

Morphological differentiation of Pitcher Plant (*Nepenthes singalana*) in Mount Kerinci and Mount Singgalang

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Abstract-- *Nepenthes* is a protected plant species and most of the highland *Nepenthes* species are classified as threatened. The growth and development of *Nepenthes* is influenced by abiotic and biotic factors in its habitat. This study was conducted with a survey method by determining the point of observation carried out purposively with a number of points as many as 4 points in each location. Furthermore, measurements of several morphological characters and leaves *N. singalana*. Based on the results of the Mann Whitney U test obtained several different morphological characters, the top bag obtained by five morphological characters that are different from nine characters tested. Whereas in the bottom bag there are only two different morphological characters than the 10 morphological characters tested.

Keywords-- Morphology, *Nepenthes*, *N. singalana*.

I. INTRODUCTION

Nepenthes is one of the carnivorous plants in the largest genus of the monotypic family *Nepenthaceae*. These plants are climbers, some live on the ground, and some are attached to the trunk or twigs of other trees. There are 82 species of *Nepenthes*. Most of these species are endemic to Malesia (Malaysia, Indonesia, Papua New Guinea, Philippines) [3]. It was noted that until 2012, the number continued to increase to 139 species and most of them live and grow in Indonesia, which 68 species and 59 species are endemic. In Indonesia, most are found in Sumatra (34 species) and Kalimantan (22 species) the rest are scattered in Java, Sulawesi and Papua [9]. One of the species found in Indonesia is *N. singalana* which until now is only found in West Sumatra and Jambi. The habitat of *N. singalana* is on mountain ridges with elevations ranging from 2,000 – 2,900 meters above sea level. Usually this species grows terrestrially on mountain tops in open areas or epiphytes in mossy forests [1].

Nepenthes grows in a variety of habitats from the lowest altitude to 3.000 masl. In addition, the distribution of *Nepenthes* in the Malesia area is spread in the wet tropics with high humidity. Until 2012, the number continued to increase to 139 species and most of them live and grow in Indonesia, namely 68 species and 59 species are endemic. In Indonesia, mostly there are 34 species in Sumatra and 22 species in Kalimantan, the rest are scattered in Java, Sulawesi and Papua [9].

Based on the total population and habitat conditions, 17 Sumatran *Nepenthes* species are categorized as threatened species, seven of which are classified as Critically Endangered, four species are classified as Endangered, and six species are classified as Vulnerable [7]. *N. singalana* is one of the species which is included in the Vulnerable category, Appendix II and included in a protected plant based on Ministerial Regulation Number 20 year 2018 which also requires attention and protection for its existence.

One species contained in Indonesia is *N. singalana* which is only found in the territory of Sumatra and West Jambi. Habitat *N. singalana* is on the ridge of the mountain with a height starting at 2,000 - 2,900 masl. Usually growing terrestrial at the top of the mountains in an open area and can also grow the epiphith in the forest Mossy [1]. *N. singalana* is limited to the spread of nature so that attention is better considering that the existence of *nepenthes* in the world also threatens naturally and with human intervention

because it is in the location of the mountains which can someday eruption and besides the location that the tourist area will indirectly be disturbed due to human existence. One way to preserve this plant is to grow that requires a combination of appropriate environment variables. One of them by looking at morphology development *N. singalana* so this process can be done and the maximum results are obtained. This study focused on the morphological studies of highland nepenthes, namely *N. singalana* in Sumatra is on the path of climbing Mount Kerinci and Mount Singgalang which is very vulnerable to environmental changes due to contact with human activities.

II. METHODS

A. Study Area

The research was carried out from April to May 2019. Two sampling locations used were Mount Singgalang, West Sumatra which is included in the Singgalang-Tandikat Nature Reserve area and Mount Kerinci, Jambi which is within the Kerinci Seblat National Park (TNKS). The forest type in the Mount Singgalang and Mount Kerinci areas based on their altitude (ranged from 1,100-3,800 masl) are mixed forest (800-1,400 masl), mountain forest (1,400-1,900 masl), upper mountain forest (1,900-2,400 masl) and sub alpine (>2,400 masl).

B. Sampling Methods

This study was conducted with a survey method by determining the observation point carried out purposively with a number of plots as much as four points in each location and then measurements of pitchers and leaves morphology (Fig.1). In addition, observations are carried out on each plot of environmental factors (altitude, temperature, humidity, light intensity, canopies, soil chemical levels such as environmental factors C, N and PH) that support nepenthes growth.

