UDC 630

FLORISTIC DIVERSITY AND THE STRUCTURE OF THE POLE LEVEL VEGETATION AT BUKIT MANDIANGIN, SOUTH KALIMANTAN

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ABSTRACT
The high diversity of pole species indicates the possibility of numerous unidentified pole types, leading to an unclear understanding of their distribution, abundance, and actual pole community structure. The ULM Special Purpose Forest Area (KHDTK ULM) covers an area of 1,617 hectares. It includes different locations with varying elevations, such as Bukit Besar, Bukit Mandiangin, Bukit Pamaton, and Bukit Pandamaran. Conducting a study on the pole canopy community structure at Bukit Mandiangin is essential for the conservation of germplasm in KHDTK ULM. The objectives of this research are (1) to assess the presence of pole species at different elevations, (2) to analyze the distribution and abundance of pole species at various elevations, and (3) to analyze the diversity, evenness, and community similarity of canopy plant species.

KEY WORDS
Elevation, pole level vegetation, training and education forest.

The forest is a highly complex natural ecosystem that serves various functions, such as providing germplasm resources, regulating water supply, maintaining ecosystem stability, producing oxygen, preventing landslides, supporting livelihoods, and supplying natural resources for economic benefits and community needs. Additionally, forests have the potential to be natural tourist destinations, research facilities, and a means to appreciate the magnificence of the divine Creator. Vegetation in forests varies from the undergrowth, seedlings, saplings, poles, to trees. The presence of pole vegetation not only contributes to biodiversity but also plays a crucial role in soil and soil organism protection, microclimate regulation within the forest floor, erosion control, and soil fertility maintenance.

Pole plants possess extensive root systems that form dense clusters, effectively preventing soil erosion, shielding the soil from raindrops and surface runoff, and enhancing organic matter content in the soil as green manure or mulch (Erna, 2017). Apart from their ecological functions, certain pole species have been identified for their potential use as food sources, medicinal plants, and alternative energy sources. However, poles can also act as weeds that hinder the growth of tree seedlings.

The exceptionally high diversity of pole plant species indicates the likelihood of numerous unidentified pole vegetation types, thereby leaving the true extent of their diversity and community structure unknown. Lambung Mangkurat University has been entrusted by the Ministry of Environment and Forestry to manage a forest area spanning 1,617 hectares in the Karang Intan District, Banjar Regency. This location is adjacent to the Sultan Adam Grand Forest Park (Tahura). Bukit Mandiangin is part of the Special Purpose Forest Area (KHDTK) and has an approximate elevation of 275 meters above sea level (asl). This hill still maintains a significant expanse of natural forest vegetation.

The issue at hand is the distribution and abundance of pole species at different elevations within the Bukit Mandiangin area. Specifically, the study aims to identify species capable of thriving at varying elevations, analyze their distribution and abundance, calculate important value indices, assess diversity, evenness, and community similarity of the plant species, and determine whether different elevations significantly influence the number of species present. Information regarding the distribution, abundance, dominance of pole species, and other aspects investigated will be valuable for KHDTK management in planning and implementing advanced silviculture techniques for the natural forest vegetation regeneration process in KHDTK ULM.

METHODS OF RESEARCH

This research will be conducted at Bukit Mandiangin in the Mandiangin Village, Karang Intan District, Banjar Regency, within the ULM KHDTK. The research process will involve several stages, including obtaining necessary permits, preparing equipment and materials, data collection in the field, and processing and organizing the data for the research report. The equipment and materials to be used include the research location map, GPS (Global Positioning System), raffia rope, phiband or measuring tape, machete, camera, light meter, tally sheet, thermohygrometer, white A4 paper, whiteboard, wooden stakes, plastic bags, and a laptop. The object of study is the pole vegetation found in Bukit Mandiangin within the ULM KHDTK. The method employed to determine the locations is purposive sampling, and sample plots will be established using the curve species area (CSA) technique, as depicted in Figure 1.

