plants decreases, which affects butterfly diversity. The abundance of butterfly species decreases with increasing altitude (Sesar *et al*., 2020). The Pranji Hill area has the potential to have high butterfly diversity, as it has a variety of habitat types and altitudes.

Pranji Hill is one of the local potentials included in the Geopark area that is used for tourism activities located at the border of Pengaringan Village and Watumalang Villages, Pejagoan district, Kebumen regency, Central Java (Hapsari *et al*., 2020). Habitats in the Pranji Hill area have different characteristics, creating a complex and diverse environment that can support butterfly life. Available habitats range from open areas, plantations and fields, shrubs, streams, and secondary forest areas that are preferred by butterflies (Wardhani, 2019). Overall, the habitats in the Pranji Hill area provide a variety of microenvironments that support high biodiversity, including different butterfly species that can find optimal conditions to grow and develop in the Pranji Hill area. This is evidenced by the frequent occurrence of various species of Lepidoptera from the superfamily Papilionoidea.

To date the diversity of butterflies in the Pranji Hill area has not been optimally identified and utilized. Further identification and inventory of butterfly diversity in the Pranji Hill area based on elevation needs to be done as there is still no data on butterlfy diversity in the Pranji Hill area based on elevation. The great potential of biodiversity in Pranji Hill, both flora and fauna, especially butterfly diversity, can be utilized as something that can promote people's love for butterflies and increase sensitivity in protecting and preserving the environment, becoming a scientific reference for researchers. students, and nature lovers who are interested in the fields of entomology and conservation, and can provide benefits to the world of education as scientific data about butterfly diversity in the area as a learning resource in the form of developing reference book products. Apart from that, the diversity of butterflies based on height in the Pranji Hill area can be a tourist attraction in the Pranji Hill area.

In addition, butterfly diversity based on elevation in the Pranji Hill area can contribute to the world of education as scientific data on butterfly diversity in the study area and as a learning resource. Learning resources should also refer to the local potential to understand the conditions and environment around there they live, and to increase conservation behavior to prevent

extinction (Situmorang. 2016). This study aims to assess the diversity and abundance of butterfly species and analyze the diversity index (H'), uniformity index (E), and dominance index (C).

METHOD

The tools used in this observation taking environmental data as supporting data for diversity using pH indicator, hygrometer, digital anemometer, lux meter, scissors, shovel, jar, meter, stakes, and raffia. Then take butterfly samples using insect nets, insect killer bottles. Likewise for preserving or embedding insects used insect pin. There are several applications used in this research, such as My Elevation, Google Lens, Picture Insect, and Kupunesia applications. The materials used were distilled water, 75% alcohol, papilot paper, styrofoam, and pain. The research method used is the exploratory survey method by walking along the transect line at each research station. Butterflies will be captured by using insect net with sweeping technique. The research was carried out on April 22 – May 17 2024. The method used is *Visual Encounter Survey (VES)* or *Direct Encounter Survey*. Observations were made along the transect line with a distance of 800 meters divided into 3 sampling points (200 x 50 m / point) in the area of Pranji Hill. The *Visual Encounter Survey (VES)* method is carried out at predetermined sampling points, then the records encounters with butterflies, the parameters measured are species, number, activity, and morphology.

Observations were carried out in the morning at 09.00-11.00 WIB and in the afternoon at 14.00-16.00 WIB with a total of 6 sampling times, because butterflies will be active in the morning because the anthesis time of most flowers is in the morning. so that is the basis of time in determining sampling. This time is the active hours of butterflies, the morning is used to sunbathe to increase body heat and in the afternoon it will increase again to find food or migrate (Rohman et al, 2019). Measurement of abiotic data pH, temperature, light intensity, humidity, and wind speed and recording biotic data in the form of plant vegetation at the observation site during observation. Each species will only be taken one sample as a representation. If more than one individual butterfly of the same species is found, only the number will be counted and its characteristics recorded, then the butterfly will be released back to its habitat. Captured butterfly samples will be placed in numbered papillot paper and their characteristics will be recorded on an identification sheet. After that, the butterflies will be preserved by injecting 75% alcohol into the mesothorax perpendicularly. The butterfly wings will be stretched on a stretcher board so that they can stretch perfectly.

The next step is to place the butterfly on the styrofoam by stabbing it with a stick. The butterfly’s wings are pinched with pieces of waxed paper that are held in place with needles stuck to a stretcher board. The butterfly wings were stretched with tweezers to avoid damaging the butterfly wings. Label each specimen with the species and species description. Identification of the specimens obtained using Borror and Delong's Introduction to the Study of Insects identification guidebook (Borror *et al*., 2005) and Butterfly Bioecology (Rahman *et al*., 2019). The identification method used is the Merfometric method, where researchers make

identification by observing morphological structures in the form of shape, size, color and pattern which are then compared with the butterfly identification key.

The results of the data obtained were analyzed using the diversity index, uniformity index, and dominance index.

