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Study of Gastropod Abundance and Diversity in Rajolelo Forest Park Bengkulu Province

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Abstract
Gastropods are a group of mollusks that play a crucial role in maintaining the balance of aquatic and terrestrial ecosystems through decomposition and as components of the food chain. This study aimed to analyze the diversity, abundance, dominance, and similarity of gastropod communities in the Rajolelo Grand Forest Park, Central Bengkulu. The study was conducted from October 2025 to December 2025 using the Visual Encounter Survey (VES) method combined with transects in two habitat types: an artificial lake and secondary forest. The data obtained were analyzed using the Shannon-Wiener diversity index, Simpson dominance index, relative abundance, and community similarity index. The results showed nine gastropod species from several families distributed across both study habitats. The artificial lake habitat had a higher number of individuals with certain species dominating, while the secondary forest habitat showed a more even community composition. These differences in community structure are related to habitat conditions, food source availability, and environmental factors such as temperature, pH, and humidity. In general, both habitats exhibit distinct yet complementary gastropod community characteristics in maintaining ecosystem balance in the Rajolelo Grand Forest Park area.

Keywords: Forest Ecosystem; Mollusk Community; VES Method; Transect.

INTRODUCTION

Biodiversity describes the level of variation of life in nature, including the number, frequency, and diversity of living organisms within an ecosystem (Nakhili et al., 2026; Verones & Dorber, 2023). It encompasses plants, animals, microorganisms, genetic variation, and the ecosystems they inhabit. Biodiversity is not only about the number of species, but also about their roles, functions, and interactions in maintaining ecological balance (Biella et al., 2025; Hosoda et al., 2023; Li et al., 2024). For example, in Taman Hutan Raya Rajolelo, gastropods play a role in decomposing organic matter and serving as a food source for other organisms (Angraini et al., 2024; Ridwan *et al.* 2025). Their presence represents a crucial aspect of biodiversity that supports forest stability and ecosystem health.

Gastropods are a class of invertebrate mollusks with soft bodies that move using a muscular foot (O'Brien & Pellett, 2022). They possess a head, a muscular foot on the ventral side, and a dorsal part that is often protected by a hard calcareous shell. Most gastropods have shells, although some species do not (Gefaell et al., 2023; Afkar & Aldyza 2017). Gastropods inhabit various environments such as rice fields, rivers, lakes, and ponds (Dražina *et al.* 2022) .

Gastropods are mollusks that live in both terrestrial and aquatic habitats (Bidat et al., 2023). Unpolluted waters are generally characterized by an even distribution of gastropods, whereas polluted environments are often indicated by the dominance of a single species (Samsi et al., 2017). The distribution and abundance of gastropods are influenced by both biotic and abiotic factors (Sunday & Oso 2025) . Gastropods also have economic value as supplementary food sources and ornamental materials derived from their shells (Pausi *et al.* 2023). Therefore, gastropods need to be conserved to maintain their diversity, abundance, and habitats (Gümüş et al., 2022; Gupta et al., 2025; Zaidi et al., 2021). Ecologically, gastropods function as herbivores, carnivores, and detritivores in the food chain, as well as prey for other organisms (M. F. Purnama et al., 2024).

Gastropod diversity and abundance are important indicators of ecosystem condition (Safitri et al., 2025). An ecosystem becomes unbalanced when the variation in individuals and the number of gastropod species are low due to pressures such as habitat change and pollution (Hasanah *et al.* 2023). Gastropod populations influence the decomposition of organic matter and environmental changes (Awang *et al.* 2023). Gastropods are aquatic resources with high species diversity that provide value to humans (Gümüş et al., 2022; Malto et al., 2025).

This study aims to examine the diversity and abundance of gastropods in the secondary forest and artificial lake of Taman Hutan Raya Rajolelo, as well as to identify the gastropod species present in the area.

METHODS

Research Time and Location

The research was conducted from October 2025 - December 2025, in the Rajolelo Grand Forest Park, located in Tanjung Terdana Village, Pondok Kelapa District, Central Bengkulu Regency, Bengkulu Province. This location was chosen because it has a well-preserved tropical forest ecosystem, providing a high diversity of flora and fauna that is highly relevant to the research objectives.

Tools and Materials

The tools used in this research include stationery, buckets, cameras, thermohygrometers, soil meters, water thermometers, white manila paper, specimen bottles, label paper, transek roll, rulers, gloves, vernier calipers, tweezers, and materials used: 50% and 70% alcohol, and 4% formalin.

Methodology

Studies of the distribution and abundance of gastropods in natural habitats require systematic and measurable survey methods to ensure data reflect field conditions (Nhat *et al.* 2026). The Visual Encounter Survey (VES) method, which records individuals directly in the field in real time, is effective. This method is combined with transects for quantitative measurements along specific observation paths, resulting in more statistically accurate analysis.

