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Species Diversity of Butterflies at Suaka Elang (Raptory Santuary) at Gunung Halimun Salak National Park in West Java

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ABSTRACT

Lepidoptera (butterfly) is one of the most pervasive orders of insects after Coleoptera, Diptera and Hymncoptera. It is estimated that Indonesia has more than 2,500 species of butterfly. This study aims to observe the types of butterfly at Suaka Elang conservatory that is located at Taman Nasional Gunung Halimun Salak (TNGHS) national park in West Java, on March to April 2013. The butterflies at Suaka Elang play an important role in preserving the local ecosystem in terms of food cycle and flower fertilization. A comprehensive research on the diversity of butterflies in the area is therefore needed. The observation was conducted in Cibadak waterfall (curug) and three locations of open scrubland from morning until dusk when the butterflies were doing their activities. The observation at the TNGHS national park resulted in the finding of 170 individual butterflies which consist of 40 types and four families: Nymphalidae (22 types), Pieridae (eigh types), Piapilionidae (eight types) and Lycacaenidae (two types). The Cibadak waterfall has a medium diversity index (H'=2.39), medium evenness index (E=0.862), medium richness index (R=3.875) and high dominance index (C=0.12). Meanwhile, the open scrubland has a high diversity index (H'=3.05), high evenness index (E=0.865), high richness index (R=6.869) and low dominance index (C=0.071). The comunity similarity index for both locations is 36.5 percent (CS= 0.365).

Key words: butterfly, diversity, Suaka Elang, TNGHS

INTRODUCTION

The earth is home to around 10 million species of organism, including some 7 million species of insects (Ride, 1978; Hidayat *et al*., 2004). It is estimated that 15% of them, or around 250,000 species of insects, can be found in Indonesia (Bappenas, 1991; Supriatna 2008).

The Lepidoptera is among the four biggest insect orders, along with the Hymenoptera, Diptera, and the Coleoptera. Adult Lepidoptera (imago) are generally called butterflies or moth (Hidayat *et al.,* 2004). Their main characteristics are the scales covering their bodies and wings. These scales contain wax and are modified, giving butterflies and moths their variety of colors and patterns (Kristanto and Momberg 2008).

It is estimated that Indonesia has around 2,500 species of butterflies. Countries like Peru and Brazil in South America, in comparison, have around 3,700 species. But Indonesia has a very high endemicity level of butterflies at more than 35% of the total number of species. Whereas Peru, Brazil and other countries in South America have only 10% of the total amount of species. Indonesia, therefore, harbors the greatest number of endemic butterflies than any country in the world. (Peggie 2011).

Leipdoptera could be found in various places, in the forests, savannahs, snowy areas, swamps and even open areas like cities and sandy beaches. *Delias hyperete,* for example- their natural habitats include the forests and urban areas.

The population of butterflies has shrunk mostly due to high demand of certain species such as Birdwings (*kupu-kupu sayap burung*) or Ornithoptera and Monarch butterflies (*kupu-kupu raja*) or Danaus plexippus (Soehartono and Mardiastuti 2002; Peggie 2011), as well as the destruction of their natural habitats throughland conversion and deforestation on a massive scale, which makes it difficult for them to reproduce.

The Suaka Elang raptor sanctuary at the Gunung Halimun Salak National Park in West Java is one of Indonesia's educational and conservation centers for birds. It has diverse habitats, ranging from savannah to homogenous forest (pine forest) and heterogeneous forest (Cibadak waterfall). These habitats are where the wild lives including butterflies look for food. The butterflies in Suaka Elang are varied in terms of type, size and wing shape and color. They play an important role in preserving the ecosystem in terms of food cycle by helping flowering plants in fertilization. Considering the roles of butterflies in Suaka Elang, it is necessary for scientists to conduct a research on the diversity of butterflies in the area.

MATERIALS AND METHODS

This research was conducted from March to April 2013 at Suaka Elang (Raptor Sanctuary) in two different locations. The first location is an open scrubland at coordinate S $06^0$43'17.4" and E $106^0$46'26.7" at an altitude of 813 mdpl. The second location is Curug Cibadak (Cibadak Waterfall) at coordinate S 06^0 42'49.5" and E $106^0$45'35.5" at an altitude of 997 mdpl. Suaka Elang is geographically located at S 6 43'117" - E 106 46'177" at altitude 800 mdpl and is a part of the Gunung Halimun Salak National Park at the east side of

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Salak I Mountain foothill, next to the Pasir Jaya Hamlet's Neighborhood Unit 02/09 of Loji Village in Cigombong District, Bogor Regency, West Java.