Diversity Index (H')

$$H' = -\sum_{i=1}^{n} (\rho i)(\text{In } \rho i)$$

Description:

H' : Shannon-Wienner Diversity Index

In : Individual diversity of the i-th species

pi : Number of individuals of a species/total number of all species (*ni/N*)

N : Total number of individuals

Uniformity Index (E)

$$\text{E} = \frac{\text{H}'}{lnS}$$

Description:

E : Uniformity index

H' : Diversity index

S : Number of organism type

ln : Natural logarithm

Dominance Index (C)

$$C = \Sigma(pi)^2$$

Description:

C : Species dominance index

Pi : The proportion of the number of individuals of the 1th species to the total number of individuals of all species

RESULTS AND DISCUSSION

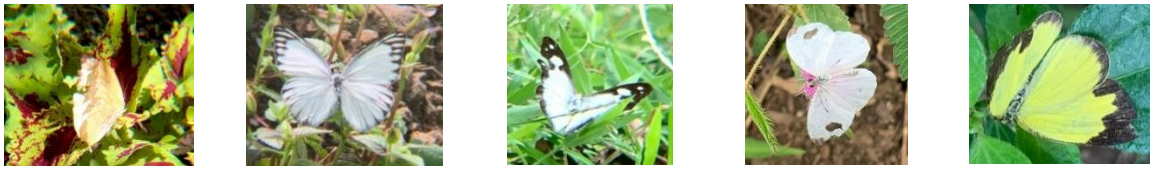
Based on the research conducted at Pranji Hill in April - May 2024, it was found that there were 360 individuals from a total of 25 species that were successfully obtained based on altitude. Station 1 with an altitude of 300 meters above sea level, Station 2 with an altitude of 400 meters above sea level, and Station 3 with an altitude of 500 meters above sea level. The results of butterfly species identification were then validated by an expert lecturer in entomology, Dr. Setyo Prajoko, M.Pd. The total data of the research results of butterfly species found based on altitude are presented in Table 1.

Tabel 1. Butterfly Species Found in the Study at each Altitude

Family	Species	Location		
		1	2	3
Pieridae	*Aphrissa statira*	√	√	√
	Appias libythea	√	√	√
	Appias paulina	√	√	√
	Eurema hecabe	√	√	√
	Leptosia nina	√	√	–
Papilionidae	*Graphium agamemnon*	√	√	–
	Papilio demoleus	√	√	–
	Papilio memnon	√	√	√
	Papilio polytes	√	√	√
Nymphalidae	*Acraea terpsicore*	√	√	–
	Cupha erymanthis	√	√	–
	Elymnias hypermnestra	√	√	–
	Elymnias nesaea	√	–	–
	Euploea climena	√	√	–
	Euploea mulciber	√	–	–
	Hypolimnas bolina	√	√	√
	Ideopsis juventa	√	√	√
	Junonia atlites	√	√	√
	Junonia hedonia	√	√	–
	Lethe Europa	–	√	–
	Melanitis leda	√	√	–
	Neptis hylas	√	√	–
	Phalanta phalantha	√	–	–
Lycaenidae	*Arhopala anthelus*	√	–	–
	Arhopala eumolphus	–	√	–

Source: Researcher Data

The following figure 1 is a species of butterfly family Pieridae found in the Pranji Hill area.



a b c d e

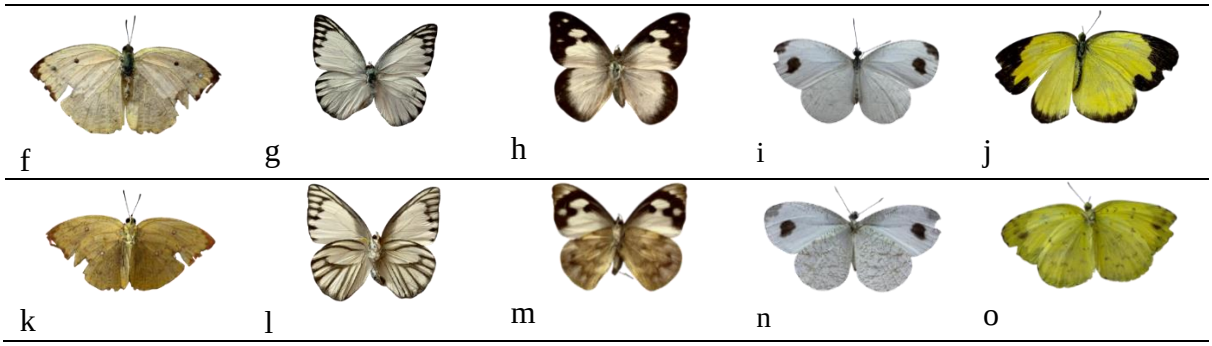


Figure 1. Butterfly species of family Pieridae found Pranji Hill area
a) *Aphrissa statira*; b) *Appias libythea*; c) *Appias paulina*; d) *Leptosia nina*; e) *Eurema hecabe*; f) Dorsal part of *Aphrissa statira*; g) Dorsal part of *Appias libythea*; h) Dorsal part of *Appias paulina*; i) Dorsal part of *Leptosia nina*; j) Dorsal part of *Eurema hecabe*; k) Ventral part of *Aphrissa statira*; l) Ventral part of *Appias libythea*; m) Ventral part of *Appias paulina*; n) Ventral part of *Leptosia nina*; o) Ventral part of *Eurema hecabe*
(Source: Researcher Data)

The following figure 2 is a species of butterfly family Papilionidae found in the Pranji Hill area.

