



Diversity of Species and Conservation Priority of Butterfly at Suranadi Natural Park of West Lombok, Indonesia

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Abstract

Butterflies play an important role in the ecosystem of Suranadi Natural Park in West Lombok. Butterflies help preserving the existence and diversity of flora by facilitating the process of pollination so it is crucial for flowering plants. The present study aimed at analyzing the diversity and determining the priority of butterfly conservation at Suranadi Natural Park of West Lombok. This exploration is a descriptive study. Data were observed in four-time repetition in the morning and in the afternoon for two months. The sweeping net technique following observation path was employed in this research (line left, line right, line central and line waterway). The data analysis used the Shannon-Wiener diversity index and priority for conservation determined by Ministry of Forestry Regulation Number: P.57 / Menhut-II / 2008. Fourty (40) species of butterflies belonging to 5 families identified. The diversity index (H') of butterflies ranges from 2.63 to 3.43 (medium-high). The two species of the Papilionidae family found at TWA Suranadi, namely, *Troides helena* and *Papilio memnon* were the priority of conservation. This research would be helpful to consider conservation strategy and ecotourism.

How to Cite

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INTRODUCTION

Lombok island in Indonesia has a high level of animal diversity, one of which is the diversity of butterflies. Gradually, the land use for any purposes outside the forestry increased and significantly depleted the forest which leads to deforestation. So, the butterflies existence is threatened and its habitat is rarely found. One of the well-preserved forest areas for biodiversity protection is the Suranadi Natural Tourism Park (hereafter Suranadi Natural Park).

Suranadi Natural Park was formerly recognized as Suranadi and Ranget Protected Forest based on the decision of Bali Resident-Lombok No. 1/4/3 and No. 1/4/4 of 2 February 1934 about the establishment of Suranadi and Ranget Protected Forests. Suranandi forest area signed on 10 September 1941 with 60 ha of forest area that needed to protect. Its relatively maintained natural potency makes Suranadi Natural Park forest rich in various flora and fauna. Several studies have been conducted to explore the diversity of fauna species at Suranadi Natural Park. The fauna species found at Suranadi Natural Park included four species of amphibians of the anura order (Satyawan, 2009), mammals (Gray apes/*Macaca Fascicularis*), Black macaques (*Presbytis cristata*), water civet (*Cyngale benniti*), jelarang (*Ratufa bicolor*), Birds (Eagle/Falchonidae), Honeybirds (Nectariniidae), Reptile Lizard (*Varanus salvator*) and Snake Calobridae (BKSDA NTB, 2015).

One of the fauna that plays an important role in the ecosystem at Suranadi Natural Park is butterfly. Ariani *et al.* (2013) found 28 species of butterflies in the Suranadi Natural Park region. Butterfly is a wildlife that plays an important role in the life cycle of flowering plants. It helps preserving the existence and diversity of flora by facilitating the process of pollination.

The great variety of the butterfly species provides an interesting picture for protection purposes as well as for the benefit of sustainable research and utilization. The recent number of the identified butterflies is about 17,000 species. The survival of the butterfly is strongly influenced by its adaptability to climate and habitat. Butterflies are not only crucial as a pollinator or flower but also very vulnerable to environmental changes as the bioindicators of environmental quality changes (Basset *et al.*, 2012). Many butterflies are hunted by collectors as its high economical value (Ngatimin *et al.*, 2014). This condition triggers excessive and uncontrolled hunting and exploitation. In addition, clearing land and fo-

rest conversion for economical purposes are the major factors in the loss of butterfly habitats. If this continues, then negative impacts, such as the drop of the numbers even to extinction of species, poses a serious threat to the existence of butterfly populations.

Given the importance of the role of butterflies for the balance of the forest ecosystems, it is imperative that conservation efforts should be undertaken to repress the negative impacts of forest exploitation and conversions on the survival of the butterfly population. To determine the accurate strategy for the conservation of butterflies in Suranadi Natural Park, it is necessary to study the species diversity and prioritize the conservation of butterfly species at Suranadi Natural Park. The present study aimed at analyzing the diversity and determining the priority of butterfly conservation at Suranadi Natural Park of West Lombok. This research contribut to develop conservation strategy and ecotourism.

METHOD

The study was conducted from April to May 2017 at Suranadi Natural Park in West Lombok (Figure 1).

