BioEksakta: Jurnal Ilmiah Biologi Unsoed
Volume 6, Nomor 2 (2024): 59-64
DOI. 10.20884/1.bioe.2024.6.2.11671

Diversity of The Family Pandanaceae in The Sibayak II Forest Area, North Sumatra

Ayu Puspita*, Melfa Aisyah Hutasuhut , Rahmadina
Biology Study Program, Faculty of Science and Technology, Universitas Islam Negeri Sumatera Utara, Medan 20353, Indonesia
**Corresponding author*, Email: cantikaayu2909@gmail.com

Article History:
Submitted: 21/03/2024
Accepted : 10/05/2024

Abstract
Pandanaceae is a plant family which includes shrub, liana, and trees. This study aims to determine the types of members of the *Pandanaceae* family that grow in the Sibayak II Forest Area in North Sumatra with the diversity index. The method used in this research is an exploratory survey method with a purposive sampling with a quadrat plot technique with 10 plots measuring 10m x 10m. The results of this study showed that there were six species of *Pandanaceae*, namely *Freycinetia javanica* Blume, *Freycinetia sumatrana* Hemsl., *Freycinetia* sp., *Pandanus furcatus* Roxb., *Pandanus houletti* Carriere, and *Pandanus* sp. The diversity index of the *Pandanacaeae* is 2.504 which is classified as moderate. The identification key for the *Pandanaceae* was presented here. The *Pandanaceae* family is found in highland tropical forests with high rainfall and reproduces vegetatively under favorable environmental conditions..
Key Words: diversity, Family, *Pandanaceae*, Sebayak, North Sumatra

INTRODUCTION

Forests function as a source of energy reserves on earth and have an important role in controlling the weather and regulating various water cycles. Forests in Indonesia are tropical rainforests, home to a variety of flora and animals and have the most diverse and abundant ecosystems on the planet. It is estimated that Indonesia's tropical rainforest area is approximately 1,148,400 km2, making it the country with the largest tropical rainforest area (Anggraini, 2018). One of the government's efforts to protect diversity in Indonesia's forest areas is by preserving and protecting forests. One of the forests in Indonesia which is included in the protected forest is the Sibayak II Forest in North Sumatra (Nakita et al, 2022).

Sibayak II Protected Forest is a protected forest covering an area of 70,030 hectares and is located in the Grand Forest Park area of Karo Regency, North Sumatra. This includes Mount Sibayak as high as 2,094 meters, which is located in the Sibayak Protected Forest and stands tall above the surrounding ocean (Rhevia et al, 2018). Based on the results of observations made by researchers in the Sibayak II Forest Area, North Sumatra, it is known that there are quite a lot of rivers and springs and temperatures ranging from approximately 20˚C, so the forest has quite high humidity. In the Sibayak II forest you can also find various types of plants ranging from higher plants, namely pine (Pinus mercusii), areca nut (Areca catecu), ferns, Bryophyta, understory plants and plants of the Pandanaceae family.

In terms of geography, it stretches from the coast to the highest mountain peak. According to some estimates, there are up to 700 types. Currently there are five members of the genus belonging to the Pandanaceae family (Parinding, 2021). These members belong to the genus Freycinetia, which has more than 250 species and is distributed in Java, Sumatra and Maluku (Keim, 2017). The morphological characteristics of plants belonging to the Pandanaceae family are usually tree-shaped and woody. In addition, some varieties of this plant usually have a tap root, while other types of plants do not. The leaves look like stiff ribbons and are pointed at the edges. They are grouped in a spiral pattern. Flowers from the Pandanaceae family are usually small and unisexual or dioecious (Ulfa et al., 2023).

This research aims to determine the types of members of the Pandanaceae family that live in the Sibayak II Forest Area, North Sumatra, as well as the diversity index and key identification of these plant members.

MATERIAL AND METHOD

Materials and tools

The materials used in this research were 70% alcohol, newspapers, and samples of plants from the Pandanaceae family. The tools used are *Global Positioning System* (GPS), identification book, soil tester, thermohygrometer, lux meter, raffia rope, label paper, measuring tape, digital camera, plant scissors, plastic sample bag.

