The Richness and Diversity of Plant Pollinator (Ordo: Lepidoptera) in Cigeulis District, Banten, Indonesia

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Abstract. Most of order Lepidoptera is a plant pollinator, ecologically play a major role in maintaining the balancing of ecosystem and enriching biodiversity. This study aims to observe the richness and diversity of order Lepidoptera as plant pollinator in Cigeulis district, Banten, Indonesia. This study used a transect route method while data were analyzed by Shannon-Wiener index. The results recorded that 10 species with 114 individuals of three families found as different plant pollinator. The value of the highest species richness found in Banyuasih village is 2.2, while the lowest in Tarumanagara. Diversity analysis using Shanon-Wiener formula classified as moderate category.

1. Introduction

Butterflies are a part of biological wealth that must be conserved [1], ecologically contributes to maintaining the balance of ecosystems in nature [2], [3]. Butterflies act as pollinators in the process of flower pollination, thus helping natural plant propagation in an ecosystem [4]. The role of insect pollinators is very evident in cross-pollination which can increase agricultural and quality production, also the genetic quality of the offspring [5], [6].

Cigeulis district is one of the districts in Pandeglang regency, Banten province, Indonesia and consists of nine villages: Banyuasih, Cigeulis, Ciseureuheun, Karangbolong, Karyabuana, Katumbiri, Sinarjaya, Tarumanagara and Waringin Jaya [7]. Most of the Cigeulis district area is plantations and forests, specifically secondary forests and mixed forests [8]. Both of these serves as a refuge and foraging place for young and mature insects [9][10]. Land-use change, tree felling, and wild insect capture can affect the decline of butterfly species [11][12], especially those that play a role in the process of pollinating plants. Consequently, a research is required to analyze the richness and diversity of plant pollinator insects specially order lepidoptera as an effort to enforce Cigeulis environmental conditions that support insects during flowering and pollination, thus crop yields can be obtained optimally.
2. Methodology
Collecting data to determine the species richness used the transect method, by walking along the transect line and recording each individual of insect-infested plant [13]. Samples were identified and collected in the Laboratory of the Faculty of Mathematics and Natural Sciences, Universitas Mathla'ul Anwar and Puslitbang Biology LIPI Cibinong, West Java. Data was analyzed quantitatively by calculating diversity values using the Shanon-Winner index with the formula [14]:

\[ H' = -\sum pi \log pi \]

where:
- \( H' \) = species diversity index
- \( pi = \frac{ni}{N} \)
- \( pi \) = the proportion of species in the community
- \( ni \) = number of individuals of a species-i
- \( N \) = total number of individuals

3. Result and Discussion
3.1 Species composition of order Lepidoptera
The results of the research in Cigeulis district succeeded in obtaining information about Lepidoptera which acts as a plant pollinator. The butterfly consists of three families with 10 species, namely family Pieridae (3 species), family Papilionidae (2 species) and family Nymphalidae (5 species). The results showed that butterflies in Cigeulis district were dominated by family Pieridae with 89 individual. This amount is 62% of all families found, followed by the family Nymphalidae 25% and Papilionidae 13% (Figure 1).

![Figure 1. Percentage composition of three families order lepidoptera found in Cigeulis district](image)

Butterfly species from the family Pieridae consist of three species: *Eurema blanda*, *Appias olferna*, and *Leptosia nina*. *Eurema blanda* was found to dominate the number of individuals in this family as many as 56. Butterflies from this family have wings that are yellow, white or orange with a little black. Small-medium body size. The range of wings between 25-110 mm. Lepidoptera-infested plant for pollination process include family of Fabaceae, Melastomataceae, Malvaceae, Asteraceae, Polygonaceae, Solanaceae, Cucurbitaceae, and Rubiaceae. Most species of butterflies found are members of family Pieridae, inseparable from the availability of hostplant evenly distributed in nine villages, Cigeulis district. Pollen, nectar, resin, and oil on the hostplant flower become the food resource and as a shelter for the family Pieridae.