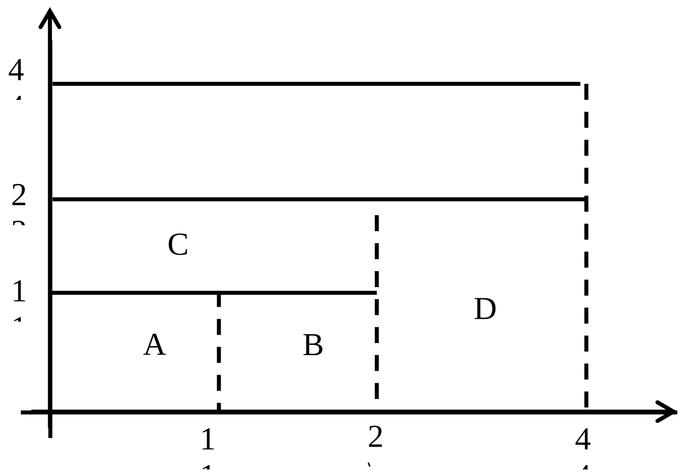


Figure 1 – *Curva Species Area* (CSA) Plot
Note. A: Plot 1 m x 1m; B: Plot 1 m x 2 m; C: Plot 2 m x 2 m; D: Plot 2 m x 4 m and so on until there are no more additional individuals

The addition of area will be done until the addition of individuals ≤ 10%, which is the sample plot size (Oosting, 1973 in the Department of Forestry, 2004). Based on the final presentation results, the minimum plot size for vegetation analysis in the study can be determined. The positioning of the plots within the designated forest area will take into account the estimated distances between points at each elevation to ensure representative vegetation conditions. This will be further adjusted according to the direction of the transect lines created using the grid line method. The determination of elevation will align with contour lines at intervals of 25 meters above sea level (asl), and three classifications will be created as shown in Table 1.

Table 1 – Classification of Research Site Elevation

No	Classification	Elevation
1	Lower	125-150 masl
2	Middle	150-175 masl
3	Summit	175-200 masl

Based on observations of the research location map, the research plots are located at positions 1 and 2. Three transects will be established, each with a width of 20 meters and a length of 300 meters. The distance between observation plots within each transect will be 30 meters, while the distance between transects will be 15 meters. The diagram illustrating the arrangement pattern of the research plots can be seen in Figure 2.

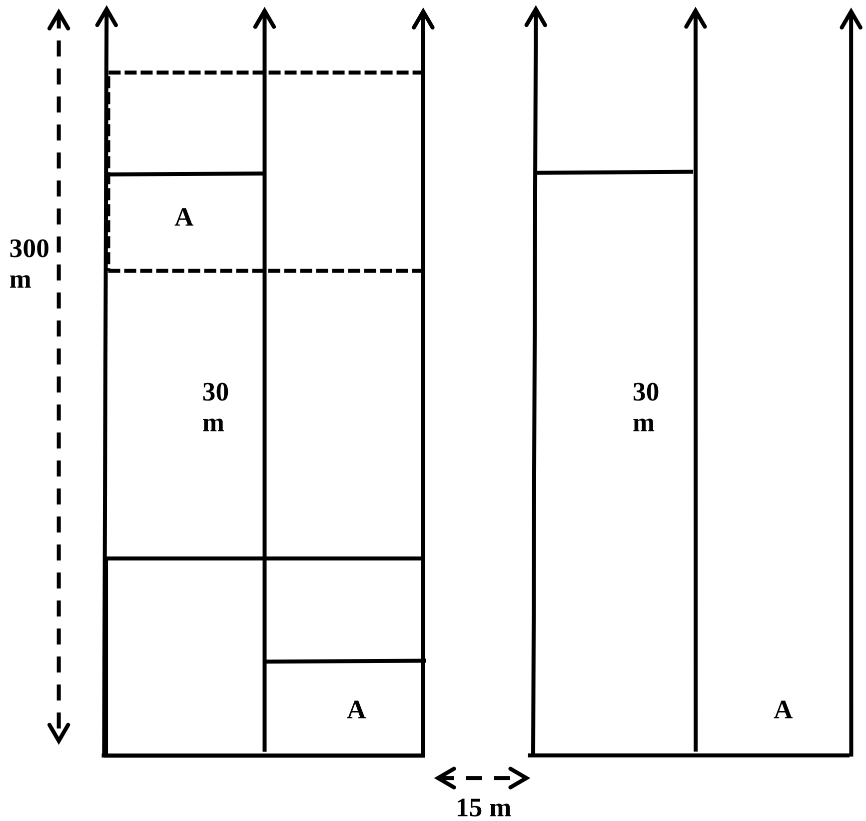


Figure 2 – Layout of Plots and Observation Trails
Note. A: Observation plot for tree height (10 m x 10 m)

The research will utilize a Completely Randomized Design (CRD) to determine the differences in the number of species and individuals at each elevation, with 6 replications. The presence, distribution, and abundance of species at different elevations will be analyzed quantitatively and presented using histograms. The field data collected, which consists of recording various vegetation types, will be calculated and expressed as the Importance Value Index (IVI) using the formula proposed by Soerianegara and Indrawan (1978).