Methods

The method used in this research was survey method with purposive sampling techniques which was carried out by exploring, where there are famiy *Pandanaceae* members. The 10 plots of 10 m x 10 m subplots were established in the Sibayak II Forest Area, North Sumatra.

Data collection technique

Data was obtained using a survey method with a purposive sampling strategy to collect data directly on quadratic plots. Sampling was carried out in plots measuring 10 meters by 10 meters, totaling 14 plots, with a distance between each pair of plots of around 20 meters. Samples collected during the research were collected and identified with the help of a field guidebook. Next, the data is processed to obtain the Importance Value Index (IVI) of Tribal Plants *Pandanaceae* in the Sibayak II Forest Area located in North Sumatra

Research parameters

To obtain plant diversity results, an analysis of the data collected from the results of the investigation was carried out (Soerianegara and Indrawan, 1988):

1. Absolute Density (AD)

$$AD = \frac{\text{Number of individuals in the sample plot}}{\text{Total area of sample plots}}$$

2. Relative Density (RD)

$$RD = \frac{\text{Density of a species (D)}}{\text{Density of all species}} \times 100\%$$

3. Frequency (F)

$$F = \frac{\text{Number of plots where a species was found}}{\text{Total number of plots}}$$

4. Relative Frequency (RF)

$$RF = \frac{\text{Frequency of a species}}{\text{Total frequency of all types}} \times 100\%$$

5. Importance Value Index

$$IVi = RD + RF$$

Keterangan:
IVi = Important value index
RF = Relative density
RF = Relative Frequency

6. Diversity Indec (H)
To find out the diversity index, use the Shannon-Wiener equation as follows:

$$H' = -\Sigma\, Pi\, InPi$$

Keterangan:
H´ = Diversity index
Pi = Index of each type (ni/N)
ni = Number of individuals of a species
N = Total number of all individuals
Σ = Number of individual species

Family diversity indeks *Araceae*can be determined based on the following conditions, which are obtained based on the results of the diversity index calculation obtained:

If H < 1 indicates low species diversity

If H 1 ≤ 3 indicates moderate species diversity

If H > 3 indicates high species diversity

The data studied was tested using the Univariate ANOVA analysis test with the help of the SPSS application and if the variance had a real effect then the test was done using mean value analysis with the Duncan test treatment.

RESULTS AND DISCUSSION

Description of plant species of the Pandanaceae family

1. Freycinetia javanica Blume

Lives in epiphytic habitats, lianas (climbing), total length ranging from 500-600 cm, has Proproots, length ranging from 450-500 cm, diameter 1.5 cm, stem surface has auricles, visible auricle arrangement on the stem. The leaves are flexible, thick, and tough, the tip of the leaf is tapered, the edge of the leaf is spiked ± 0.1 cm, the upper and lower surfaces of the leaf are dark green, the length of the leaf is ± 10-15 cm, the width of the leaf is about 6-7 cm.

Figure 1. *Freycinetia javanica Blume*

2. Freycinetia sp.

Lives in epiphytic, liana (climbing) habitats, total length ranging from 600-700 cm. Does not have Proproots, 500-600 cm long, 0.5 cm in diameter, stem surface has auricles, visible auricle arrangement on the stem. The leaves are flexible, thin, and flat, the tip of the leaf is pointed, the edge of the leaf is spiked ± 0.01 cm, the upper and lower surfaces of the leaf are dark green, the length of the leaf is ± 30 cm, the width of the leaf is about 2-1 cm.

Figure 2. *Freycinetia* sp.

3. Ellipses Freycinetia sumatrana Hemsl.

Lives in epiphytic habitats, lianas (climbing), total length ranging from 700-800 cm, does not have Proproots, length ranging from 600-750 cm, diameter 2.5 cm, stem surface has auricles, visible auricle arrangement on the stem. The leaves are flexible, thin, and flat, the tip of the leaf is pointed, the edge of the leaf is spiked ± 0.2 cm, the upper and lower surfaces of the leaf are dark green, the length of the leaf is ± 25-35 cm, the width of the leaf is about 3-4 cm.