Observations were conducted around the Rajolelo Forest. Gastropod sampling using VES was combined with the transect method (Setiawan *et al.* 2024). VES is a technique for capturing individuals based on direct observation during field surveys (Islands *et al.* 2025). Gastropod sampling with VES involves observing potential gastropod habitats, such as substrate, vegetation, and gastropod habitats (Purnama *et al.* 2022). To quantitatively measure gastropod abundance, observations were conducted along transect areas (Wahida *et al.* 2024).

Sampling

Sampling was conducted manually using hand-picking and hand-sorting techniques, which involved collecting gastropods directly by hand to separate individuals (Khan et al., 2024; Bhuyain et al. 2020). Researchers supplemented the data by sampling gastropods, identifying species, and recording their numbers in each survey area. Identification was based on shell shape, color, pattern, and number of whorl. Analysis methods included abundance, diversity, dominance, and community similarity indices.

The habitat types used in this study were secondary forests and artificial lakes. Secondary forests were chosen because they have diverse vegetation and substrate, providing microhabitats for gastropod survival and reproduction (Centre & Geometry, 2025). These habitats function as ecological buffers that support biodiversity, connected to aquatic ecosystems. Meanwhile, lakes were chosen as freshwater habitats with diverse physical-chemical conditions such as temperature, pH, and food sources such as algae and detritus that affect gastropod life (Olkeba et al. 2020). Gastropod life in lakes is influenced by seasonal changes and environmental parameters (Meleko et al. 2025). The use of these two habitats aims to obtain comprehensive data on gastropod diversity in different environments, to analyze distribution patterns, species adaptation, and environmental factors that influence their abundance. This approach provides a more complete picture of gastropod population dynamics in terrestrial and aquatic ecosystems.

Sample Identification

Sample identification was performed out in the laboratory for further analysis. Wearing gloves for safety, hold the sample with tweezers to clean it, place it on a Styrofoam base, and observe the detailed morphology with a magnifying glass while comparing it with gastropod identification books and taxonomic guides. Document the sample by photographing it on white manila paper as a base. Next, preservation was performed out in stages, moving from 50% to 70% alcohol in a wet herbarium, using a two-alcohol technique to optimize specimen storage. Identification data was systematically recorded based on the number of individuals and location, then used to calculate the abundance and diversity indices of gastropod species in the study area (Leng et al., 2025).

Data Analysis

Abundance Index

The gastropod abundance index was calculated using the formula (Zaidi et al., 2021):

$$\mathrm{Kr} = \frac{ni}{N} \times 100\%$$

Description:

Kr = Relative abundance (%)

ni = Number of individuals of each species

N = Total number of individuals of all species

Diversity Index

Shannon-Wiener (Zaidi et al., 2021) uses the diversity index to calculate the amount of species diversity. To determine the diversity index for gastropod species, the formula can be used:

$$\mathrm{H}' = -\sum_{i=l}^{n} \mathrm{Pi} \ln \mathrm{Pi}$$

Description:

Pi = ∑ni/N

H: Shannon-Wiener Diversity Index

Pi: Number of individuals of a species/total number of all species

ni: Number of individuals of the i-th species

N: Total number of individuals

Dominance Index

The gastropod dominance index is calculated using the formula (Zaidi et al., 2021):

$$\mathrm{D} = \sum \left(\frac{ni}{N} \right) 2$$

Description:

C = Simpson's dominance index

ni = Number of individuals of each species

N = Total number of individuals

Community Similarity Index

The Community Similarity Index can be calculated according to (Zaidi et al., 2021) as follows :

$$S = = \frac{2c}{A+B} \text{ x } 100\%$$

Description:

A = Number of species at location 1

B = Number of species at location 2

C = Number of species in common at both locations

S = Similarity index between the two communities

RESULT AND DISCUSSION

This study identified nine gastropod species from nine families: Subulinidae, Achatinidae, Oxychilidae, Viviparidae, Ampullariidae, Bradybaenidae, Ariophantidae, Pachychilidae, and Bulinidae. Four species (four families) were found in the artificial lake, while five species (five families) were found in the secondary forest. The differences in the number of species and families are likely due to the conditions of their habitats.

Table 1. Families, species, and dominance index of gastropods in taman hutan raya rajolelo.