The object of observation in this study is the type of butterflies that can be found in three locations. The tools and materials used are among others: nets, GPS (global positioning system), tweezers, digital clock, SLR camera, caliper, rain coat, stationery, gloves, altimeter and books: *Precious and Protected Indonesian Butterflies* (Peggie 2011), *Botanic Garden* (Peggie and Amir 2006) and 500 *Butterflies from Around the World* (Preston and Mafham 2007).

The observation was conducted during the height of the butterflies' activity from morning until the afternoon. Using a net, butterflies of the same species are caught from two different locations in Suaka Elang, an open brush and the Cibadak Waterfall. Measurements are then taken using a caliper of the butterflies' wing lengths, spans of upper and lower wings and their body lengths. Afterwards, observers took pictures of the butterflies and noted down the time of encounter. There were butterflies that observers could only get a photo of but could not be caught. Other environmental conditions data such as air temperature, humidity and location altitude were also taken. The results of every observation are recorded in the observation (Figure 1).

The data collected from the observation were then analyzed using the Shonnon-Wiener diversity index (H'= -∑ Pi Ln Pi) (Price 1997; Suheriyanto 2008), the Margalef richness index ($R = \frac{(S-1)}{\ln N}$) (Suheriyanto 2008), the Pielou evenness index ($E = \frac{H'}{\ln S}$) Suheriyanto (2008), Simpson dominance index ($C = \Sigma(\frac{ni}{N})^2$) (Smith dan Smith, 2006; Suheriyanto, 2008), Sorensen community similiarity index (CS) ($Cs = \frac{2j}{(a+b)}$) (Southwood 1980; Suheriyanto 2008).

RESULTS AND DISCUSSION

According to the observation conducted in two different locations, the open scrubland and Cibadak waterfal, it was found that there are 170 individual butterflies that consist of 40 different species and four families: Nymphalidae, Pieridae, Papilionidae dan Lycaenidae.

Nymphalidae has the most species in Suaka Elang with 22 types of butterflies. This family has various shapes, colors and sizes. Dendang (2009) explains that the butterflies in this family have front legs but they are not used for walking. Trimurti (2009) states that the butterflies have legs that could shrink and have no nails. Only middle and rear legs are used for walking.

The Pieridae family has eight species of butterflies in Suaka Elang. They have different colors: white with black stripes, white with black dots, yellow with black patterns and also white with yellow and red patterns. Trimurti (2009) explains that these butterflies have radial veins in their front wings, usually with 3 or 4 branches. The front leg spreads and are stiff, with a split tarsus. Theses types of butterflies found in Suaka Elang are medium sized.

The Pailionidae family has eight species. The ones found in Suaka Elang mostly have dark colors such as black with yellow, red, green and white pattern. According to Trimurti (2009), these butterflies have five radial veins on their front wings with one of them long enough to look like a tail in the rear areas. These types of butterflies found in Suaka Elang were mostly medium and large sized.

The Lycaenidae family has the least species in the conservation area with only two types. The ones found have dark colors like such as deep blue and brown with black stripes strecthing along their wings. They are mosly small in size.

There are 16 species of butterflies found in Cibadak waterfall: *Ypthima pandonus* (11), *Eurema alitha* (5), *Eurema hecabe* (7), *Eurema blanda* (2), *Symbrenthia lilaea* (1), *Stibochioma coresia* (1), *Faunis canens* (1), *Ypthima philomela* (3), *Troides c. curneifera* (1), *Melanitis phedima* (1), *Papilio polytes* (2), *Papilio memnon* (3), *Jamides pura* (1), *Junonia almana* (1), *Delias belisama* (1), *Anthene lycaenina* (7). Sedangkan di ladang terdapat 34 jenis kupu-kupu antara lain: *Ypthima pandonus* (9), *Faunis canens* (2), *Ypthima philomela* (10), *Danaus genutia* (3), *Phaedyma columella* (5), *Euoploea leucostictos* (1), *Neptis hylas* (7), *Euoplea mulciber* (3), *Junonia atlites* (2), *Euoploea eunice* (1), *Mycalesis janardana* (10), *Hypholimnas bolina* (3), *Mycalesis mineus* (3), *Junonia iphita* (2), *Melanitis leda* (2), *Orsotrianea medus* (2), *Cupha erymanthis* (2), *Ariadne ariadne* (1), *Pachliopta aristolochiae* (2), *Lamproptera curius (1), Papilio demolion* (1), *Papilio memnon* (1), *Graphium agamemnon* (1), *Papilio polytes* (1), *Troides helena helena* (1), *Delias belisama* (4), *Catopsilia pyranthe* (1), *Leptosia nina* (1), *Eurema alitha* (7), *Eurema blanda* (6), *Eurema hecabe* (23), *Delias periboea* (1), *Prioneris autothisbe* (2), and *Jamides pura* (1).