To assess the stability of a community, the degree of species diversity will be calculated using the Shannon-Weiner formula (Umar, 2013). The community structure of plants within the research plots will be evaluated using the Evenness Index, as suggested by Odum (1993). The Community Similarity Index will be employed to determine the relative similarity of species composition between two stands compared at each growth level. The Community Similarity Index between habitats, as per Suin (2002), can be calculated using the Sorensen formula.

RESULTS AND DISCUSSION

The vegetation composition indicates the potential and diversity of plant species in the area (Wibisono and Azham, 2017). The composition of pole species at lower elevations can be seen in Table 2.

Based on Table 2, which consists of a total of 12 plant species, it can be observed that the species with the highest number of individuals in the pole vegetation is Jamai from the Fabaceae family, with 6 individuals. This is followed by Alaban and Bati-Bati menjangan, each with 4 individuals. Damar kumbang, Mahoni, and Tengkook ayam have 3 individuals each. Additionally, Kamalaka, Lalangsatan, and Madang puspa each have 2 individuals, while Bangkal gunung and Marsihung have the lowest number of individuals, with only 1 individual each. The composition of pole vegetation species at the middle elevation (150-175 meters above sea level) can be seen in Table 3.

Table 2 – Composition of Pole-Level Vegetation Types at an Elevation of 125-150 masl

No	Local Name	Scientific name	Number of individuals	Family
1	Alaban	*Vitex pinnata*	4	Verbenaceae
2	Bangkal gunung	*Nauclea subdita*	1	Rubiaceae
3	Bati-bati menjangan	*Eugenia spicata*	4	Myrtaceae
4	Damar kumbang	*Agathis* sp	3	Araucariaceae
5	Jamai	*Instia* sp	6	Fabaceae
6	Kamalaka	-	2	-
7	Lalangsatan	*Lansium* sp	2	Meliaceae
8	Madang puspa	*Schima wallichii*	1	Theaceae
9	Mahoni	*Swietenia macrophylla*	3	Meliaceae
10	Marsihung	*Alseodaphne* sp	1	Lauraceae
11	Medang puspa	*Schima wallichii*	2	Theaceae
12	Tengkook ayam	*Nephelium massoia*	3	Sapindaceae
	Total		32	

Table 3 – Composition of Pole-Level Vegetation Types at an Elevation of 150-175 masl

No	Local Name	Scientific name	Number of individuals	Family
1	Alaban	*Vitex pinnata*	1	Fabaceae
2	Bati-bati menjangan	*Eugenia spicata*	1	Myrtaceae
3	Jamai	*Instia* sp	3	Fabaceae
4	Madang puspa	*Schima wallichii*	8	Theaceae
	Total		13	

Based on Table 3, which includes a total of 4 plant species, it can be observed that the species with the highest number of individuals is Madang puspa from the Theaceae family, with 8 individuals. Jamai follows with 3 individuals, while Alaban and Bati-Bati Menjangan have the lowest number of individuals, each with 1 individual. At this elevation, there is a significant decrease in the number of species compared to the previous elevation. The composition of pole vegetation species at the upper elevation (175-200 meters above sea level) can be seen in Table 4.

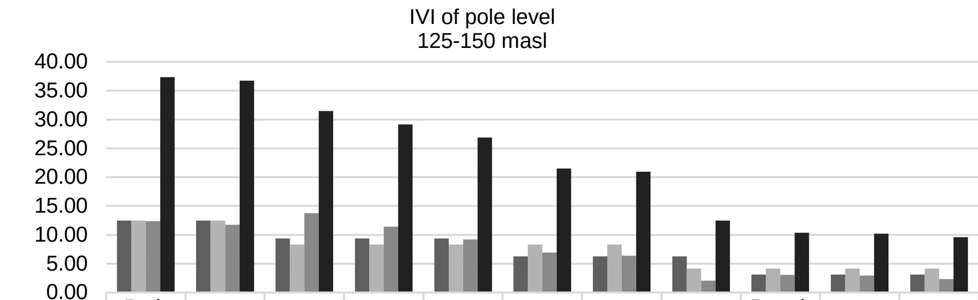
Table 4 – Composition of Pole-Level Vegetation Types at an Elevation of 175-200 masl

