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The Diversity and Abundance of Termites (Order : Isoptera) at Altitude 200 M Asl Karst Area Southern Gombong, Kebumen Regency

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Abstract
Termites are social insects that have a very wide distribution. The termites in the forest ecosystem have many species and feeding habits, and their diversity and abundance determine the role of termites in the ecosystem. Termite is very important as a mediator for the decomposition process of the karst area ecosystem. Therefore, this study aimed to determine the diversity and abundance of termites in karst area at an altitude of 200 m asl Southern Gombong, Kebumen Regency. The study was conducted with a random sampling method and arranged as follows, in which 20 sub transect size of 5 m x 2 m as repetition and the termite found taken to vial bottle with alcohol 70% for identification. The data analysis using F test and continue with the LSD analysis. The study obtained three species of termites in the karst area, and there are *M. gilvus*, *M. inspiratus* and *S. javanicus*. The highest abundance of termites was obtained by *M. gilvus* with a percentage of 90% and mostly found in plot 1 with the percentages 30,4%.
Keywords: *abundance, altitude, karst area, survey methods, termites*

INTRODUCTION

Termites are dominant invertebrates in tropical soils and included in Isoptera order. Termite is very important as mediators of the decomposition process in terrestrial ecosystems. Termite nests are found mostly in damp places (soil and wood rot) and eating wood, litter, soil, yeast, and other cellulose (Amir, 2003). The diversity of termites is greatly influenced by environmental factors such as crown cover, altitude, air temperature, soil pH, light intensity, and air humidity (Choosai *et al*., 2009). One of the termite habitats is the karst area. The karst area is a well-developed porosity landscape with a specific condition and formed as a result of soluble rock development in the process of karstification. Karst has a unique environment because the soil has low nutrients, but it has high calcium and magnesium content (Suhendar *et al*., 2018). The vary of microclimate in the karst area may affect the diversity and abundance of organisms live in that habitat, include termites (Auslander *et al*., 2001).

According to Gathorne-Hardy *et al*. (2001), the altitude factor has a significant influence on the composition and abundance of individual species of termites in tropical forest ecosystems. The diversity and abundance of termites drop even with the increase of 100 m in altitudes. But according to Lomolino *et al*. (2006), the diversity and abundance of termite species reaching a peak at medium altitude. This phenomenon is decanal with the term ecotone effect. The ecotone effect occurs because the environmental conditions at medium altitudes reach optimal. However, Hemachandra (2011) stated that human disturbance factors also play a role in determining the high and low diversity of termites species.

Termites are insects with incomplete metamorphosis. Based on the colony, termites divided into three castes, such as reproductive castes, soldier castes, and worker castes. The feeding habits of these termite groups reflect the metabolic processes of termites in their ecosystems (Rao *et al*., 2012). According to Donovan (1999), there are four groups of feeding habits, namely: (1) Group 1 is the low level of termites eating the wood (low level) and grass. (2) Group 2 is a high level of termites eating the wood. (3) Group 3 is termite-eating humus. (4) Group 4 is termite-eating soil with low organic matter content.

The objectives of this research were:

1. To know the termite species diversity in a karst area at an altitude of 200 m asl South Gombong, Kebumen Regency.
2. To know the abundance of each species of termites in a karst area at an altitude of 200 m asl South Gombong, Kebumen Regency.

MATERIAL AND METHOD

The research was conducted in June 2019 until September 2019 and carried out in the homogeneous forest of a teak tree (*Tectona grandis*), Karst area of Southern Gombong, Kebumen Regency, and located at 200 m asl with position 7 ° 42'10,91 "LS and 109 ° 26'46,39" BT. Karst area structure in Southern Gombong has the Miocene limestone, which is hard, compact, and partially coated, including pure milk-white and pale yellow sunlike. Karst area in

Southern Gombong has a cockpit type, namely karst hills (form such as cone), dense and resembles a nest egg. The termite's identification carried out at the Entomology and Parasitology Laboratory of Jenderal Soedirman University.