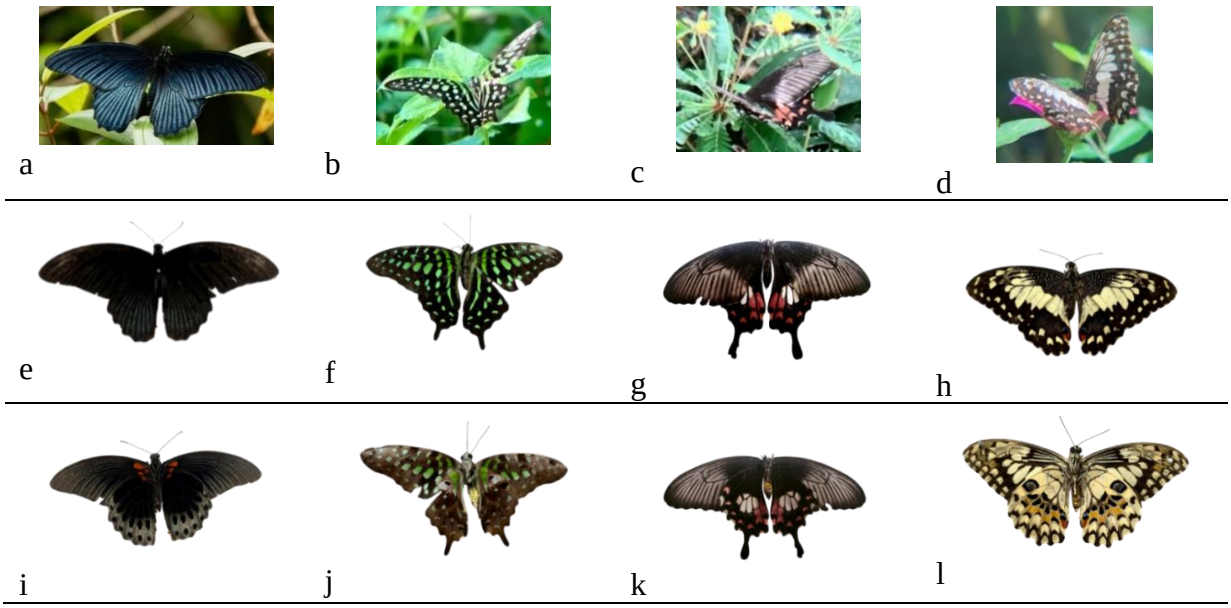


Figure 2. Butterfly species of family Papilionidae found Pranji Hill
a) *Papilio memnon*; b) *Graphium agamemnon*; c) *Papilio polytes*; d) *Papilio demoleus*;

e) Dorsal part of *Papilio memnon*; f) Dorsal part of *Graphium agamemnon*; g) Dorsal part of *Papilio polytes*; h) Dorsal part of *Papilio demoleus*; i) Ventral part of *Papilio memnon*; j) Ventral part of *Graphium agamemnon*; k) Ventral part of *Papilio polytes*; l) Ventral part of *Papilio demoleus*;
(Source: Researcher Data)

The following images 3,4, and 5 are butterfly species of the family Nymphalidae found in the Pranji Hill area.