Of the forty types found in Suaka Elang, one of them, *Troides helena helena*, is legally protected. While the *Troides c. curneifera* is not legally protected in Indonesia, it is included in Appendix II CITES and could only be used for non-scientific purposes if they are products of conservation or farming. Indonesia has enacted legislation that controls the circulation of wild lives: PP No. 7 1999 and Law No. 5 1990 (Peggie 2011)

The type of butterfly that is most ubiquitous in Suaka Elang is *Eurema hecabe* with 30 individuals, seven of which were found at Cibadak waterfall and 23 in scrubs, which provide them with plants that have become their natural food. They were also seen devouring animal feces in a group in the grass field. The second most ubiquitous butterfly is *Ypthima pandonus* with 20 individuals, 11 of which were encountered in Cibadak waterfall and the rest in the field. This type of butterfly is often found in Cibadak waterfall as they have dark wings, which enable them to avoid predators and easily adapt to their surroundings.

How a type of butterfly becomes pervasive in one area and scarce in another area depends on the supporting capacity of each area, which includes the availability of plants consumed by the larvaes of certain butterflies (Yamamoto et al. 2007; Syafitri *et al.* 2010) as

well as the availability of the flowering plants they are fond of. Butterflies like flowers which havea sweet flavor and thin and deep petals, hang on a branch and have a lot of pollens (Sastrodiharjo *et al.* 2000; Syafitri *et al.* 2010). Other than that, butterflies also eat the residu of animal feces that fall to the ground.

Research on butterflies in Suaka Elang were initially conducted by Uni Konservasi Fauna IPB, which only found 25 types of butterfly. The figure is much smaller than the 40 types of butterfly found in this study. The number of findings in this study is more abundant than the other previous researches by Dendang (2009) in Selabintana National Park in Gunung Gede Pangrango (with 248 individual butterflies and 17 species) and Syafitri *et al.* (2010) in Gunung Putri National Park in Gunung Gede Pangrango (with 131 individual butterflies and 19 species).

Past research on butterflies in the 40,000-hectare Gunung Halimun National Park (Amir et al. 2003; Fitrayanti 2008) encountered 53 types of butterfly. The 2008 research conducted by Fitriyanti at Pusat Pendidikan Konservasi Alam Bodogol (PPKAB), which is 200-hectare wide, found 46 types of butterfly. Meanwhile, this study, which was conducted at only the 3-hectare land, found 40 types of butterfly. While the Gunung Halimun National Park is 39,997 hectare bigger and the PPKAB is 197 hectares bigger than Suaka Elang, respectively, the difference in the number of findings between Suaka Elang and the two areas are only 13 and six types of butterfly, respectively.

This shows that the butterflies in Suaka Elang are much more varied. This is due to a number of factors, such as research schedule, research location, the altitude of the research location, weather and the types of plants in the surroundings where the observation is conducted.

Based on the calculation using the Shannon-Wiener diversity index we can conclude that the diversity index (H') of butterflies in open scrubland is 3.05. This is caused by biotic and abiotic factors in the scrubland ecosystem, such as predators, the diversity of flowering plants and butterfly food that contributed to the proliferation in the number of butterfly types. The diversity level of butterflies in open shrubs can be categorized as high as it is higher than 3. Meanwhile, the results of the diversity calculation in Cibadak waterfall shows that it has an index of 2.39. As it is below 3 [1<H'<3], it is considered as medium. The difference of indexes between Cibadak waterfall and scrubland is influenced by the surrounding factors. The number of types found in open shrubs is higher than that in Cibadak waterfall. Ludwig and Reynold (1998) and Suheriyanto (2008) argues that a diversity index of a community depends in the richness and evenness of species. The statement is consistent with the results of this research, that the higher the richnes and evenness of species in a certain location, the higher the diversity of that species in the said location.

