

## Bamboo diversity in Weh Island, Aceh, Indonesia

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**Abstract.** Ritonga MA, Syamsuardi, Nurainas, Damayanto IPGP. 2023. Bamboo diversity in Weh Island, Aceh, Indonesia. *Biodiversitas* 24: 2563-2576. Bamboo is an important plant resource in Indonesia, whose inventories were mostly conducted on the main islands. In contrast, the inventory for small islands, such as Weh Island in Northern Sumatra, has never been done. Weh Island, however, is an atoll island that has been raised above sea level and is suspected to have a unique diversity of flora, especially bamboo. This study aimed to understand the diversity of bamboo on Weh Island. Fieldwork was conducted in August-September 2022 in Weh Island, Aceh, Indonesia. Bamboo specimens were collected by collecting flora diversity method and deposited in Herbarium Andalas and Herbarium Bogoriense. Morphological characteristics were observed to identify and arrange species descriptions and as a determination key. The spatial distribution of bamboo was analyzed using QGIS software and overlaid with a land cover and altitude map. We also performed a similarities analysis using morphological characteristic. There are eight species of bamboo on Weh Island: *Bambusa multiplex* (Lour.) Raeusch. ex Schult.f., *Bambusa spinosa* Roxb., *Bambusa tuldooides* Munro, *Bambusa vulgaris* Schrad. ex J.C.Wendl., *Dendrocalamus asper* (Schult.f.) Backer, *Schizostachyum brachycladum* (Kurz ex Munro) Kurz, *Schizostachyum silicatum* Widjaja, and *Thyrsostachyum siamensis* Gamble. *B. vulgaris* is most abundant and widespread on Weh Island; meanwhile, *B. multiplex* and *B. tuldooides* are the least common. The presence of *S. silicatum* on Weh Island and Bangka Island was additional information on the expansion of these species distributions outside the mainland of Sumatra. Bamboos on Weh Island were found around settlements, plantations, and forests at 1 to 212 m asl. Bamboo species on Weh Island can be clustered into four groups based on their morphological characteristics.

**Keywords:** Bambusoideae, diversity, Poaceae, Sabang, spatial distribution

**Abbreviations:** ANDA: Herbarium Andalas; BM: The Natural History Museum; BO: Herbarium Bogoriense; GOET: Herbarium of Universität Göttingen; K: Herbarium Royal Botanic Garden Kew; MVSP: Multi-Variate Statistics Package; UPGMA: Unweighted Pair Group Method with Arithmetic Mean; QGIS: Quantum Geographic Information System

### INTRODUCTION

Woody bamboo belongs to the Poaceae family and is the sub-family of Bambusoideae (Zhou et al. 2017). Generally, bamboo has cylindrical, hollow, and segmented culms and is covered with sheaths (Widjaja 2001). Bamboo nodes bear leafy branches. Bamboo reproduces mainly by rhizomes so that it grows in a clump, especially in the tropics. Bamboos in the sub-tropic are generally running bamboo due to their long necks of rhizomes. The bamboo inflorescences are spikelets, and some species rarely flower (Janzen 1976). The bamboo fruit is indehiscent and the single-seed or some species with fleshy and spherical to pear-shaped.

Bamboo is a cultivated plant and one of the community plantations grown in rural areas. Besides being cultivated, bamboo can also be found growing wild in primary and secondary forests (Damayanto and Fefirenta 2021). In Indonesia, bamboo is known to have high interaction with the communities. Most bamboo species in Indonesia have been used by people in daily life, i.e. as materials for making houses, households utensil, furniture, crafts (Tamang et al. 2013; Honfo et al. 2015; Liana et al. 2017;

Ervany et al. 2020; Ritonga et al. 2020; Hanun et al. 2023), fish trap (Damayanto et al. 2016), food container (Damayanto and Rahmawati 2020), firewood (Damayanto et al. 2018), medicines, and vegetables (Damayanto 2018, Sholekha et al. 2023). Ecologically, bamboo can resist erosion. Furthermore, bamboo roots can maintain the hydrological system because they bind water (Yasin and Priyanto 2019; Kaushal et al. 2020; Dlamini et al. 2022). In addition, bamboo acts as carbon storage (Devi and Singh 2021). Thus, it can lighten the greenhouse effect. Bamboo is also known as the habitat of animals such as civet *Paradoxurus hermaphroditus* Pallas 1777 (*musang luwak*) that reportedly made a nest in a bamboo clump in Sumba, Indonesia (Hamidy et al. 2017). In addition, the *ghost orchid*, *Didymoplexis pallens* Griff., was known to grow under bamboo clumps (Zulkarnaen et al. 2020).

There are an estimated 1,439 to 1,662 species of bamboo in the world (Widjaja et al. 2014; Canavan et al. 2017). In Indonesia alone, it is estimated 176 species of bamboo (Widjaja 2019), although Damayanto and Fefirenta (2021) corrected that there are 175 species of bamboo in Indonesia according to Widjaja (2019). There are 105 species of bamboo in Indonesia that are endemic to the

region (Widjaja 2019). Bamboo inventories in Indonesia, however, were mostly conducted on the main islands (Damayanto et al. 2016, 2020b; Hidayatullah 2016; Ervianti et al. 2019a, 2019b; Muzakki 2020; Muzakki et al. 2020). Bamboo inventory on small islands in Indonesia is less of a concern, even though it can potentially discover something new. For example, Widjaja (2020) has described a new bamboo species from Alor Island, East Nusa Tenggara. Damayanto (2018) reports new records of bamboo distribution in Indonesia found on Karimun and Batam Islands, Sumatra. Therefore, it is necessary to study the diversity of bamboo in small islands in Indonesia to reveal the richness of bamboo and its potency.

A bamboo inventory for small islands in Indonesia, especially Weh Island, has never been done. Administratively, Weh Island (also known as Sabang Island) belongs to Sabang, Aceh Province, Indonesia, with an area of 120.7 km<sup>2</sup> (PKS 2023). Geographically, Weh Island is located at the westernmost tip of Sumatra Island at 05°46'28"-05°54'28" N and 95°13'02"-95°22'36" E

(BPSKS 2020). This island is formed due to volcanic movement; it is divided into three terraces with the highest plateau in the western part of the island, namely Mt. Jaboi, with an altitude of 617 m above sea level (asl) (Kurnio et al. 2015). Weh Island is an atoll island that has been raised above sea level and is suspected to having a unique diversity of flora, especially bamboo. This study aimed to understand the diversity of bamboo on Weh Island. In addition, this study can be used as basic data for bamboo conservation efforts on this island.

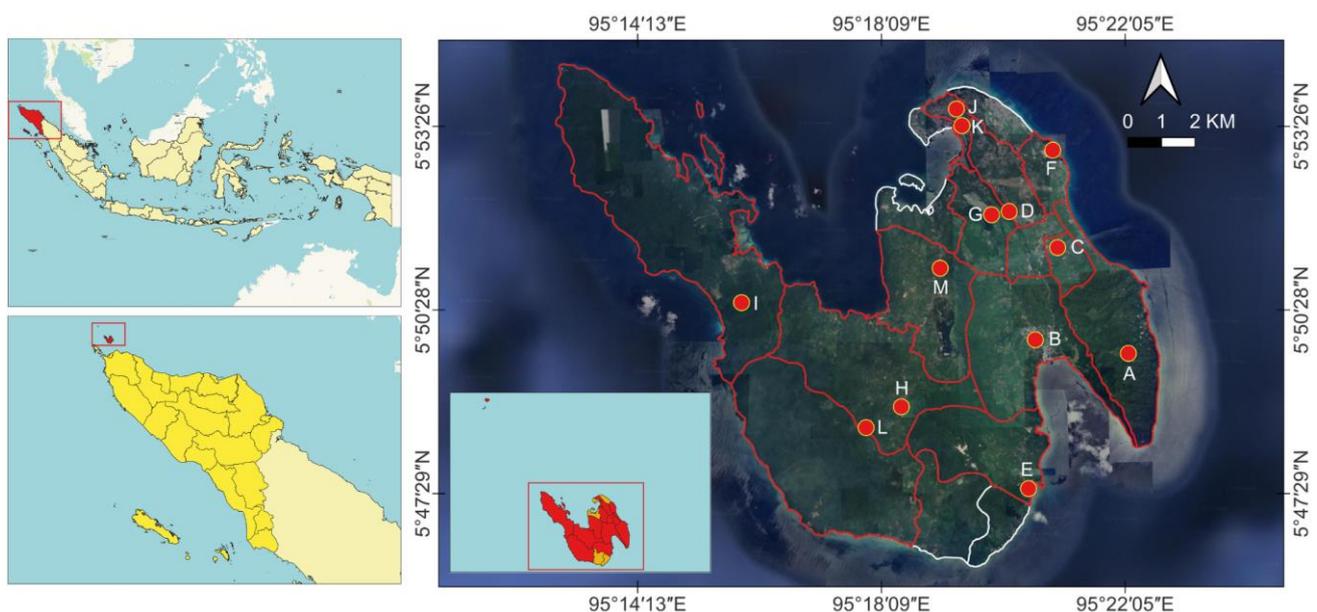
## MATERIALS AND METHODS

### Study period and area

Fieldwork occurred on Weh Island, Aceh Province, Indonesia, from August to September 2022. Several villages on Weh Island were surveyed based on local communities' information (Table 1 and Figure 1).

