

Potential insects as pollinators in Lumbok Seminung Biodiversity Park, West Lampung, Indonesia

Mohammad Kanedi^{a*}, Lili Chrisnawati^a, Mahfut^a, Dzul Fithria Mumtazah^a,

Yulia Rahma Syari^a

*wegayendi@yahoo.com

^aDepartment of Biology, Faculty of Mathematics and Sciences, University of Lampung, Bandar Lampung, Indonesia

Abstract

Lumbok Seminung Biodiversity Park is a biodiversity conservation area in Lumbok Seminung District, West Lampung Regency, Lampung Province of Indonesia established in 2015 in an area previously designated as a tourism resort. The purpose of establishing a biodiversity park is to provide reserve area, both in-situ and/or ex-situ, for local biological resources especially plants whose structure and composition can support the existence and sustainability of animal diversity. One group of animals that has an important role in the sustainability of flora biodiversity is pollinators, especially insects. This research conducted to find out the current biodiversity status of pollinating insects in the Lumbok Seminung Biodiversity Park after being established for more than five years. The sampling approach used is to find as many insect species as possible that are actually present in the study area. Sampling was carried out on sunny days between 07.00-16.00 by catching insects that visited and perched on flowers during anthesis. Measurement of the ecological diversity of the pollinators was determined by calculating the richness, abundance, dominance and diversity indices. There are 3 orders of flower-visiting insects found in this study, namely Lepidoptera, Hymenoptera and Diptera. Lepidoptera is the most diverse group, while bees (Hymenoptera) *Apis dorsata* are the most abundant pollinating insect species. Overall the diversity of pollinating insects in the park is classified as moderate. In conclusion, the Lumbok Seminung Biodiversity Park is supported by sufficient diversity of pollinating insects to maintain and sustain biodiversity.

Keywords: Biodiversity Park; Taman Kehati; Lumbok Seminung; Pollinating Insect; Pollinators.

1. Introduction

In 2009 the government of the Republic of Indonesia issued a national policy concerning environmental protection and management that mandates the need for efforts to maintain biodiversity as a capital for sustainable national development. This policy was then followed up by the relevant ministries by issuing guidelines for conservation of biodiversity at the regional level. One of the mandates set by the government through the Ministry of Environment is encouraging authorities at the regency and/or city levels to establish a Biodiversity Parks which is in Indonesia called Taman Keanekaragaman Hayati (Taman Kehati) [1].

In the perspective of legislation in Indonesia, a biodiversity park (Taman Kehati) is defined as a reserve area for local biological natural resources outside the forest area that has the function of in-situ and/or ex-situ conservation, especially for plants whose pollination and/or dispersal of seeds must be assisted by animals with the structure and composition of the vegetation able to support the preservation of pollinators and seed disperser animals [2]. Until 2021 throughout Indonesia at least 80 biodiversity parks have been established,

one of which is the Lumbok Seminung Biodiversity Park (Taman Kehati Lumbok Seminung) in Lumbok Village, Lumbok Seminung District, West Lampung Regency, Lampung Province [3].

As mentioned above, the ecological objective of establishing a biodiversity park is to conserve plants especially the native plants as well as to attract and preserve animals. The animals that are expected to exist and vary in the area of biodiversity conservation are pollinators. Pollinators are important because they determine the success of plant reproduction. One group of highly effective pollinating animals are insects [4,5].

The study which results are presented in this paper was conducted as an effort to find out the existing condition of pollinating insect diversity at the Lumbok Seminung Biodiversity Park after being established for more than 5 years.

2. Materials and Methods

2.1 Study area

Lumbok Seminung Biodiversity Park is located on the shores of a lake called Danau Ranau near a mountain called Gunung Seminung at an altitude of 560 to 780 m above sea level. Before designated as a conservation area in 2015, this 15 hectare park was designated by the authority of West Lampung Regency in as a tourist resort since 2009. As is usually the case in a tourist spot, this park is equipped with several tourist facilities such as parking lots, children's playgrounds, lodging and canteens. Meanwhile, the plants in this park are a mixture of various types of plants ranging from ornamental plants, horticulture, plantations, fruits, to trees. Sapodilla, duku, mangosteen, durian, mango, rambutan, avocado, jackfruit, coconut, cocoa, coffee, banana, papaya, cassava, taro and ginger are examples of plantation and horticultural crops planted on this park.

2.2 Sampling methods

The research was performed from September-October 2021 on sunny days between 07:00 and 16:00. Sampling technique applied in this study following Nageleisen and Bouget (2009) that intended to contact the maximum number of species of pollinating insects that are actually present at the whole studied area [6]. The pollinating insect criteria used in this study were insects that visited flowers during anthesis. The insects are caught using hand nets. The collected insects were recorded with photo and video cameras. After that, the insect specimens were preserved for identification. Order to family level of the insect was determined using the identification keys of Borror et al. (1981) [7]. While the determination of species was carried out using various references that have been widely published on credible websites including consult the insect experts.

2.3 Data analysis

Data analysis used in this study refers to the technique of ecological diversity measurement in Marguran (2004). The diversity of pollinators was evaluated by species richness, diversity, and dominance. The species richness is the total number of species collected and identified. The dominance was assessed using Simpson's index (D) and the diversity was assessed using Shannon-Wiener's index [8].