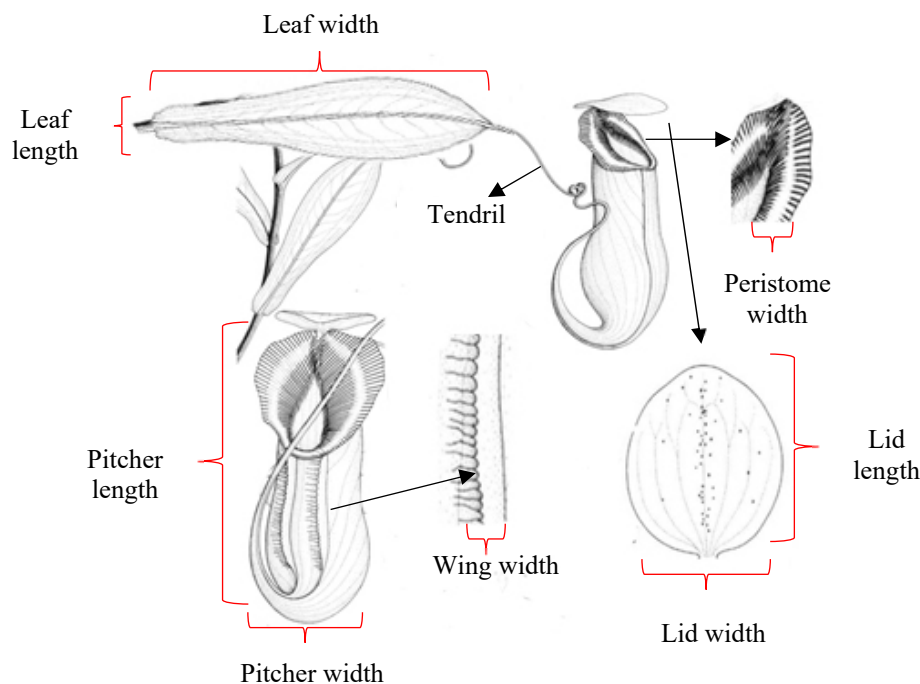


Fig. 1. Morphological measurment of *N. singalana*

C. Data Analysis

Morphological data was analyzed using the Mann Whitney U test to find out significantly different morphological characters ($P < 0.05$) of two research locations.

III. RESULT AND DISCUSSION

N. singalana in both research locations was found at an altitude of 2,692-2,859 masl, the air temperature between 13.9-18 °C, air humidity ranges from 70-90%, soil pH 4.49-5.56 and the average canopy cover of 68%. *N. singalana* included the type of

nepenthes highland found at 2,000-2,900 masl [3]. Some studies in the highland such as Mount Kinabalu and Tambuyukon, *Nepenthes* were found to grow terrestrial with pH ranging from 4.4-7.7 [8]. As for lowland areas such as peat areas, *Nepenthes* can grow at pH 4-6.5 [12]. In addition, in research conducted in Lore Lindu National Park at 17.00-1,900 masl has a humidity of 77-85% and at a minimum temperature of 12-17 °C and a maximum temperature of 26-36 °C [13].

TABLE 1. THE RESULTS OF MANN WHITNEY U TEST BETWEEN UPPER PITCHER *N. SINGLANA* MOUNT SINGGALANG AND MOUNT KERINCI

No.	Morphology	Kerinci (n=14) (mm)	Singgalang (n=11) (mm)	P
1	Pitcher height	93.71±17.84	160.36±24.58	0*
2	Pitcher width	25.77±4.63	28.18±4.06	0.244ns
3	Leaf length	149.64±15.12	133.27±26.58	0.095ns
4	Leaf width	30.63±3.25	34.94±7.31	0.344ns
5	Lid length	30.71±5.85	37.13±6.56	0.058ns
6	Lid width	30.29±5.99	40.35±6.57	0*
7	Peristome	5.38±6.86	6.76±2.15	0*
8	Tendrill	154.02±52.19	287.27±31.81	0*
9	Pitcher volume	28.93±11.17	55.91±10.95	0*