**Table 1.** The locations of the fieldwork on Weh Island, Aceh Province, Indonesia

Code	Location			Coordinate	Altitude (m asl.)	Major surrounding landscape
	District/City	Subdistrict	Villages			
A	Sabang City	Sukajaya	Anoe Itam	5°49'39.07" N, 95°22'21.55" E	6-62	Forests and plantations
B	Sabang City	Sukajaya	Balohan	5°50'10.30" N, 95°20'26.71" E	2-131	Settlements and forests
C	Sabang City	Sukajaya	Cot Abeuk	5°51'05.35" N, 95°20'31.29" E	17-164	Settlements
D	Sabang City	Sukajaya	Cot Ba'u	5°52'03.24" N, 95°20'12.62" E	13-153	Settlements and a lake
E	Sabang City	Sukajaya	Jaboi	5°47'43.23" N, 95°20'31.21" E	2-12	Settlements and forests
F	Sabang City	Sukajaya	Ujong Kareung	5°53'02.59" N, 95°20'54.82" E	0-12	Settlements
G	Sabang City	Sukakarya	Aneuk Laot	5°51'59.95" N, 95°19'55.64" E	12-51	Settlements and plantations
H	Sabang City	Sukakarya	Batee Shoek	5°49'06.28" N, 95°18'27.24" E	12-165	Forests and rivers
I	Sabang City	Sukakarya	Iboih	5°52'34.66" N, 95°15'53.72" E	0-1	Settlements
J	Sabang City	Sukakarya	Kuta Ateueh	5°53'42.60" N, 95°19'21.41" E	6-32	Settlements
K	Sabang City	Sukakarya	Kuta Timu	5°53'26.39" N, 95°19'26.94" E	35-36	Settlements
L	Sabang City	Sukakarya	Paya	5°48'33.40" N, 95°17'54.20" E	26-213	Settlements and rivers
M	Sabang City	Sukakarya	Paya Seunara	5°51'07.98" N, 95°19'05.87" E	32-100	Rivers



**Figure 1.** The locations of the fieldwork in Weh Island, Aceh Province, Indonesia. Note: Village names (A-M) refer to Table 1.

## Procedures

Bamboo exploration was carried out using a method of collecting flora diversity (Rugayah et al. 2004) by exploring the study site through forest trails, along riverbanks, the edge of the forest, along the roads, and the villages. During exploration, samples of bamboo were collected using the method of Djarwaningsih et al. (2002), which involved gathering parts of the young shoots (approximately 20-30 cm in length), branches, leafy branches, culm sheaths, and inflorescences (if available). A hanging label was attached to each sample, indicating the collector's name, collection number, and collection date. Additional information such as habitat, location, coordinates, altitude, and local name were recorded, and photographic documentation was also taken. The bamboo samples were carefully wrapped in newspaper and moistened with 70% alcohol, then packaged in air-tight plastic and sent to the Herbarium Andalas (ANDA) and Herbarium Bogoriense (BO) for further processing (Djarwaningsih et al. 2002) to create herbarium specimens. The bamboo materials were then meticulously pressed and dried in an oven before being identified using the specimen collections at ANDA and BO and relevant literature. The identified herbarium specimens were then mounted on the paper, labeled, and stored in ANDA and BO. To enhance

our understanding, we conducted a similarity analysis using several morphological characteristics outlined in Table 2.

## Data analysis

Morphological characteristics were analyzed descriptively. Here we presented a determination key, taxonomy information, distribution, photographs, and a similarity analysis of the bamboo species on Weh Island. The spatial distribution of bamboo was made using QGIS ver. 3.10 software and overlaid with a map of land cover and altitude from online data of <http://www.indonesia-geospasial.com>. Herbarium abbreviation followed Girmansyah et al. (2018) or Index Herbariorum of New York Botanical Garden Steere Herbarium (Thiers 2023). The accepted names of the species followed Vorontsova et al. (2016), Widjaja and Wong (2016), Wong and Dransfield (2016), and websites the International Plant Names Index (<https://ipni.org>) or the Plants of the World Online (<https://powo.science.kew.org>) (see Damayanto et al. 2020a). We performed a similarity analysis using the Multi-Variate Statistics Package (MVSP) ver. 3.22 software (KCS 2023) with the unweighted pair group method with arithmetic mean (UPGMA) and the coefficient of Nei & Li. The dendrogram resulting from the similarity analysis was then analyzed descriptively to identify clusters and patterns within the data.

**Table 2.** Morphological characteristics for a similarity analysis

Morphological characters	Score
Culm color	Green (0); yellow (1); green/yellow (2); others (3)
Culm stripes	Absent (0); present (1); others (2)
Culm diameter	<7 cm (0); ≥7 cm (1)
Culm height	<10 m (0); ≥10 m (1)
Culm internodes	<40 cm (0); ≥40 cm (1)
Culm-sheath persistency	Caducous (0); persistent (1)
Culm-sheath length	<30 cm (0); ≥30 cm (1)
Culm-sheath width	<30 cm (0); ≥30 cm (1)
Shape of culm-sheath auricles	Rim-like or inconspicuous (0); small (1); rounded (2)
Bristle of culm-sheath auricles	Present (0); absent (1)
Bristle length of culm-sheath auricles	Absent (0); <3 mm (1); ≥3 mm (2)
Height of culm-sheath ligule	<0.5 cm (0); ≥0.5 cm (1)
Culm-sheath ligule	Entire (0); toothed (1)
Bristle of culm-sheath ligule	Present (0); absent (1)
Bristle length of culm-sheath ligule	Absent (0); <1 cm (1); ≥1 cm (2)
Position of mature culm-sheath blade	Deflexed (0); erect (1); spreading (2); erect to deflexed (3); spreading to deflexed (4)
Shape of culm-sheath blade	Oblong (0); broadly lanceolate (1); narrowly lanceolate (2); broadly triangular (3); narrowly triangular (4); linear (5)
Length of culm-sheath blade	<15 cm (0); ≥15 cm (1)
Width of culm-sheath blade	<5 cm (0); ≥5 cm (1)
Branches	One dominant branch and several smaller branches (0); several sub-equal branches (1)
Branch spines	Absent (0); present (1)
Length of lamina leaves	<30 cm (0); ≥30 cm (1)
Width of lamina leaves	<4 cm (0); ≥4 cm (1)
Shape of leaf-sheath auricles	Rim-like or inconspicuous (0); small (1); rounded (2)
Bristles of leaf-sheath auricles	Absent (0); present (1)
Bristle length of leaf-sheath auricles	Absent (0); <1 cm (1); ≥1 cm (2)
Height of leaf-sheath ligule	<2 mm (0); ≥2 mm (1)
Bristles of leaf-sheath auricles	Absent (0); present (1)

## RESULTS AND DISCUSSION

There are eight species and four genera of bamboo on Weh Island, namely *Bambusa multiplex* (Lour.) Raeusch. ex Schult.f., *Bambusa spinosa* Roxb., *Bambusa tuldoidea* Munro, *Bambusa vulgaris* Schrad. ex J.C.Wendl., *Dendrocalamus asper* (Schult.f.) Backer, *Schizostachyum brachycladum* (Kurz ex Munro) Kurz, *Schizostachyum silicatum* Widjaja, and *Thyrsostachys siamensis* Gamble.

