



Research Paper

Community Structure of Terrestrial Gastropods Based on Elevation in the Kabawetan Tea Plantation, Bengkulu, Indonesia

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Abstract

Terrestrial gastropods are a group of soil biota that function as herbivores, detritivores, and predators, with their presence contributing to the balance of soil ecosystems, including agroecosystems. This study aims to analyze the community structure of terrestrial gastropods based on elevation at the Kabawetan Tea Plantation, Kepahiang Regency, Bengkulu Province. Observation stations were determined using the stratified sampling method, consisting of locations at elevations of 800, 900, and 1000 meters above sea level (m asl). Sample collection was conducted using the horizontal line transect method along a 100-meter transect at each research location, with 20 plots of 50 cm × 50 cm along each transect, spaced 5 m apart. The species of terrestrial gastropods in the Kabawetan Tea Plantation comprised four species belonging to four families: Achatinidae (*Achatina fulica*), Subulinidae (*Allopeas gracile*), Camaenidae (*Bradybaena sp.*), and Ariophantidae (*Parmarion martensi*). Based on elevation, different species of terrestrial gastropods were found; at elevations of 800 and 900 m asl, two common species were identified, namely *Achatina fulica* and *Bradybaena sp.*, while at 1000 m asl, three species were found, namely: *Allopeas gracile*, *Bradybaena sp.*, and *Parmarion martensi*. The highest density of terrestrial gastropods was recorded at 1000 m asl. The species *Bradybaena sp.* consistently exhibited the highest abundance across all three research locations. The diversity of terrestrial gastropods at the three elevation strata in the Kabawetan Tea Plantation was classified as low ($H' < 1$), and their distribution followed a cluster pattern.

Keywords

Abundance, Altitude, Gastropods, Tea plantation, Terrestrial

1. INTRODUCTION

Terrestrial gastropods belong to the phylum Mollusca are a group of soil macrofauna commonly found in moist soils with pH levels ranging from slightly acidic to alkaline. Taxonomically, terrestrial gastropods are classified under the order Pulmonata, which is divided into three suborders, namely: Basommatophora, Stylommatophora, and Systelommatophora. Stylommatophora is the largest and most diverse suborder. This order includes various families, such as Helicidae (a family that includes garden snails), Achatinidae (which includes large species like *Achatina fulica*, or the giant African snail), and Bulimulidae (Marwoto et al., 2020; Bouchet et al., 2017). Most terrestrial gastropods prefer moist litter habitats, ranging from larger species like *Elaphroconcha spp.* and *Cyclophorus spp.*, to the smallest, such as *Carychium javanum*. Slugs, such as *Filicaulis bleekeri* and *Parmarion pupillaris*, also thrive in litter habitats (Marwoto et al., 2020).

Terrestrial gastropods play a role in maintaining the balance of soil ecosystems, including agroecosystems. Their

presence in a habitat can also serve as a bioindicator of environmental changes (Douglas et al., 2013). Terrestrial gastropods function as herbivores, detritivores (feeders on dead organic material), and predators (feeding on other animals such as Enchytraeidae worms). As herbivores, they can act as potential agricultural pests, feeding on leaves, tubers, and plant roots, as seen in species like *Achatina fulica* (Raut and Barker, 2002; Silva et al., 2022). As detritivores, gastropods consume dead organic material, contributing to nutrient cycling, particularly by aiding the humification process in the soil. As predators, gastropods help regulate the population of their prey, thus playing a role in ecosystem balance. Furthermore, the movement of terrestrial gastropods, which secretes mucous, contributes to improving soil structure by aiding the aggregation of soil particles. Terrestrial gastropods typically live in the surface layers of the soil or within the leaf litter. They can inhabit various terrestrial environments, including secondary forests, fields, and plantations (Heryanto, 2013).

The diversity and abundance of terrestrial gastropods

are influenced by various environmental factors such as humidity, temperature, soil pH, food availability, and habitat structure. High soil moisture supports gastropod activity, as they rely on humidity for respiration and movement, while extreme temperatures can limit their distribution within a habitat. Soil pH also plays a critical role, as gastropods generally prefer neutral to slightly alkaline soils for the growth of their shells. Additionally, the presence of organic matter as a food source and habitat structures that provide shelter from predators and extreme environmental conditions greatly impact terrestrial gastropod populations ((Bros et al., 2016; El-Raheem et al., 2023))