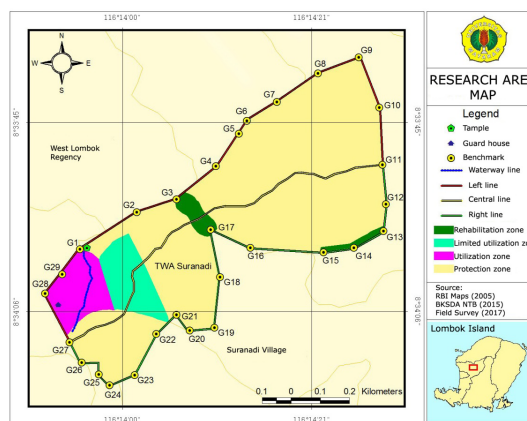


Figure 1. Research Area

The data collection in this study employed direct survey method. Butterfly catching was done by sweeping net technique along observation lines that had been determined based on the observation. The butterfly samples taken in this study were adult butterflies. Sampling was carried along each path using insect net. Data collection was done through 4 repetitions within 2 months. Butterfly catching was done in the morning from 08.00 - 11.00 AM Central Indonesian Time and in the afternoon it started at 30:00 – 5:00 PM Central Indonesian Time.

The sample of butterflies caught in the field were preserved by injecting 4% formalin solution in their thoracic parts using syringes and then stored using papilot paper. The sample was then identified in the biology laboratory of FKIP Universitas Mataram and the number of individuals was counted. Butterfly samples were identified using the Practical Handbook of Butterflies at the Bogor Botanical Gardens (Peggie & Amir, 2006) and the Butterfly Field Guide at TWA Kerandangan (Wahyuni & Fatahullah, 2015).

The data analysis used the Shannon-Wiener diversity index, as follows:

$$H' = -\sum_{i=1}^s p_i \ln p_i$$

Note: H': Index of diversity and Pi: Proportional abundance

The priority for conservation was determined by Minister of Forestry Regulation Number: P.57 / Menhut-II / 2008 on Strategic References for National Species Conservation 2008 - 2018.

RESULTS AND DISCUSSION

Diversity of Butterfly Species at Suranadi Natural Park

The results showed that in the Suranadi Natural Park area, 40 species of butterflies belonging to the 5 families of Papilionidae, Nymphalidae, Pieridae, Lycaenidae and Hesperidae were found. Table 1 displays the species of butterfly found along with the diversity index (H') on each observation path. The number of species found in this study is more than those found in the other sites such as those conducted by Ariani *et al.* (2013) who found 28 species of butterflies, Koneiri & Saroyo (2012) found 28 species of 4 families on Mount Manado Tua, Bunaken Marine National Park, North Sulawesi. The same number (40 species) classified in four families were found in the area of Halimun Salak National Park of West Java (Murwitaningsih & Dharma, 2014). The different results obtained may be due to habitat conditions, precision factors and observation time.

The existence of butterfly species is strongly influenced by vegetation, environmental factors and human disturbance. Changes in vegetation and the environment affect the composition of butterfly species. Figure 2 shows the proportion of butterfly species found in Suranadi Natural Park. Nymphalidae is a family with the highest proportion of 45%, followed by Pieridae 25%, Papilionidae 15%, Lycaenidae 13% and Hesperidae 2%.

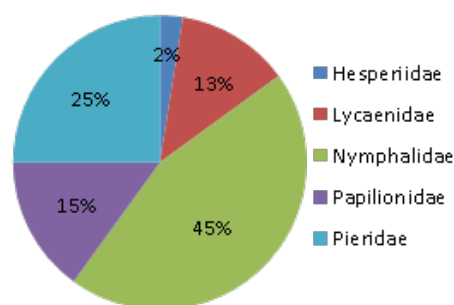


Figure 2. The proportion of the number of butterfly species found in Suranadi Natural Park

The number of butterfly species found at Suranadi Natural Park is less than those identified from other locations outside Lombok island. Rahayu & Basukriadi (2012) found 43 species (6 families) in the Sabjah City Forest of Jambi, 55 species (5 families) in Taman Kehati Unnes (Priyono & Abdullah, 2013), 60 species (5 families) in Hapanasan Rokan tourism area Upstream Riau (Febrita *et al.*, 2014), 63 species of Papilionidae family in Banyuwindu, Limbangan Kendal (Oqtafiana *et al.*, 2013), 42 species (8 families) in Tanjung Balai Karimun, Riau islands (Sutra *et al.*, 2012) and 45 species were found in the North Coast of Manokwari West Papua (Hermawanto *et al.*, 2016).