No	Local Name	Scientific name	Number of individuals	Family
1	Akasia	*Acacia mangium*	4	Fabaceae
2	Bangkal gunung	*Nauclea subdita*	1	Rubiaceae
3	Bintangur	*Calophyllum inophyllum*	1	Clusiaceae
4	Jamai	*Instia* sp	5	Fabaceae
5	Madang puspa	*Schima wallichii*	5	Theaceae
	Total		16	

Based on Table 4, which includes a total of 5 plant species, it can be observed that the species with the highest number of individuals in the pole vegetation are Jamai from the Fabaceae family and Madang puspa from the Theaceae family, each with 5 individuals. Akasia follows with 4 individuals, while Bangkal gunung and Bintangur have the lowest number of individuals, each with only 1 individual. When comparing these numbers to the two previous elevations, it can be seen that there is a tendency for a decrease in the number of species from the lower to upper elevations, although there is an addition of 1 species between the middle and upper elevations. Besides internal factors, external factors such as the environment or plant habitat, especially under the canopy, are closely related to sunlight intensity and shading (Dahlan, 2011), which also affect the growth of forest vegetation.

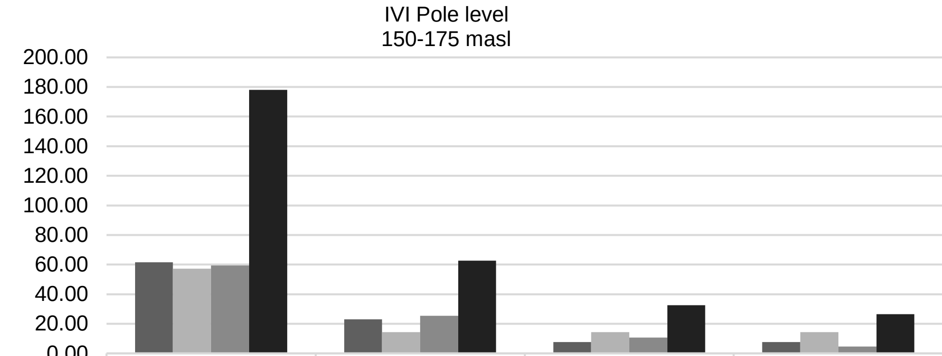
According to Maisyaroh (2010), differences in environmental conditions lead to variations in the number of plant species that grow in a particular area. Open canopy areas receive more sunlight compared to closed canopy areas, resulting in competition among plant species to obtain sunlight, which eventually hinders the growth of certain species. In addition to competition for sunlight, the decrease in the number of species may also be caused by the loss of nutrient elements in the upper soil layer due to continuous surface erosion, resulting in soil fertility decline within a forest stand.

According to Soerianegara and Indrawan (1982) as cited in Yesse (2011), plant species that play a significant role in a forest area are characterized by their high Importance Value Index (IVI), which is the sum of Relative Density (RD), Relative Frequency (RF), and Relative Dominance (RD). The higher the IVI value of a species, the greater its dominance within the community where it grows. The Importance Value Index (IVI) for pole vegetation can be seen in Figure 3.



	Bati-bati menjangan	Alaban	Damar kumbang	Mahoni	Tengkook ayam	lalang satan	Medang puspa	kamalaka	Bangkal gunung	Marsihung	Madang puspa
KR (%)	12.50	12.50	9.38	9.38	9.38	6.25	6.25	6.25	3.13	3.13	3.13
FR (%)	12.50	12.50	8.33	8.33	8.33	8.33	8.33	4.17	4.17	4.17	4.17
DR (%)	12.34	11.75	13.75	11.42	9.19	6.93	6.39	2.03	3.05	2.92	2.31
INP (%)	37.34	36.75	31.46	29.13	26.90	21.51	20.98	12.45	10.34	10.21	9.60