* : Significant
ns : Non significant

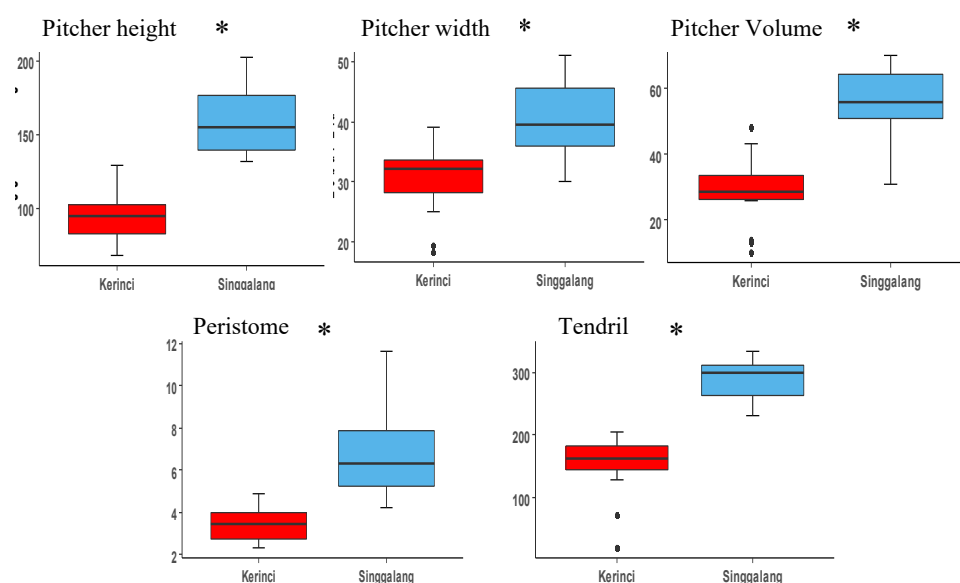


Fig. 2. Upper pitcher significant characters comparison boxplot

Mann Whitney U Test has also been carried out between *N. singalana* on Mount Singgalang with *N. singalana* in Mount Kerinci, between open vegetation and closed. In addition, analysis of Mann Whitney U Test was also carried out between Upper Pitcher and Lower Pitcher. It aims to determine the differentiation between the lower pitcher and top pitcher.

The results of Mann Whitney U Test against the upper pitcher of *N. singalana* found in Mount Singgalang with *N. singalana* found in Mount Kerinci there are 5 differentiated characters significantly ($P < 0.05$) of 9 characters tested (Table 1 and Fig 2). The character is significantly differentiated, namely, pitcher height, lid width, peristome, tendril and pitcher volume.

TABEL 2. THE RESULTS OF MANN WHITNEY U TEST BETWEEN LOWER PITCHER *N. SINGLANA* MOUNT SINGGALANG AND MOUNT KERINCI

No.	Morphology	Kerinci (n=8) (mm)	Singgalang (n=7) (mm)	P
1	Pitcher height	100.49±27.11	133.86±30.54	0.072ns
2	Pitcher width	31±9.25	31.72±7.46	0.955ns
3	Leaf length	181.63±27.31	145.71±13.39	0.009*
4	Leaf width	41.63±6.38	37.24±4.64	0.121ns
5	Lid lenght	43.23±18.28	45.07±10.43	0.779ns
6	Lid width	43.93±17.56	44.28±9.04	0.955ns
7	Peristome	6.94±1.86	11.57±1.81	0*
8	Tendril	178.38±49.39	186±29.02	0.536ns
9	Pitcher volume	5.19±36.13	60.29±23.12	0.694ns
10	Wing width	3.80±1.49	11.8±19.95	0.613ns

* : Signifikan
ns : Tidak Signifikan

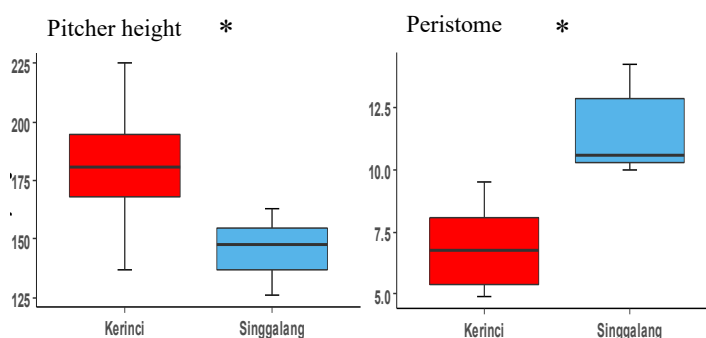


Fig. 3. Lower pitcher significant characters comparison boxplot

Mann Whitney U Test between lower pitcher *N. singlana* Mount Singgalang and Mount Kerinci, there are only two real differentiated characters, namely the Character of Leaves and the rest of the remaining $P > 0.05$ value which means not significantly different from the 10 characters tested. As for the character that is not significantly different is a pitcher height, leaf width, lid lenght, lid widht, tendril, pitcher volume and wing width (Table 2 and Fig. 3).

