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# Species richness, distribution, and phenotype relationship of bamboos in Kecubung Ulolanang Nature Reserve (KUNR) on Batang

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Abstract. Bamboos have various benefits and disadvantages. Research on bamboo in KUNR has never been done, so there is a need for research related to species richness, distribution, and kinship relationships. The purposes of this research were to identify species and determine bamboos kinship relationships. Research is useful to provide information of Bamboos in KUNR to the community, BKSDA of Central Java, and subsequent researchers. The data collection method uses the observation method. Species and number of individual data were analyzed qualitatively and quantitatively, determine descriptions, weights at each OTUs, analyzed Margalef species wealth index, Pearson correlation and Cluster analysis. Types of bamboos found included: Gigantochloa apus, Bambusa blumeana, Bambusa vulgaris var. vulgaris, Bambusa vulgaris var. striata, Gigantochloa atriviolaceae, Dendrocalamus asper, Schizostacyum sp, and Schizostachyum silicatum. The bamboo species wealth index in all PALs falls into the bad category, because it has a value of <2.5. The closest bamboos kinship is Bambusa vulgaris var. vulgaris with Bambusa vulgaris var. striata, while the furthest is Bambusa blumeana with Bambusa vulgaris var. vulgaris and Bambusa vulgaris var. striata.

#### 1. Introduction

Bamboo plants have many uses in the community, both in agriculture, household utensils, buildings, and even ecologically useful for the environment of soil, water, and air [1]. Some kinds of bamboos have the allelopathic substances, so, it can repel the other kind of plants, especially if they are around local plants that are most protected in a conservation area, the examples are Apus Bamboo (Gigantochloa apus) [2], and Betung Bamboo (Bambusa vulgaris var. vulgaris) [3].

Apus Bamboos in Kecubung Ulolanang Nature Reserve (KUNR) have been shown to inhibit are growth the conservation priority species, Plahlar (Dipterocarpus gracilis) at sapling level [4]. Bamboo with all its uses and disadvantages is part of diversity, therefore species richness and fenotipe relationship of its species needs to be understood. Until now, an inventory of the diversity of bamboo species in KUNR have never been carried out [4], so there is need for research related to species richness and kinship of bamboo in KUNR.

The bamboo is origin from *Bambusoideae* subfamily, and including in the *Poaceae* family [5]. The parts which can characterize the genera and species of bamboos are stem, branches, stem midrib, and clinging leaves [6].

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## 2. Methods

Data collection techniques in this research used the observation (survey) method in the KUNR areas which there are bamboo plants. This research area namely Phase Alternation Line (PAL), whereas the PAL area where the bamboos were located are on 66 PALs from 92 PALs that available in KUNR. The number of PAL area where the bamboos were located are PAL 8, 9, 10, 11, 12, 13, 19, 20, 21, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 41, 42, 44, 45, 46, 47, 48, 49, 50, 51, 52, 54, 55, 56, 57, 59, 60, 61, 62, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 86, 87, 88, 89, 90, 91, and 92 (See on the Figure 1).



Figure 1. The number of PAL area where the bamboos were located in KUNR (Adriani., 2020).

The PAL areas there are bamboos were marked by mark bend. In each PAL, each bamboo clump that was found is recorded about its local name, and determines its coordinates using GPS. The calculation of kinds and number of individuals of bamboos are based on waypoint track of each which is recorded in datasheet. Next, on each clump that was known of its local name is recorded its morphology characteristic, that can be distinguishing and equalization characteristics between each bamboos species. Identification of bamboo is based on identification book, namely *Plant Resources of South – East ASIA 7, PROSEA*. As supporting data, for each PAL where bamboo clumps are found, the abiotic environmental factors are measured. The abiotic environmental factors are temperature, air humidity, soil pH, soil humidity, light intensity, which conducted on different days, different places, and in time range between 08.00 until 10.00 WIT (Western Indonesian Time).

## 3. Results and Discussion

Based on the research result about bamboos in KUNR of 69.7 hectares with 92 PALs, found as many 4 genera with 8 species. That 4 genera covers of *Gigantochloa, Bambusa, Dendrocalamus,* and *Schizotachyum*. The 8 species from 4 genera can be seen in Table 3. The Latin names of each type of bamboo in Table 1 are taken from a valid source of bamboo taxonomy book, namely *Prosea* 7 [7].