Figure 3 – Importance Value Index of Pole-Level Vegetation at Lower Elevations



	Madang puspa	Jamai	Alaban	Bati-bati menjangan
KR (%)	61.54	23.08	7.69	7.69
FR (%)	57.14	14.29	14.29	14.29
DR (%)	59.43	25.34	10.66	4.57
INP (%)	178.11	62.70	32.64	26.55

Figure 4 – Importance Value Index of Pole-Level Vegetation at Middle Elevations

The species found in the pole vegetation include Bati-Bati Menjangan (*Eugenia spicata*), Alaban (*Vitex pubescens*), Damar kumbang (*Agathis* sp), Mahoni (*Swietenia macrophylla*), Tengkook ayam (*Nephelium massoia*), Lalangsatan (Lansium sp), Madang puspa (*Schima wallichii*), Kamalaka, Bangkal gunung (*Nauclea subdita*), Marsihung (*Alseodaphne* sp), and Madang puspa (*Schima wallichii*). The highest IVI value is obtained by Bati-Bati Menjangan, which is 37.34%. This is calculated by summing up the RD (Relative

Density) of 12.50%, RF (Relative Frequency) of 12.50%, and RD (Relative Dominance) of 12.34%. On the other hand, the lowest IVI value is obtained by Madang puspa, which is 9.60%. The difference in IVI between Bati-Bati Menjangan and Madang puspa is 27.74%. The IVI values for the middle elevation (150-175 meters above sea level) can be seen in Figure 4.

The species found in the pole vegetation at the upper elevation include Madang puspa (*Schima wallichii*), Jamai (*Instia* sp), Alaban (*Vitex pubescens*), and Bati-Bati Menjangan (*Eugenia spicata*). In the above figure, the species with the highest value has reversed compared to the previous elevation. While Bati-Bati Menjangan had the highest IVI in the previous elevation, it has the lowest IVI at this elevation. On the other hand, Madang puspa becomes the species with the highest IVI, with a value of 178.11%. The difference in IVI between Madang puspa and Bati-Bati Menjangan is 151.56%. From the IVI graph above, it is evident that the presence and dominance of Madang puspa are relatively high compared to the other species.

The species found in the pole vegetation at the upper elevation include Madang puspa (*Schima wallichii*), Jamai (*Instia* sp), Akasia (*Acacia mangium*), Bangkal gunung (*Nauclea subdita*), and Bintangur (*Calophyllum inophyllum*). In the pole vegetation at the upper elevation, it can be observed that Madang puspa has the highest IVI value, which is 99.05%, while Bintangur has the lowest IVI value, which is 22.86%. The difference in IVI between Madang puspa and Bintangur is 76.19%.

The diversity index (H) according to Shannon-Weiner states that if the value of H < 1, the diversity is low. Furthermore, if the value of H is between 1 and 3, the diversity is moderate, and if the value of H > 3, the diversity is high. The diversity index (H) for pole vegetation can be seen in Table 5.

Table 5 – Species Diversity Index (H) Values for Pole-Level Vegetation

No	Altitude Level (masl)	Diversity Index (H’)	Category
1	125-150	2,35	Moderate
2	150-175	1,09	Moderate
3	175-200	1,46	Moderate

The highest diversity index (H') for the pole vegetation is observed at the lower elevation, with a value of 2.35, while the lowest index is found at the middle elevation, with a value of 1.09. According to Magurran (1988), the value of the diversity index (H') is not only related to the species richness in a particular location but is also influenced by the distribution of species abundance. The higher the diversity index value (H'), the greater the species diversity, ecosystem productivity, pressure on the ecosystem, and ecosystem stability. Low values of (H') can be attributed to the presence of species in physically controlled ecosystems and high in biologically regulated ecosystems (Odum, 1993). Overall, the calculated value of (H') falls within the moderate range, indicating that the plant community in the location is still in a stable condition.

The evenness index (E) has values between 0 and 1. As the evenness value approaches 1, it indicates a more even distribution of species, and vice versa (Magurran, 1988). The evenness index (E) for pole vegetation can be seen in Table 6.

Table 6 – Species Evenness Index (E) Values for Pole-Level Vegetation

No	Altitude Level (masl)	Eveness Index (E)	Category
1	125-150	0,95	High
2	150-175	0,79	High
3	175-200	0,90	High

Data source: Primary data collected in the field, 2022.