Figure 3. *Freycinetia sumatrana* Hemsl.

4. Pandanus furcatus Roxb.

Lives in terrestrial habitats, habit in the form of trees, grows upright, has a total height of about 300-400 cm, has Proproots, spiny and brownish in colour, 300-400 cm high, 9-10 cm in diameter, the surface of the stem shows traces of leaf mounts, brownish stems. The leaves are stiff, thick, pointed leaf tips, small spiny leaf edges, tight, light green in colour, very sharp spines, spines measuring ± 0.8 cm, the upper and lower surfaces of the leaves are solid green, the length of the leaves is about 150-300 cm, the width of the leaves is 8-9 cm.

Figure 4. *Pandanus furcatus* Roxb.

5. Pandanus houllettii Carriere

Lives in terrestrial habitats, shrubs, grows upright, total height of 100-200 cm, has no Proproots, height of about ± 100 cm, diameter 6-7 cm. Leaves are thin and flexible, leaf surfaces are smooth and reddish in colour, leaf margins are ± 0.4 cm spiny, the upper surface of the leaf appears darker and the lower surface of the leaf appears lighter, leaf length is about ± 80-120 cm, leaf width is about ± 7-8 cm.

Figure 5. *Pandanus houllettii* Carriere

6. Pandanus sp.

Lives in terrestrial habitats, trees, grow upright, have a total height of about 400-500 cm, have, spiny and brownish in colour, 10-12cm in diameter, the surface of the stem shows traces of leaf mounts, the stem is brownish in colour, the leaves are stiff, thick, leaf tips are pointed, the edges of the leaves have large spines, dark green in colour, the spines are very sharp, the spines are ±1 cm in size, the upper and lower surfaces of the leaves are solid green, the length of the leaves is about 200-300 cm, the width of the leaves is 10-12 cm.

Figure 6. *Pandanus* sp.

Key to Plant Identification of the Pandanaceae Family

Key to genus identification

1. Pandanus Genus
   Tree or shrub; has proproots in some species; lacks climbing roots; leaf margins are spiny; has thorns on back of leaves; lacks auricles.
2. *Freycinetia Genus*
   Liana; has proproots; has climbing roots; leaf margins without spines; has no spines behind leaves; has auricles..

Type Identification Key

1. a. Upright woody..... 2
   b. Liana..... 4
2. a, Shrub Habit..... 3
   b. Tree Habit..... *Pandanus* sp.
3. a. The surface of the proproots ispeckled ..... *Pandanus furcatus*
   b. No *proproots*.....*Pandanus houllettii*
4. a. Ellipses.....*Freycinetia javanica*
   b. Ribbon..... 5
5. a. Auricle lobed..... *Freycinetia sumatrana*
   b. Auricle curved..... *Freycinetia* sp.

The results of the Type Identification Key in accordance with the characteristics of plants of the Pandanaceae family are:: 2b. *Pandanus* sp., 3a. *Pandanus furcatus*, 3b. *Pandanus houllettii*, 4a. *Freycinetia javanica*, 5a. *Freycinetia sumatrana*, 5b. *Freycinetia* sp.

Table 1. Types of Plants in the Pandanaceae Family in the Sibayak II Forest Area, North Sumatra

Family	Type	Number of Individuals
Pandanaceae	*Freycinetia javanica* Blume	77
	Freycinetia sp.	22
	Freycinetia sumatrana Hemsl.	93
	Pandanus furcatus Roxb.	107
	Pandanus houllettii Carriere	61
	Pandanus sp.	78
Jumlah		438