The diversity of butterflies in Suaka Elang is also affected by biotic factor in an open scrubland, which has many flowering plants. Butterflies always come to the flower of various plants to suck up their nectar and take their pollens. The shape, the colors, and the scent of the flowers are used by the butterfly to pick their diets (Proctor and Yeo 1957; Dendang 2009). Butterflies take up nectars by only resting on the flowers as it has elongated sucking mouthpart (proboscis) to touch the base of the flowers that might be deep. This activity enables butterfly to help flower pollination from the stigma through self-pollination or cross-pollination (Faegri 1978; Dendang 2009). Different kind of butterfly has different

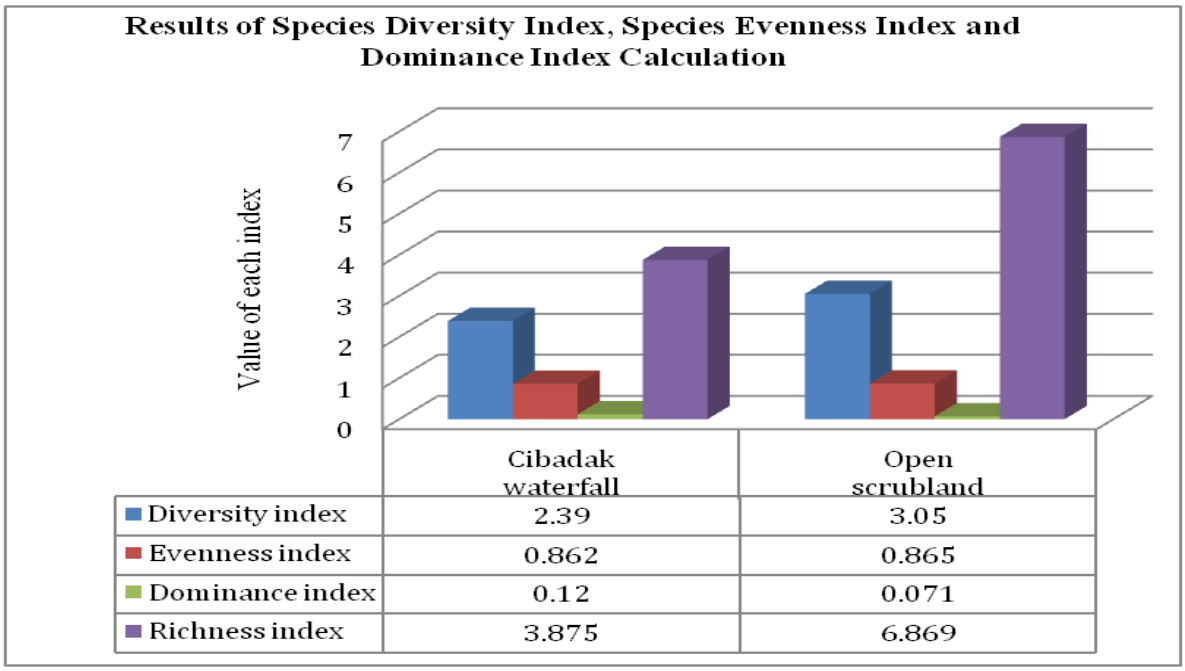

Figure 1. Diagram of the Shannon-Wiener diversity index, the evenness index and dominance index of the type of butterflies in scrublands and Cibadak waterfall.

stances for their larvae development (Patton 1963; Dendang 2009). Species richness index in Suaka Elang scrublands is 6.869 with 34 species in it. While species richness in Cibadak waterfall is 3.875 with 16 species in it. From this result, it can be concluded that open scrubland has higher species richness than Cibadak waterfall.

The result also showed evenness index (E) in Suaka Elang scrubland is 0.865, which means that the areas has more diverse butterfly communities that Cibadak waterfall which has 0.862. This finding is inline with Dendang (2009), that the higher diversity value in one habitat, the higher is its community balance.

Dominance index in Suaka Elang scrubland is 0.071, which is classified as a low number. While, dominance index in Cibadak waterfall is 0.12, which is classified as high. When species diversity and evenness index increases, it is getting close to 0 (zero) (Smith dan Smith 2006; Suheriyanto 2006). High dominance index shows low diversity.

Index of similarity of both the scrubland and Cibadak waterfall with open scrubland is 0.365. It means that similarity level of butterfly species in both sites were low (36.5%).