The tools used in this research are vial bottles, raffia, spoons, small hoes, tweezers, plastic, scissors, camera, stopwatch, altimeter, thermo-hygrometers, soil tester, microscopes, labels, books, laptops, pens, petri dish, millimeters block, tissue, gloves, and meter. The materials used in this research are termite samples, soil samples, and 70% alcohol.

The location of altitude 200 m asl divided into three plots: plot 1 (Rowokele), plot 2 (Ayah), and plot 3 (Ayah). Every plot divided into 20 sub-transect with 2 m x 5 m in size as a repetition. The termite sampling is carried out for 1 hour by one person per sub-transect. Termite samples taken in each sub-transect included living trees, tree bark, parts of living trees, the remaining stalks, litter, and soil. The variables observed in this research were the diversity and abundance of termite species found in each sub-transect of Karst area Southern Gombong, Kebumen Regency. The observed parameters include environmental factors: altitude, humidity, temperature, light intensity, soil pH, and crown cover. The diversity and abundance of termites were calculated, and then being identified and collected into 70% alcohol. The identification book references used in this research are Tho (1992) & Ahmad (1959). The identification process carried out by observing the termites characters, including body size, mandible shape, head size, and antenna segment. The data analysis using F test analysis.

RESULT AND DISCUSSION

Karst area is a landscape with the escarpment, and there are many cavities, irregular and protruding limestone, rocky, groundwater system that are mutually sustainable, and forests with different soil surface textures and compositions at each altitude (Suhendar *et al*., 2017). This study showed the diversity and abundance of termites and different plants in each plot at an altitude of 200 m asl. Based on the termite sampling, plot 1 (Rowokele) showed the diversity of heterogeneous vegetation of plants such as teak (*Tectona grandis*), pine (*Pinus merkusii*), dammar (*Agathis damara*), coconut (*Cocos nucifera*), melinjo (*Gnetum gnemon*), and low-level plants. Plot 2 (Ayah) showed the domination homogeneous vegetation teak tree (*Tectona grandis*), cassava (*Manihot esculenta*), and other low-level plants. Plot 3 (Ayah) dominated by homogeneous vegetation of teak tree (*Tectona grandis*), melinjo tree (*Gnetum gnemon*) and other low-level plants.

Based on the results of termite sampling at an altitude of 200 m above sea level in plot 1 (Rowokele), plot 2 (Ayah), and plot 3 (Ayah) karst area range 100 - 200 m asl, showed that there are three species of termites, namely: *Microtermes inspiratus* (Figure 1), *Macrotermes gilvus* (Figure 2), and *Schedorhinotermes javanicus* (Figure 3).

Figure 1. *Macrotermes gilvus* (Magnification 400 x)

Figure 2. *Microtermes inspiratus* Kemner (Magnification 400 x)

Figure 3. *Schedorhinotermes javanicus* (Magnification 400 x)

Macrotermes gilvus has a brownish yellow color, with a curved mandible shape, crescent-shaped and looks crossed inside, has an oval-shaped head and is darker in color than its body, antenna consists of 16 segments, has an overall body length of 7 mm, head length 2 mm, and abdomen length 3 mm. This species found in the karst region of plots 1, 2 and 3, especially under the deadwood. Taxonomically, this species classified into the family Termitidae (wood eaters) or included group II feeding habits species. *Macrotermes gilvus* termites have two sizes of soldiers are major and minor. Major warrior size larger than a minor warrior. *M. gilvus* can be found in teak trees, remnants of deadwood, tree litter, former plantations, and settlements (Donovan *et al*., 2001).