### Determination key to the genera of bamboo in Weh Island

- 1 a. Branch complements with several sub-equal branches..... *Schizostachyum*
- b. Branch complements with one dominant branch and several smaller branches.....2
- 2 a. Culms slightly zigzag, internodes relatively short in the middle part of culm.....*Bambusa*
- b. Culms relatively straight, internodes relatively long in the middle part of culm.....3
- 3 a. Clumps closely to densely tufted; culms moderately thick to thick and rarely solid in lower part; leaves lanceolate to oblong .....*Dendrocalamus*
- b. Clumps very densely tufted; culms very thick and solid in lower part; leaves narrow and linear ..... *Thyrsostachys*

### Determination key to the bamboo species in Weh Island

- 1 a. Branch complements with several sub-equal branches.....2
- b. Branch complements with one dominant branch and several smaller branches.....3
- 2 a. Culm-sheath blades erect, broadly triangular; culm-sheath auricles rounded ..... *S. brachycladum*
- b. Culm-sheath blades deflexed, narrowly lanceolate or linear; culm-sheath auricles inconspicuous..... *S. silicatum*
- 3 a. Clumps very densely tufted; culm-sheaths covered with white hairs; culms very thick and solid in lower part; culms greyish-green and usually covered with persistent old culm-sheaths..... *T. siamensis*
- b. Clumps closely to densely tufted; culm-sheaths usually covered with brown to black hairs and rarely white; culms moderately thick to thick and rarely solid in lower part; culms green, green with yellow striped, yellow with green striped and rarely covered with persistent old culm-sheaths .....4
- 4 a. Culms relatively straight; young culms covered with velvety golden-brown appressed hairs, later glabrous; internodes relatively long in the middle part of culm; nodes with aerial roots in the lower to the upper part of culm .....*D. asper*
- b. Culms slightly zigzag; young culms covered with brown to black hairs, later persistent or glabrous; internodes relatively short in the middle part of culm; nodes with aerial roots only in the lower part of culm .....5
- 5 a. Culms and branches bearing spines..... *B. spinosa*
- b. Culms and branches without spines .....6

- 6 a. Culm-sheath auricles rim-like; leaf-blades whitish-green..... *B. multiplex*
- b. Culm-sheath auricles rounded; leaf-blades green.....7
- 7 a. Culm-sheaths glabrous, apex asymmetrically arched ..... *B. tuldoidea*
- b. Culm-sheaths hairy, apex symmetrical arched..... *B. vulgaris*

### List of bamboo species in Weh Island

*Bambusa multiplex* (Lour.) Raeusch. ex J.A. & J.H.Schult.  
*Bambusa multiplex* (Lour.) Raeusch. ex J.A. & J.H.Schult., Syst. Veg. 7(2): 1350. 1830. Figure 2A. Type: Cochinchinae [Vietnam] (see de Loureiro in 1790 "Flora Cochinchinensis: Sistens Plantas in Regno Cochinchina Nascentes. Quibus Accedunt Aliae Observatae in Sinensi Imperio, Africa Orientali, Indiaeque Locis Variis. Omnes Dispositae Secundum Systema Sexuale Linnaeanum").

*Homotypic synonym(s)*. *Arundarbor multiplex* (Lour.) Kuntze, Revis. Gen. Pl. 2: 761. 1891; *Arundo multiplex* Lour., Fl. Cochinch.: 58. 1790; *Bambusa multiplex* var. *normalis* Sasaki, Cat. Governm. Herb. (Form.): 68. 1930, *not validly publ.*; *Leleba multiplex* (Lour.) Nakai, J. Jap. Bot. 9: 14. 1933.

*Morphological description*. Sympodial bamboo and densely tufted. Young shoots green, covered with white wax. Culms green to yellowish-green, slightly zigzag, 3-5 m high, 0.5-2 cm in diameter, internodes 16-22 cm, erect with arching tips. The branch complements with one dominant branch and several smaller branches. Culm-sheaths deciduous and glabrous, 10.5-14.5×3-4 cm; auricles rim-like, 1-2 mm high, bristles 2 mm long; ligule irregularly toothed, up to 1 mm high, glabrous; blades erect, triangular, 4-9×1-4 cm. Leaf-blades whitish-green, 7.5-12×1-1.4 cm; leaf-sheath auricles small, up to 1 mm high, bristles short up to 1 mm long; ligule toothed up to 1 mm high, glabrous. The inflorescence is unavailable. Based on Dransfield and Widjaja (1995a), inflorescence with linear-lanceolate spikelet, spikelet 3-4 cm long, glumes 2, fertile florets up to 10 with a rudimentary in uppermost.

*Habitat and ecology*. Settlements on the edge of the market at 14 m asl.

*Distribution*. Kuta Ateueh Village, Sukakarya Subdistrict (Figure 3A).

*Local name(s)*. *Igeuh pageue* or *igeuh kawé* (Aceh).

Specimen(s) examined. Sumatra, Aceh, Weh Island, Sukakarya Subdistrict, Kuta Ateueh Village, 5°53'51.68" N 95°19'5.44" E, 31 August 2022, M. A. Ritonga 073 (ANDA, BO).

*Bambusa spinosa* Roxb.

*Bambusa spinosa* Roxb., Hort. Bengal.: 25. 1814. Figure 2B. Type: Herb. Amboin, Rumphius. 4: t. 3. 1743 (Lectotype designated by Merrill in 1917 "An Interpretation of Rumphius's Herbarium Amboinense").

*Homotypic synonym(s)*. *Arundarbor spinosa* (Roxb.) Kuntze, Revis. Gen. Pl. 2: 761. 1891; *Arundo spinosa* (Roxb.) Oken, Allg. Naturgesch. 3(1): 423. 1841; *Bambusa arundinacea* var. *spinosa* (Roxb.) E.G.Camus, Bambusées: 129. 1913; *Bambusa bambos* var. *spinosa* (Roxb.) S.S.Jain & S.Biswas, Indian J. Forest. 26: 433. 2003; *Ischurochloa*

*spinosa* (Roxb.) Buse, F.A.W.Miquel, Pl. Jungh., prepr.: 50. 1854.

**Morphological description.** Sympodial bamboo and densely tufted. Young shoots orange-green or orange, covered with brown hairs. Culms green, slightly zigzag, 8-23 m high, 3.5-9 cm in diameter, internodes 19.5-31 cm, erect. The branch complements with one dominant branch and several smaller branches, bearing spines. Culm-sheaths deciduous and covered with brown to black hairs, 19-37.5×9-20.5 cm; auricles small and wrinkled, 2-6 mm high, bristles up to 2 mm long; ligule entire, up to 1 mm high, bristles short up to 1 mm long; blades erect, triangular, 3.5-14×1-3.7 cm. Leaf-blades green, 12.5-22.5×1.5-3 cm; leaf-sheath auricles small, up to 1 mm high, bristles short up to 1 mm long; ligule toothed up to 1 mm high, glabrous. The inflorescence is unavailable. Based on Roxas (1995), reported as “*B. blumeana*”, inflorescence with laterally compressed spikelet, spikelet up to 5 cm long, comprising 2-3 empty glumes and 5-12 florets and caryopsis is not known.

**Habitat and ecology.** Riverbanks and near settlements at an 8-12 m asl.

**Distribution.** Villages of Balohan and Jaboi, Sukajaya Subdistrict (Figure 3B).

**Local name(s).** *Trieng duroe* (Aceh).

**Specimen(s) examined.** Sumatra, Aceh, Weh Island, Sukajaya Subdistrict, Balohan Village, 5°49'58.60" N 95°20'37.90" E, 30 August 2022, *M. A. Ritonga 038* (ANDA, BO); Jaboi Village, 5°47'42.93" N 95°20'35.94" E, 30 August 2022, *M. A. Ritonga 042* (ANDA, BO); Balohan Village, 5°49'49.15" N 95°20'45.64" E, 30 August 2022, *M. A. Ritonga 054* (ANDA, BO).

#### *Bambusa tuldoides* Munro

*Bambusa tuldoides* Munro, Trans. Linn. Soc. London 26: 93. 1868. Figure 2C. *Type:* Hongkong, *Hance 3657* (syntype BM!).

**Homotypic synonym(s).** *Arundarbor tuldoides* (Munro) Kuntze, Revis. Gen. Pl. 2: 761. 1891; *Leleba tuldoides* (Munro) Nakai, J. Jap. Bot. 9: 17. 1933.

**Morphological description.** Sympodial bamboo and densely tufted. Young shoots green, glabrous, or covered with brown hairs. Culms green, slightly zigzag, 3-6 m high, 1.5-5 cm in diameter, internodes 28-31 cm, erect, and internodes inflated in dry areas or cultivated in a pot. The branch complements with one dominant branch and several smaller branches. Culm-sheaths deciduous and glabrous, 12.5-15×4.5-8 cm, apex asymmetrically arched; auricles rounded, small, 3-4 mm high, bristles up to 3 mm long; ligule entire, up to 1 mm high, glabrous; blades erect, triangular, 3-3.5×1.5-2 cm. Leaf-blades green, 12-18.5×1-3 cm; leaf-sheath auricles small, up to 1 mm high, bristles short up to 2 mm long; ligule entire up to 1 mm high, glabrous. The inflorescence is unavailable. Based on But and Chia (1995), inflorescence with 2-5 cm long spikelet, bearing 2-5 perfect florets and above these 1-2 reduced florets.