This similarity is affected by different habitats in one region, be it biotic or abiotic factor. From biotic factor, vegetation plays an important role. This is because different species of butterfly in the same genus could have different relationship with host plants. There are some butterflies that can lay their eggs in several kinds of plants, but there are also some butterflies that can only lay their eggs in a certain plant (Ariyanto 2005; Fitrayanti 2008). Abiotic factors suchas temperatures, elevation, humidity, also affect the kind of butterfly and hosts. The higher the place, the lower the temperature. It makes the diversity of vegetation in that area, as the feeding source for the butterflies, decreases. Thus, the diversity of the butterfly will also decrease.

This makes for different Community Similarity Levels.And in turn influences the Community Similarity Level. However, if the similarity of butterfly species is higher, the habitats will also be similar in both biotic factors (i.e. vegetations) and abiotic factors (i.e. air temperature, latitude, humidity and open space).

Measurement of the environment's physical data was taken during the observation. The result was as follows: in Cibadak waterfall, maximum air temperature was around 23^0Celcius and minimum air temperature was 13^0Celcius; Air humidity ranged from 61% to 100%; The latitude was measured at 997 mdpl. This shows that the condition of the environment in Cibadak waterfall can still promote the existence of butterflies. The area around the waterfall is filled with high vegetations of many kinds. This area also includes a small, empty field. The wall and the bed of the Cibadak waterfall are covered with big rocks. High cliffs line the area on the west and east side of the waterfall, obstructing sunlight from the base of the Cibadak waterfall during the morning and the afternoon. Therefore, butterflies are more often seen on the upper side of the cliffs where there is more sunlight. Sunlight can travel farther into the waterfall location just before noon. Air temperature rises and butterflies do more flight activity. Dark clouds and rain often occur in the afternoon, lowering the air temperature and increasing its humidity and turning the environment colder. Butterflies are mostly idle in this condition and do not do much activities, therefore less number of species are caught during this time in Cibadak waterfall than in the scrubland.

In the scrubland, the result of measurement of the environment's physical data was as follows: maximum air temperature was 33^0 Celcius and minimum air temperature was around 24^0 Celcius; Air humidity varied from 80% to 84%; The latitude was around 813 mdpl.

The environment's physical condition (i.e. its air temperature and humidity) proves that the open scrubland can highly promote the existence of butterflies. The scrubland is a vast open space that is exposed to more sunlight throughout the day than the Cibadak waterfall area. Odum (1976); Dendang (2009) wrote that butterflies like open space areas that are cold and clean from polutants like insecticides, smoke, foul smells, etc. If a high number of variety of butterflies can be found in an area, that means that area still have good environmental condition.

Air humidity in the open scrubland is lower than in the Cibadak waterfall area. The air temperature and humidity of an area is influenced by its latitude. Different locations in different latitudes means different air temperature and humidity and therefore will affect the diversity of the butterflies in the areas. This is because butterflies are cold blooded; they take on the surrounding temperature as their body temperature. Butterflies can only fly if their body tempearture is above 30^0 Celcius. When flying, a butterfly's body temperature is 5^0 to 10^0 Celcius above its surrounding's air temperature. (Dephut 2006; Fitriyanti 2008).

CONCLUSION

1. On the observation sites in Cibadak waterfall and open scrubland in Suaka Elang, we found 170 individual butterflies that consist of 40 different species and four families: Nymphalidae (22 types), Pieridae (eight types), Papilionidae (eight types) and Lycaenidae (two types).

2. Cibadak waterfall and open scrubland have different species diversity index, species evenness index and dominance index. Cibadak waterfall has a diversity index of H' = 2,39 (categorized of medium); evenness index of E = 0,862 (medium); richness index of of R = 3,875 (low); and dominance index of C = 0,12 (high). Meanwhile, the open scrubland has a diversity index of H' = 3.05 (high), evenness index of E = 0.865 (high), richness index of R = 6.869 (high) and dominance index of C = 0.071 (low).

3.Cibadak Waterfall open scrubland have Community Similarity index of CS = 0,365 or 36,5% of similar butterflies in two different observation sites.

RECOMMENDATIONS

1. It is suggested that a similar research be conducted on the dryseason and wet season in order to gain a more diverse data of the butterflies' diversity.

2. A research on the butterflies' favorite host plants should also be carried out in order to obtain the data of plants that become a source of food to the butterflies.
3. The Suaka Elang surroundings should be preserved to enable the butterflies to flourish and produce new species.
4. Endangered butterflies in Suaka Elang should be protected to save them from extinction.

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