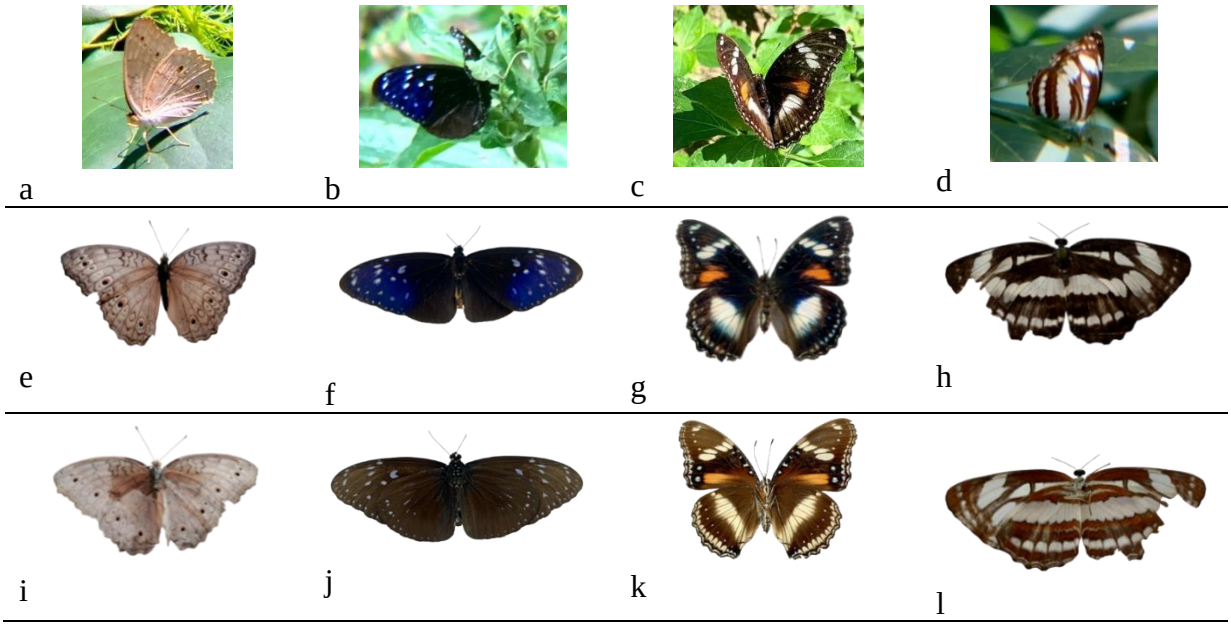


Figure 3. Butterfly species of family Nymphalide found in Pranji Hill Area
a) *Junonia atlites*; *b) Euploea mulciber*; *c) Hypolimnas bolina*; *d) Neptis hylas*; e) Dorsal part of *Junonia atlites*; f) Dorsal part of *Euploea mulciber*; g) Dorsal part of *Hypolimnas bolina*; h) Dorsal part of *Neptis hylas*; i) Ventral part of *Junonia atlites*; j) Ventral part of *Euploea mulciber*; k) Ventral part of *Hypolimnas bolina*; l) Ventral part of *Neptis hylas*
(Source: Researcher Data)

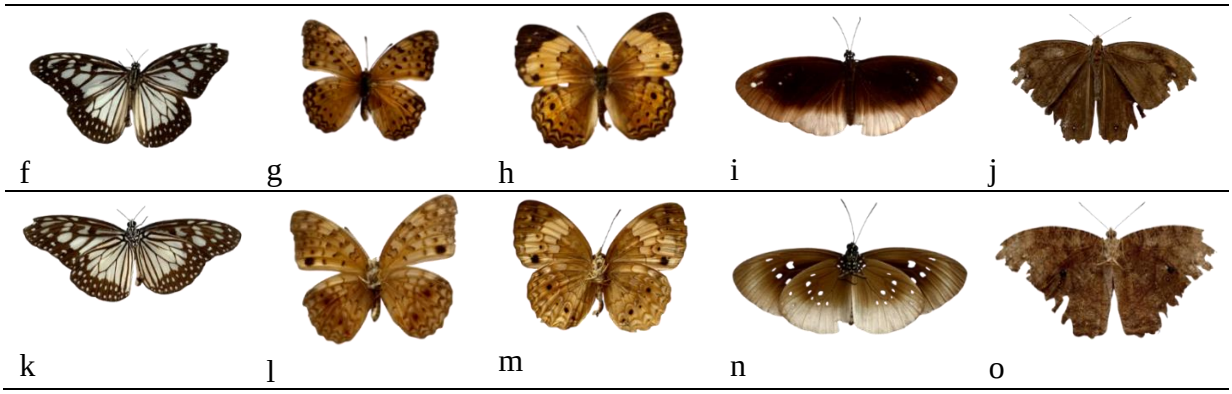


Figure 4. Butterfly species of family Nymphalide found in Pranji Hill Area
a) Ideopsis *juventa*; b) *Phalanta phalantha*; c) *Cupha erymanthis*; d) *Euploea climena*; e) *Melanitis leda*; f) Dorsal part of *Ideopsis juventa*; g) Dorsal part of *Phalanta phalantha*; h) Dorsal part of *Cupha erymanthis*; i) Dorsal part of *Euploea climena*; j) Dorsal part of *Melanitis leda*; k) Ventral part of Ideopsis *juventa*; l) Ventral part of *Phalanta phalantha*; m) Ventral part of *Cupha erymanthis*; n) Ventral part of *Euploea climena*; o) Ventral part of *Melanitis leda*
(Source: Researcher Data)