Research on terrestrial gastropods in Indonesia has made significant contributions to understanding the biodiversity and ecology of soil fauna in tropical regions. Previous studies include Heryanto (2013), who investigated the diversity and density of terrestrial gastropods in the Bogorejo Plantation, Gedongtataan District, Pesawaran Regency, Lampung Province. Garmellia et al. (2017) conducted research on the diversity of terrestrial mollusks along the Selo hiking trail in Mount Merbabu National Park, Boyolali Regency, Central Java. Nurinsiyah et al. (2016) studied terrestrial gastropods by examining the impact of different land-use types and environmental factors on native and introduced species of terrestrial gastropods in East Java. In a subsequent study, Nurinsiyah et al. (2019) researched the diversity and ecology of terrestrial gastropods in tropical mountains within Mount Halimun Salak National Park, Java.

Research on gastropods in tea plantations is still very limited, particularly with respect to elevation variations. In this regard, it is necessary to conduct a study on the abundance and distribution of terrestrial gastropods in the Kabawetan Tea Plantation, Bengkulu, at elevations of 800 m, 900 m, and 1000 m above sea level. This research is crucial for understanding the relationship between biodiversity and environmental factors within agroecosystems. Different elevations affect temperature and humidity, which in turn impact the community structure of terrestrial gastropods. The aim of this study is to analyze the diversity, similarity, abundance, and distribution patterns of terrestrial gastropods based on elevation in the Kabawetan Tea Plantation, Kepahiang Regency, Bengkulu Province. The findings of this research are expected to contribute to the sustainable management of tea plantations, as gastropods can serve as bioindicators of soil health, which directly influences plant productivity.

2. EXPERIMENTAL SECTION

2.1 Research Location

This research was conducted from June to December 2019 at the Kabawetan Tea Plantation, Kepahiang Regency, Bengkulu Province. The research sites consisted of three locations: station 1 at an altitude of 800 m, station 2 at an altitude of 900 m, and station 3 at an altitude of 1000 m above sea level

(Fig.1).

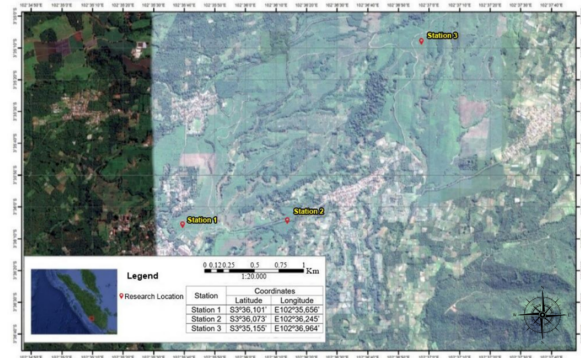


Figure 1. The research location map (Google Earth 2019) at the Kabawetan Tea Plantation, Bengkulu

2.2 Material and Methods

The determination of sampling points for terrestrial gastropods was conducted using stratified sampling, based on elevation, which consisted of three altitude strata (800, 900, and 1000 m asl). Sampling was carried out using a horizontal line transect method, with a transect length of 100 m at each research location. Along each transect, 20 plots measuring 50 cm × 50 cm were established, with a distance of 5 m between plots. In each plot, leaf litter was collected by hand, placed in plastic bags, and sprayed with 4% formalin to both kill and preserve the collected gastropods. Gastropod sampling was conducted in the morning between 8 : 00 and 10 : 00 AM. The gastropod specimens collected were all live specimens. All samples collected were then taken to the laboratory to be sorted, preserved, and identified. Morphological identification of terrestrial gastropod was based Quigley and Madge. (1988), Vermeulen and Whitten (1998), Mujiono (2019) and Sysoev and Schileyko (2009).

During the research, several abiotic factors were measured as supporting data, including light intensity, soil organic content, soil moisture, soil pH, and soil temperature. Light intensity was measured using a lux meter, soil pH with a soil tester, and soil temperature with a soil thermometer. Soil moisture content and organic matter content were measured using the gravimetric method.