**Habitat and ecology.** Along the main road near the market and near the settlements at 14 m asl.

**Distribution.** Kuta Ateueh Village, Sukakarya Subdistrict (Figure 3C).

**Local name(s).** *Trieng biasa* (Aceh).

**Specimen(s) examined.** Sumatra, Aceh, Weh Island, Sukakarya Subdistrict, Kuta Ateueh Village, 5°53'51.76" N 95°1'6.89" E, 31 August 2022, *M. A. Ritonga 075* (ANDA, BO).

#### *Bambusa vulgaris* Schrad. ex J.C.Wendl.

*Bambusa vulgaris* Schrad. ex J.C.Wendl., Coll. Pl. 2: 26. 1808. Figure 2D-E. *Type:* Ex Herb. Wendland Nos. 13986-13989 (GOET) (*see* Greuter and Rodríguez 2015).

**Homotypic synonym(s).** *Leleba vulgaris* (Schrad. ex J.C.Wendl.) Nakai, J. Jap. Bot. 9: 17. 1933.

**Morphological description.** Sympodial bamboo and loosely tufted. Young shoots green or yellow, covered with blackish-brown hairs. Culms green or yellow with green stripes, slightly zigzag, 5-23 m high, 3.5-9 cm in diameter, internodes 13-32 cm, erect, internodes of *B. vulgaris* var. *wamin* inflated when in dry areas or cultivated in a pot. The branch complements with one dominant branch and several smaller branches. Culm-sheaths deciduous and covered with brown to black hairs, 12-38.5×12-24 cm; auricles rounded and curved outward, 7-10 mm high, bristles 4-9 mm long; ligule toothed, 1-4 mm high, bristles 1-3 mm; blades erect, triangular, 3.5-15×2-8.5 cm. Leaf-blades green, 14.5-32.5×2.5-4 cm; leaf-sheath auricles small, up to 1 mm high, bristles short 1-2 mm long; ligule entire up to 1 mm high, glabrous. The inflorescence is unavailable. Based on Dransfield and Widjaja (1995b), inflorescence with laterally flattened spikelet, spikelet up to 19 mm long, comprising 5-10 perfect florets and a terminal vestigial floret.

**Habitat and ecology.** Riverbanks, near the settlements, along the road, and the plantations at 14-213 m asl.

**Distribution.** Villages of Balohan, Ujong Kareung, Cot Ba'u, and Anoe Itam in Sukajaya Subdistrict and villages of Batee Shoek, Paya, Paya Seunara, Aneuk Laot, and Kuta Ateueh in Sukakarya subdistrict (Figure 3D).

**Local name(s).** *Trieng kuneng* (Aceh).

**Notes.** *Bambusa vulgaris* consists of three varieties: *B. vulgaris* var. *vulgaris* (culms green), var. *striata* (culms yellow with green stripes), and *B. vulgaris* var. *wamin* (culm green with inflated internodes when in dry areas) (Widjaja 2001). In Weh Island, two varieties are found: *B. vulgaris* var. *vulgaris* (Figure 2D) dan *B. vulgaris* var. *striata* (Figure 2E).

**Specimen(s) examined.** Sumatra, Aceh, Weh Island, Sukajaya Subdistrict, Balohan Village, 5°50'10.30" N 95°20'26.71" E, 30 August 2022, *M. A. Ritonga 039* (ANDA, BO); Balohan Village, 5°49'13.20" N 95°20'24.91" E, 30 August 2022, *M. A. Ritonga 045* (ANDA, BO); Ujong Kareung Village, 5°52'41.13" N 95°21'9.31" E, 30 August 2022, *M. A. Ritonga 052* (ANDA, BO); Cot Ba'u Village, 5°52'3.24" N 95°20'12.62" E, 31 August 2022, *M. A. Ritonga 070* (ANDA, BO); Anoe Itam Village, 5°49'45.50" N 95°22'7.85" E, 1 September 2022, *M. A. Ritonga 076* (ANDA, BO); Anoe Itam Village, 5°49'39.07" N 95°22'21.55" E, 1 September 2022, *M. A. Ritonga 079*

(ANDA, BO); Anoe Itam Village, 5°50'1.05" N 95°22'22.04" E, 1 September 2022, M. A. Ritonga 082 (ANDA, BO). Sukakarya Subdistrict, Batee Shoek Village, 5°48'53.63" N 95°18'28.34" E, 31 August 2022, M. A. Ritonga 055 (ANDA, BO); Paya Village, 5°48'37.14" N 95°18'28.39" E, 31 August 2022, M. A. Ritonga 056 (ANDA, BO); Paya Village, 5°48'33.40" N 95°17'54.20" E, 31 August 2022, M. A. Ritonga 057 (ANDA, BO); Paya Seunara Village, 5°51'7.98" N 95°19'5.87" E, 31 August 2022, M. A. Ritonga 059 (ANDA, BO); Batee Shoek Village, 5°49'5.77" N 95°18'31.22" E, 31 August 2022, M. A. Ritonga 064 (ANDA, BO); Aneuk Laot Village, 5°52'27.64" N 95°19'22.23" E, 31 August 2022, M. A. Ritonga 067 (ANDA, BO); Aneuk Laot Village, 5°52'24.89" N 95°19'21.75" E, 31 August 2022, M. A. Ritonga 068 (ANDA, BO); Aneuk Laot Village, 5°51'59.95" N 95°19'55.64" E, 31 August 2022, M. A. Ritonga 069 (ANDA, BO); Kuta Ateuh Village,

5°53'51.62" N 95°19'5.68" E, 31 August 2022, M. A. Ritonga 074 (ANDA, BO).

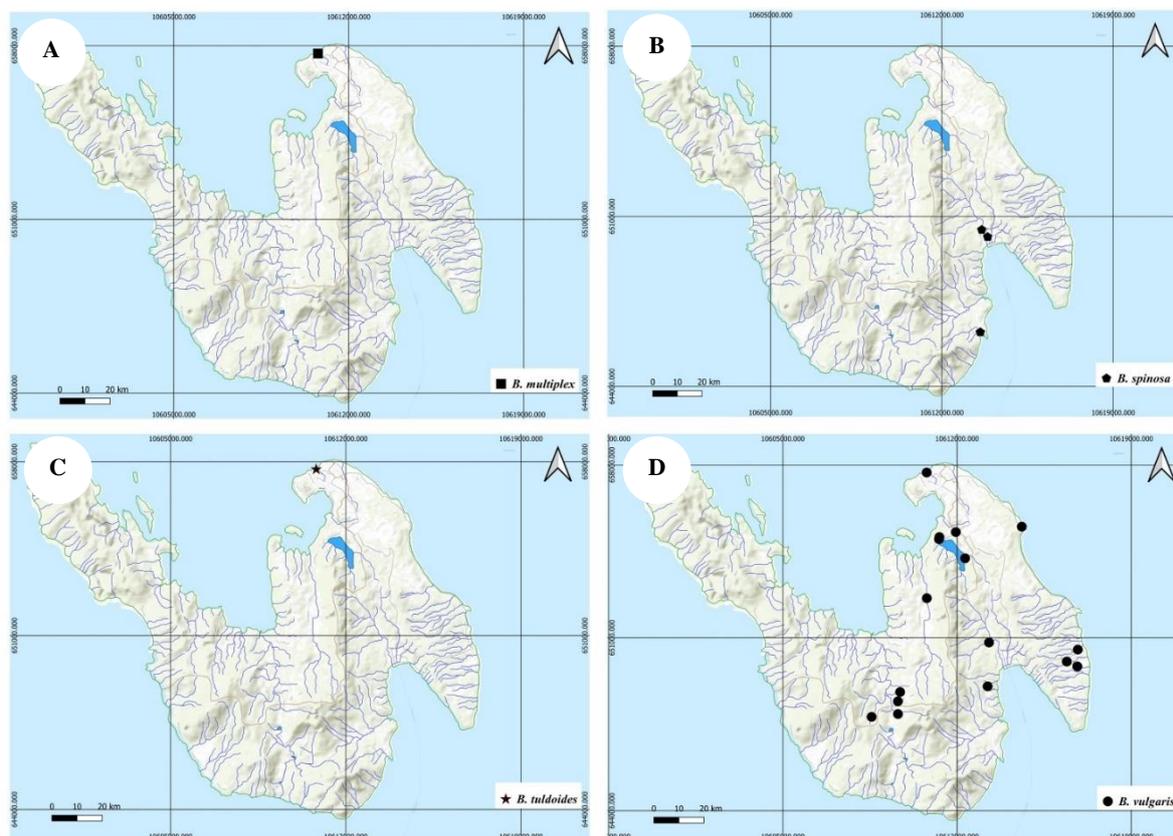
*Dendrocalamus asper* Backer ex Heyne

*Dendrocalamus asper* Backer ex Heyne, Nutt. Pl. Ned.-Ind. Ed. 2, 1: 301. 1927. Figure 4A. *Type*: In Amboina et Huamchela ad montium pedes (*see* Roemer and Schultes in 1830 "Caroli a Linné, Systema Vegetabilium: Secundum Classes, Ordines, Genera, Species. Cum Characteribus Differentiis et Synonymis. Editio Nova, Speciebus Inde ab Editione XV. Detectis Aucta et Locupletata").