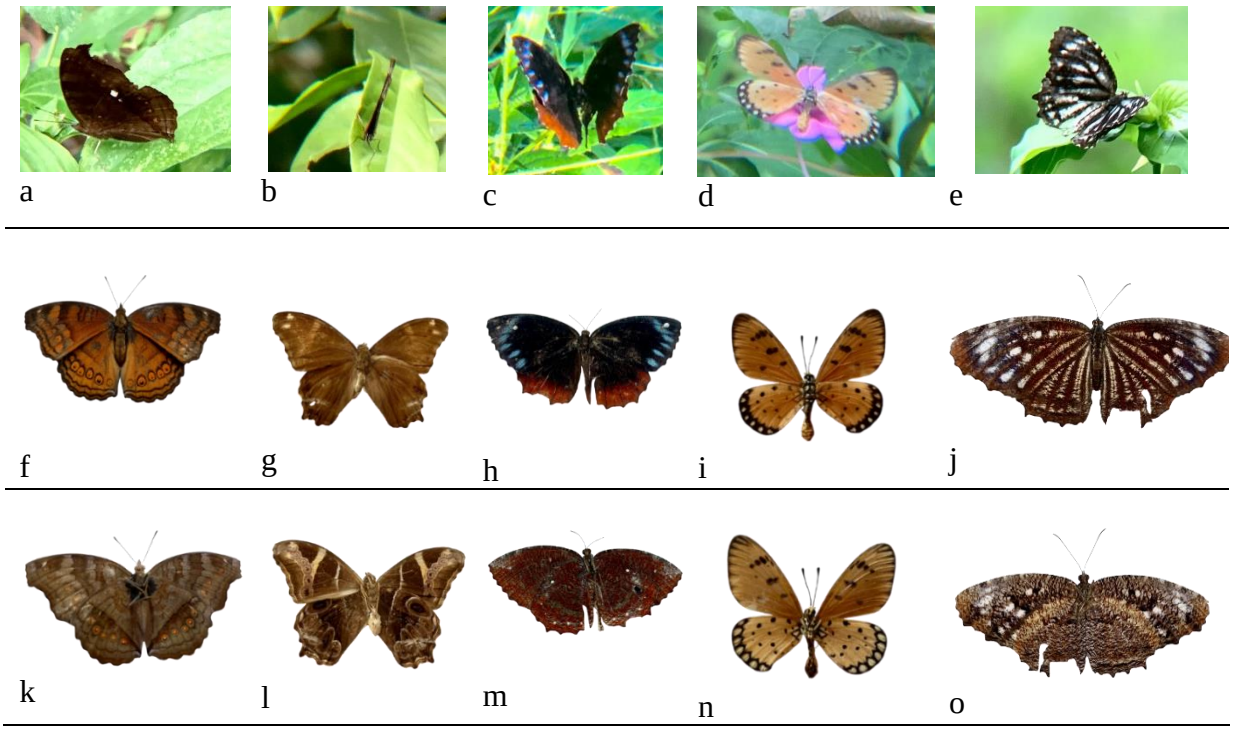


Figure 5. Butterfly species of family Nymphalide found in Pranji Hill Area
a) *Junonia hedonia*; b) *Lethe europa*; c) *Elymnias hypermnestra*; d) *Acraea terpsicore*;

e) *Elymnias nesaea*; f) Dorsal part of *Junonia hedonia*; g) Dorsal part of *Lethe europa*; h) Dorsal part of *Elymnias hypermnestra*; i) Dorsal part of *Acraea terpsicore*; j) Dorsal part of *Elymnias nesaea*; k) Dorsal part of *Junonia hedonia*; l) Ventral part of *Lethe europa*; m) Ventral part of *Elymnias hypermnestra*; n) Ventral part of *Acraea terpsicore*; o) Ventral part of *Elymnias nesaea*
(Source: Researcher Data)

The following figure 6 is a species of butterfly family Lycaenidae found in the Pranji Hill area.

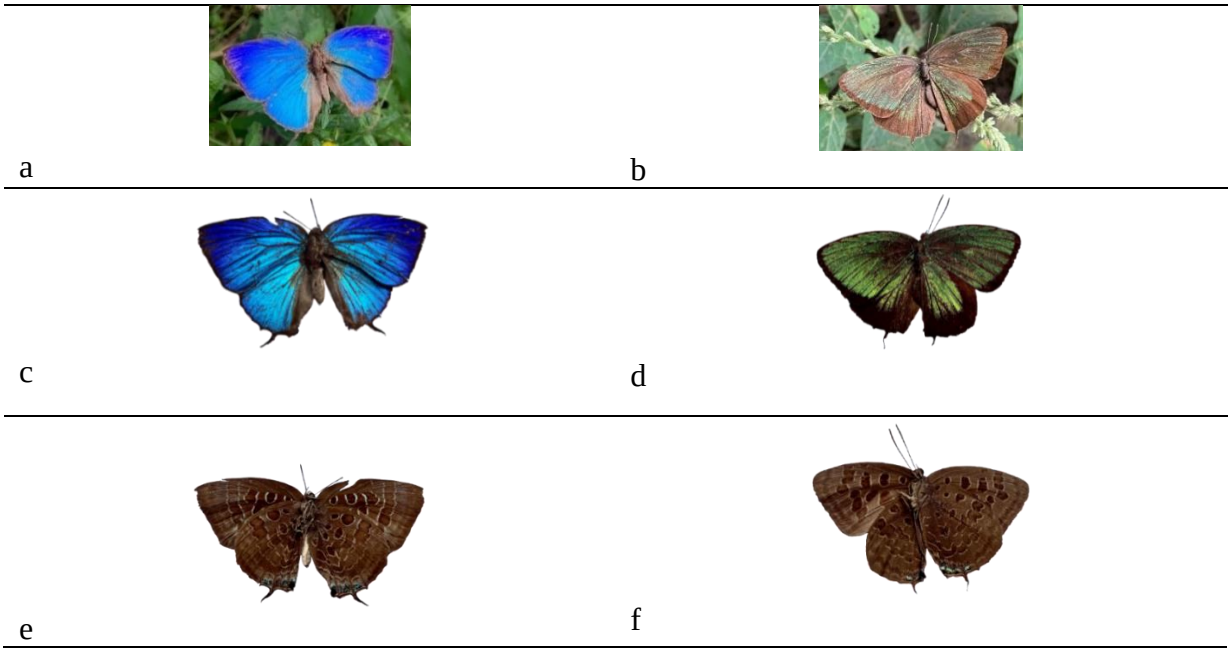


Figure 6. Butterfly species of family Nymphalide found in Pranji Hill Area
a) *Arhopala anthelus:* b) *Arhopala eumolphus*; c) Dorsal part of *Arhopala anthelus*: d) Dorsal part of *Arhopala eumolphus*; e) Ventral part of *Arhopala anthelus*: f) Ventral part of *Arhopala eumolphus*
(Source: Researcher Data)

After calculating and knowing the number of individual counts of butterfly population estimates, then determine the Shannon-Wiener butterfly diversity index (H'), uniformity index (E), and dominance index (C) of butterflies in the Pranji Hill Area obtained at Station 1 to Station 3 can be seen in Table 2.

