The Diversity of Butterfly (Lepidoptera) and Longhorn Beetles (Coleoptera: Cerambycidae) Protection Areas in Kalimantan Barat

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Abstract. Butterfly and longhorn beetles have an important roles in forest ecosystems. Both of this insect have role as bioindicator of environment. So that the present of butterfly and longhorn beetles held gain value to keep the sustainability of ecosystem. Survey of this study were studied in protection area of PT WanaHijauPesaguan, Kalimantan Barat. The aim of this study to examine diversity of butterfly and longhorn beetles in protection areas. Butterfly were collected using sweeping net and longhorn beetles were collected using Arthocarpus trap. The datas were collected from three different areas of protection area, such as wildlife conservation area (KPSL), germplasm conservation area (KPPN),and buffer zone (BZ). All samples were identified up to species level. A total of 186 individuals from 83 species butterfly were collected from three different areas. This survey was recorded 6 family of butterfly from three different areas. A total of 137 individuals from 23 species longhorn beetles were collected from three different areas. The highest number of species of butterfly and longhorn beetles was found in KPSL. The highest number of individuals of longhorn beetles was found in KPSL, however butterfly was found in KPPN. The result of survey indicated that species diversity of longhorn beetles and butterfly in protection areas of PT WHP is high.

Key words: Arthocarpus trap, bioindicator, butterfly, longhorn beetles

1. Introduction

World Demand for pulp and paper in 2011 reached 370 million tons and predicted to increase up to 490 million tons by the year 2020 [1]. It is one of the triggers for the growth of pulp and paper industry in Indonesia. Until now, the raw materials of the pulp and paper industry in Indonesia are mostly derived from plantations forest which utilize the production forest areas.

As a result of the high demand for raw materials of paper, the development of plantations forest continue to increase. Recorded in 2009 permit for forest timber product exploitation permit - planted forest (IUPHHK-HT) in West Kalimantan amounted to 1.54 million ha [2]. Furthermore, the development of forest plantations leads to impact the changes of forest ecosystems, one of which is the decline of biodiversity. According to [3], the impacts of land use change can affect the species richness and abundance of flora, invertebrates, vertebrates, has impact on ecosystem function. However, each company which have permit the IUPHHK-HT must prepare 10% areas for protection
areas (SK Menhut No. 246/Kpts-II/1996). The protection area serves to protect the conservation of the environment, especially the diversity of flora and fauna.

Insect is one of the ecosystem components that belong to the phylum Arthropoda. Several arthropod groups can be used as bioindicators in forest management, one of which is butterflies (Lepidoptera) and longhorn beetles (Cerambycidae) [4]. Butterfly (Lepidoptera) is the second largest order in insect class with an ecologically important role, such as balancing forest ecosystem, pollinator, and part of the food chain which are able to be used as an bioindicator in forest utilization [5]. Meanwhile, longhorn beetles (Cerambycidae) is one of the families of the largest order in the class Insecta of the Coleoptera. Cerambycidae is also known as the largest group of wood borers insects [6], both in a living and dead trees. Moreover, longhorn beetles have a crucial role in the forest ecosystem, including parts of the nutrient cycle, as decomposers [6] and as pollinators.

Measurement of species diversity is one way to monitor ecosystem conditions and the key points for understanding a community within a forest ecosystem. Therefore, this study aimed to measure the diversity of butterfly and longhorn beetles in the protection areas of PT Wana Hijau Pesaguan, West Kalimantan. Based on this study, the data is expected to be the baseline for ecosystem management information.

2. Study sites and methods

2.1. Collecting and identification
Survey was held in three different locations in the protection area of PT Wana Hijau Pesaguan (PT WHP) West Kalimantan, the Wildlife Conservation Area (KPSL), Germplasm Conservation Area (KPPN), and Buffer Zone (BZ). The data collected in north and south of protection areas. Data was collected in May, 2014.