2.3 Data Analysis

The terrestrial gastropods obtained from the research locations were analyzed quantitatively. Several parameters were analyzed, including density, relative density, similarity index, and diversity index (Soegianto, 1994; Wallwork, 1976).

a. Density (D)

$$\text{Density} = \frac{ni}{A}$$

- K = Density of a species (individuals/m²)
 - ni = Total number of individuals of species i (individuals)
 - A = Number of plots
- b. Relative Density (RD)

$$\text{Relative Density} = \frac{ni}{\sum n} \times 100\%$$

- RD = Relative density of a species (%)
- ni = Number of individuals of species i
- $\sum n$ = Total number of individuals of all species

c. Indeks Similaritas Sorensen (Q/S)

$$Q/S = \frac{2j}{(a + b)} \times 100\%$$

- j = Number of identical species at both locations
- a = Number of species at location A
- b = Number of species at location B

d. Shannon Diversity Index (H'), Shannon Evenness Index (J), and Simpson's Dominance Index (D)

$$H' = - \sum_{i=1}^s (P_i \ln P_i) \quad J' = \frac{H'}{H'_{max}} \quad D = \sum_{i=1}^s \left[\frac{n_i}{N} \right]^2$$

- P_i = n_i/N
- H'_{max} = Log s
- s = Number of species in the community
- n_i = Number of individuals of a species in the community
- N = Total number of individuals of all species in the community

e. Morisita Index (Id)

The analysis of distribution patterns in this study utilizes the standardized Morisita Index, referring to Jongjitvimol et al. (2005):

$$Id = n \frac{\sum x^2 - \sum x}{(\sum x)^2 - \sum x}$$

- Id = Morisita index
- n = number of sampling plots
- x_i = the number of individuals found in each plot.

The calculation of the Morisita Index values also considers the Mu and Mc indices, using the following formula:

$$Mu = \frac{(\chi_{0.975}^2 - n + \sum x_i)}{(\sum x_i) - 1} \quad Mc = \frac{(\chi_{0.025}^2 - n + \sum x_i)}{(\sum x_i) - 1}$$

- Mu = Morisita Index for uniform patterns
- Mc = Morisita index for clustering patterns
- $\chi_{0.975}^2$ = The chi-square table value at a 97.5% confidence interval and df = n - 1
- $\chi_{0.025}^2$ = The chi-square table value at a 2.5% confidence interval and df = n - 1

Morisita degree standards are calculated by the formula:

$$Ip = 0.5 + 0.5 \left(\frac{Id - Mc}{n - Mc} \right) \text{ if } Id \geq Mc \geq 1$$

$$Ip = 0.5 + \left(\frac{Id - 1}{Mc - 1} \right) \text{ if } Mc \geq Id \geq 1$$

$$Ip = -0.5 + 0.5 \left(\frac{Id - 1}{Mu - 1} \right) \text{ if } 1 \geq Id \geq Mu$$

$$Ip = -0.5 + 0.5 \left(\frac{Id - Mu}{Mu} \right) \text{ if } 1 \geq Mu \geq Id$$

- Note: $Ip < 0$: uniform distribution
- $Ip = 0$: random distribution
- $Ip > 0$: cluster distribution

3. RESULT AND DISCUSSION

3.1 Species of Terrestrial Gastropods in the Kabawetan Tea Plantation, Bengkulu

The species of terrestrial gastropods found in the Kabawetan Tea Plantation, Bengkulu, consist of four species belonging to four families: Achatinidae (*Achatina fulica*), Subulinidae (*Allopeas gracile*), Camaenidae (*Bradybaena sp.*), and Ariophantidae (*Parmarion martensi*), as shown in Table 1 and Fig. 2. These four species of terrestrial gastropods found in the Kabawetan Tea Plantation are also commonly found in various habitats, such as agricultural and plantation lands in Java, and are considered invasive terrestrial gastropod species (Nurinsiyah et al., 2016; Marwoto et al., 2020; Nurinsiyah, 2021).

The number of terrestrial gastropod species found in this study (tea plantation) is lower (4 species) compared to previous research. Heryanto (2013) studied terrestrial gastropods in smallholder rubber, cocoa, and oil palm plantations, finding 10 to 20 species. The low number of gastropod species found in this study is closely related to the monoculture condition of the land and the effects of land intensification, such as regular pruning, pesticide use, and consistent weeding in tea plantations, which limit the diversity of gastropod species able to adapt to that habitat. Additionally, Belhiouani et al. (2019) also reported 3 to 10 species of terrestrial gastropods from lowland to highland areas in Algeria, with varying levels of anthropogenic influence. The diversity of terrestrial gastropod species is higher in mountainous areas (993 m above sea level) that are far from anthropogenic influence compared to lowland areas with strong anthropogenic impact.