Table 2. Plant Importance Index of 3the Pandanaceae Family

No	Type	D	RD%	F	RF%	IVI
1.	*Freycinetia javanica* Blume	0,77	17,579	1,4	19,719	37,298
2.	*Freycinetia* sp.	0,22	5,023	0.4	5,634	10,657
3.	*Freycinetia sumatrana* Hemsl.	0,93	21,233	1,4	19,718	40,951
4.	*Pandanus furcatus* Roxb.	1,07	24,43	1,7	23,944	48,373
5.	*Pandanus houllettii* Carriere	0,61	13,927	0,10	14,084	31,012
6.	*Pandanus* sp.	0,78	17,809	1,2	16,901	34,711
Amount		4,38		7,1		200,000

Types of Plants in the Pandanaceae Family in the Sibayak II Forest Area, North Sumatra

Based on research conducted in the Sibayak II forest area, North Sumatra, 6 types of plants from the Pandanaceae family were found as shown in (Table 1).

Based on (Table 1) the results of research in the Sibayak II Forest Area, North Sumatra, 2 genera from the Pandanaceae family were found, namely the Freycinetia clan and the Pandanus clan. The Freycinetia genus has vines (lianas) and has auricles on the leaf midribs. The Pandanus genus has the appearance of a bush or tree and has leaf fibers that are not clearly visible. A total of 438 individual plants belonging to the Pandanaceae family were collected from a total of 10 different plots. Pandanus Furcatus Roxb is a type of plant belonging to the Pandanaceae family and has a total of 107 individuals, making it the type of plant with the largest number of individuals. According to Purwanto & Esti (2010), the genus species of Pandanus and its diversity in Indonesia are relatively high, with an estimated diversity of around 450 species, many of which are spread throughout Indonesia.

The type of plant in the Pandanaceae family that has the lowest number of individuals is Freycinetia sp. which has a total of 22 individuals. This can happen because the conditions where it grows are attached to trees that are under 50 m high. In general, the Freycinetia sp. attached to trees that have a height above 50-60 m (Woersoek et al, 2022).

The variety of plant types in the Pandanaceae family in the Sibayak II Forest Area, North Sumatra is influenced by several factors, for example environmental conditions that support the living habitat of plants in the Pandanaceae family. Based on the environmental parameters that have been measured, it can be seen that the research location has a soil pH of 6, air humidity of around 40% with a temperature of around 20˚C. These conditions support the growth of the Pandanaceae family which lives in moist and watery habitats with high rainfall. Pandanaceae family plants require a natural habitat with high rainfall and fairly high air humidity (Marpaung, 2018).

Plant Importance Index of the Pandanaceae Family

The purpose of the Importance Value Index (IVI) is to identify the presence of a species in a community. Density, Relative Density, Frequency and Relative Frequency values, as well as Importance Value Index values were calculated for plants in the Pandanaceae family found in the Sibayak II Forest Area, North Sumatra. The results of this calculation are presented in (Table 2).

In (Table 2) it can be seen that there were 6 types of plants from the Pandanaceae family found in the research. The type that has the highest Relative Density (RD) value is Pandanus furcatus Roxb. with a value of 24%, while the type that has the lowest Relative Density (RD) value is Pandanus sp. with a value of 5%. According to Siregar et al (2021), the high or low Relative Density (KR) value of a plant type can be caused by the nature of the plant type in the Pandanaceae family itself and depends on natural changes that occur. Changing environmental factors can occur naturally, for example due to floods, landslides or earthquakes which can result in a decrease in temperature, humidity and soil nutrients, thereby disrupting the growth of certain types of plants.

The type that has the highest Relative Frequency (RF) value is Pandanus furcatus Roxb. with a value of 23.9%, while the type that has the lowest Relative Frequency (RF) value is Freycinetia sp. with a value of 5.6%. This is in line with research by Harahap et al (2021), which showed that the lowest Relative Frequency value was *Freycinetia* sp. with a value of 4.9%. The low Relative Frequency

Table 3. Plant Diversity Index of the Pandanaceae Family

No	Type	Pi	InPi	H’
1.	*Freycinetia javanica* Blume	0,176	-8,85	0,479
2.	*Freycinetia* sp.	0,050	-2,991	0,150
3.	*Freycinetia sumatrana* Hemsl.	0,212	-4,587	0,466
4.	*Pandanus furcatus*Roxb.	0,244	-7,782	0,593
5.	*Pandanus houllettii* Carriere	0,140	-5,342	0,370
6.	*Pandanus* sp.	0,178	-10,324	0,446
	Jumlah		-39,882	2,504

value of a plant type is because this type of plant is found less frequently at the research location. This could be caused by growth factors that do not support this type to grow and develop at the research location.