Local Name of Species	Latin Name of Species
Apus (Tali) Bamboos	Gigantochloa apus (J.A. & J.H. Schultes) Kurz
Tembelang Bamboos	Schizostachyum sp.
Wulung / Black Bamboos	Gigantochloa atroviolaceae Widjaja
Ampel Bamboos	Bambusa vulgaris var. vulgaris Schrader ex Wendland
Gading Bamboos	Bambusa vulgaris var. striata (Lodd. ex Lindley) Gamble
Ori Bamboos	Bambusa blumeana J.A. & J.H. Schultes
Betung Bamboos	Dendrocalamus asper (Schult f.) Backer ex Heyne
Wuluh Bamboos	Schizostachyum silicatum Widjaja

Table 1. The kinds of bamboos in KUNR Batang

The fundamental difference between the 4 genera of bamboos based on the type of branch, which are on the genus of *Gigantochloa*, *Dendrocalamus*, *Bambusa* have a *Polykotom unequal* branch type, that is one branch bigger from the other, and also have an air roots on its nodes, while does not in the genera of *Schizostachyum*, it has *Polykotom equal* branch type, that is the size of the branches is the same [8]. The diagnosis descriptions of each bamboo species in KUNR are shown in table 2 below.

Table 2.	The diagn	osis desci	riptions o	f each l	bamboo	species	in KU	JNR	are shown	in Tab	le 2 below.

Local name	The thew of each species
Apus (Tali)	Scrambling growing type, dull dark green stem with the black little hairs, has
Bamboos	small and folded back midrib leaves with width: $2 - 3$ cm, and height: $5 - 6$ cm.
Tembelang	Have dull dark green stem with an ivory white ring on top and a pure white
Bamboos	below the node, have a light brown <i>slumpring</i> with white edges on each side
	and has brown streaky hair on abaxial, midrib width: 13 cm, and $7 - 8$ cm high.
Wulung Bamboos	Stem color is black.
Ampel Bamboos	<i>Erect</i> growing type, has the bright dark green stem without hairs on their surface.
Gading Bamboos	Have yellow stem with a green stripe around the waist (Figure 2e, boxed in red).
Ori Bamboos	Have 2 branches with the spines on each node (Figure 1g, circled in yellow),
	has very small leaf size (widht: $2 - 2.5$ cm, length: $4 - \langle 25$ cm, boxed in red).
Betung Bamboos	The circumference of the stem is very large with bright dark green color, that is
	> 40 cm, there are air roots in the nodes, <i>slumpring</i> leaves are upright, narrow,
	and long, width: $2 - 3$ cm, and height: $10 - 15$ cm.
Wuluh Bamboos	The circumference of the stem just in < 10 cm, the width of <i>slumpring</i> leaf just

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#### in 2-3 cm, long: 10-15 cm, and folded back.

The pictures of the eight types of bamboos found in KUNR based on the main characteristics of the eight types of bamboos are as shown in figure 2 below.



**Figure 2.** Eight types of bamboos that found in KUNR; (a): Apus Bamboo, (b): Tembalang Bamboo, (c): Wulung Bamboo, (d): Ampel Bamboo, (e): Gading Bamboo, (f): Betung Bamboo, (g): Ori Bamboo, (h): Wuluh Bamboo. (Source: Doc. Adriani, 2020).

The results of the analysis showed that the bamboo species richness index  $(D_{mg})$  in all PAL was in the bad category, because there is no number is more than number 4, all number is under 2.5. As many as 49 PALs from 66 PALs that contained bamboo had a 0 score of  $D_{mg}$  value, this happened because in 49 PALs there was only 1 type of bamboo, even though the number of individuals PAL was more than 200 individuals. One individual in this analysis is one clump of bamboo. The highest  $D_{mg}$  value was found in PAL 66, that is 0.868, where on that PAL there were 3 types of bamboos, with the total of individuals are 10. A high Dmg value was found in a high number of the species total, while a low Dmg was found in PAL which had a low number of species total. More high the number of species, and more slight the number of individuals in a PAL, then, more high the  $D_{mg}$  value in a PAL. According to theory, this is because the species richness index is influenced by sample size (number of species of individuals) and the time it takes to achieve it. Here is a list of 18 PALs that have a Dmg greater than 0 in Table 3 below.

						 e	-	_			-		
PAL	$D_{mg}$	PAL	$D_{mg}$	PA	L D <sub>mg</sub>	PAL	$D_{mg}$		PAL	$D_{mg}$		PAL	$D_{mg}$
66	0,868	88	0,501	20	0,402	 47	0,291	-	32	0,247	-	25	0,213
48	0,593	30	0,472	34	0,352	51	0,283		87	0,240		26	0,198
62	0,522	90	0,455	33	0,345	79	0,251		86	0,221		27	0,187