The method for collecting butterfly and longhorn beetles used line transect method. Butterfly were collected by sweep net. Longhorn beetles traps used in this survey was Arthocarpus trap [6]. In each locations, three Arthocarpus traps installed with 30 meters spaced for three days.

Butterfly and longhorn beetles were identified up to the species level. Identification process was performed in Laboratory of Forest Entomology, Faculty of Forestry and in the Laboratory of Entomology, Zoology Section, Indonesian Institute of Sciences (LIPI). Indetification of butterfly were base on [7-10].

2.2. Data analysis
Data analysis was performed by calculating number of indivdu, number of species, the diversity index of Shannon-Wiener, Richness index of Margalef, eveness index of Pielou calculated using the Species Diversity and Richness-2.64 program. The use of this indexes because the commonly used and easy calculation. Species similarity calculated with similarity index of Jaccard (1).

\[
CJ = J/(a + b - J) \quad (1)
\]

- \( CJ \) = similarity Index of Jaccard
- \( J \) = number of species in habitat a&b
- \( a \) = number of species in habitat a
- \( b \) = number of species in habitat b

3. Results

3.1. The Diversity of Butterflies
The total species of butterflies found in three different locations in the protection area of PT WHP were 83 species with a total abundance of 186 individuals (figure 1). The result of the survey in all three different locations of the protection areas showed that the largest number of species butterflies were found in KPSL, while the largest number of individuals were found in KPPN.
The results of the butterflies diversity index analysis in three different locations are presented in table 1. Table 1 shows that the highest index of diversity, richness, and evenness of butterfly was found in KPSL.

![Bar graph showing butterfly abundances in KPSL, KPPN, and BZ.](image)

**Figure 1.** The species and individual abundances of butterflies in Wildlife Conservation Area (KPSL), Germplasm Conservation Area (KPPN), Buffer Zone (BZ).

**Table 1.** The diversity of butterflies in the protection area of PT WHP.

| Biodiversity Indices         | KPSL  | KPPN  | BZ   |
|------------------------------|-------|-------|------|
| Diversity Index of Shannon-Wiener | 3,6209| 3,1205| 3,5199|
| Richness Index of Margalef    | 9,9735| 8,2948| 9,6462|
| Evenness Index of Pielou      | 0,81942| 0,70619| 0,79657|

*Wildlife Conservation Area (KPSL)
\(^b\) Germplasm Conservation Area (KPPN)
\(^c\) Buffer Zone (BZ)

The results of the analysis of similarity index butterfly indicated that the highest of similarity index was found in KPPN with BZ (table 2), perhaps it was because the distance of both areas is close to each other. The same number of butterfly on the areas is as much as 14 species.

**Table 2.** Jaccard similarity index of butterflies in Wildlife Conservation Area (KPSL), Germplasm Conservation Area (KPPN), Buffer Zone (BZ).

| Locations | KPSL | KPPN | BZ  |
|-----------|------|------|-----|
| KPSL      | 0,22 |      |     |
| KPPN      |      | 0,19 |     |
| BZ        |      | 0,23 |     |
The results of the survey were found 5 butterfly families (Lycaenidae, Nymphalidae, Papilionidae, Pieridae, and Riodinidae) that belong to the superfamily Papilionoidea and family Hesperiidae that belong to superfamily Hesperioidea [11]. The results of the survey showed that the Nymphalidae family had the largest number of species and individuals compared to the five other families (figure 2).

![Figure 2. Butterfly families found in three different locations based on the number of species.](image)

3.2. The Diversity of longhorn beetles
The total species of longhorn beetles found in three different locations of the WHP protection area were 23 species with a total abundance of 137 individuals (figure 3). Figure 4 shows that the largest number species and individuals of longhorn beetles were found in KPSL, while the smallest number of individuals and longhorn beetles was found in KPPN.