The number of species found in the Suranadi Natural Park area is also less than that found in other countries as reported by Lodh & Agarwala (2016) which found 53 species (5 families) in the Rowa Indian Natural Reservation, 63 species (5 families) on foot Itanagar hills India (Sarma *et al.* 2012) and 74 species (6 families) in the Rema-Kalenga wildlife reserve of Bangladesh (Shihan & Prodhan, 2014). Majumder *et al.* (2013) reports that in the South Asian Trishna Natural Reservation, it was found 59 species of butterflies belonging to 12 distinct species and 9 threatened species. In the Bangladeshi Forest, 125 species (6 families) and 23 threatened species were found, including *Troides helena* (Haidar *et al.*, 2017). Several species of dominant butterflies were found in the area of Suranadi Natural Park (Figure 3).

Butterflies usually live in the terrestrial habitats but the composition of the species varies according to their habitat conditions. Butterfly habitat is characterized by the availability of host plants to feed the larvae, and the nectar-producing plants for their imago. When these two plants are available in a habitat, they allow the butterflies to survive. If only one of them is available, butterfly cannot survive. In addition, it also needs a sufficient light factor, clean air, and water as the

Table 1. Diversity of Butterfly Type on each observation line

| No. | Family | No. | Species of butterflies | The number of individual species per line | | | |
|-----|---------------------------|--------|----------------------------------|---|-----------------------|--------------|---------------|
| | | | | line Left | line Right | line Central | line Waterway |
| 1 | Hesperiidae | 1 | <i>Ancisfroides nigrita</i> | 2 | 2 | 1 | 0 |
| 2 | Lycaenidae | 2 | <i>Leptotes sp</i> | 7 | 3 | 0 | 0 |
| | | 3 | <i>Jamides alecto</i> | 20 | 9 | 2 | 0 |
| | | 4 | <i>Floss annuela</i> | 0 | 4 | 0 | 0 |
| | | 5 | <i>Jamides celeno</i> | 38 | 7 | 0 | 2 |
| | | 6 | <i>Lambides boeticus</i> | 4 | 0 | 0 | 5 |
| | | 7 | <i>Euploea eunica</i> | 6 | 5 | 1 | 2 |
| 3 | Nymphalidae | 8 | <i>Vindula dejone dorokusana</i> | 3 | 11 | 3 | 4 |
| | | 9 | <i>Danaus genutia</i> | 6 | 6 | 3 | 0 |
| | | 10 | <i>Melanitis leda</i> | 6 | 4 | 4 | 0 |
| | | 11 | <i>Mycalesis janardana</i> | 2 | 1 | 0 | 0 |
| | | 12 | <i>Doleschallia bisaltide</i> | 1 | 7 | 0 | 2 |
| | | 13 | <i>Ideopsis juvena</i> | 5 | 0 | 0 | 0 |
| | | 14 | <i>Euploea climena</i> | 12 | 3 | 1 | 0 |
| | | 15 | <i>Pantoporia hardonia</i> | 7 | 5 | 0 | 1 |
| | | 16 | <i>Elymnias hypermenestra</i> | 2 | 11 | 0 | 1 |
| | | 17 | <i>Hypolimnas bolina</i> | 4 | 1 | 2 | 0 |
| | | 18 | <i>Tirumala hamata</i> | 10 | 2 | 0 | 0 |
| | | 19 | <i>Mycalesis horfieldi</i> | 3 | 3 | 1 | 0 |
| | | 20 | <i>Polyura hebe</i> | 7 | 4 | 0 | 1 |
| | | 21 | <i>Junonia sp</i> | 6 | 5 | 1 | 0 |
| | | 22 | <i>Athyma nefte</i> | 2 | 2 | 1 | 0 |
| | | 23 | <i>Nepthis hylas</i> | 5 | 3 | 0 | 0 |
| | | 24 | <i>Melanitis phedippus</i> | 9 | 4 | 2 | 0 |
| | | 4 | Papilionidae | 25 | <i>Papilio memnon</i> | 26 | 7 |
| 26 | <i>Papilio polytes</i> | | | 2 | 3 | 1 | 0 |
| 27 | <i>Papilio peranthus</i> | | | 8 | 4 | 0 | 1 |
| 28 | <i>Graphium doson</i> | | | 2 | 14 | 0 | 1 |
| 29 | <i>Graphium Agamemnon</i> | | | 2 | 6 | 0 | 6 |
| 30 | <i>Troides Helena</i> | | | 0 | 0 | 0 | 1 |
| 5 | Pieridae | 31 | <i>Catopsila sp</i> | 4 | 4 | 1 | 0 |
| | | 32 | <i>Leptosia nina</i> | 8 | 8 | 3 | 1 |
| | | 33 | <i>Eurema blanda</i> | 13 | 6 | 0 | 2 |
| | | 34 | <i>Cepora iudith</i> | 10 | 16 | 11 | 4 |
| | | 35 | <i>Cepora sp</i> | 10 | 8 | 1 | 1 |
| | | 36 | <i>Delias sp</i> | 7 | 5 | 0 | 0 |
| | | 37 | <i>Catopsila pamona</i> | 5 | 13 | 7 | 0 |
| | | 38 | <i>Catopsila pyranthi</i> | 2 | 5 | 1 | 0 |
| | | 39 | <i>Hebomoia glaucipe</i> | 2 | 4 | 0 | 0 |
| | | 40 | <i>Eurema hecabe</i> | 4 | 3 | 0 | 1 |
| | | Amount | 272 | 208 | 48 | 41 | |
| | | H' | 3.29 | 3.43 | 2.63 | 2.65 | |