Microtermes inspiratus are bright yellow color to brownish, with an elongated mandible shape, crescent-shaped and cross-shaped, have an oval-shaped head, 13 antennas, have an overall body length of 4 mm with a head length of 1 mm, and abdominal length 0,5 mm. This termite species was found in the karst area in plots 1,2 and 3. Caste soldiers have a pair of mandibular anterior caput

apparent that resembles a sickle. Soil termites of *M. inspiratus* require high humidity. The optimum development of termites is achieved in the humidity range of 80-90% (Evans *et al*., 2013). Taxonomically, this species classified into family Termitidae (wood eaters) or included group II feeding habits species. *M. inspiratus* is found in the remnants of deadwood, tree litter, and in areas of land that are overgrown by timber trees (Donovan *et al*., 2001).

Schedorhinotermes javanicus has a yellow color transparent, the shape of the mandible elongated, sickle-shaped and look cross, having heads are round oval, 14 segments antenna, has a body length overall average of 6 mm to the length of the head 2 mm, and abdominal length 1.5 mm. These termite species are found in the karst area of plots 2 and 3. Taxonomically, this species classified into the family Rhinotermitidae (low-level wood eaters) or included the group I feeding habits species. This species was found in plots 2 and 3 coincide with *M. gilvus*. *S. javanicus* is often found in teak, deadwood, and litter trees (Donovan *et al*., 2001).

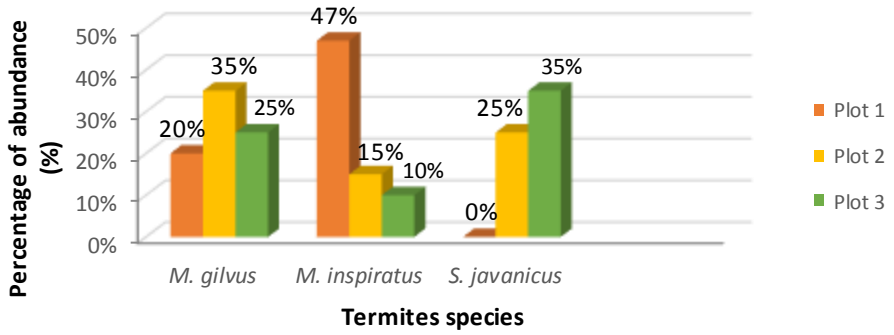

Figure 4. The percentage of termites abundance in each plot.

Based on Figure 4, the percentage of termites abundance found in the three plots karst area showed that *M. gilvus* species mostly found in plot 2 with a percentage of 35%, while the plots 1 is 30% and plot 3 is 25%. The species of *M. inspiratus* was mostly found in plot 1 with a percentage of 47%, while plot 2 is 15% and plot 3 is 10%. *S. javanicus* was mostly found in plot 3 with a percentage of 35%, while plot 1 is 0% and plot 2 is 25%. Based on Figure 4, plot 1 have the highest abundance of termite than the other plots. The highest abundance of termites species is showed by *M. gilvus*. The vary of termites abundance caused by the different environmental vegetation and condition in each plot, and also influenced by the feeding habits of termite species.

Table 1. The average of environmental factors in Karst Area of Souther Gombong.

No	Environmental Factor	Plot 1 (R)	Plot 2 (A)	Plot 3 (A)
1.	Temperature	27,1-32 ºC	28,8-31 ºC	28,8-31 ºC
2.	Humidity	53%	63%	63%
3.	Light intensity	3466 cd	5111 cd	5111 cd
4.	Soil pH	7	6,9	6,9
5.	Crown cover	85%	75%	75%