Tabel 2. Butterfly Ecological Index Value in Pranji Hill Area

Observed Ecological Index	Station 1	Station 2	Station 3
H'	2,933	2,868	2,475
Category	Medium	Medium	Medium
E	0,911	0,891	0,965
Category	High	High	High
C	0,065	0,067	0,092
Category	Low	Low	Low

Source: Researcher Data

Description:
H' : Diversity Index
E : Uniformity Index
C : Dominance Index

The presence and diversity of butterflies in an area are closely related to abiotic factors in the area. Table 3 is the result of abiotic factor data measurement in Pranji Hill Area.

Tabel 3. Abiotic Factor

Location	Observation Time	Altitude	Light Intensity (lux)	Temperature (C°)	Humidity (RH)	Wind Speed (m/s)	pH
Stasiun 1	09.00-11.00	300 mdpl	5850	33,8°C	74 RH	0,50 m/s	7
	14.00-16.00		4302	32,55°C	74,5 RH	0,65 m/s	
Stasiun 2	09.00-11.00	400 mdpl	4839	32,5°C	75,5 RH	0,675 m/s	7
	14.00-16.00		2512	30,5°C	77,5 RH	0,855 m/s	
Stasiun 3	09.00-11.00	500 mdpl	4086	31,5°C	77 RH	0,80 m/s	7
	14.00-16.00		1993	29,75°C	79 RH	1,04 m/s	

Source: Researcher Data

Based on the research that has been conducted in the Pranji Hill area which is divided into three observation station locations with one replicate at each location, it can be seen in Table 4.1 that there are 25 species from 4 families, with details of 175 individuals of 23 species found at Station 1 (300 masl), 133 butterfly individuals of 21 species found at Station 2 (400 masl), and 52 butterfly individuals of 13 species found at Station 3 (500 masl). A total of 25 butterfly species were successfully found and identified including 14 species from the family Nymphalidae, 5 species from the family Pieridae, 4 species from the family Papilionidae, and 2 species from the family Lycaenidae.

Based on the data in Table 1, it can be seen that there are 4 families of butterflies found, namely the Pieridae, Papilionidae, Nymphalidae, and Lycaenidae families. The family Pieridae in general has the characteristics that the butterflies are generally white, yellow, or yellowish orange, the outside of the hind wings is brightly colored. The family also has well-developed forelimbs and the tarsal nails are bisected or forked (Borror *et al*., 2005). There is

distinct humeral wing skeleton on the hind wing and the third segment of the palpus labialis is long and pointed (Borror *et al*., 1996). Based on the results of the study, 5 butterfly species found in the Pranji Hill area have the same characteristics as the family Pieridae. The butterflies found are Aphrissa statira, Appias libythea. Appias paulina, Leptosia nina, and Eurema hecabe. They have brightly colored outer sides of the hind wings and have well-developed forelimbs and bifurcated or forked tarsal nails. The butterflies also have the typical colors of the family Pieridae: *Aphrissa statira* is yellow, *Appias libythea* is yellow and white. *Appias paulina* is white, *Leptosia nina* is white, and *Eurema hecabe* is yellow. Butterfly species in the family Pieride are shown in Figure 1.

The family Pieridae tends to fly in groups. The flight behavior of adult butterflies varies, with the genera Eurema, Elodina, and Leptosia being relatively slow, weak, mobile and close to the ground, and the genera Captopsilia, Appias Cepora being very fast, strong, and directional flight speed. The genus Delias tends to be slow in flight but usually flies high between the trees (Rohman F *et al*., 2019). This is in consistent with the results of research on the flight behavior of butterflies included in the family Pieridae, namely *Aphrissa statira, Appias libythea*, and *Appias paulina* seen flying with high speed, strong, and directional flight. *Leptosia nina* and *Eurema hecabe* were seen flying at low speed, weak, moving, and close to the ground.

The family Papilionidae has general characteristics such as larger body size than other families and has beautiful and striking color patterns, such as red, yellow, green, with a combination of black and white (Rahman F *et al*., 2019). Some types of butterflies on the back of the hind wings there is an extension like a tail (Borror *et al*., 1992). Based on the results of the study, the butterfly species included in the family Papilionidae are *Papilio memnon, Graphium agamemnon, Papilio polytes*, and *Papilio demoleus.* The butterfly species in the family Papilionidae are shown in Figure 2. The butterflies found have the same characteristics as the family Papilionidae, including having a large body with beautiful and striking color patterns. *Papilio memnon* has a wingspan of 13 cm with black and gray color patterns, *Graphium agamemnon,* has a wingspan of 10 cm with black and green color patterns, *Papilio polytes* has a wingspan of 9.6 cm with black and white color patterns, and *Papilio demoleus* has a wingspan of 7 cm with black and yellow color patterns. In addition, *Graphium agamemnon* and *Papilio polytes* also have hind wings with tail-like extensions.

Family Nymphalidae has general characteristics such as diverse body sizes, beautiful and attractive wing colors, anterior wings are not wide, form angles, have uneven edges and the length of the antenna is half the length of the wings (Rohman F *et al*., 2019). According to Peggie & Amir (2006) Nymphalidae butterflies are brown, orange, yellow, and black. A distinctive feature of Nymphalidae is the pair of forelimbs wich are reduced (except in female butterflies of Libythinae) (Borror *et al*., 2005). This pair of forelimbs is reduced and covered by a dense collection of scales resembling a brush, so these butterflies are also known as brush-limbed butterflies. When perched, this butterfly uses only four of its six limbs because the forelimbs are folded on to the body (Peggie & Amir, 2006).