Family	Species	Reseach Station		∑ Ind	Dominance Index
		1	2		
Subulinidae	*Subulina octona*	-	18	18	Low
Achatinidae	*Achatina fulica*	-	23	23	Low
Oxychilidae	*Oxychilus draparnaudi*	-	3	3	Low
Viviparidae	*Filopaludina javanica*	168	-	168	High
Ampullariidae	*Pomacea canaliculata*	7	-	7	Low
Bradybaenidae	*Bradybaena similaris*	-	23	23	Low
Ariophantidae	*Macrochlamys hippocastaneum*	-	8	8	Low
Pachychilidae	*Sulcospira testudinara*	26	-	26	Low
Planorbidae	*Indoplanorbis exutus*	4	-	4	Low
Total number of individuals		205	75	280	

Description:

Station 1 = Lake

Station 2 = Land

∑ *Ind = Total Individuals of Each Species*

Based on Table 1 of the study in Rajolelo Grand Forest Park, Simpson's dominance index shows a significant difference between the artificial lake and the secondary forest. The artificial lake had a C value of 0.6893 (high dominance >0.60), dominated by *F. javanica*. In contrast, the secondary forest had a C value of 0.2635 (low dominance <0.30), indicating a more balanced community without a dominant species. The high dominance in the artificial lake is due to a homogeneous environment such as mud substrate, still water, and stable organic matter, which favors tolerant species like *F. javanica* (Gümüs *et al.* 2022).

Conversely, the low dominance in the secondary forest is due to a heterogeneous habitat with leaf litter, decaying wood, varying soil moisture, and shade from vegetation, forming numerous microhabitats. This allows various gastropod species to occupy different ecological niches, preventing any single species from overpowering resources. These conditions indicate a stable ecosystem with low to moderate disturbance. The rainy season increases humidity which supports gastropod activity and reproduction, while the dry season suppresses sensitive species and changes the dominance structure, tending to decrease (Islam et al., 2025)

Table 2. Results of calculations of abundance, diversity, dominance and community similarity indices in artificial lake and secondary forest habitats.

Indicators	Artificial Lake	Des	Secondary Forest	Des
Diversity	H' = 0,6175	Low	H' = 1,44	Moderate
Abundance	205%	Moderate	75%	Moderate
Dominance	C = 0,6893	High	C = 0,2635	Low
Community Similarity	0%	No similarity	0%	No similarity

In Table 2, the relative abundance index in the artificial lake was 205%, while in the secondary forest it was 75%. This indicates that a greater number of gastropod individuals were found in lake habitats. The high value in lakes is related to the concentration of individuals in aquatic habitats that provide mud substrates and organic matter as food sources. Seasonal factors such as rainfall and temperature also influence the increase or decrease of gastropod populations (Islam et al., 2025). The diversity value (H') in the artificial lake was 0.6175, which is categorized as low (H' < 1). Meanwhile, in the secondary forest, the H' value = 1.44 is categorized as medium (1 < H' < 3). Low diversity indicates a small and uneven number of species, while the medium category indicates better species variation and a more balanced distribution of individuals (Bae & Park, 2020). Secondary forests are rich in microhabitats such as leaf litter, decaying wood, and moist soil, which enable gastropods to survive. Soil humidity and temperature also influence the activity of terrestrial gastropods.

The dominance value (C) in the artificial lake was 0.6893, which is categorized as high (C > 0.60). In the secondary forest, the C value = 0.2635 is categorized as low (C < 0.30). High dominance means one species dominates the community, while low dominance indicates a more balanced community (Gümüs *et al.* 2022). High dominance in the lake may be influenced by more uniform environmental conditions that support the rapid growth of one species. The community similarity index between the artificial lake and the secondary forest was 0%. This means that no similar species were found in either habitat. This difference occurs because aquatic gastropods adapt to aquatic habitats by breathing gills (branchs) to absorb dissolved oxygen from the water, while terrestrial gastropods use lungs (pallial cavities) to breathe air freely. Physical conditions such as water content, substrate, and humidity act as natural barriers to species movement. Community similarity value of 0% indicates that differences in habitat type are the main factor in not finding the same species in both locations (Bidat *et al.* 2023).

Data on the abundance of gastropods in the artificial lake habitat can be seen in Figure 1. This diagram displays the number of individuals of each species based on field observations so that differences in abundance, community structure, and dominance can be clearly observed.

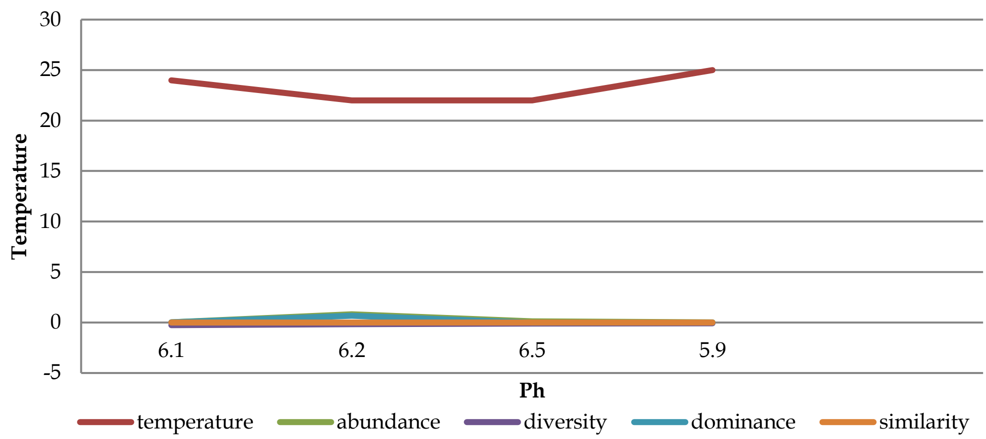

Figure 1. Abundance index, diversity, dominance, community similarity and environmental parameters in rajolelo artificial lake