material needed to maintain the moisture of the environment.



Figure 3. Dominant butterfly species found in Suranadi Natural Park; (a) *Papilio polytes*, b) *Jamides celeno*, c) *cepora iudith*, d) *Eurema blanda*

Figure 4 shows the proportion of the individual number of each butterfly family found at Suranadi Natural Park. The largest proportion of families was Nymphalidae (35%) followed by Pieridae (30%), Lycaenidae (18%), Papilionidae (16%) and Hesperidae (1%). The dominance of the Nymphalidae family butterfly is a common pattern in many places. The Nymphalidae family not only has a high species diversity but also has a wider range and higher abundance than other families. Nymphalidae prefers to live in forests, bright areas and fields.

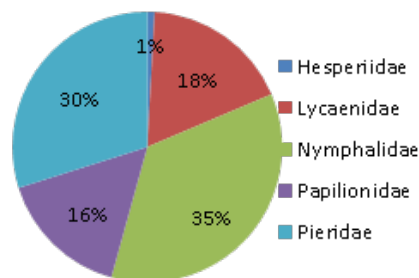


Figure 4. Proportion of Number of Individuals of each butterfly family found at Suranadi Natural Park

The index of the diversity of butterflies at Suranadi Natural Park is 3.47 which was analyzed with Shannon-Wiener index, while each observation path had different value. Figure 4 displays the highest index value found on the right lane ($H' = 3.43$) followed by the left lane ($H' = 3.29$), the water line ($H' = 2.65$) and the middle lane ($H' = 2.63$). The differences in the index values of the diversity of butterfly species in the Suranadi Natural Park region were influenced by

the different vegetation structure of secondary forest composition in the form of tall trees and varied canopy.

The variety of canopies affected the difference of sunlight to each part of the forest, so that habitat conditions varied. The right and left lanes were the margins of the secondary forest that is directly adjacent to the community plantations, so that they had a fairly open canopy. The existence of community flower fields and fields provided an attractive source of foods for butterflies, so that many species were concentrated here. Unlike the middle path that had a canopy, it was solid enough to block the penetration of sunlight that affected the less butterfly species found.

The index of the diversity of butterfly species at Suranadi Natural Park is greater compared to those found in other places. Nisa *et al.* (2013) find indices of diversity ($H' = 2.199$) in Malang City Green Open Space.

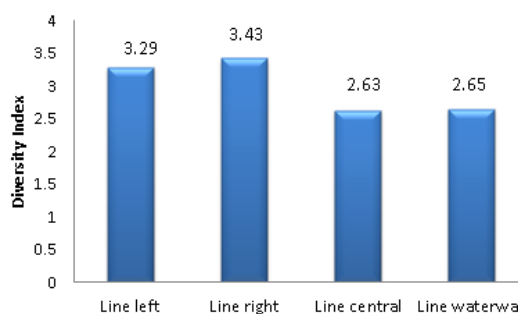


Figure 5. Shannon-Wiener Diversity Index on each observation path

Priority of Butterfly Conservation at Suranadi Natural Park

Habitat is the result of interaction between the biotic and abiotic components, the components interact to form interrelated relationships. If only one of them is available, then the butterfly cannot survive, especially if there is no host plant. The butterfly habitat should be a moist place with lots of flower vegetation, aquatic bodies and plenty of sunshine. Most species live in agricultural areas, orchards, primary and secondary forests. The highest frequency of butterflies flowering is at 09.00-13.00 and the colors of flowers have a positive effect on the number of butterflies that perceive it (Duara & Kalita, 2014).