The results of the diversity index analysis of longhorn beetles in three different locations are presented in table 3. Table 3 shows that the highest index of diversity, richness, and evenness of longhorn beetles were found in KPSL while the lowest was found in BZ.

![Figure 3. The species and individual abundances of longhorn beetles in Wildlife Conservation Area (KPSL), Germplasm Conservation Area (KPPN), Buffer Zone (BZ).](image)
Table 3. The diversity of Longhorn beetles in the protection area of PT WHP in Wildlife Conservation Area (KPSL), Germplasm Conservation Area (KPPN), Buffer Zone (BZ).

| Biodiversity Indices             | KPSL | KPPN | BZ  |
|----------------------------------|------|------|-----|
| Diversity Index of Shannon-Wiener| 2.64 | 1.84 | 1.75|
| Richness Index of Margalef       | 4.50 | 2.46 | 1.86|
| Evenness Index of Pielou          | 0.84 | 0.59 | 0.56|

The results of the analysis of similarity index longhorn beetles indicated that the highest of similarity index was found in KPPN with BZ (table 4). Perhaps it was because the distance of both areas is close to each other. The same number of beetles in the areas is as much as 5 species. Based on the survey, longhorn beetles that commonly found in all three locations were from the subfamily Lamiinae (figure 4).

**Figure 4.** Longhorn beetles subfamilies found in three different locations based on the number of species

4. Discussion

4.1. The Diversity of Butterflies

The survey area of KPSL is located on the edge of the forest along the main road with richly flowering understories. KPSL is also adjacent to the production area that has been treated with land clearing so that the boundary between KPSL and production area is relatively open. The high diversity of butterflies in KPSL is influenced by the openness of the area that potentially used as a butterfly feeding site and there are understory flower as feed of butterfly. The results of our survey showed that
the diversity of butterfly species in three different locations in the protection area of PT WHP was quite high compared to the finding research by [12]. This is might be caused by the presence of a river in the survey location and the abundance of feed plants at the edge of the forest. On the other hand, the protection area of PT WHP is a secondary forest, where the butterflies are commonly found around the river [13]. This is due to the environmental conditions around the river such as light, temperature, humidity, and the food that supports the life of butterflies.

The family Nymphalidae is also known as the largest family of the superfamily Papilionidae[14]. The high number of species and individuals of Nymphalidae influenced by the presence of plants as food resources and shelter of butterflies. Some plant families that used as feed by butterflies from the family Nymphalidae are Arecaceae, Musaceae, and Poaceae[8]. In addition, The butterfly species of Nymphalidae are also adaptable to new environments compared to other butterfly families. The most common species found in three different locations is the *Vindula dejone* that belongs to the family Nymphalidae (figure 5). This species was also found in the research by [12].

![Figure 5. Vindula dejone, the most common species found in survey locations.](image)

4.2. The Diversity of longhorn beetles

The Difference of abundance and diversity of longhorn beetles in all three locations can be caused by the tree composition. According to [15], the difference of abundance of longhorn beetles due to the differences in its habitat characteristics. In addition, the abundance and diversity of longhorn beetles may be due to the availability of twigs, branches, bark, and tree trunks as food resource and host for longhorn beetles. However, the number of traps used affects the diversity value of longhorn beetles in the survey results. The diversity of longhorn beetles in our survey was lower than that finding by [16]. This is because the number of traps used is also lower. Meanwhile, compared with the finding research by [15] conducted in Gunung Walat Education Forest, the value of diversity in three different locations in the protection area of PT WHP suggested the higher result. This is because the protection area of PT WHP is a secondary forest which stores various types of trees and other living or dead plants that can be used as food resource, place to lay eggs, and habitat of longhorn beetles. According to [16], the availability of tree trunk, decayed wood, and a canopy that relatively dense can affect the high diversity of Cerambycidae.