Based on Figur 1. the artificial lake habitat in Rajolelo Grand Forest Park shows a more dynamic variation in the number of gastropod individuals compared to secondary forests. Some species have higher values, while others have lower, resulting in clear differences in abundance. This is influenced by aquatic environmental conditions such as depth, clarity, pH, temperature, and the availability of aquatic vegetation, which determine the distribution and survival of gastropods (Bae & Park, 2020). Species with the highest values generally have good tolerance to changes in water quality and are able to adapt to open water, while species with low values usually have more specific habitat requirements, such as certain types of substrate or vegetation.

Data on the abundance of gastropods in the secondary forest habitat in Rajolelo Grand Forest Park can be seen in Figure 2. The diagram shows the number of individuals of each species from the sampling results so that comparisons of abundance, distribution patterns, and dominance tendencies can be analyzed visually.

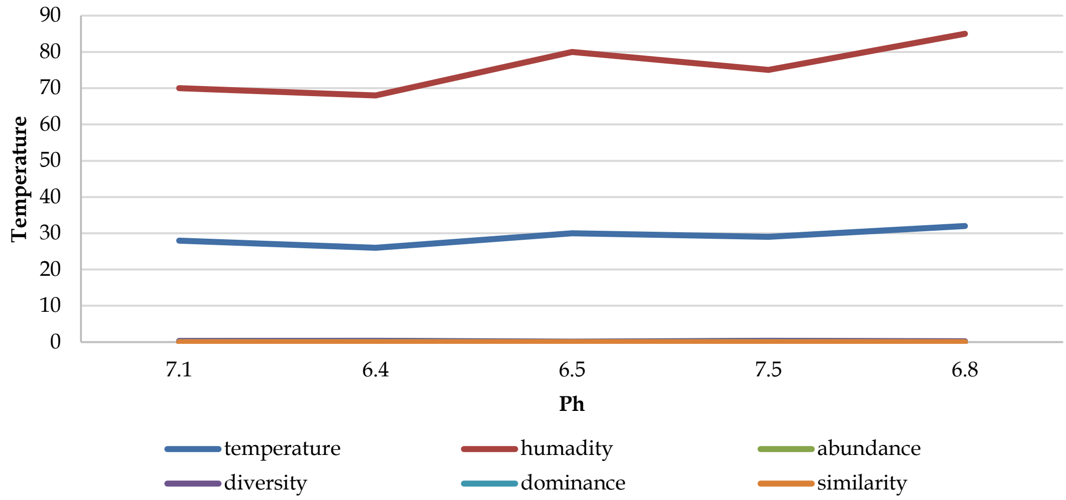

Figure 2. Abundance index, diversity, dominance, community similarity and environmental parameters in rajolelo secondary forest

Based on Figure 2. the secondary forest habitat in Rajolelo Grand Forest Park shows a relatively stable pattern with not too striking differences in values between species. The increase and decrease in the line represent variations in number of individuals in each species, but the differences are not extreme, thus reflecting a fairly balanced community structure (Warna *et al.* 2025). This condition is related to the characteristics of secondary forests that have experienced vegetation regeneration after disturbance, resulting in a dense canopy that maintains soil moisture and produces litter accumulation as a primary microhabitat niche for gastropods, namely a source of detritus food, shelter from predation, and stable humid conditions for respiration and reproduction (Rosales *et al.* 2025). Species at the highest line tend to have a wider ecological niche, broader environmental tolerance and good adaptability to microclimate dynamics (Pranowo *et al.* 2023). While species with lower values generally have more specific habitat preferences and higher sensitivity to changes in temperature and humidity (Peralta-madriz *et al.* 2025).

CONCLUSION

Based on research results in the Rajolelo Grand Forest Park in Central Bengkulu, the reported abundance and diversity of gastropods in secondary forest and artificial lake habitats showed clear differences. The artificial lake habitat had a higher reported number of individuals with a total of 205 individuals, while the secondary forest had 75 individuals. The overall index value showed that the artificial lake was classified as low, while the secondary forest was classified as moderate. These results indicate that habitat conditions and characteristics are disappointing and gastropod diversity.

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