Composition and diversity of underground plants in the Bohulo camp tourist area

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Abstract. This study aims to determine the types and number of understory plants in the Bohulo Camp Tourism area, Dulamayo Village, Telaga District, Gorontalo. To obtain data, direct observations were conducted in the field, taking photographs, and recording coordinate points using GPS to identify plant types and calculate several values such as the level of diversity, evenness, and number of species. The results showed that there were 8 types of understory plants with a total of 50 individuals originating from 6 families, namely Poaceae, Zingiberaceae, Araceae, Euphorbiaceae, Cannabaceae, and Gnetaceae. Of these families, Poaceae, especially Bambusa sp., had the largest number of individuals. The Shannon-Wiener diversity index (H') value was 1.8103, which indicates a fairly high level of diversity. Meanwhile, the evenness index (E = 0.8706) indicates that the distribution of individuals in this area is relatively even. Overall, the composition of understory plants in the Bohulo Camp Tourism area is quite stable and reflects good ecological conditions.

1 Introduction

Understory plants play a crucial role in forest ecosystems because they help maintain environmental balance. They reside on the forest floor and absorb rainwater and surface runoff, thus preventing soil erosion. Furthermore, understory plants serve as a food source for herbivores and indicate soil fertility through fallen and decomposed leaves, which return nutrients to the soil (Soerianegara & Indrawan, 2008). Economically and ecologically, some understory plants can be used as food, medicine, and as an alternative energy source (Abdiyani, 2008). However, understory plants can have negative impacts if they grow invasively, as they can inhibit the growth of young trees, particularly in monoculture farming systems (Suprihatno, Hamidy, & Amin, 2012).

Within forest ecosystems, plant communities demonstrate a mutually influential relationship between organisms and the environment, evident in the variety of plant species and structures. The diversity and form of plant structures in forests are constantly changing

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and are influenced by both biological and non-biological factors. Understory vegetation includes low vegetation such as grasses, herbs, and shrubs, and is located in the D layer of tropical rainforest structure. In tropical regions, forest vegetation is crucial in mitigating global warming due to its ability to absorb greenhouse gas emissions. Indonesia, as the country with the third-largest tropical forest in the world after Brazil and Kenya, requires baseline data on forest vegetation as a basis for carbon management and efforts to address climate change (Siregar & Heriyanto, 2010). One area with ecological value and tourism potential is Dulamayo Village, Telaga District, Gorontalo Regency, Gorontalo Province. This village boasts a beautiful, tranquil, and well-preserved natural environment. In this area, there is the Bohulo Camp and Eat tourist destination, a recreational area surrounded by green vegetation and cool air, making it easy to observe natural vegetation, including understory vegetation. Bohulo Camp is located not too far from the center of Telaga District and has good transportation access, making it easily accessible. The quiet environment and dominance of natural vegetation make Bohulo Camp an ideal location for research on the composition and diversity of understory plants.

2 Research Methods

2.1 Study Area

This study was conducted in the Bohulo Camp Tourism Area, located in Dulamayo Village, Telaga District, Gorontalo Regency, Indonesia. The site was selected due to its relatively undisturbed ecological conditions and its potential to support diverse understory vegetation.

2.2 Research Design

A field-based vegetation survey approach was employed to assess the composition and structure of understory plant communities. The study population included all understory plant species found within the observation area. Sampling was conducted using systematically established plots distributed at regular intervals across the study site.

2.3 Data Collection

Data were collected through the following procedures:

1. **Field Observation**
   Direct observations were conducted in each plot to record species composition, number of individuals, and relevant ecological characteristics. Environmental conditions such as canopy cover, slope, and light availability were also noted.
2. **Photographic Documentation**
   A mobile phone camera was used to document each understory plant species and its surrounding environmental conditions. This documentation supported species identification and data validation.
3. **GPS Coordinate Recording**
   A Global Positioning System (GPS) device was used to record the geographic coordinates of each sampling plot to ensure positional accuracy and to describe the spatial distribution of understory vegetation.

2.4 Data Analysis

The collected data were analyzed in several stages:

1. **Vegetation Structure Analysis**
   Frequency, density, dominance, and the Important Value Index (IVI) were calculated to determine the structural characteristics of the understory plant community.
2. **Species Diversity Analysis**

The Shannon–Wiener diversity index (H′) was calculated to assess species diversity within each plot.

