Diversity of insect pollinator on farmland near to Mount Ciremai National Park

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Abstract. The purpose of this study was to determine the diversity and abundance of insect pollinator and to determine the correlation of insect pollinator to the distance between farmland and the conservation area of Mount Ciremai National Park (MCNP). The method used is scan sampling. Traps were installed sequentially at intervals of 100m, with 5 observation points (100 m, 200 m, 300 m, 400 m, and 500 m) with 3 replications. There are 573 individual insects found, with a value of $H' = 3.285$ (moderate diversity). There are 94 individuals ($relative abundance = 16.4\%$) were insect pollinator, consisting of 3 orders, 7 families, and 8 species. The pollinator species found were: Anopilus, Athyma perius, Campsomeris plumipes fossulana, Erynnis tages, Pison spinolae, Syrphus ribesii, Vanessa sp, and Xylocopa. The order of Hymenoptera was most found followed by the order of Lepidoptera and Diptera. The distance between farmland and the MCNP area has a positive correlation ($r = 0.592$) with the amount of pollinator, meaning that the amount of pollinator increases as the distance between farmland and the MCNP area increases. The distance between farmland and the MCNP area has a negative correlation ($r = -0.576$) with the amount of insect species, meaning that the distance the farmland to the MCNP area increasingly, more insect species are found.

1. Introduction

Insects are one of the ecosystem services that are very beneficial for human life and other living things. More than 90% of the 250,000 species of flowering plants the pollination process is assisted by insects [1]. As many as 75% of the 1300 types of plants pollinated by animals assisted [2]. According to Widhiono, the factors that influence the diversity and abundance of insect pollinator are: 1) fragmentation and loss of habitat, 2) intensification of agricultural land, and 3) global warming [3]. Land fragmentation can lead to the loss of insect pollinator habitat, because the vegetation that makes up its constituent changes, especially the reduction in flowering wild plants as a source of food for insect pollinator. Habitat manipulation or refugia can be carried out to increase the diversity of insect species.

Mustakim et al. showed that the refugia block combination Ageratum conyzoides and Capsicum frutescens had the same composition of insect pollinator with the refugia block combination Ageratum conyzoides, Ageratum hostionum, Commelina difussa, and Capsicum frutescens. This is different from refugia block with a combination of other wild plant species [4]. The 10% treatment of Borreria laevicalius increased the production of strawberries by 76.12% [5]. One of the ways of intensifying
agricultural land is the use of pesticides. In 1967, in the United States about 500,000 pollinator colonies were killed or damaged by pesticide use [6]. Karangsari is a village near Mount Ciremai National Park which is known as one of the vegetable producing areas in Kuningan Regency. Agricultural crops are scattered from in the yard, community forests, and farmland which are located far away or adjacent (directly adjacent) to the forest. Forest directly adjacent to farmland is dominated by pine vegetation. Landscape seems a clear fragmentation of land between monoculture farmland and pine forests.

Based on these conditions, there has been a threat to the diversity and abundance of insect pollinator. Land fragmentation and agricultural intensification in the research location may affect the diversity and abundance of insect pollinator. The objectives of this study are: 1) To determine the diversity of insects and the abundance of insect pollinator on farmland near the MCNP conservation area, 2) To determine the correlation between insect pollinator with distance farmland to the MCNP conservation area.

2. Methodology
The research was conducted in August-September 2020. The research location was in the community farmland of Karangsari Village, Darma District, Kuningan Regency.

![Figure 1. Map of the research location](image)

This research was conducted by using the scan sampling method. Traps are installed sequentially at intervals of 100 m with 5 of traps located at observation points (100 m, 200 m, 300 m, 400 m, and 500 m) on farmland. Each point is repeated 3 times in the observation path. The distance between the lines of observation is 100 m. Thus, in total there are 15 observation points. Traps used are: 1) light traps, installed throughout the night, observations are made at 5-6 pm, 2) insect nets (Sweep nets), observations are made in the morning 9-10 am, 3) traps fall (Pit fall trap), installed for 24 hours, observations made at 7-9 am., and 4) Yellow trap, installed for 24 hours, observations made at 7 am-5 pm. Insects found in all plots were identified at the Laboratory of the Faculty of Forestry, Kuningan University. The variables observed were the type, amount, and functional group of insects. The calculation of the diversity index using the Shannon-Wienner diversity index [7], as follows:

\[ H' = -\sum \frac{ni}{N} \ln \left( \frac{ni}{N} \right) \]

