



Analysis of Diversity and Abundance Soil Insects in Taman Gumi Banten, Forest of Wanagiri Village, Buleleng

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Abstract

The forest in Wanagiri Village about 1.055 ha, and almost 250 ha of that forest managed as “village forest”. Village forest is the forest that is used by villagers, and in addition to being a natural reservoir area and maintaining water availability. This research aims to explore diversity and abundance soil insects that play a role in maintaining soil fertility. Surface insects were collected using the pitfall trap method, while infauna or ground insects were collected using the core method. The site of this research consists of 8 plots each site with random purposive sampling. The results showed that macrofauna species were higher than infauna. The diversity Index of soil insects is in the low category (0.355987).

Keywords: *biodiversity; soil insects; taman gumi banten*

Abstrak

Hutan di Desa Wanagiri sekitar 1.055 ha, dan hampir 250 ha hutan itu dikelola sebagai “hutan desa”. Hutan desa adalah hutan yang dimanfaatkan oleh masyarakat desa, selain sebagai daerah reservoir alami dan menjaga ketersediaan air. Penelitian ini bertujuan untuk mengeksplorasi keanekaragaman dan kelimpahan serangga tanah yang berperan dalam menjaga kesuburan tanah. Pengumpulan serangga permukaan dilakukan dengan metode *pitfall trap*, sedangkan infauna atau serangga tanah dikumpulkan menggunakan metode *core*. Lokasi penelitian ini terdiri dari 8 plot setiap lokasi dengan *random purposive sampling*. Hasil penelitian menunjukkan bahwa spesies makrofauna lebih tinggi dari pada infauna. Indeks keanekaragaman serangga tanah termasuk dalam kategori rendah (0.355987).

Kata-kata kunci: *biodiversitas; serangga tanah; taman gumi banten*

Introduction

Wanagiri Village is one of the villages located on the southern side of Buleleng Regency, Bali. Wanagiri Village has a strategic role seen from an area of 15.75 km², topographically located at an altitude of 1,220 m above sea level [1], its location is directly adjacent to Buyan Lake and the landscape is mostly hilly with a fairly dense forest ground cover. so that Wanagiri Village has a role and potential for development as a tourism area, conservation of springs, forestry, and plantations.

The forest in Wanagiri Village has an area of 1,055 ha, of which 250 ha of forest is managed by the village as a tourism forest, where one of the areas is used for Banten plant tourism and as a place to support ceremonial facilities so it is called the Taman Gumi Banten Forest (Gumi Banten Park) [3]. The location of the Banten Gumi Park Forest is located on the eastern margin of the forest area of Wanagiri Village. The forest of Taman Gumi Banten has 68 useful plant species, with a density of 348 individuals/ha and the diversity index is classified as moderate [2]. Fertile and sustainable vegetation is also determined by the fauna present in the soil as decomposers of soil organic matter or decomposers [11-14].

The role of these decomposer insects is often forgotten in forest conservation studies, the existing research only focuses on studies on the diversity and distribution of forest vegetation, including the Wanagiri Village Forest. Studies on the diversity of soil insects in the Wanagiri Village Forest have never been carried out, even though if we want to manage what lives on the ground we cannot escape the knowledge of what organisms live in and on the soil surface, because interactions must occur. Therefore, this study was conducted to examine the diversity of soil insects and their abundance in the forest area of the eastern part of Wanagiri Village, namely the Taman Gumi Banten Gumi Forest.

Method

This research is an exploratory research, carried out to identify soil insects in the forest of Taman Gumi Banten, Wanagiri Village and measure the abundance of these insects and look for interactions or their role in the local ecosystem.