Based on the conservation priority analysis, two species of the Papilionidae family were the main priority of butterfly conservation in Suranadi Natural Park namely *Troides helena* and *Papilio memnon*. This type of butterfly *Troides helena* (Common Birdwing) was one of the rare spe-

Table 2. Priority of butterfly conservation at Suranadi Natural Park

| No | Family | No | Species | E | SP | HC | R | SSM | TOTAL |
|----|--------------|----|----------------------------------|----|----|----|----|-----|-------|
| 1 | Hesperiidae | 1 | <i>Ancistroides nigrita</i> | 5 | 20 | 5 | 10 | 10 | 50 |
| 2 | Lycaenidae | 2 | <i>Leptotes sp</i> | 5 | 20 | 5 | 10 | 10 | 50 |
| | | 3 | <i>Jamides alecto</i> | 5 | 20 | 5 | 10 | 10 | 50 |
| | | 4 | <i>Floss annuela</i> | 5 | 20 | 5 | 10 | 10 | 50 |
| | | 5 | <i>Jamides celeno</i> | 5 | 20 | 5 | 10 | 10 | 50 |
| | | 6 | <i>Lambides boeticus</i> | 5 | 20 | 5 | 10 | 10 | 50 |
| 3 | Nymphalidae | 7 | <i>Euploea eunica</i> | 5 | 20 | 5 | 10 | 10 | 50 |
| | | 8 | <i>Vindula dejone dorokusana</i> | 5 | 20 | 5 | 10 | 10 | 50 |
| | | 9 | <i>Danaus genutia</i> | 5 | 20 | 5 | 10 | 10 | 50 |
| | | 10 | <i>Melanitis leda</i> | 5 | 20 | 5 | 10 | 10 | 50 |
| | | 11 | <i>Mycalesis janardana</i> | 5 | 20 | 5 | 10 | 10 | 50 |
| | | 12 | <i>Doleschallia bisaltide</i> | 5 | 20 | 5 | 10 | 10 | 50 |
| | | 13 | <i>Ideopsis juvena</i> | 5 | 20 | 5 | 10 | 10 | 50 |
| | | 14 | <i>Euploea climena</i> | 5 | 20 | 5 | 10 | 10 | 50 |
| | | 15 | <i>Pantoporia hardonia</i> | 5 | 20 | 5 | 10 | 10 | 50 |
| | | 16 | <i>Elymnias hypermenestra</i> | 5 | 20 | 5 | 10 | 10 | 50 |
| | | 17 | <i>Hypolimnias bolina</i> | 5 | 20 | 5 | 10 | 10 | 50 |
| | | 18 | <i>Tirumala hamata</i> | 5 | 20 | 5 | 10 | 10 | 50 |
| | | 19 | <i>Mycalesis horfieldi</i> | 5 | 20 | 5 | 10 | 10 | 50 |
| | | 20 | <i>Polyura hebe</i> | 5 | 20 | 5 | 10 | 10 | 50 |
| | | 21 | <i>Junonia sp</i> | 5 | 20 | 5 | 10 | 10 | 50 |
| | | 22 | <i>Athyma nefte</i> | 5 | 20 | 5 | 10 | 10 | 50 |
| | | 23 | <i>Nepthis hylas</i> | 5 | 20 | 5 | 10 | 10 | 50 |
| | | 24 | <i>Melanitis phedipus</i> | 5 | 20 | 5 | 10 | 10 | 50 |
| 4 | Papilionidae | 25 | <i>Papilio memnon</i> | 5 | 20 | 10 | 20 | 10 | 65 |
| | | 26 | <i>Papilio polytes</i> | 5 | 20 | 5 | 10 | 10 | 50 |
| | | 27 | <i>Papilio peranthus</i> | 5 | 20 | 5 | 10 | 10 | 50 |
| | | 28 | <i>Graphium doson</i> | 5 | 20 | 5 | 10 | 10 | 50 |
| | | 29 | <i>Graphium agamemnon</i> | 5 | 20 | 5 | 10 | 10 | 50 |
| | | 30 | <i>Troides helena</i> | 20 | 15 | 10 | 20 | 10 | 75 |
| 5 | Pieridae | 31 | <i>Catopsila sp</i> | 5 | 20 | 5 | 10 | 10 | 50 |
| | | 32 | <i>Leptosia nina</i> | 5 | 20 | 5 | 10 | 10 | 50 |
| | | 33 | <i>Eurema blanda</i> | 5 | 20 | 5 | 10 | 10 | 50 |
| | | 34 | <i>Cepora iudith</i> | 5 | 20 | 5 | 10 | 10 | 50 |
| | | 35 | <i>Cepora sp</i> | 5 | 20 | 5 | 10 | 10 | 50 |
| | | 36 | <i>Delias sp</i> | 5 | 20 | 5 | 10 | 10 | 50 |
| | | 37 | <i>Catopsila pamona</i> | 5 | 20 | 5 | 10 | 10 | 50 |
| | | 38 | <i>Catopsila pyranthi</i> | 5 | 20 | 5 | 10 | 10 | 50 |
| | | 39 | <i>Hebomoia glaucipe</i> | 5 | 20 | 5 | 10 | 10 | 50 |
| | | 40 | <i>Eurema hecabe</i> | 5 | 20 | 5 | 10 | 10 | 50 |