Where:
- \( H' \) = diversity index
- \( Pi = \frac{ni}{N} \) = comparison of the number of individuals of a species with all species
- \( ni \) = number of species caught
- \( N \) = total number of individuals of all types
- Values \( H' \leq 1 \) included in low category, \( H' = 1-3 \) medium category, and \( H' \geq 3 \) was a high diversity category. Data analysis was continued with Rank-Spearman correlation analysis using the SPSS software.
3. Result and Discussion

The insects found on farmland around the MCNP area were 573 individuals consisting of 11 orders, 40 families and 57 species. Eleven order were found, namely: Coleoptera, Dermaptera, Diptera, Hemiptera, Hymenoptera, Lepidoptera, Mantodea, Neuroptera, Odonata, Orthoptera, and Trichoptera. The most common orders are the Hymenoptera and Orthoptera, and the least orders are the Odonata and Trichoptera. As in previous studies, the Hymenoptera order is the most commonly found order of insect pollinator [8][9]. The diversity of insects is included in the high category with $H' = 3.285$.

Table 1. Diversity of insects on farmland near the MCNP area

| Distance from MCNP area (m) | H' | Number of individuals | Number of insect species | Number of insect pollinator |
|-----------------------------|----|-----------------------|--------------------------|-----------------------------|
| 100                         | 2.224 | 122                   | 23                       | 3                           |
| 100                         | 2.308 | 40                    | 16                       | 2                           |
| 100                         | 2.205 | 42                    | 14                       | 5                           |
| 200                         | 2.449 | 26                    | 14                       | 3                           |
| 200                         | 2.472 | 33                    | 16                       | 1                           |
| 200                         | 2.463 | 24                    | 14                       | 4                           |
| 300                         | 2.372 | 52                    | 17                       | 6                           |
| 300                         | 2.567 | 36                    | 17                       | 0                           |
| 300                         | 2.414 | 27                    | 13                       | 11                          |
| 400                         | 2.860 | 35                    | 21                       | 9                           |
| 400                         | 2.358 | 26                    | 13                       | 7                           |
| 400                         | 2.480 | 30                    | 14                       | 6                           |
| 500                         | 2.063 | 38                    | 13                       | 15                          |
| 500                         | 1.987 | 15                    | 9                        | 5                           |
| 500                         | 2.326 | 28                    | 12                       | 5                           |
| Total                       |      | 573                   | 94                       |                             |

There were 573 individual insects found, while 94 individuals (16.4%) were insect pollinator, consisting of 3 orders, 7 families, and 8 species. The insect pollinator species found were: Anopilus, Athyma perius, Campsomeris plumipes fossulana, Erynnis tages, Pison spinolae, Syrphus ribesii, Vanessa sp, and Xylocopa. The order of Hymenoptera was most found followed by the order of Lepidoptera and Diptera, respectively. The relative abundance of insect pollinator of 16.4% indicates the presence of relatively few insects. This can be caused by several things such as: abundance of feed, temperature, light intensity, humidity, and wind speed. At the time of the study the temperature ranged from 19-21 °C with a humidity of 88-90%. The weather changes every day from sunny, foggy, to rainy so that the light intensity is lower because it coincides with the transition from the dry season to the rainy season. This is in line with Hasan's research which shows a positive correlation between the number of insect pollinator species and light intensity. Meanwhile, air temperature did not correlate with the number of individual and species of insect pollinator [10].