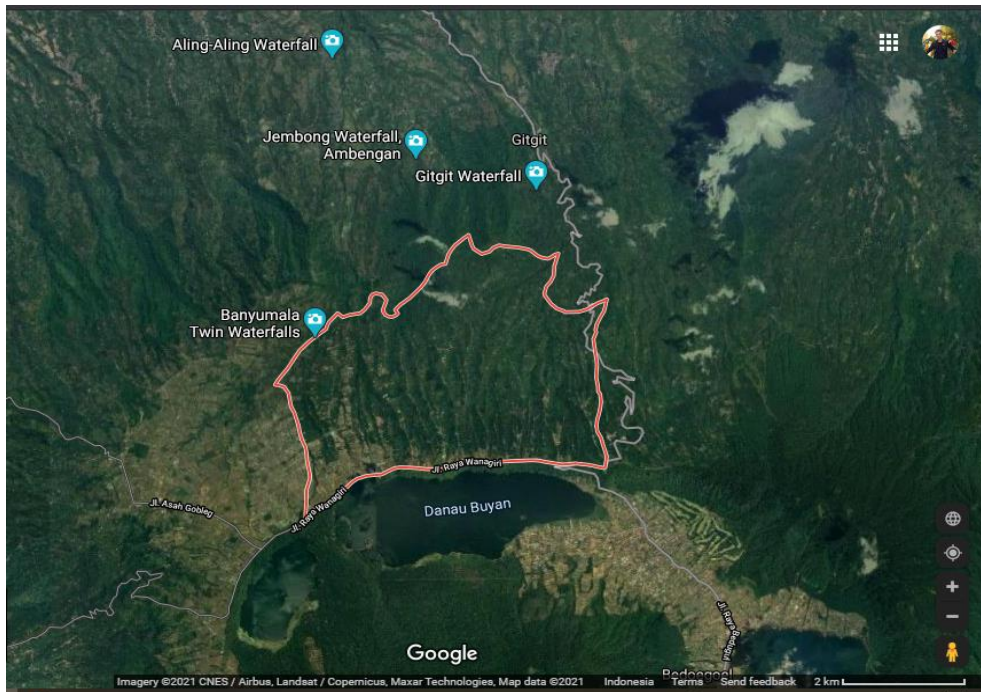


Figure 1. Forest Area of Wanagiri Village, Sukasada District, Buleleng, Bali.
(source: <http://maps.google.com/>)

1. Sample collection method

Insect sampling was divided into 2, ground insects and underground insects. Surface insects were collected using the pitfall trap method, while infauna or insects in the soil were collected using the core method. The sampling site is divided into 4 sites. Each site consists of 8 plots. The next step is to measure the temperature, pH, water content, and observe the texture and color of the soil.

2. Data analysis

The data analysis of this research includes:

- a. Identifying soil insects collected using identification keys Borror et al. (1996) [22], Soil Animal Ecology Book [15], and online databases.
- b. Determining the dominance index of a type of soil insect against its community.
- c. Determining the evenness index of soil insects
- d. Determining the index value of soil insect diversity using the Shannon and Wiener formulas.

$$H' = -\{n_i/N \ln n_i/N\}.$$

Result and Discussion

Result

The results of the study are presented in the following table.

Table 1. List of Insects collected at the surface area of the ground

Species	Site			
	1	2	3	4
<i>Componotus pennylvanicus</i>	1	1	0	0
<i>Stenomacra marginella</i>	0	6	0	0
<i>Monomorium minimum</i>	0	0	4	0
<i>Myrmica rubra</i>	1	0	0	0
<i>Harpocera thoracica</i>	0	6	0	0
<i>Odontomachus bauri</i>	1	0	0	0
<i>Orchesella cincta</i>	0	11	0	0
<i>Staphylinus erythropterus</i>	14	0	0	0
<i>Paederus littoralis</i>	3	1	0	0
<i>Acroleucus brevicollis</i>	0	1	0	0
<i>Blatta orientalis</i>	0	1	0	0
<i>Willowsia platani</i>	0	1	1	0
<i>Pison spinolae</i>	0	2	0	0
<i>Macrocentrus sp.</i>	9	0	0	0
<i>Periplaneta fuliginosa</i>	0	1	0	0
<i>Myrmeleon formicarius</i>	7	0	0	0
<i>Alobates pennsylvanica</i>	0	3	0	0
<i>Phloeodes diabolicus</i>	0	1	0	0
<i>Ochetellus</i>	0	2	0	0
<i>Culex pipiens</i>	1	0	0	0
<i>Chorthippus parallelus</i>	2	0	0	0
<i>Lygaeus kalmii</i>	0	1	0	0
<i>Polyrhachis dives</i>	7	0	0	0
<i>Boisea rubrolineata</i>	0	1	0	0
<i>Sphaeridium marginatum</i>	3	0	0	0
<i>Micromus tasmaniae</i>	0	1	0	0
<i>Glauningia macrocephala Ramme</i>	1	0	0	0
<i>Entomobrya atrocincta</i>	0	8	0	0
<i>Chelisoches morio</i>	1	0	0	0
<i>Spondylis buprestoides</i>	0	1	0	0
<i>Blatella germanica</i>	0	1	0	0
<i>Apis Andreniformis</i>	0	1	0	0
<i>Maritime Earwig</i>	0	1	0	0
<i>Lasius niger</i>	0	1	0	0
<i>Isotomurus plumosus</i>	0	1	0	0