Our survey results are similar to those found by [15] and [16], which suggested that all of the observed longhorn beetles belong to the subfamily Lamiinae, that is the largest group of the family Cerambycidae [17]. The three most common species of longhorn beetles obtained in three locations were *Epepeotes luscus*, *Acalolepta dispar*, and *E. spinosus* (figure 6) with a wide distribution scheme. The Result also suggested that *E. luscus*, *A. dispar*, and *E. spinosus* were found in Sumatra, Java, and Borneo [6,15,16].

5. Conclusion

The highest number of butterfly and longhorn beetle are in wildlife conservation area, compare to Germplasm Conservation Area and Buffer Zone. Species diversity of longhorn beetles and butterfly in protection areas of PT WHP is high. The most common species of butterfly is *Vinduladejone*, while *Epepeotesluscus*, *Acaloleptadispar*, and *E. spinosus* are the most common of longhorn beetle. Ecosystem factors significantly affect to diversity of butterfly and longhorn beetle.
Figure 6. The most common species found in three different locations: A) Acalolepta dispar, B) Epeopeotes luscus, dan C) Epeopeotes spinosis.

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References
[1] Kusumaputra R A 2011 Indonesia's 9th World Pulp Producer[Internet]. [download 15 July2017]. On:http://bisniskeuangan.kompas.com/ read/2011/12/15/17463654/ Indonesia.ke9.Penghasil.Pulp.Dunia.
[2] Dirjen BPK 2010 Progress Report on Utilization and Use of Production Forest: Quarter IV (October-December 2009) (Jakarta: Dirjen BPK)
[3] Sodhi N S, Koh L P, Clements R, Wanger T C, Hill J K, Hamer K C, Clough Y, Tscharttke T, Posa M R C and Lee T M 2010 Biologica Conservation 143 2375-2384
[4] Maleque M A, Maeto K, Ishii H 2009 Appl. Entomol. Zool. 44 (1) 1–11
[5] Cleary D F 2004 J Econ Entomol 97(2) 429-435
[6] Makihara H, Noerdjito WA, and Sugiar B 2002 Bulletin of FFPRI 1(3) 189-223
[7] Corbet A S and Pendlebury H M 1992 The Butterflies of the Malay Peninsula (Malaysia: United Selangor Press SDN. BHD)
[8] Peggie J and Amir M 2006 Partical Guide to the Butterflies of Bogor Botanical Garden (Bogor: Bidang Zoologi, Pusat Penelitian Biologi, LIPI)
[9] Peggie D, Vane-Wright R I and Yata O 1995 Butterflies 11 23-40.
[10] Yong H 1983 Malaysian Butterflies- An Introduction (Malaysia: Tropical Press SDN. BHD)
[11] Kristensen N P, Scoble M J and Karsholt B 2007 Zootaxa 1668 699-747.
[12] Indriani Y, Ginoja L N and Masy’ud B 2010 Media Konservasi 15(1) 1-2
[13] Rusman R 2015 Butterfly (Lepidoptera: Papilionoidae) at Mount Sago, West Sumatra: the diversity and reference of flowers visit [Thesis] (Bogor: Institut Pertanian Bogor)
[14] Borror D J and White R E 1970 A Field Guide to Insect America North of Mexico (New York: Houghton Mifflin Company)
[15] Sataral M, Atmowidi T and Noerdjito W A 2015 Journal of Insect Biodiversity 3(17) 1-12
[16] Fahri, Atmowidi T and Noerdjito W A 2016 Hayati Journal of Biosciences 23 56-61
[17] Noerdjito W A, Makihara H and Kahono S 2002 Fauna of Cerambycid beetles from Gunung Halimun National Park. In: Osaki M, Iwakuma T, Kohyama T, Hatano R, Yonebayashi K, Tachibana H, Takahashi H, Shinano T, Higashi S, Simbolon H. Proceedings of International Symposium on Land Management and Biodiversity in Southeast Asia. [Bali, 17-20 Sep 2002] p 195-201.