**Table 3.** List of PALs that have a  $D_{mg}$  value greater than 0

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Distribution maps will be very useful and can be a guide to describe the whereabouts of a plant species in an area (see figure 1) [9]. Distribution is strongly influenced by environmental factors which determine the tolerance limit for each species in a habitat. Each organism has tolerance ranges for each environmental factor and has a preference for each environmental factor [10], the species of bamboo that has the widest tolerance range is Apus bamboo, because it grows in almost every PAL (62 PALs) with a very large number of individuals (2593 clumps), and can live in conditions of environmental factors that have span quite a distance, while the species of bamboo that has high levels of the lowest tolerance are Wulung Bamboos and Gading Bamboos, because each were spread over 1 PAL with 1 clump only.

Apus bamboo can live on light intensity in range 29 - 1935 Lux, temperature  $22 - 44^{\circ}$ C, air humidity 4 - 74%, soil humidity 21-75% at any altitude (86 - 254 masl), and at regardless of topography, either: flat (0% - 8%), sloping (8% - 15%), rather steep (15% - 25%), steep (25% - 45%), and very steep (45%), soil pH 6.9, soil humidity 30%, and just found in PAL 88, on high altitude of 249 masl, grows together with Betung at the same location. While, Gading bamboo only can live on light intensity of 245 Lux, temperature of  $28^{\circ}$ C, air humidity 67%, soil pH of 7, soil humidity of 50%, at PAL 30, precisely on the riverbank at 38 masl altitude. Based on that data of environmental factor, most likely what happens is KUNR area is the most optimal habitat for growth of Apus bamboo, and not the optimal habitat for growth of Gading and Wulung bamboo. Based on the literature, Gading bamboo just found at lowland on 21 masl of altitude [11]. Every plant species need suitable environmental conditions for life, growth, and thrive, so that the requirements for its life [12].

The last result of Pearson correlation and Cluster analysis are a phenogram that connects 2 or more taxon into one small or large group, as in Figure 3 below.



Figure 3. The phonogram, the last result of Pearson correlation and Cluster analysis.

Based on the phonogram above, the closest or strongest level of taxon relationship is shown by the taxon of species D with E. While, on species A with C taxon have a moderate taxon relationship level, and the other taxon group have low level of taxon relationship. The taxon groups that has the farthest or weakest level of taxon relationship in a row from the first weakest are A-C-G-B-H with D-E-F, A-C-G, with B-H, D-E with F, A-C with G, and taxon B with H. Score of r which unites between taxons, either the taxon which have the strong, moderate, and weak taxon relationship, are determined based on the existence of several similarities in characteristics between taxon which are calculated through Cluster analysis [13].

Taxon D and E have 29 similarities in characteristics because they are origin from 1 species and just them variations that are different, taxon A and C have 23 similarities in characteristics, taxon D, E, F have 21 similarities in characteristics because they are origin from the same genus, taxon B and H have 17 similarities in characteristics, taxon A, C, G have 16 similarities in characteristics. Taxons that

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have closest relationship also have closeness or similarity in term of use, such as Ampel Bamboo (*Bambusa vulgaris* var. *vulgaris*), Gading Bamboo (*Bambusa vulgaris* var. *striata*), Ori Bamboo (*Bambusa blumeana*) that are often used by Indonesians as one of the building constituents (house roofs, house floors), while the genus *Schizostachyum* is often used as basic material for *Angklung*, Aerophones ("*Kan*" or "*Sompolan*") [7,14]. Based on the research result from [15] and [16] leaf of Apus and Ampel bamboos can use for bio herbicide against weeds.

### 4. Conclusion

There are 8 species of bamboos found in KUNR, covers of *G. apus, B. blumeana, B. vulgaris* var. *vulgaris*, *B. vulgaris* var. *striata, G. atriviolaceae, D. asper, Schizostachyum* sp, and *S. Silicatum*. The richness index value ( $D_{mg}$ ) of bamboo in all PALs include in bad category, where the highest value of  $D_{mg}$  is present in PAL 66, which is 0,868. The closest taxon relationship of bamboo is *Bambusa vulgaris* var. *vulgaris* (Ampel Bamboo) with *Bambusa vulgaris* var. *striata* (Gading Bamboo), while the most distant taxon relationship of bamboo is *Bambusa blumeana* (Ori Bamboo) with *Bambusa vulgaris* var. *vulgaris* and *Bambusa vulgaris* var. *striata*.

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