The Simpson index (D) for dominance is calculated using Formula 1:

$$D = \frac{\sum(n_i(n_i-1))}{N(N-1)} \dots\dots\dots 1$$

where:

ni, the number of individuals in the i-th species;
N = Total number of individuals

The Shannon-Wiener index (H') is calculated using Formula 2 bellows:

$$H' = -\sum pi \ln pi , \dots\dots\dots 2$$

where:

pi, the proportional of the i-th species = ni/N;
ni, the number of individuals in the i-th species;
N = Total number of individuals

3. Results and Discussion

There were 2213 specimens belongs to three orders of pollinating insects that were collected in this study. The details of number of individuals of each species of pollinating insects collected at Lumbok Seminung Biodiversity Park (LSBP) according to their families and orders are presented in Table 1.

Table 1 The type and number of individuals of pollinating insects collected from the LSBP

Order	Family	Species	No. Individuals
Lepidoptera	Nymphalidae	Junonia orithya	207
		Neptis hylas	201
		Hypolimnas missipus	192
		Hypolimnas bolina	173
		Acrae terpsicore	75
		Ypthima horsfieldii	55
	Pieridae	Leptosia nina	113
		Eurema hecabe	27
		Appias libythea	26
	Lycaenidae	Zizina otis	35
		Cheritra freja	24
	Papilionidae	Graphium agamemnon	97
Graphium doson		87	
Hymenoptera	Erebidae	Amata huebneri	27
	Apidae	Apis dorsata	259
		Apis cerana	232
		Xylocopa confusa	107

		<i>Amegilla cingulate</i>	10
	Vespidae	<i>Vespa affinis</i>	152
		<i>Polistes fuscata</i>	89
Diptera	Tephritidae	<i>Bactrocera dorsalis</i>	25
Total individuals			2213

The profile of ecological diversity of pollinating insects found in LSBP analyzed using indices of richness, abundance, dominance and diversity are presented in Table 2.

Table 2 Ecological diversity profile of pollinating insects at the LSBP

Indices	Overall	Lepidoptera	Hymenoptera	Diptera
Richness (# Species)	21	14	6	1
Abundance (# Individuals)	2213	1339	849	25
Dominance (D)	0,072	0,1066	0,4912	1
Simpson's index (1 - D)	0,928	0,8934	0,5088	0
Shannon-Wiener index (H')	2,77018	2,3865	1,5744	0

Based on the data in Table 1 and 2 above, at the order level, the most pollinating insects found in the LSBP are Lepidoptera. At the family level, the butterflies family that most common in the study area belong to Nymphalidae. However, based on the number of specimens collected, the most abundant pollinating insect species in the park is *Apis dorsata*, a member of the Apidae family of the order Hymenoptera.

The results of this study where butterflies are the most diverse of flower-visiting insects are reasonable. It has long been known that some families of butterflies, such as the Nymphalidae, all of their species depend on a liquid diet contained in flowers [9]. The results of other studies that are similar to the findings of this study also found that Nymphalidae, Pieridae, Lycaenidae, and Papilionidae are groups of butterflies that commonly visit flowers [10]. The dependence of pollinating butterflies on flowers is not solely on the liquid component of the flower, nectar, but also on the solid component in the form of flower pollen grains which are known to contain various kinds of amino acids [11].

The second largest group of flower-visiting insects found in the LSBP is Lepidoptera, where *Apis dorsata* (family Apidae) is the most abundant species. This finding also confirms the results of other studies which state that *A.dorsata* is a bee that is distributed in the tropical forests of southern Asia at an altitude of < 100 up to 2000 m above sea level [12]. Like butterflies, *A.dorsata* bees also have a high dependence on flowers because they need nectar and pollen [13].

The second most common bee species that was found in the biodiversity psrk studied was *Apis cerana*. These bees naturally abound here because they have similarities in terms of distribution, habitat, and behavior with *A.dorsata*. *Apis cerana* bees, as reported by Jasmi (2017), really like to visit flowers of cultivated plants such

as avocado (*Persea americana*), mango (*Mangifera* sp), coconut (*Cocos nucifera*), to banana (*Musa paradisiacal* L) [14].

For cultivated plants, the presence of pollinating insects has been known to greatly affect crop production. Honeybees of *Apis mellifera* is one among pollinating bees suggested sufficient to provide pollination services for crop productivity [15]. One of the fruit plants whose pollination supported by *Apis mellifera* bees is avocado (*Persea americana*) [16]. In mango plantations for another instance it was known that the role of pollinating bees, such as *Trigona* sp and *Apis* sp, is able to increase fruit formation up to 200 % [17]. Given at the LSBP, as previously described in the study area section, there are lots of cultivated plants grown, so that the high abundance of bees detected is in accordance with the plant diversity on it [18].

Apart from the differences in the index of ecological diversity among insect orders and families found, overall the diversity of pollinating insects in the LSBP is classified as moderate. This category is based on the value of the Shannon-Wiener index where $H'=2.77018$ as shown in Table 2. With such a high diversity of pollinating insects, there is positive hope that the goal of establishing LSBP as a biodiversity conservation area can be achieved.

4. Conclusion

There were 21 types of flower visiting insects identified in this study, in which butterflies are the most varied in types, whereas bees are the most abundant. Thus it can be concluded that the Lumbok Seminung Biodiversity Park is supported by sufficient diversity of pollinating insects to maintain and sustain biodiversity of the region.

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