Where: E: Endemicity SP: Status of Population HC: Habitat Condition R: Risk SSM: Status of Species Management

cies found at Suranadi Natural Park. *Troides helena* is a type of butterfly protected by SK Mentan No.576/Kpts/Um/8/1980; PP. No. 7 Year 1999, Minister of Agriculture Decree No.716/Kpts/m1 /10/1980 and included in CITES Appendix II (Noerdjito & Aswari, 2003).



Figure 6. Species of butterflies being a conservation priority at Suranadi Natural Park; (a. *Troides helena*, b. *Papilio memnon*)

Butterflies from the Papilionoidea Family loves light very much. Light is needed to dry its wings upon exit from the cocoon. Light provides heat energy to the body, so that body temperature increases and metabolism becomes faster. The raise of body temperature accelerates the growth of butterfly larvae. The existence of *Troides helena* and several other butterfly species, especially from the Papilionidae family was in danger due to human hunting for trading, or due to the decline in the quality of butterfly habitats in nature. Type *Troides helena* are much hunted for their beauty and rarity (Noerdjito & Aswari, 2003).

Pontororing *et al.* (2016) reported that *T. helena* belonged to animals with high flying ability. His ability to fly high is used to alight, eat, breed, and play. The range of flight frequency of *T. helena* was 06.00 - 17.00. The highest flying frequency was found at 08.00-10.00 am. Flying high is done to increase body temperature and dry the wings. Pontororing *et al.* (2016) also reported that the frequency of *T. helena* during nectar sipping (food) begins at 07.00 - 16.00. Frequency increased at 07.00 - 09.00, and it decreased and then increased again at 12.00 - 15.00. Nectar is needed by the butterfly as a foodstuff and then converted into energy to fly.

The existence of *Troides helena* is influenced by the existence of feed and host plants. *Aristolochia tagala* from the family Aristolochiaceae is a host plant for the species. *Troides helena* was found in the waterway positioned between G1-G6 and only found at the third sampling. This related to butterfly flying period and was likely close to the host plant. According to Peggie & Amir (2006), the observations at different times may show different types because they have different flying periods. This is obviously observable in the 4 seasons area. In Indonesia, there are also differ-

ences in the distribution and diversity of butterflies in the rainy season and in the dry season.

The population of *Troides helena* in the secondary forest of Suranadi Natural Park was small. This condition can threaten the survival of *Troides helena*, because besides the rare host plants, its breeding ability is also low. *Troides helena* is large, eggs are produced a bit, and the reproduction time is long enough. Based on the Nurjannah (2010), *Troides helena* produces 35-150 eggs, and the success rate until imago phase is only 8-12%. This condition decreases the number of *Troides helena* and the frequency of their meeting with their 'imago' is rare. The phenomenon indicated that this natural tourism park area needs to be preserved. The population of butterflies is limited in nature, and its high sensitivity to potential disturbance due to the environmental imbalances threatens its survival, even causes the extinction of the butterflies in their habitat. This research contributes in developing conservation strategy and ecotourism at Suranadi Natural Park.

CONCLUSION

The results showed that forty (40) species of butterflies found were classified in five (5) families; Hesperidae (1 species), Lycaenidae (5 species), Nymphalidae (18 species), Papilionidae (6 species) and Pieridae (10 species). The index of the diversity of butterflies at Suranadi Natural Park was 3.47. The species diversity varied on each observation path. There were 2 species of the Papilionidae family, *Troides helena* and *Papilio memnon*, at Suranadi Natural Park as the conservation priorities.

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