This is consistent with the characteristics of *Junonia atlites, Euploea mulciber, Hypolimnas bolina, Neptis hylas, Ideopsis juventa, Phalanta phalantha, Cupha erymanthis, Euploea climena, Melanitis leda, Junonia hedonia, Lethe europa, Elymnias hypermnestra, Acraea terpsicore,* and *Elymnias nesaea* found in the study. These species have characteristics that are consistent with the characteristics of the family Nymphalidae, where these species have pairs of forelimbs that are reduced or reduced and covered by a dense collection of scales resembling a brush so that when this butterfly perches it uses only four of its six limbs. The species also have beautiful and attractive wing variations with body sizes ranging from small to medium (5-9 cm). The butterfly species of the family Nymphalidae can be seen in Figure 3, Figure 4, and Figure 5 respectively.

The last family found in the Pranji Hill area is Lycaenidae. The least number of butterfly species found in the study area belong to this family. Based on the results of the study, there are two species included in the family Lycaenidae, including *Arhopala eumolphus* and *Arhopala anthelus*. The family has common characteristics, namely striking colors, such as blue, purple or orange with metallic, black or white spots, and many species have tails as an extension of the hind wings with one, two or three depending on the species (Rohman *et al*., 2019). This is concsistent with the characteristics of the blue *Arhopala anthelus* and metallic green *Arhopala eumolphus* species with hind wings that appear to have thread-like tails that resemble antennae (typical "hairline") with bright colors and metallic spots. Butterfly species of the family Lycaenidae are shown in Figure 6.

Based on the calculation of the diversity index at all stations, the data obtained at Station 1 has a diversity value of 2.993 with 23 species, Station 2 has a diversity value of 2.868 with 21 species, and Station 3 has a diversity value of 2.475 with 13 species. The most abundant families found at the research site were the family Nymphalidae with 56%, while the family Pieridae with 20%, the family Papilionide with 16%, and the family Lycaenidae with 8%.

The highest diversity index was found in the area of station 1 with a value of 2.993, the number almost reached 3. Based on the Shannon-Wiener index, values above 1 and below 3 indicate moderate diversity. This means that Station 1, with a diversity index value of 2.993 has good environmental conditions for butterfly life. The number is also close to the index value of 3 which indicates a high level of diversity. A community is said to have high species diversity when the community is composed by many species. This is consistent with the conditions when carrying out research, where 175 individuals of 23 butterfly species were in the area of Station 1.

The highest uniformity index was recorded at station 3 with a value of 0.965, while the uniformity index value recorded at station 1 was calculated as 0.911, and the evenness index at station 2 was 0.891. Thus, all the plots in Pranji Hill as a whole have a high level of uniformity so that the community is stable because the uniformity index in all the plots is close to 1, which means that the uniformity between species can be said to be relatively even or in other words that the number of individuals of each species is relatively the same, the difference is not too striking. This is consistent with the results of the study that the species types found have an even

distribution of individuals between species or there is no tendency for one family to dominate at each station.

The lowest dominance index value was found at station 1 with a value of 0.065, then station 2 with 0.067, while the highest dominance index value was found at station 3 with a value of 0.092. Overall, the three observation areas with different altitudes have a dominance index value that is close to 0, so they are classified into the low dominance category ($0 < C \leq 0.5$). The data show that no dominant butterfly species was found in the three observation areas as a whole. This is consistent with the results of the study, which found that there were no dominant species in species that dominate the three stations. Although there are several types of species that dominate, these species dominate together so that the dominance index value will be low.

Altitude plays an important role for butterflies because altitude affects vegetation and the availability of host plants and other environmental factors. According to Muslim & Subosit, with increasing altitude the temperature of the area will be lower and humidity will increase with increasing altitude, because the altitude of the area affects the intensity of sunlight, humidity, temperature, and wind speed. The Pranji Hill area has an altitude of 500 meters above sea level which supports the formation of a variety of dominat vegetation, such as the family Fabaceae, for example acacia trees, Poaceae, for example grasses such as reeds, the family Musaceae, the family Gnetaceae and the family Euphorbiaceae and other plants. According to Atonio (2022), the density and diversity of vegetation will be lower with increasing altitude. This is supported by the statement of Pahman *et al.* (2022) which states that plant growth depends on the altitude of a place because it affects air pressure, sunlight intensity, and ambient temperature, so that the diversity, composition, distribution, and structure of plants will vary at each altitude.

Among the environmental conditions that vary greatly with altitude is temperature, which gradually decreases with altitude and is detrimental to butterfly communities. Butterfly survival and reproduction of butterflies are highly dependent on temperature fluctuations. Any deviation from the optimal temperature causes significant inhibition and dispersal. Apparently, temperature decreases with increasing altitude, resulting in reduced pecies richness and abundance (Darussalam *et al*., 2022). Similar results have been shown for precipitation. As altitude increases, humidity decreases, inhibiting the growth of vegetation, that butterflies depend on for survival and reproduction. Therefore, species richness and abundance decrease. This is in line with the results of the study which show that the Pranji Hill area with an altitude of 300 meters above sea level has the most abundant butterfly species as many as 162 individuals of 24 species were identified, then at Station 2 with an altitude of 400 meters above sea level 131 individuals of 24 butterfly species were found were found, then at Station 3 with an altitude of 500 meters above sea level only 35 butterflies of 13 species were found.