3. **Environmental Factor Analysis**
   Environmental variables such as light intensity, canopy cover, slope, and humidity were analyzed descriptively to examine their potential influence on understory vegetation composition.

2.5 Data Validation

To ensure accuracy and reliability, the following validation procedures were implemented:

a. **Technical Triangulation**
   Data from field observations, photographic documentation, and GPS coordinates were cross-checked to strengthen data consistency.
b. **Species Identification Verification**
   Field identification results were compared with botanical references and identification manuals to ensure taxonomic accuracy.

3 Result and Discussion

3.1 Result

Table 1. Total Number of Individuals at the Lower (Understory) Level

No.	Local Name	Family	Scientific Name	Number of Individuals
1	Alpinia zerumbet	Zingiberaceae	*Alpinia zerumbet*	3
2	Sente	Araceae	*Alocasia macrorrhizos*	2
3	Puring	Euphorbiaceae	*Codiaeum variegatum*	7
4	Mengkirai	Cannabaceae	*Trema orientalis*	5
5	Bambu ampel	Poaceae	*Bambusa* sp.	18
6	Serai	Poaceae	*Cymbopogon sp.*	4
7	Mata puti	Euphorbiaceae	*Macaranga sp*	9
8	Bohu	Gnetaceae	*Gnetum cuspidatum*	2
	Total			**50**

Table 2. Diversity, Evenness, and Species Richness Indices (Lower Level)

Vegetation Stratum	Total Individuals (N)	Shannon–Wiener Index (H′)	Evenness (E)	Richness Index (R)
Lower Level	50	1.8103	0.8706	1.7894

3.2 Discussion

The understory vegetation in the Bohulo Camp Tourism Area demonstrates moderate species diversity, although the total number of individuals is lower compared to the tree stratum. A total of 50 individuals representing eight species were recorded. These species belong to several plant families, including Poaceae, Zingiberaceae, Araceae, Euphorbiaceae, Cannabaceae, and Gnetaceae, indicating a relatively heterogeneous understory composition.

The Poaceae family was the most dominant, particularly Bambusa sp. (18 individuals) and Cymbopogon sp. (4 individuals). Such dominance is commonly observed in areas with relatively open canopy conditions and sufficient sunlight penetration. The presence of

Alpinia zerumbet, Alocasia macrorrhizos, and Macaranga sp. suggests moderately humid environmental conditions that support the growth of herbaceous and shrub vegetation.

The Shannon–Wiener diversity index (H′ = 1.8103) indicates moderate diversity at the understory level. This suggests that while species variation exists, it is not as complex as that observed in the tree layer. The moderate value is influenced by the relatively high abundance of certain species, particularly Bambusa sp., compared to others.

The evenness index (E = 0.8706) indicates a fairly uniform distribution of individuals among species, suggesting the absence of extreme dominance. This reflects relatively stable ecological conditions at the understory level. Meanwhile, the species richness index (R = 1.7894) indicates moderate richness, consistent with the limited number of species recorded.

Overall, the understory vegetation exhibits a stable structure with moderate diversity and relatively balanced species distribution. The composition reflects local environmental conditions and suggests that the ecosystem remains capable of supporting understory plant growth. Continued monitoring is recommended to assess potential changes resulting from tourism activities or environmental disturbances.

4. Conclusion

The study of understory vegetation in the Bohulo Camp Tourism Area identified eight species comprising a total of 50 individuals, representing several plant families, including Poaceae, Zingiberaceae, Araceae, Euphorbiaceae, Cannabaceae, and Gnetaceae. The dominance of Poaceae, particularly Bambusa sp., reflects environmental conditions that favor the growth of understory species typically associated with semi-open habitats. The calculated ecological indices indicate moderate diversity (H′ = 1.8103), relatively high evenness (E = 0.8706), and moderate species richness (R = 1.7894). These values suggest that the understory vegetation structure is relatively balanced, with no excessive dominance by a single species. Overall, the understory layer contributes significantly to the ecological structure of the Bohulo Camp Tourism Area. The findings provide baseline data for sustainable tourism management and highlight the importance of maintaining understory vegetation to support ecosystem stability and environmental quality within the site.

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