*Homotypic synonym(s)*. *Arundo aspera* (Schult. & Schult.f.) Oken in Allg. Naturgesch. 3(1): 422. 1841; *Bambusa aspera* Schult. & Schult.f. in J.J.Roemer & J.A.Schultes, Syst. Veg. ed. 15[bis]. 7: 1352. 1830; *Gigantochloa aspera* (Schult. & Schult.f.) Kurz in Indian Forester 1: 221. 1876; *Sinocalamus flagellifer* T.Q.Nguyen in Bot. Zhurn. (Moscow & Leningrad) 74: 1662. 1989, nom. superfl.



**Figure 2.** A. *B. multiplex*; B. *B. spinosa*; C. *B. tuldooides*; D. *B. vulgaris* var. *vulgaris*; and E. *B. vulgaris* var. *striata*. Photos: Muhammad Azli Ritonga



**Figure 3.** Distribution of A. *B. multiplex*; B. *B. spinosa*; C. *B. tuldooides*; and D. *B. vulgaris*. (Made using QGIS software)

**Morphological description.** Sympodial bamboo and densely tufted. Young shoots purplish-black, covered with blackish-brown hairs. Young culms covered with velvety golden-brown appressed hairs, later glabrous. Culms green, relatively straight, 10-22 m high, 10-15 cm in diameter, internodes 23.5-30 cm, erect, nodes with aerial roots in the lower to the upper part of culm. The branch complements with one dominant branch and several smaller branches. Culm-sheaths deciduous and covered with brown to black hairs, 37-46×16-20 cm; auricles rounded and crisped, 3-4 mm high, bristles 1-2 mm long; ligule toothed, 1-7 mm high, bristles short; blades deflexed, narrowly triangular, up to 12×2 cm. Leaf-blades green, 32-47×3.5-8 cm; leaf-sheath auricles small, up to 1 mm high, glabrous; ligule entire up to 1 mm high, bristles 1-2 mm long. The inflorescence is unavailable. Based on Dransfield and Widjaja (1995c), inflorescence with slightly laterally flattened spikelet, spikelet up to 9 mm long, comprising 4-5 florets often with a sterile apical floret.

**Habitat and ecology.** Along the main road, riverbanks, and settlements at 36-51 m asl.

**Distribution.** Villages of Batee Shoek and Aneuk Laot, Sukakarya Subdistrict (Figure 5A).

**Local name(s).** *Trieng betung* (Aceh).

**Specimen(s) examined.** Sumatra, Aceh, Weh Island. Sukakarya Subdistrict, Batee Shoek Village, 5°50'12.73" N 95°17'59.57" E, 31 August 2022, M. A. Ritonga 060 (ANDA, BO); Aneuk Laot Village, 5°52'24.08" N

95°19'26.08" E, 1 September 2022, M. A. Ritonga 081 (ANDA, BO).

*Schizostachyum brachycladum* (Kurz ex Munro) Kurz

*Schizostachyum brachycladum* (Kurz ex Munro) Kurz, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 39: 89. 1870. Figure 4B. **Type:** Buitenzorg [Bogor] (see Munro in Trans. Linnean Soc. London 26(1): 1-157. 1868).

**Homotypic synonym(s).** *Melocanna zollingeri* var. *brachyclada* Kurz ex Munro, Trans. Linn. Soc. London 26: 134. 1868.

**Morphological description.** Sympodial bamboo and densely tufted. Young shoots yellowish-green, covered with dark brown hairs. Culms green or yellow with green stripes, relatively straight, 4-14 m high, 1.5-5.5 cm in diameter, internodes 37-68 cm, erect. The branch complements with several sub-equal branches. Culm-sheaths long persistent and covered with brown hairs, 27×18 cm; auricles small, 2-3 mm high, bristles up to 5 mm long; ligule entire, up to 1 mm high, glabrous; blades erect, broadly triangular, 9-11×4.5-8 cm. Leaf-blades green or sometimes with white stripes along the midrib, 23-31.5×2.5-6 cm; leaf-sheath auricles small, up to 1 mm high, bristles 3-11 mm long; ligule entire up to 1 mm high, glabrous. Inflorescence 16-27 cm long, spikelet 1-1.5 cm long, comprising 1-2 perfect florets and a rachilla extension bearing a rudimentary floret.

**Habitat and ecology.** Riverbanks, backyard, along the main road, and settlements at 24-45 m asl.

*Distribution.* Balohan Village, Sukajaya Subdistrict and Villages of Kuta Timu and Batee Shoek, Sukakarya Subdistrict (Figure 5B).

*Local name(s).* *Buloh leumang* (Aceh).

*Notes.* This species has two varieties: culm with green color and yellow with green stripes. In Weh Island, only the green culm was found.

*Specimen(s) examined.* Sumatra, Aceh, Weh Island, Sukajaya Subdistrict, Balohan Village, 5°50'10.30" N 95°20'26.71" E, 30 August 2022, *M. A. Ritonga 040* (ANDA, BO). Sukakarya Subdistrict, Batee Shoek Village, 5°50'12.41" N 95°17'30.23" E, 31 August 2022, *M. A. Ritonga 063* (ANDA, BO); Kuta Timu Village, 5°53'26.39" N 95°19'26.94" E, 31 August 2022, *M. A. Ritonga 071* (ANDA, BO).

*Schizostachyum silicatum* Widjaja

*Schizostachyum silicatum* Widjaja, *Reinwardtia* 11(2): 145. 1997. Figure 4C. *Type:* Indonesia, Sumatra, Priaman, *Kurz s.n.* (holotype BO!).

*Morphological description.* Sympodial bamboo and densely tufted. Young shoots green, covered with pale brown hairs. Culms green, relatively straight, 2-10 m high, 0.6-2.5 cm in diameter, internodes 31-87 cm, erect. The branch complements with several sub-equal branches. Culm-sheaths long persistent and covered with pale brown hairs, 19-28.5×3-6 cm; auricles inconspicuous, 2-4 mm high, bristles up to 4 mm long; ligule entire, up to 1 mm high, glabrous; blades deflexed, narrowly triangular or linear, 12.5-15×0.5-4 cm. Leaf-blades green 12.5-31.5×4.5-6.5 cm; leaf-sheath auricles small, up to 1 mm high, bristles 10-14 mm long; ligule entire up to 1 mm high, glabrous. Inflorescence 15-28 cm long, spikelet 1-2 cm long, fertile floret 1.

*Habitat and ecology.* Forest and along the main road at 8-131 m asl.

*Distribution.* Villages of Balohan and Anoe Itam, Sukajaya Subdistrict and Batee Shoek Village, Sukakarya Subdistrict (Figure 5C).

*Local name(s).* *Igeuh* (Aceh).

*Specimen(s) examined.* Sumatra, Aceh, Weh Island, Sukajaya Subdistrict, Balohan Village, 5°49'50.36" N 95°21'27.80" E, 30 August 2022, *M. A. Ritonga 037* (ANDA, BO); Balohan Village, 5°50'28.28" N 95°20'50.58" E, 30 August 2022, *M. A. Ritonga 047* (ANDA, BO); Balohan Village, 5°49'31.24" N 95°21'22.60" E, 30 August 2022, *M. A. Ritonga 053* (ANDA, BO); Anoe Itam Village, 5°49'41.45" N 95°22'16.82" E, 1 September 2022, *M. A. Ritonga 077* (ANDA, BO); Anoe Itam Village, 5°49'41.08" N 95°22'18.93" E, 1 September 2022, *M. A. Ritonga 078* (ANDA, BO); Anoe Itam Village, 5°49'30.04" N 95°22'24.93" E, 1 September 2022, *M. A. Ritonga 080* (ANDA, BO); Anoe Itam Village, 5°49'50.7" N 95°22'2.99" E, 1 September 2022, *M. A. Ritonga 083* (ANDA, BO). Sukakarya Subdistrict, Batee Shoek Village, 5°50'12.41" N 95°17'30.23" E, 31 August 2022, *M. A. Ritonga 062* (ANDA, BO); Batee Shoek Village, 5°49'6.28" N 95°18'27.24" E, 31 August 2022, *M. A. Ritonga 065* (ANDA, BO).