<i>Forficula auricularia</i>	0	0	3	0
<i>Entomobrya schoetti</i>	0	1	0	0
<i>Allonemobius fasciatus</i>	0	0	1	0
<i>Entomobrya nigrocincta</i>	0	1	0	0
<i>Blister beetles</i>	0	0	1	0
<i>Rove Beetle</i>	0	0	3	0
<i>Cosmolestes sp.</i>	0	0	6	6
<i>Chondropygadorsalis</i>	0	0	1	0
<i>Vespa affinis</i>	0	0	1	0
<i>Velarifictorusmicado</i>	0	0	1	1
<i>Opiliones</i>	0	0	2	0
<i>Gryllus bimaculatus</i>	0	0	1	1
<i>Orius niger</i>	0	0	0	1
<i>Carabus coriaceus</i>	0	0	0	3
<i>Miris striatus</i>	0	0	0	1
<i>Nemobius sylvetris</i>	0	0	0	1
<i>Eumodicogryllus bordigalensis</i>	0	0	0	2
<i>Bactrocera tryoni</i>	0	0	0	1
<i>Sitophilus granarius</i>	0	0	0	1
<i>Stathmopoda auriferella</i>	0	0	0	1
<i>Antherenus verbasci</i>	0	0	0	1
<i>Asiotmethis limbatus</i>	0	0	0	1
Total Number of Individuals	51	56	25	21
Dominance index	0,50781	0,42857	0,5556	0,5
Evenness index	0,65467	0,346574	0,036652	0,69
Diversity index	1	0,5	0,4	0

Table 2. List of Insects collected in the soil

Species	Site			
	1	2	3	4
<i>Solenopsis invicta</i>	5	1	0	0
<i>Rugilus rufipes</i>	1	0	0	0
<i>Lepisma saccharina</i>	3	0	0	0
<i>Aphis gossypii</i>	1	1	0	0
<i>Pediculus sp.</i>	1	0	0	0
<i>Oecophylla smaragdina.</i>	2	0	0	0
<i>Solenopsis sp.</i>	3	0	0	0
<i>Camponotus snellingi</i>	0	1	0	0
<i>Ocypus olens</i>	0	2	0	0

<i>Tipulidae latreille</i>	0	1	0	0
<i>Pison spinolae</i>	0	1	0	0
<i>Allonemobius fasciatus</i>	0	1	0	0
<i>Rove Beetle</i>	0	3	0	0
<i>Paraponera clavata</i>	0	0	0	2
<i>Formicidae</i>	0	0	0	1
<i>Monomorium minimum</i>	0	0	0	2
Total Number of Individuals	13	11	0	5
Dominance index	4	0,44	0	0
Evenness index	0,39	0,28	0	0
Diversity index	0,64	0,48	0	0

Table 3. Soil Parameters

Parameter	Site			
	1	2	3	4
pH	5,5	4,1	5,1	4,1
Water content (%)	85	80	70	80
Temperature (°C)	24	24	24	24
Soil texture	Loose	Loose	Loose	Loose
Color	Dark brown	Dark brown	Dark brown	Dark brown

Discussion

From the data presented in Tables 1 and 2, it was found that the number of insects in the forest soil of Taman Gumi Banten was 57 types of insects on the ground with a total of 157 individuals, and 16 types of small insects in the soil as many as 26 individuals. The most common insects found were from the Order Coleoptera and then the Order Collembola. The types and numbers of individuals found at each site tend to be different, and each site has different types and numbers of soil insects. So from the data, it can be said that the population tends to clump. This insect distribution occurs due to the influence of the environment [24] and the character of the insect population [25].