Table 2. Insect pollinator on farmland around the MCNP area

| No  | Scientific name                  | Local name     | Order          | Family         |
|-----|----------------------------------|----------------|----------------|----------------|
| 1   | Anopilus                         | tawon laba laba| Hymenoptera    | Pompilidae     |
| 2   | Athyma perius                     | kupu kupu      | Lepidoptera    | Nymphalidae    |
| 3   | Campsomeris plumipes fossulana   | lebah           | Hymenoptera    | Scoliidae      |
| 4   | Erynnis tages                    | skiper          | Lepidoptera    | Hesperiidae    |
| 5   | Pison spinolae                   | tawon mason     | Hymenoptera    | Crabronidae    |
| 6   | Syrphus ribesii                  | lalat bunga     | Diptera        | Syrphidae      |
| 7   | Vanessa sp                       | kupu kupu      | Lepidoptera    | Nymphalidae    |
The main crops at observation location are: coffee, chilies, corn and cauliflower. Not all of these plant is flowering, because these commodities have different ages. At several observation points, the land was not planted and there were only weeds. Flowering wild plants found around the observation points were: Crassocephalum crepidiodes, Galinsoga parviflora, Ageratun conyzoides, Syndrella nodiflora, Bidens pilosa, Conyza sumatrensis, Cucurbits pepo, Lantana camara, Phytolacca icosandra, Commelina diffusa, and Mimosa pudica. The condition of agricultural crops that are not all flowering may cause the low number of insect pollinator found. Insect pollinator relies more on wild flowering plants to fulfill their feed. Apituley reported that the source of forage affects insect abundance and diversity [11]. The total abundance of pollinating insects was greater (31%) in the spring than in the fruiting season (25%) [12]. The more flowers, the higher the abundance of insect pollinator [13].

Pison spinolae or mason wasps are the most common insect pollinator. It’s belongs to the order Hymenoptera (the race of bees and wasps) which is the main order of insect pollinator. Pison spinolae was found at almost all points of observation with the number of individuals found to be relatively even between 3-10 individuals. This is because mason wasps are a type of solitary wasp, so that in their activities they do not cluster like honey bees. The results showed a trend of decreasing population and number of insect species when the distance between farmland and the MCNP area grew further. In contrast, the number of pollinator shows an increasing trend when farmland is further away from the MCNP area. The MCNP area can be said to be a natural habitat for insect pollinator.

The difference in the distance between natural habitat and agricultural land has an effect on the diversity of insect species of flower visitors, but does not affect their abundance. The proximity of natural habitats to agricultural land can increase the diversity and species richness of flower-visiting insects [14]. Other studies have shown that the highest diversity of insect pollinator is found in plantation forest habitat on Mount Slamet, and the lowest is on agricultural land [15].
The distance between farmland and the MCNP area has a positive correlation ($r=0.592$) with the number of pollinator, meaning that the number of pollinator increases as the distance between farmland and the MCNP area increases. The distance between farmland and the MCNP area has a negative correlation ($r=-0.576$) with the number of insect species, meaning that the closer the farmland is to the MCNP area, the more insect species are found.

Table 3. Correlation of distance with $H'$, population, number of species and number of insect pollinator

| Variable          | Distance | $H'$  | Population | Number of species | Insect pollinator |
|-------------------|----------|-------|------------|-------------------|-------------------|
| Distance          | 1.000    | -0.044| -0.415     | -0.576*           | 0.592*            |
| $H'$              | -0.044   | 1.000 | -0.148     | 0.457             | -0.153            |
| Population        | -0.415   | -0.148| 1.000      | 0.665**           | -0.102            |
| Number of species | -0.576*  | 0.457 | 0.665**    | 1.000             | -0.396            |
| Insect pollinator | 0.592*   | -0.153| -0.102     | -0.396            | 1.000             |

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

4. Conclusion
There are 573 individual insects found, with a value of $H'=3.285$ (high diversity). Total of 94 individuals (relative abundance = 16.4%) were insect pollinator, consisting of 3 orders, 7 families, and 8 species. The insect pollinator species found were: Anopilus, Athyma perius, Campsomeris plumipes fossulana, Erynnis tages, Pison spinolae, Syrphus ribesii, Vanessa sp, and Xylocopa. The distance between farmland and the MCNP area has a positive correlation ($r = 0.592$) with the number of pollinator, meaning that the number of pollinator increases as the distance between agricultural land and the MCNP area increases. The distance between farmland and the MCNP area has a negative correlation ($r = -0.576$) with the number of insect species, meaning that the closer the farmland is to the MCNP area, the more insect species are found.

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