*Thyrsostachys siamensis* Gamble

*Thyrsostachys siamensis* Gamble, *Ann. Roy. Bot. Gard. (Calcutta)* 7: 59. 1896, nom cons. Figure 4D. *Type:* Thailand, *Kurz s.n.* (lectotype K) [Lectotype designated by Stapleton in *Taxon* 47(3):739-740. 1998].

*Homotypic synonym(s).* *Arundarbor regia* (Thomson ex Munro) Kuntze, *Revis. Gen. Pl.* 2: 761. 1891; *Arundinaria siamensis* Kurz, J.E.Teijsmann & S.Binnendijk, *Cat. Hort. Bot. Bogor.*: 19. 1866; *Bambusa regia* Thomson ex Munro, *Trans. Linn. Soc. London* 26: 116. 1868; *Bambusa siamensis* Kurz ex Munro, *Trans. Linn. Soc. London* 26: 116. 1868; *Thyrsostachys regia* (Thomson ex Munro) Bennet, *Indian Forester* 114: 711. 1988.

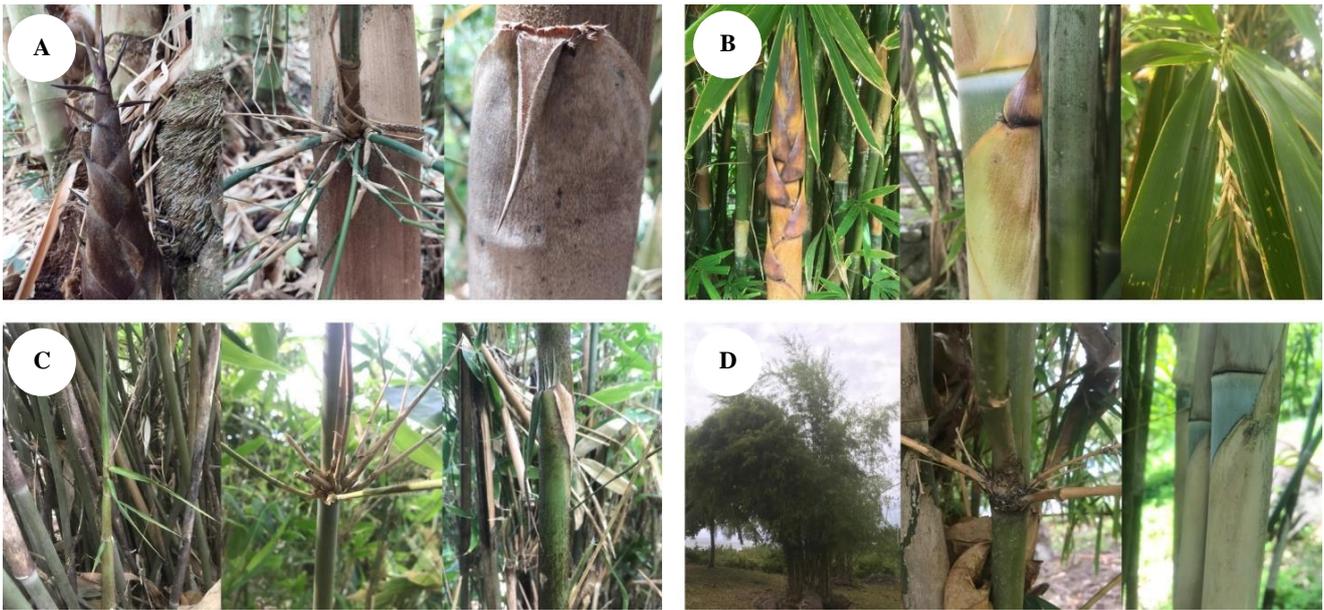
*Morphological description.* Sympodial bamboo and very densely tufted. Young shoots pale green to purplish-green, glabrous. Culms green, relatively straight, 8-11 m high, 3.5-8 cm in diameter, internodes 15-36 cm, erect. The branch complements with one dominant branch and several smaller branches. Culm-sheaths persistent and covered with white hairs, 24.5-27.5×5.5-9.5 cm; auricles inconspicuous, glabrous; ligule entire, up to 1 mm high, glabrous; blades erect, triangular, persistent. Leaf-blades green or whitish-green, 6-17×0.6-1 cm; leaf-sheath auricles inconspicuous, glabrous; ligule entire up to 1 mm high, glabrous. The inflorescence is unavailable. Based on Duriyaprapan and Jansen (1995), inflorescence with 17 mm long spikelet, usually 2 perfect florets and a rachilla extension bearing a rudimentary floret.

*Habitat and ecology.* Along the main road, riverbanks, forests, plantations, and near settlements at 12-212 m asl.

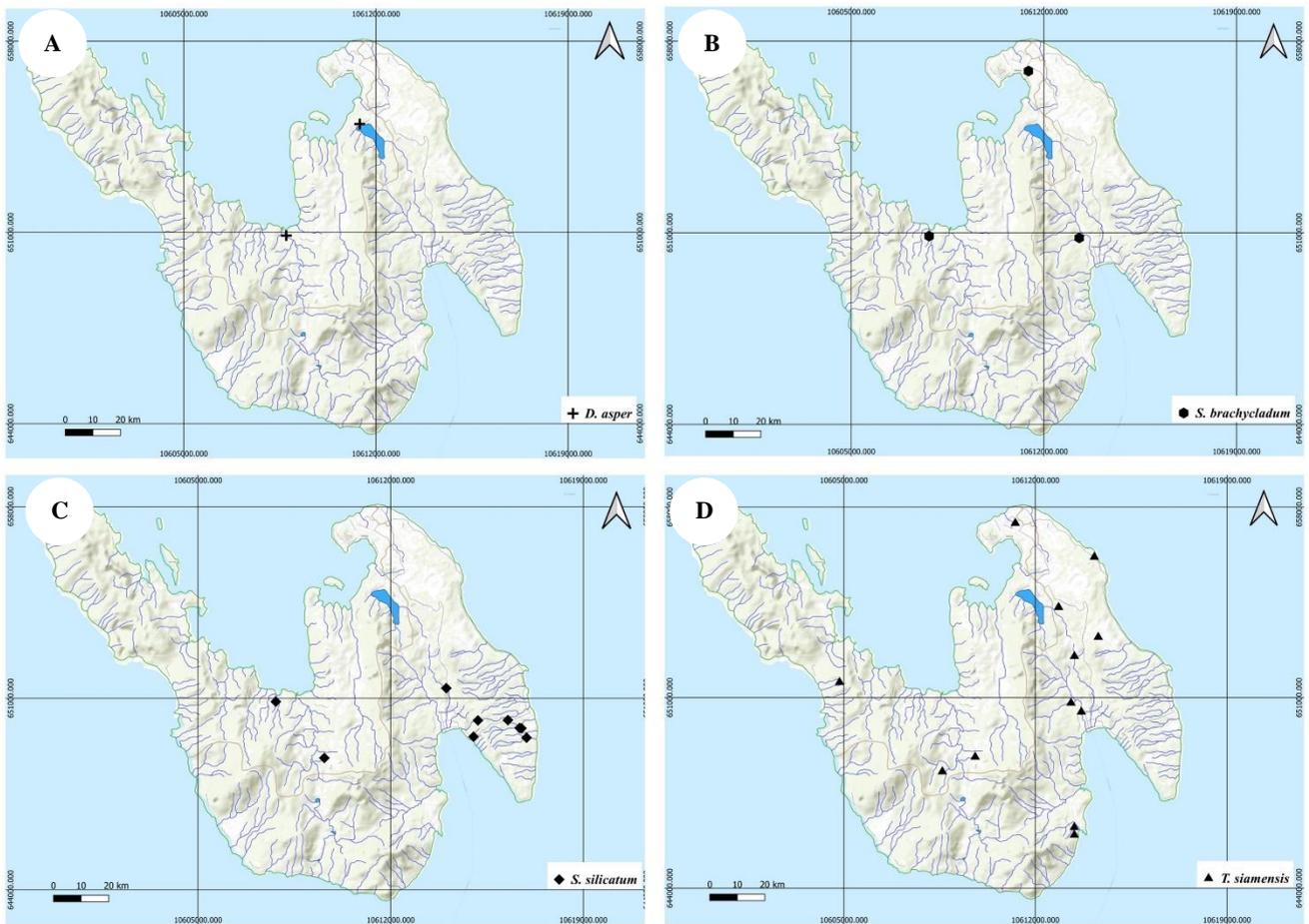
*Distribution.* Villages of Balohan, Jaboi, Cot Abeuk, Cot Ba'u, and Ujong Kareung in Sukajaya Subdistrict and Villages of Batee Shoek, Paya, Iboih, and Kuta Ateueh in Sukakarya Subdistrict (Figure 5D).