The order Coleoptera from the family Staphylinidae was the most common soil insect found during this study. This group of these insects has an ecological role as predators of other smaller insects. During this research, the organic matter found in the soil was very abundant, seen from the number of leaf residues found in the forest area. Leaves are a source of organic matter used by caterpillars and other decomposers as a food source. This causes predation interactions that occur, namely the abundant food source of *Staphylinus*

erythropterus and as a result, this species is commonly found in the research area. Soil insects will migrate if there is a distribution or change in food sources, intraspecific competition, the presence of predators, and also environmental factors such as temperature and humidity [26].

In general, the diversity index of soil insects in the Taman Gumi Banten Forest can be said to be in the low category (average 0.355987). The diversity index 0.50 means the diversity is low, the diversity index value 0.50 to 0.75 means the diversity index is moderate, while 0.75 to close to 1 means the diversity index is high [23]. The results of the calculation of the diversity index value showed that macrofauna species that had a moderate diversity index value with a high dominance index value and infauna species had a low diversity index value and a high dominance index value. A community has high species diversity if the community is composed of many species, otherwise if the community is composed of very few species and only a few species are dominant, then the species diversity is low.

Diversity is identical to the stability of an ecosystem, if the diversity of an ecosystem is relatively high, the condition of the ecosystem tends to be stable [23]. Ecosystem environment that has diversity disturbance tends to be moderate, in the case of polluted ecosystem environment species diversity tends to be low. In the forest area of the Taman Gumi Banten as the research location, almost no process of forest destruction or pollution was found, this happened because the forest area was located at an altitude and far from the residential area of the villagers. However, the low diversity index occurs due to the limited duration of sampling in the forest and due to high rainfall so that the insect catches in the pitfall are not optimal.

Environmental factors or soil parameters can affect the number and abundance of species in a habitat. In this study, measurements of temperature, pH, moisture content, texture, and soil colour were carried out (table 3). The temperature of the 4 sites reaches 24°C. This temperature is the ideal temperature for insects found during sampling, so the presence of insects at each site is not affected by temperature. In pH parameters, each site is different. The pH levels at all sites have been averaged and the result is the average pH at all sites is 4.6. Soil pH is a limiting factor for organisms including insects. Soil pH can cause organisms to experience imperfect life or even die at a pH that is too acidic or too alkaline.

Because most of the pH levels in each plot are less than 7, the average pH is classified as acidic but there is a pH level that is close to 7 which means that the pH is neutral while the pH is 5 and below insects can still live, at that pH ants and grasshoppers are often found. However, infauna organisms are rarely found at pH 7 and below because these organisms live in the soil, which means that insects in the soil cannot live in acidic soil levels, so infauna organisms are rarely found. The cause of acidic soil pH at the research site is because the soil texture is like peat with a slightly acidic pH, this is because this soil contains very high organic matter originating from parts or plant remains that fall to the ground so that the activity of decomposition of organic matter is also high. where in the process is always accompanied by the loss of calcium elements in the soil.

In addition to these factors in the study area experiencing the rainy season, high rainfall can result in the decomposition of nutrients in the soil so that naturally the soil will become acidic. Moisture content includes humidity, on insects the effect of humidity is direct. Many types of insects have a narrow tolerance for humidity. If the environmental conditions are very high humidity can cause the death of insects or migrate to other places. Dry conditions sometimes also reduce certain species due to reduced population. Besides that, humidity also controls the activity of moving and eating. moisture content at all stations is 70%-85%. Soil Texture, based on the research location, it was found that the texture of the existing research sites was on average loose textured. The range is still in good condition because it is very suitable for the location of insect life. Soil colour, from the results of research found at the research site, it was found that the colour level of the soil was blackish brown, where in standardization it was found that this was still in the good category for insect life.

Conclusion

The number of soil insects in the Taman Gumi Banten Forest is as many as 57 types of insects on the ground with a total of 157 individuals, and 16 types of small insects in the soil with a total of 26 individuals. The order Coleoptera of the family Staphylinidae is the most common soil insect. The diversity Index of soil insects is in the low category (0.355987). Soil parameters indicate the abundance of organic content contained, so further research is needed to obtain more detailed soil insect diversity.

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