Based on the results of measurements environmental factors (Table 1), the optimum temperature for termites is between 15 - 38ºC, but the preferred temperature range for termites is 21.1 - 26.6ºC (Gathorne-Hardy *et al*., 2001). The activity and development of termites are greatly influenced by environmental factors such as temperature and humidity. Soil termites such as *Coptotermes*, *Macrotermes*, and *Odontermes* require high humidity (75-90%). Rainfall has a role in external breeding and stimulates the release of reproductive caste termites out of the soil (Nandika *et al*., 2003). According to Pomeroy (1978), there is a real correlation between environmental temperatures with the two genera of the family Termitidae, where the genus *Macrotermes* is more dominant at higher temperatures. Korb & Linsenmair (1998) stated that termites need to maintain and find a suitable temperature for the optimal growth of fungal feed and the development of offspring. Soil pH in plots 2 and 3 (Ayah) is 6.9, lower than plot 1 (Rowokele) pH 6.8. Based on the classification of acidity, according to the USDA, the pH is relatively close to neutral pH (Riyanto, 2010). Besides, the three plots have a different crown cover. The vegetation in plot 1 is heterogeneous, while in plots 2 and 3 is homogeneous vegetation (Aini, 2005).

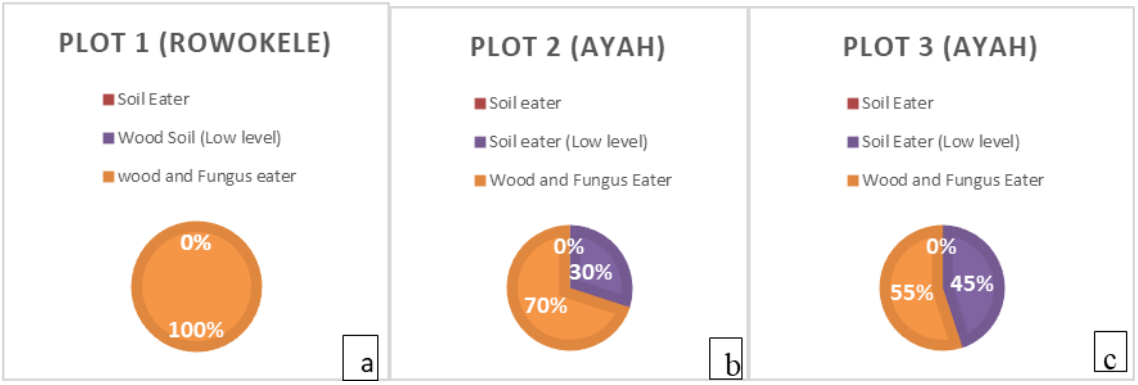

Figure 1. Termite's group percentage based on feeding habits : (a) plot 1, (b) plot 2, (c) plot 3

According to Donovan *et al.* (2001), termites show different ecological responses according to their feeding habits, for example, respect for habitat disturbance and naturally caused by human succession. Based on Figure 5, the wood-eater and fungus groups are *Macrotermes gilvus* and *Microtermes inspiratus*. The two species are live wood eaters, dead wood, soil, and litter, so *M. gilvus* and *M. inspiratus* are categorized as group II because they included the Termitidae family. While for wood eaters (low level) is *S. javanicus* because this species eats pure wood and categorized as a member of a group I and classified into the Rhinotermitidae family. According to Faszly *et al.* (2005), the Termitidae family is a high-level termite species. The majority of members of the Termitidae family can be distinguished from the type of food. This family eats wood, grass, and includes moss. However, not all members of the Termitidae family are members of Group II feeding habits. One of them is a genus *Pericapritermes*. This genus is a member of group III feeding habits species. Termite members of the Termitidae family also soil eaters with high organic content while the Rhinotermitidae family is a low-level termite species. Genus *Schedorhinotermes*, it is distinguished from food type, this genus feeds on non-fungus low-level wood and includes to the group I feeding habits.

CONCLUSION

Based on the results and discussion, this research can be concluded are the termite species was found in the karst area Southern Gombong are three species, namely *M.gilvus*, *M. insperatus* and *S. javanicus* . The abundance of termite species was obtained plot 1 is highest than other plots with percentages are plot 1 is 30,4 %, plot 2 is 25,4 % and plot 3 is 18,04 %. Between locations (plots), there is the abundance of termites are not significantly different.

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