*Local name(s).* *Trieng pageue* (Aceh).

*Specimen(s) examined.* Sumatra, Aceh, Weh Island, Sukajaya Subdistrict, Balohan, 5°50'10.16' N 95°20'27.27" E, 30 August 2022, *M. A. Ritonga 041* (ANDA, BO); Jaboi Village, 5°47'43.23" N 95°20'31.21" E, 30 August 2022, *M. A. Ritonga 043* (ANDA, BO); Jaboi Village, 5°47'34.22" N 95°20'31.20" E, 30 August 2022, *M. A. Ritonga 044* (ANDA, BO); Balohan Village, 5°49'59.63" N 95°20'39.47" E, 30 August 2022, *M. A. Ritonga 046* (ANDA, BO); Cot Abeuk Village, 5°51'5.35" N 95°20'31.29" E, 30 August 2022, *M. A. Ritonga 048* (ANDA, BO); Cot Abeuk Village, 5°51'27.97" N 95°20'59.44" E, 30 August 2022, *M. A. Ritonga 049* (ANDA, BO); Cot Ba'u Village, 5°52'3.24" N 95°20'12.62" E, 30 August 2022, *M. A. Ritonga 050* (ANDA, BO); Ujong Kareung Village, 5°53'2.59" N 95°20'54.82" E, 30 August 2022, *M. A. Ritonga 051* (ANDA, BO). Sukakarya Subdistrict, Paya Village, 5°48'48.99" N 95°17'55.21" E, 31 August 2022, *M. A. Ritonga 058* (ANDA, BO); Iboih Village, 5°52'34.66" N 95°15'53.72" E, 31 August 2022, *M. A. Ritonga 061* (ANDA, BO); Batee Shoek Village, 5°49'6.40" N 95°18'34.02" E, 31 August 2022, *M. A. Ritonga 066* (ANDA, BO); Kuta Ateueh Village, 5°53'42.60" N 95°19'21.41" E, 31 August 2022, *M. A. Ritonga 072* (ANDA).



**Figure 4.** A. *D. asper*; B. *S. brachycladum*; C. *S. silicatum*; and D. *T. siamensis*. Photos: Muhammad Azli Ritonga



**Figure 5.** Distribution of A. *D. asper*; B. *S. brachycladum*; C. *S. silicatum*; and D. *T. siamensis*. (Made using QGIS software)

## Discussion

The bamboo specimens that we collected from Weh Island constitute a new addition to ANDA and BO's collection from that location since there were no bamboo specimens collected from the island in ANDA and BO before. Based on these specimens, there were four genera and eight species of bamboo found on Weh Island, namely *B. multiplex*, *B. spinosa*, *B. tuldooides*, *B. vulgaris*, *D. asper*, *S. brachycladum*, *S. silicatum*, and *T. siamensis*. *B. vulgaris* was the most frequently found (16 collection numbers), meanwhile, *B. multiplex* and *B. tuldooides* were the least found (1 collection number respectively) on Weh Island. Therefore, *B. vulgaris* was widespread and the most abundant species on Weh Island. This was in line with some studies which stated that *B. vulgaris* were also abundantly found in the Banggai Kepulauan (Damayanto and Rahmawati 2020), Sulawesi (Ervianti 2019a), Lombok (Damayanto et al. 2020b), and Tenggulun District, Aceh (Ritonga et al. 2020).

Plants thrive abundantly in areas with the right climate, soil quality, and water availability. However, *B. vulgaris* stands out from other plants, as it can survive in less-than-ideal environments such as extremely humid or dry areas (Dransfield and Widjaja 1995b). It can even adapt to flooded areas for several months (Widjaja 2001) or grow well on degraded soils containing tin (Dransfield and Widjaja 1995b). This makes *B. vulgaris* capable of withstanding challenging environmental conditions. Despite not having a straight culm, *B. vulgaris* is the most commonly used bamboo species (Dransfield and Widjaja 1995b). People may have intentionally planted and cultivated it for commercial or subsistence purposes, leading to its spread and abundance in certain areas. Due to its versatility, *B. vulgaris* is used in various applications. In summary, the adaptability of *B. vulgaris* to challenging environments, intentional cultivation by people, and its versatility in various applications, all contribute to its abundance in certain areas.

Bamboo species in Weh Island are around 10.5% of all bamboo species in Sumatra (76 species) (Widjaja 2019) and around 4.5% of all bamboo species in Indonesia (175 species) (Damayanto and Fefirenta 2021). The bamboo genera on Weh Island are around 33.3% of all bamboo genera in Sumatra (12 genera) (Widjaja 2019) and around 16.6% of all bamboo genera in Indonesia (24 genera) (Damayanto and Fefirenta 2021). The diversity of bamboo species on Weh Island is quite high compared to several small islands in Indonesia (Figure 6). For example, Peleng Island in Sulawesi with an area of 2,340 km<sup>2</sup> has eight species and six genera of bamboo (Damayanto and Rahmawati 2020) and Selayar Island in Sulawesi with an area of 1,357 km<sup>2</sup> has nine species and four genera of bamboo (Liana et al. 2017), while on Pulau Weh with an area of only 120.7 km<sup>2</sup> (PKS 2023) has eight species and four genera of bamboo. Compared with the diversity of bamboo species on small islands in the Sumatra region, such as Bengkalis Island and Rupert Island, the diversity of bamboo species on Weh Island almost matches those of the two islands even though Weh Island is only 7.9% to 12.8% of the area of Rupert Island and Bengkalis Island. In detail,

Rupert Island with an area of 1,524 km<sup>2</sup> (DPPKI 2023) and Bengkalis Island with an area of 938.4 km<sup>2</sup> (BPSKB 2018) were found nine species of bamboo (versus eight species on Pulau Weh) respectively (Rijaya and Fitmawati 2019; Fitmawati 2021).

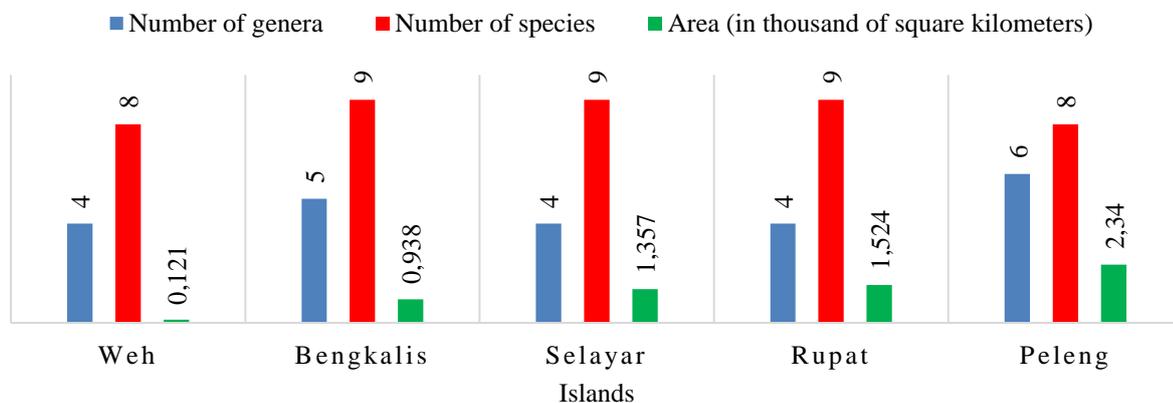
Bamboo diversity can be affected by the size of an area, with larger areas generally having more habitats and ecosystems to support more species. However, bamboo diversity can also vary greatly within a small area, as shown in the data in Figure 6. In addition, the island's unique combination of temperature, rainfall, humidity, sunlight, and geological conditions may contribute to its diverse bamboo species. On the other hand, historical and cultural context can also play a role in increasing bamboo diversity. For example, some islands having a rich history of human settlement leading to the introduction of different bamboo species on the island over time. There is a need for more research to understand these factors fully. However, one possible explanation for the variation in species diversity among small islands is the differences in bamboo exploration and survey methods conducted on each island. Limited exploration to survey bamboo on the islands can also affect species diversity data. For instance, a flora survey conducted on Peleng Island in 2014 only reported one species of bamboo found there (Rahmadi et al. 2014), but a more intensive survey in 2019 discovered eight bamboo species on the same island (Damayanto and Rahmawati 2020). A similar situation happened on Lombok Island. The first survey reported only one bamboo species (Rustiami and Sulistianingsih 2020). However, a more intensive survey later found 11 bamboo species (Damayanto et al. 2020b), adding to the diversity of bamboo species on the island. Understanding bamboo diversity requires a multidimensional approach, considering geological and climate conditions, historical and cultural context, and exploration methods.