Based on elevation in the Kabawetan Tea Plantation area, a variety of terrestrial gastropod species were identified. At elevations of 800 and 900 m asl, two common species were found, namely: *A. fulica* and *Bradybaena sp.*, with a similarity index value of 100%. At an elevation of 1000 m asl, three species were found: *A. gracile*, *Bradybaena sp.*, and *P. martensi*. The similarity index between the terrestrial gastropod species at the 800 m and 900 m locations and the 1000 m location was 40%, indicating that only 40% of the species were the same at these sites (Table 2). The high similarity between the 800 m and 900 m locations is

Table 1. Species Richness of Terrestrial Gastropods in The Kabawetan Tea Plantation, Bengkulu

Species of terrestrial gastropods	Family	Altitude of Location		
		800 m	900 m	1000 m
<i>A. fulica</i>	Achatinidae	✓	✓	-
<i>A. gracile</i>	Subulinidae	-	-	✓
<i>Bradybaena sp</i>	Camaenidae	✓	✓	✓
<i>P. martensi</i>	Ariophantidae	-	-	✓
	Total	2	2	3

Note :

✓ = Present; - = not present

Table 2. Similarity index (%) of terrestrial gastropods in the Kabawetan Tea Pantation, Bengkulu

Altitude of Location	800 m	900 m	1000 m
800 m	-	-	-
900 m	100	-	-
1000 mg	40	40	-

likely related to the relatively similar abiotic conditions at both sites, particularly soil temperature, soil pH, and light intensity. Conversely, the similarity of terrestrial gastropod species between the 800 m and 900 m locations is much lower with the 1000 m asl location, as the abiotic conditions are notably different; soil temperature, humidity, and light intensity tend to be lower at the 1000 m asl site. Generally, terrestrial gastropods prefer moist and cool soil conditions, as observed at the 1000 m asl location, which shows lower soil temperatures and light intensity (Table 3). Nurinsiyah et al. (2019) also stated that the community composition of terrestrial gastropods correlates with temperature, pH, and the availability of organic material or dead wood in the soil.

The gastropod species found exclusively at an elevation of 1000 m asl are *A. gracile* and *P. martensi*, which were not found at the 800 m and 900 m asl locations. Nurinsiyah and Hausdorf (2020) stated that these two gastropod species are often found in habitats at elevations above 800 m, as they prefer moist and cool conditions. *A. gracile* and *P. martensi* are only found at 1000 m asl because they possess ecological adaptations that are more suited to the environmental conditions at this elevation, such as cooler temperatures and higher humidity (Nunes and Santos, 2012; Capinera, 2017; Nurinsiyah and Hausdorf, 2020). These factors support their survival and reproduction, which may be less optimal at elevations of 800-900 m asl. Additionally, the more limited distribution of *P. martensi* is also related to the spread of invasive species that tend to occupy habitats with specific microclimates (Hollingsworth et al., 2007).



Figure 2. Species of terrestrial gastropods in the Kabawetan Tea Plantation, Bengkulu

Table 3. Abiotic factors in the Kabawetan Tea Plantation Bengkulu.

Abiotic factor	Abiotic factor value ($\bar{x} \pm SD$)		
	800 m	900 m	1000 m
Soil temperature (°C)	26.00 ± 1.63	26.50 ± 1.73	24.25 ± 0.96
Soil pH	5.88 ± 0.39	5.40 ± 0.69	5.05 ± 0.76
Soil moisture (%)	47.04 ± 5.55	45.72 ± 5.31	48.78 ± 4.82
Soil organic matter (%)	45.90 ± 3.28	43.80 ± 3.87	47.95 ± 3.99
Light intensity (lux)	1625.5 ± 110.40	1554.00 ± 6.14	1016.50 ± 7.73

3.2 Density and Relative Density of Terrestrial Gastropods in the Kabawetan Tea Plantation, Bengkulu

The abundance of terrestrial gastropods in the tea plantation varied across the three locations. At the highest location of 1000 m, the abundance was 4 individuals/m², followed by 800 m with 3.4 individuals/m² and 900 m asl with 2 individuals/m² (Table 3). At altitude of 1000 m asl, not only was there a greater variety of terrestrial gastropod species, but the density was also higher compared to the 800 and 900 m asl locations (Tables 1 and 2). The 1000 m asl location had lower soil temperature and light intensity, along with higher soil moisture compared to the 800 m and 900 m asl locations.