The butterfly recorded from the family Nymphalidae consists of five species: *Melanitis leda*, *Mycalesis janardana*, *Athyma reta*, *Neptis hylas* and *Mycalesis mineus*. *Mycalesis mineus* which plays a role as a plant pollinator was found as many as 21 individuals and is the highest among the four other species. The morphology characters of family Nymphalidae include varied wings of brown, yellow,
orange, and black; 2.5 to 15 cm; and the front limbs are shrinking (except for female Libytheinae). Lepidoptera-infested plant for pollination process include family of Melastomataceae, Myrataceae, Lamiaceae, Solanaceae, Malvaceae, Nyctaginaceae, Rutaceae, Cannaceae, Polygonaceae, Cucurbitaceae, Zingiberaceae, Rubiaceae, and Caricaceae.

*Papilio polytes* and *Papilio memnon* were butterfly found from the family Papilionidae. The number of *Papilio memnon* detected was 18 individuals, whereas *Papilio polytes* was only 1 individual. The unique morphological character of family Papilionidae include the long shape and pointed front wings resembling the tail of a wallet. The wing color patterns are very attractive such as red, yellow, green with a combination of black and white. Lepidoptera-infested plant for pollination process include Malvaceae, Poaceae, Lamiaceae, Polygonaceae, Solanaceae, Rosaceae, Rubiaceae, and Campanulaceae.

### 3.2 The richness of order Lepidoptera

The abundance and presence of butterflies depends on the type of plant used in the pollination process in their habitat [15]. Research in this Cigeulis district succeeded in observing 114 individual. The results showed that the value of the highest richness species found in Banyuasih village was 2.2 and the lowest was discovered in Tarumanagara village at 0.7 (Figure 2).

![Figure 2. Value of species richness of order Lepidoptera based on each location in Cigeulis district](image)

From the total 10 species, seven species found in Banyuasih Village include *Eurema bland*, *Papilio polytes*, *Papilio memnon*, *Appias olferna*, *Mycalesis janardana*, *Neptune hylas* and *Mycalesis mineus*. Banyuasih located on the southern of Pandeglang Regency, causes this location more difficult to reach by public transportation, thus that not many human activities are realized. The community generally works as farmers and fishermen. The land that is still widely utilized by the community for gardening and planting various types of plants. One of them is lime (*Citrus limon*) planted by people at their garden. People use lime as a complement to cooking ingredients. Lime flower has a powerful scent that can captivate lepidoptera to infest and pollinate into it. Floral scent also become important as smelling signal other than visual signal.

### 3.3 The diversity of order Lepidoptera

High species diversity shows that a community has a high complexity, interaction formed between species in the community [16][17]. The results of data analysis on the diversity of order Lepidoptera in Cigeulis district can be seen in Figure 3.
Figure 3. The species diversity of order Lepidoptera based on each location in Cigeulis district (CG: Cigeulis; BA: Banyuasih; CI: Ciseureuheun; KB: Karangbolong; KA: Karyabuana; KT: Katumbiri; SJ: Sinarjaya; TN: Tarumanagara; WJ: Waringin Jaya)

Diversity index of plant pollinator at eight locations in Cigeulis district shows a uniform type, categorized as moderate based on the Shanon-Winner index. Except for Tarumanagara village, which is in the low category. The plant pollinator community has not reached the climax community and stability, also still affected by environmental conditions. This one is influenced by soil type that generally latosol in nine locations. Some types of hostplant can grow on this soil, but other types do not. People who garden by adding natural fertilizer to the hostplant, cause the hostplant able to produce flowers which then pollinated by order lepidoptera. Whereas in Tarumanagara village, the area is located closest to the beach. People generally works as fishermen thus that vacant land gets less attention, affects the number of wild plants that grow with less attractive flowers for order lepidoptera.

4. Conclusion
Research of order Lepidoptera as plant pollinator in Cigeulis district obtained 10 species from three families consisting of family Pieridae (3 species), family Papilionidae (2 species) and family Nymphalidae (5 species). Family Pieridae has the most individual members and found in nine research locations. The value of the highest richness species found in Banyuasih village was 2.2 and the lowest was in Tarumanagara. Diversity analysis using Shanon-Wienner formula classified as moderate category.

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