The Pandanaceae family plant that has the highest Importance Value Index (INP) is Pandanus furcatus Roxb., with a value of 48.3%. This can happen because of the number of Pandanus *furcatus* Roxb individuals. the highest of all types of the Pandanaceae family, namely 107 individuals. If a plant type has an Important Value Index (IVI) within the same vegetation scope, it is called the dominant type, while the type that has the lowest Important Value Index (IVI) is *Freycinetia* sp. namely with a value of 10.6%. The type that has the lowest Importance Value Index (IVI) indicates that this type has the fewest numbers or is rarely found in the research location (Sofyan, 2015). The Importance Value Index (IVI) is used to determine the dominance of species in the plant community studied. The greater the INP of a species, the more important the role of that species in the community (Harahap et al, 2021).

Plant Diversity Index of the Pandanaceae Family

The diversity index, which is often referred to as H', is a reference used to describe the overall level of diversity that exists in a community. The diversity index is used to find out how many types of plants there are in the forest. According to Sriastuti et al (2018), the amount of diversity or the number of species that can be found increases in proportion to the diversity value of a species. It can be seen in (Table 3) that the results of the calculations used to determine the Plant Diversity Index of the Pandanaceae family in the Sibayak II Forest Area located in North Sumatra are presented.

In (Table 3) it can be seen that the diversity index value for plants in the Pandanaceae family in the Sibayak II Forest Area, North Sumatra is 2.504, which indicates that the diversity of plants in the Pandanaceae family is classified as moderate. This is due to the results of observation data calculations which show that the value of the diversity of plant species in the Pandanaceae family as a whole at the observation location is at a value less than ($1 \leq H' \leq 3$), which means that the value of the Diversity Index for plants in the Pandanaceae family in the Sibayak II Forest Area of North Sumatra in the 6 types of Pandanaceae are classified as low, because the Pandanaceae family requires a natural habitat with high rainfall and high air humidity (Marpaung, 2018).

The values obtained from the Diversity Index calculations refer to the categories determined by Shannon-Wiener. According to the Shannon-Wiener determination, there are 3 categories in the level of diversity, namely if the value of $H' < 1$ indicates that species diversity is low, if the value ($1 \leq H' \leq 3$) indicates that species diversity is moderate, and if the value of $H' > 3$ indicates that diversity high type (Adelina et al., 2016).

CONCLUSION

There were 6 types of plants in the Pandanaceae family in the Sibayak II Forest Area, North Sumatra, namely Freycinetia javanica Blume, Freycinetia sp., Freycinetia sumatrana Hemsl., Pandanus furcatus Roxb., Pandanus houllettii Carriere, Pandanus sp. The total number of individual plants from the Pandanaceae family obtained from 10 plots was 438 individuals. The diversity index for plants in the Pandanaceae family in the Sibayak II Forest Area, North Sumatra for 6 types of plants in the Pandanaceae family is as many as 10 plots with a diversity index (INP) of 2.504, which shows that the species diversity in each plot is classified as moderate. The key to identifying plants in the Pandanaceae family in the Sibayak II Forest Area, North Sumatra, shows that the general characteristics and characteristics in the field are the same, such as the Freycinetia genus having liana bodies and the Pandanus genus having tree or bush bodies.

REFERENCES

Adelina, M., Harianto, S. P., & Nurcahyani, N. 2016. Keanekaragaman jenis burung di hutan rakyat pekon kelungu kecamatan kotaagung kabupaten tanggamus. *Jurnal Sylva Lestari*, *4*(2), pp. 51-60.