The high abundance of terrestrial gastropods in the tea plantation at an altitude of 1000 m compared to the 800 m and 900 m elevations is due to environmental conditions that are more suitable for their survival. At 1000 m, the soil temperature and light intensity are lower, and soil moisture is higher compared to the 800 m and 900 m locations, as shown in Table 3. The higher moisture is crucial for terrestrial gastropods, as they depend on a humid environment to prevent dehydration, maintain metabolic activity,

and enhance mobility (Nunes and Santos, 2012; Dos Santos et al., 2021; Zaidi et al., 2021). Additionally, at an altitude of 1000 m asl, the lower sunlight intensity caused by more frequent clouds or fog creates a cooler and shadier microenvironment, which is highly favored by gastropods. The availability of organic material as a food source, such as leaf litter from tea plants and other vegetation, is also more abundant at this elevation due to slower decomposition processes, providing a more sustainable food reserve. This aligns with the results showing higher soil organic content at the 1000 m asl location compared to the 800 m and 900 m asl locations (Table 3). The differences in temperature, moisture, and availability of organic material create optimal conditions for the reproduction and development of gastropods while minimizing pressure from predators or competitors. Conversely, at 800 m and 900 m, higher temperatures and lower moisture levels can cause physiological stress for gastropods, resulting in reduced diversity and abundance.

Based on the total density across the three research locations, variations were observed. At the location at 800 m asl, the density of terrestrial gastropods reached 3.4 individuals/m², then decreased at the location at 900 m asl (2.4 individuals/m²), and increased again at the location at 1000 m asl to 4 individuals/m². The low density of terrestrial gastropods at the 900 m asl location is closely related to topographic conditions that differ from the other two locations. This is also evident from the measurements of soil moisture and organic content, which were lower compared to the 800 and 1000 m asl (Table 4), making the conditions less supportive of terrestrial gastropod life at the 900 m asl

Table 4. Density of terrestrial gastropods in the Kabawetan Tea Plantation, Bengkulu.

Species of terrestrial gastropods	800m		900m		1000m	
	D	RD	D	RD	D	RD
<i>Achantina fulica</i>	0.6	17.6	0.4	16.7	0.0	0.0
<i>Allopeas gracile</i>	0.0	0.0	0.0	0.0	0.2	5.0
<i>Bradybaena sp</i>	2.8	82.4	2	83.3	3.6	90
<i>Parmarion martensi</i>	0.0	0.0	0.0	0.0	0.2	5.0
Totals	3.4	100.0	2.4	100.0	4.0	100

Note: D=Density (individuals m⁻²)

RD=Relative Density (%)

Based on the gastropod species at each location, the species *Bradybaena sp.* consistently showed high density, starting from an altitude of 800 m (2.8 individuals/m²; RD=82.4%), 900 m asl (2 individuals/m²; RD=83.3%), and 1000 m asl (3.6 individuals/m²; RD=90%). *Bradybaena sp.*

is a cosmopolitan terrestrial gastropod species found from lowland areas up to elevations of 2000 m asl and prefers habitats of shrubs and grasses (Mujiono, 2019; Nurhayati et al., 2021; Solem, 1984). Kimura et al. (2003) also stated that environmental factors in plantations can influence reproductive success of terrestrial gastropods.

3.3 Diversity Index of Terrestrial Gastropods in the Kabawetan Tea Plantation, Bengkulu

The diversity index of terrestrial gastropods at the three research locations showed low values of 0.47 at the 800 m, 0.45 at the 900 m, and 0.39 at the 1000 m (Table 5). The diversity index is directly proportional to the Evenness index and inversely proportional to the Dominance Index (Table 4). Soegianto (1994) stated that an increase in the diversity index is in line with the Evenness index, as the Evenness index is also referred to as the relative diversity index, and habitats with low diversity indices are characterized by strong dominance (values close to 1). Research by Belhiouani et al. (2019) from various habitats in Northeast Algeria (industrial, mining, urban, and mountainous areas near and far from human activities) generally showed low diversity indices (mostly below 1).

Table 5. Biodiversity index of terrestrial gastropod species.

Species of Biodiversity Index	Altitude of Location		
	800 m	900 m	1000 m
Diversity Index	0.47	0.45	0.39
Evenness Index	1.82	18.1	0.95
Dominance Index	0.71	0.72	0.82