The most important abiotic factor that can affect the behavior and distribution of adult butterflies is light intensity because butterflies are animals whose body temperature depends on their environment. Butterflies will bask in the sun in the morning to maintain body temperature, get energy, and dry their wings. Butterflies have two types of basking positions (Rahmawati, 2020). Butterflies will spread their wings openly in the sun to warm their bodies, the other way

is by tilting their wings perpendicular to the sunlight to get energy. The optimum temperature for butterfly life is 20 to 40°C (Azahra *et al*., 2016). The temperature recorded in the Pranji Hill area ranges from 29.75°C 33.8°C. The Pranji Hill area has the highest temperature of 33.8°C at station 1 with an altitude of 300 meters above sea level, while the station 2 area with an altitude of 400 meters above sea level has temperatures of 30.5°C and 32.5°C and the station 3 area has temperatures of 29.75°C and 31.5°C, so it can be concluded that the temperature in the Pranji Hill area supports the existence of butterflies to carry out their activities. This is also in accordance with the effective temperature range for butterfly life is a minimum temperature of 15° C, an optimum temperature of 25°C, and a maximum temperature of 45° C (Kamal, 2019).

The intensity of sunlight is closely related to the temperature in the Pranji Hill area as a whole and at each observation station. The intensity of sunlight affects the presence of butterflies, because butterflies need sunlight to warm their bodies, dry their wings, and get energy. If an area does not get enough sunlight, the diversity of butterflies in the area will be limited (Rahmawati, 2020). Based on field observations, the intensity recorded in the Pranji Hill area ranges from 1993 lux - 5850 lux so that the three stations get enough sunlight to support the presence of butterflies.

The presence of butterflies in the Pranji Hill area also depends on the humidity levels in each area. According to research conducted by Wardhani (2019), the ideal environmental conditions for butterfly life are with humidity between 60-94%. Areas that are too humid will interfere with butterfly life activities because butterflies will have difficulty maintaining body temperature and drying their wings. Conversely, areas with low humidity will cause butterflies to lose excess body fluids and become dehydrated. Based on this, it is known that air humidity is one of the factors limiting butterfly activity. Based on research conducted in the field, it is known that the air humidity in the Pranji Hill area ranges from 74 RH - 79 RH, which means that the Pranji Hill area is quite ideal for the development and survival of butterflies.

Vegetation components such as trees can function as a barrier or wind barrier so that wind speeds are lower in areas where there are more trees (Sulistyani *et al*., 2014). This is in accordance with the situation in the Pranji Hill area, where most of the vegetation is in the form of shrubs, ferns, and small trees so that the wind blows quite strong. Meanwhile, although the Pranji Hill area has secondary forest areas and plantations, the wind was still blowing quite strong when the research was conducted. Therefore, the flight activity of broad-winged butterflies is hampered by the wind speed in this area. Conversely, butterflies that are small and light are easily carried by the wind. The wind speed in the Pranji Hill area ranged from 0.50 m/s 1.04 m/s and was the most effective wind speed range for butterflies to perform their activities during the study.

Water quality also greatly affects the presence of butterflies because the pH of the water can affect the health of the plants that serve as food sources for butterfly caterpillars (larvae) and nectar sources for adult butterflies. For example, water that is too acidic or too alkaline can interfere with the absorption of nutrients by plants, thus reducing the quality and quantity of food available to butterflies. The study site has good water quality with no signs of pollution and has

a pH value of 7 which means it is acidic. Living things can live in an environment with a pH range of neutral to slightly acidic. This proves that the study area is a suitable area for butterflies to live.

CONCLUSION

The butterfly species found in the Pranji Hill area based on altitude totaled 25 species from 4 families, namely 14 species from the family Nymphalidae (*Junonia atlites, Euploea mulciber Hypolimnas bolina, Neptis hylas, Ideopsis juventa, Phalanta phalantha, Cupha erymanthis, Euploea climena, Melanitis leda, Junonia hedonia, Lethe europa, Elymnias hypermnestra, Acraea terpsicore,* and *Elymnias nesaea lioneli*), 5 species from the family Pieridae (*Aphrissa statira, Appias libythea, Appias paulina, Leptosia nina,* and *Eurema hecabe*), 4 species from the family Papilionidae (*Papilio memnon, Graphium agamemnon, Papilio polytes,* and *Papilio demoleus*) and 2 species from the family Lycaenidae (*Arhopala eumolphus* and *Arhopala anthelus*).

Based on the criteria for assessing the weighting of environmental quality of the diversity index value (H') of butterflies in the Pranji Hill Area at station 1 of 2.933, station 2 of 2.868, and station 3 of 2.475, meaning that at all research stations the diversity of species is said to be moderate. The value of the uniformity index (E) of butterflies in the Pranji Hill area at station 1 amounted to 0.911, station 2 amounted to 0.891, and at station 3 amounted to 0.965. So that all observation areas in Pranji Hill as a whole have a high level of uniformity so that the community is stable. While the dominance index value (C) of butterflies in the Pranji Hill area at station 1 is 0.065, station 2 (400 meters above sea level) has a value of 0.067, and at station 3 it is 0.0092, meaning that over all the three observation areas with different altitudes have a low dominance index value.

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