The table above shows that the highest evenness index (E) is observed in the pole vegetation at the lower elevation, with a value of 0.95. On the other hand, the lowest evenness index (E) is found at the middle elevation, with a value of 0.79. According to

Magurran (1988), if the evenness index is greater than 0.6, it indicates an even distribution of individuals among species. Conversely, if the evenness index is less than 0.6, it suggests an uneven distribution or dominance of a particular species. Evenness also reflects the balance between one community and another. The values in the evenness index indicate the degree of individual abundance among each species. If every species has an equal number of individuals, the community achieves maximum evenness. Overall, the calculated evenness values for the pole vegetation indicate a high degree of evenness. This suggests that the forest community at the research location is in a balanced and relatively stable state, as the plant species in the community exhibit good distribution and abundance.

Table 7 – Community Similarity Index (IS) Values for Pole-Level Vegetation

No	Altitude Level (masl)	SI (%)
1	125 - 150 *(B – T)*	50,00
2	125 - 200 (*B – A*)	35,29
3	150 – 200 *(T – A)*	44,44

Note. B-T: Lower to Middle Elevation; B-A: Lower to Upper Elevation; T-A: Middle to Upper Elevation.

The table above shows that the highest community similarity index (IS) for the pole vegetation is observed at the B-T elevation, with a value of 50.00%, while the lowest index is found at the B-A elevation, with a value of 35.29%. The magnitude of the community similarity index reflects the level of similarity in species composition and structure between the two compared communities. Ecologically, observation plots with high similarity indices indicate that the composition of the constituent species is relatively similar (Zulkarnaen, 2017).

This is relevant to the theory proposed by Barbour et al. (1980), which suggests that microclimatic conditions that tend to be similar will be occupied by individuals of the same species because they have naturally developed mechanisms and tolerances for their habitat. According to Kusmana and Susi (2015), the differences between these communities are caused by variations in the number of species influenced by environmental factors such as humidity, soil pH, and temperature. The species found in both stands can help improve soil structure, thus aiding in subsequent growth regeneration (Hilwan et al., 2013). Destaranti et al. (2017) suggest that the greater the number of shared plant species between two compared communities, the larger the community similarity index will be.

The analysis was conducted using a Completely Randomized Design (CRD) with 3 different elevations (lower, middle, upper) as Treatment 1, 2, and 3, and 6 measurement plots as replications (U1, U2, U3, U4, U5, and U6). This resulted in 3 treatments with 6 replications each, and the results are presented in Table 8.

Table 8 – ANOVA Test Values for the Influence of Elevation on the Number of Pole Species

Source of Variation	Sum of Squares (SS)	Degree of freedom (df)	Mean Square (MS)	F Value	F table (0,05)	Conclusion
Treatment	2	23.11	11.56	1.84	3.68	*H0 accepted*
Galat / error	15	94.00	6.27			
Total	17	117.11				

Based on Table 8, the analysis of the influence of elevation on the number of species shows that the null hypothesis (H0) is accepted. The lack of influence of elevation on the number of species may be due to the fact that certain plant species have been able to adapt and thrive well in their respective growing environments. This indicates that there are good interactions among the species within the forest community, as well as with other groups, forming a cohesive and integrated ecosystem.

Another possibility for the lack of influence of elevation on the number of species, in addition to the relatively close elevation intervals, is the high similarity index, indicating a tendency towards a high similarity of species. This could be attributed to the relatively similar environmental conditions between the compared locations. Since the calculation results do not indicate any influence of elevation on the number of individuals found, there is no need for further testing.

CONCLUSION

The species that are present at all three elevations for the pole vegetation are Madang puspa (*Schima wallichii*) and Jamai (*Instia* sp). Meanwhile, the species that are present at least in two elevations for the pole vegetation are Alaban (*Vitex pubescens*), Bangkal gunung (*Nauclea subdita*), Bati-Bati Menjangan (*Eugenia spicata*), and Jamai (*Instia* sp).

The distribution and abundance of species that can grow at all three elevations for the pole vegetation is Madang puspa (*Schima wallichii*) and Jamai (*Instia* sp), with a total of 15 individuals for Madang puspa (*Schima wallichii*) and 14 individuals for Jamai (*Instia* sp).

The diversity index and evenness index for the pole vegetation mostly fall within the moderate range, indicating moderate species diversity, ecosystem productivity, pressure on the ecosystem, and ecosystem stability. However, the overall evenness index is high, indicating that the forest community at the research location is in a balanced and relatively stable state.

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