The low diversity index of terrestrial gastropods in the tea plantation may be attributed to several factors related to environmental conditions and land management practices in the plantation. Tea plantations are generally monoculture systems, where only one type of plant dominates the entire area. This reduces the habitat variation necessary for terrestrial gastropods, which typically require diverse environments such as leaf litter, decaying wood, and high humidity to reproduce and survive. According to research by Tsiafouli et al. (2015), soil biodiversity tends to be lower in intensive agricultural lands compared to natural or more heterogeneous ecosystems. The use of pesticides and herbicides in tea plantations can lead to a decline in gastropod populations. Pesticides not only kill target pests but can also negatively impact non-target organisms, including gastropods. Sánchez-Bayo (2011) and Selvi et al. (2015) stated that pesticides can suppress soil invertebrate diversity by directly killing organisms or altering microhabitats. Additionally, intensive tillage often compacts the soil and causes erosion, reducing habitat quality for gastropods. According to Lavelle et al. (2006), agricultural intensification can lead to a decline in soil quality, ultimately contribut-

ing to reduced biodiversity. Research by Choi et al. (2018) showed that microclimate changes due to agricultural systems can significantly impact the community composition of soil organisms. With these factors, the tea plantation ecosystem does not support high levels of terrestrial gastropod diversity. The combination of land management practices, habitat alteration, and chemical use contributes to the low diversity index in this area. Baudouin et al. (2023) also stated that land-use changes, such as urbanization and agricultural intensification, can significantly reduce the diversity of terrestrial gastropod.

3.4 The Distribution Patterns of Terrestrial Gastropods in the Kabawetan Tea Plantation, Bengkulu

Based on the analysis using the standardized Morisita Index, it is determined that the distribution pattern of terrestrial gastropods in the Kabawetan Tea Plantation at elevations of 800 m, 900 m, and 1000 m above sea level shows a cluster pattern (Table 6).

Table 6. The Distribution patterns of terrestrial gastropods in the Kabawetan Tea Plantation, Bengkulu.

Altitude of Location	Id	Mc	Mu	Ip	Distribution Pattern
800 m	1.47	2.55	1.06	0.15	Cluster
900 m	1.52	3.35	1.17	0.11	Cluster
1000 m	1.37	2.26	1.0	0.15	Cluster

Note:

Id : Morisita dispersion index, Mc : clump index, Mu : uniform index, Ip : Standard Morisita Indeks
 Ip<0 : Uniform distribution, Ip = 0 : Random distribution, Ip>0 : Cluster distribution

The clustered distribution of terrestrial gastropods in tea plantations is caused by several key ecological factors related to the plantation environment. This clustering pattern indicates an interaction between gastropods and their microhabitats under the tea canopy, including factors such as humidity, temperature, food sources, and soil conditions. Terrestrial gastropods are highly sensitive to soil moisture, as their vulnerable bodies are prone to dehydration in dry soils with minimal plant canopy (Nurhayati et al., 2021). The tea plantation environment, with its dense plant canopy, tends to maintain higher moisture levels in the soil layer. Gastropods often cluster in areas with moist soil conditions, as these conditions allow them to remain active and adapt well. The moderate and stable temperature differences under the tea canopy also contribute to the clustering patterns in tea plantations. The relatively lower temperatures and moist conditions beneath the canopy support the life of terrestrial gastropods, as excessively high temperatures can lead to harmful dehydration. Kempster and Charwat (2003) also state that soil surface temperature

is an important factor significantly influencing the activity of terrestrial gastropods. Terrestrial gastropods are intolerant of high temperatures. Furthermore, the distribution of litter clustered under the tea canopy also causes the distribution of terrestrial gastropods to become clustered. The presence of litter on the soil surface serves as both a food source and a refuge for terrestrial gastropods. Astor et al. (2015) state that the availability of litter on the soil surface is important for the life of detritivorous terrestrial gastropods. The distribution of litter in tea plantations is concentrated beneath the canopy, leading to conditions that cause terrestrial gastropods to cluster in areas with sufficient food sources.

4. Conclusion

The terrestrial gastropod species in the Kabawetan Tea Plantation, Bengkulu, consist of four species belonging to four families: Achatinidae (*A. fulica*), Subulinidae (*A. gracile*), Camaenidae (*Bradybaena sp.*), and Ariophantidae (*P. martensi*). Based on the elevation in the tea plantation, various species of terrestrial gastropods were found. At altitudes of 800 and 900 m asl, two identical species were identified: *A. fulica* and *Bradybaena sp.* At an altitude of 1000 meters, three species were found: *A. gracile*, *Bradybaena sp.*, and *P. martensi*. The highest density of terrestrial gastropods was found at 1000 m asl. The species that consistently showed high density across all three research locations was *Bradybaena sp.* The diversity of terrestrial gastropods across all three altitude strata in the tea plantation was categorized as low ($H' < 1$), and their distribution followed a cluster pattern.

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