Anggraini, W. 2018. Keanekaragaman hayati dalam menunjang perekonomian masyarakat Kabupaten Oku Timur. *Jurnal Aktual*, *16*(2), pp. 99-106.

Harahap, E. W. N., Manalu, K., & Hutasuhut, M. A. 2021. Analisis Vegetasi Tumbuhan Liana Di Gunung Sibuatan Desa Nagalingga Kecamatan Merek Kabupaten Karo Sumatera Utara. *KLOROFIL: Jurnal Ilmu Biologi dan Terapan*, *5*(1), pp. 15-22.

Keim, A. P. 2017. Flora pandan Kawasan Semende, Muara Enim, Sumatera Selatan. *Indonesian Journal of Biotechnology and Biodiversity*, *1*(2).

Marpaung, D. R. A. K. 2018. Hubungan Kekerabatan 8 Spesies Marga Pandanus Berdasarkan Karakter Morfologi dan Anatomi. *Jurnal Education and Development*, *6*(1), pp. 47-47.

Nakita, C., & Najicha, F.U. 2022. Pengaruh deforestasi dan upaya menjaga kelestarian hutan di Indonesia. *Ius Civile: Refleksi Penegakan Hukum dan Keadilan*, *6*(1), pp. 92-103.

Parinding, Z. 2021. Identifikasi Jenis-Jenis Pandanaceae Di Pulau Pepaya Pada Kawasan Taman Nasional Teluk Cenderawasih (Identification of Pandanaceae Types in Pepaya Island in The National Park Areas of Teluk Cenderawasih). *SCIENCE: Jurnal Inovasi Pendidikan Matematika dan IPA*, *1*(1), pp. 13-18.

Purwanto. Y., dan Esti, M. 2010. Etnobotani jenis-jenis Pandanaceae sebagai bahan Pangan di Indonesia. *Jurnal Hayati Edisi Khusus*, 5A : pp. 97-98.

Rhevia, G., Affandi, O., & Rahmawaty, R. 2014. Aplikasi Sistem Informasi Geografis Untuk Pemetaan Sebaran Potensi Alam Dan Pemanfaatan Lahan Hutan Lindung Sibayak II Taman Hutan Raya Bukit Barisan. *Peronema Forestry Science Journal*, *3*(2), 162646.

Siregar, A. A., Manalu, K., & Hutasuhut, M. A. 2021. Struktur Dan Komposisi Tumbuhan Bawah Dengan Variasi Ketinggian Di Gunung Sibuatan Desa Nagalingga Kecamatan Merek Kabupaten Karo Sumatera Utara. *KLOROFIL: Jurnal Ilmu Biologi dan Terapan*, *5*(2), pp. 73-82.

Sofyan, M. Z. 2002. Analisis Vegetasi Pohon Di Hutan Salagomo. *Tesis.* Sarjana Biologi. FMIPA UNAND. Padang.

Sriastuti, W., Herawatiningsih, R., & Tavita, G. E. 2018. Keanekaragaman jenis tumbuhan yang berpotensi sebagai tanaman hias dalam kawasan IUPHHK-HTI PT. Bhatara Alam Lestari di Desa Sekabuk Kecamatan Sadaniang Kabupaten Mempawah. *Jurnal Hutan Lestari*, *6*(1).

Ulfa, S. W., Marhamah, A., Rahayu, P., & Aqmarina, T. N. 2023. Identifikasi Ciri Morfologis Tumbuhan Tingkat Tinggi pada Ordo Berbeda Di Kampus II UIN Sumatera Utara. *Biosfer: Jurnal Biologi dan Pendidikan Biologi*, *8*(2), pp. 154-164.

Woersoek, M. M., & Wanma, B. I. S. 2022. Keanekaragaman Tumbuhan Karakdop (Freycinetia) di Kampung Mindiptana Distrik Mindiptana Kabupaten Boven Digoel. *Jurnal Kehutanan Papuasia*, *8*(2), pp. 373-382.