Mann Whitney U Test Result shows that the volume of bags is not significantly different but for high and wide size can be different. So it's natural that the canopy differs its influence on height and width on the pitcher. Lower Pitcher has a wider size on a larger canopy, this is related to its function to capture prey, which is generally prey in the lower area has a size greater than the prey in the upper area [4,11]. There are many environmental factors that affect the size of the character of the morphology of nepenthes including the intensity of light, temperature, humidity and soil nutrients [6,5,2].

IV. CONCLUSION

N. singalana was found in Mount Singgalang and Mount Kerinci at a height starting from 2600-2900 Masl. Based on the results of the Mann Whitney U Test obtained several different morphological characters, namely the upper pitcher obtained as many as five morphological characters that are different from nine characters in the test. Whereas in Lower Pitcher there are only two different morphological characters of the 10 morphological characters tested.

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REFERENCES

- [1] Clarke, C. 2001. *Nepenthes of Sumatra and Peninsular Malaysia*. Natural History Publications (Borneo), Kota Kinabalu
- [2] Clarke, C. and J.A Moran. 2015. Climate, soils and vicariance - their roles in shaping the diversity and distribution of *Nepenthes* in Southeast Asia. *Plant Soil*, 403: 37-51.
- [3] Jebb, M.H.P. & M. Cheek. 1997. A Skeletal Revision of *Nepenthes* (Nepenthaceae). *Blumea* 42 (1).
- [4] Gaume L, Bazile V, Huguin M, Bonhomme V. 2016. Different pitcher shapes and trapping syndromes explain resource partitioning in *Nepenthes* species. *Ecol Evol* 6 (5): 1378-1392.
- [5] Givnish, T.J., E.L. Burkhardt, R. Happel., and J. Weintraub. 1984. Carnivory in the bromeliad *Brocchinia reducta*, with a cost/ benefit model for the general restriction of carnivorous plants to sunny, moist, nutrient-poor habitats. *Am Nat*, 124:479-497
- [6] He, J., and A. Zain. 2012. Photosynthesis and Nitrogen Metabolism of *Nepenthes alata* in Response to Inorganic NO₃- and Organic Prey N in the Greenhouse. *ISRN Botany*, 4:1-8.
- [7] Hernawati, Akhriadi P. 2006. *A Field Guide to the Nepenthes of Sumatera*. Padang: PILI-NGO Movement, *Nepenthes Team*, BP Conservation Programme. Conservation International-Indonesia.
- [8] van der Ent A., Sumail S., Clarke C. 2015. Habitat differentiation of obligate ultramafic *Nepenthes* endemic to Mount Kinabalu and Mount Tambuyukon (Sabah, Malaysia). *Plant Ecol*.
- [9] Mansur, M. 2013. *Tinjauan Tentang Nepenthes (Nepenthaceae) di Indonesia*. *Berita Biologi*. 12(1).
- [10] Magurran, A.E. 2004. *Measuring Biological Diversity*. Blackwell Publishing: Oxford University.
- [11] Moran, J.A. 1996. Pitcher dimorphism, prey composition and the mechanism of prey attraction in the pitcher plant, *Nepenthes rafflesiana* in Borneo. *Journal of Ecology*, 84:515-525.
- [12] Lestariningsih, N., and D. Setyaningsih. 2017. Explorative study of tropical pitcher plants (*Nepenthes* spp.) types and insects that trapped inside in Sebangau National Park, Palangka Raya, Central Kalimantan. *Journal Physics: Conference Series*, 795: 1-8.
- [13] Saleh, M.F.R.M., Miswan, Pitopang R., 2018. Autekologi *Nepenthes Pitopangii* Lee. Di Kawasan Taman Nasional Lore Lindu Sulawesi Tengah. *Online Jurnal of Natural Science*, Vol. 2 (2): 8-18