Most bamboo species on Weh Island are commonly found in the Sumatra region or even in other areas in Indonesia (see Widjaja 2019). However, based on this research, we reported that *S. silicatum* could be found on satellite islands of the Sumatra region. *Schizostachyum silicatum* was first described as a new species from Pariaman, West Sumatra by E. A. Widjaja in 1997 and reportedly distributed in Sumatra, Java, and Bali (Widjaja 2019). However, this species has never been officially reported outside the mainland in Sumatra, such as on Bengkalis Island (Rijaya and Fitmawati 2019) or Rupert Island (Fitmawati 2021). Based on herbarium specimens of *S. silicatum* collected from Sumatra at BO, this species was recorded in Aceh, North Sumatra, West Sumatra, Jambi, Lampung, and Bangka Island. The presence of *S. silicatum* on satellite islands of Sumatra Island, such as Weh Island and Bangka Island, is additional information on the expansion of this species distribution outside the mainland of Sumatra.

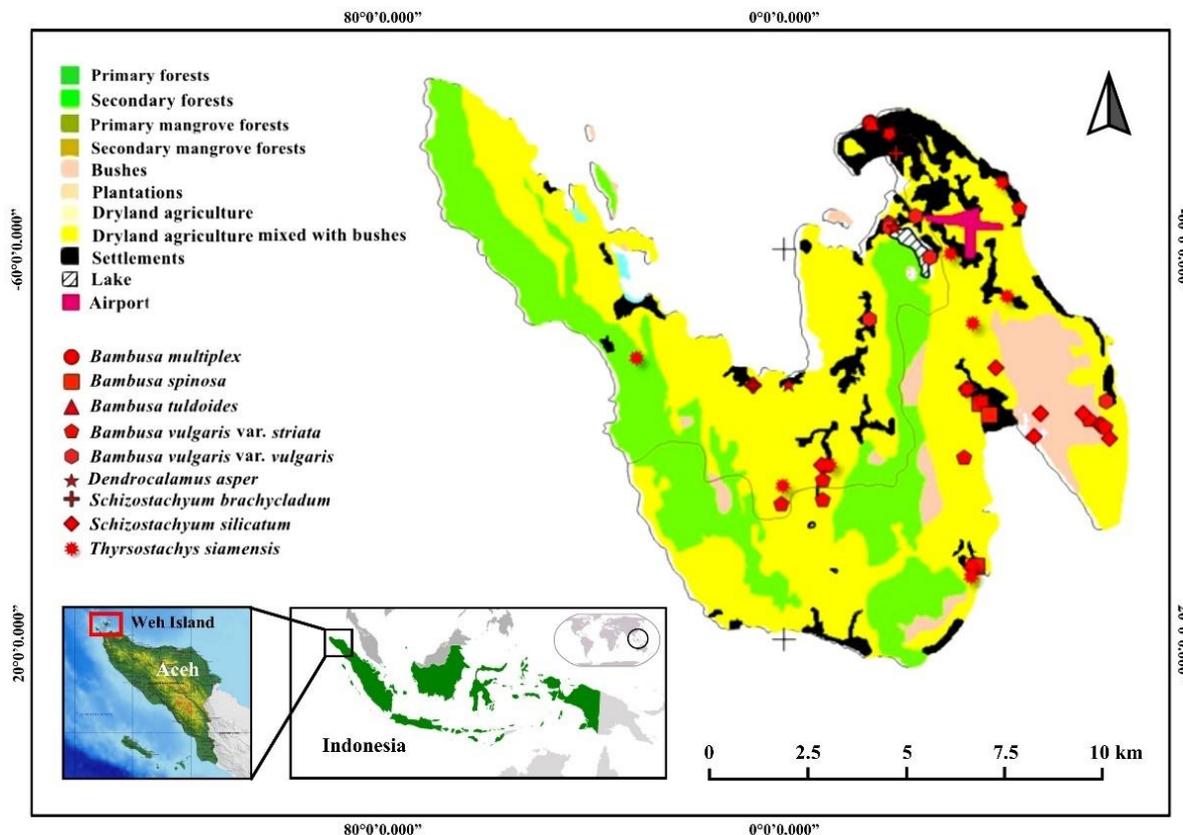
Most bamboo species on Weh Island were found in or near settlements and plantations, meanwhile, some species were found in forests (Figure 7). For example, *B. multiplex*, *B. tuldooides*, and *D. asper* on Weh Island were only found growing in or near settlements (Figure 7). *B. multiplex* and

*B. tuldooides* were often used as ornamental plants (Widjaja 2001) due to *B. multiplex* having relatively small culm and leaves and the clumps being easy to trim and shape, meanwhile, *B. tuldooides* has beautifully inflated internodes when planted in dry soil or pots. *D. asper*, meanwhile, was

known to have high benefits, such as young shoots for vegetables and culms for building construction materials and furniture (Widjaja 2001). Therefore, it is not surprising that these species are more often found in settlements.



**Figure 6.** Comparison of genera and species diversity of bamboo in several small islands in Indonesia. Source: research data, Liana et al. (2017), BPSKB (2018), Rijaya and Fitmawati (2019), Damayanto and Rahmawati (2020), Fitmawati (2021), DPPKI (2023), PKS (2023)



**Figure 7.** Overlapping map of land cover and species distribution of bamboo on Weh Island (made using QGIS software with modification)

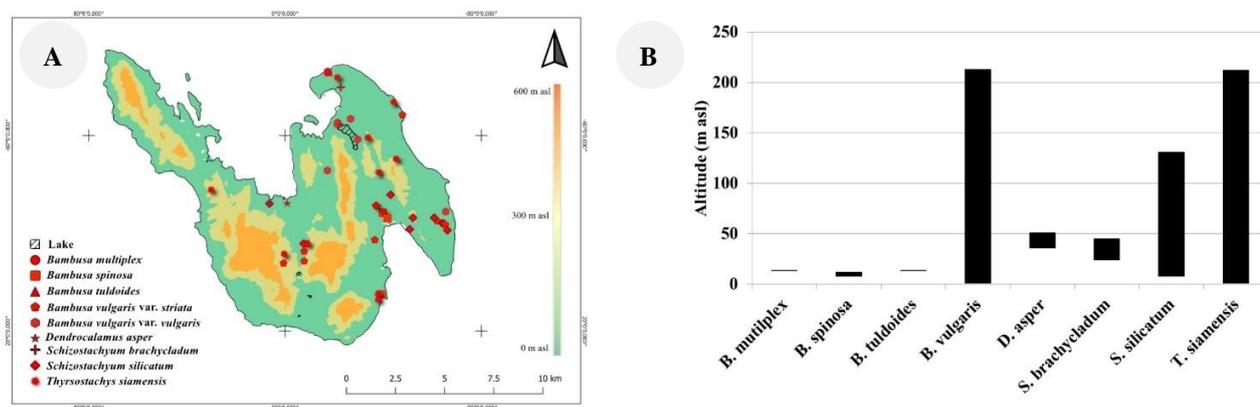
*B. spinosa*, *B. vulgaris*, *S. brachycladum*, and *T. siamensis* on Weh Island were found growing in plantations, besides in settlements (Figure 7). The plantations on Weh Island are usually dryland agriculture mixed with shrubs. *B. spinosa*, *B. vulgaris*, and *S. brachycladum* have been reported to be able to grow in dry areas (Widjaja 2001). In Lombok, *B. spinosa* is well-adapted in the dry areas (Damayanto et al. 2020b). *B. vulgaris*, even though, reportedly grows in areas with a severe dry season where the plants become completely defoliated. Meanwhile, the natural habitat of *T. siamensis* is reportedly a dry forest on poor soil. Thus, it is reasonable for these species to be found in dry plantation areas. On the other hand, *S. silicatum* and *T. siamensis* on Weh Island were also found to grow in the forests. *S. silicatum* is commonly found in forests (Widjaja 2001) and *T. siamensis* in its natural habitat is also found in the semi-evergreen forest (Duriyaprapan and Jansen 1995).

Some bamboo species on Weh Island grew in a fairly wide range of altitudes, such as *B. vulgaris* and *T. siamensis* at 1-212 m asl (Figure 8A-B). It is similar in Lombok, where *B. vulgaris* grew at the widest range of elevations (Damayanto et al. 2020b). On the other hand, *B. multiplex* and *B. tuldooides* on Weh Island were found at the narrowest and fairly low altitude at 14 m asl (Figure 8A-B). Both species are apparently not considered useful, so they are not cultivated massively. In contrast to *B. vulgaris*, which is widely cultivated and fairly useful in the daily life of rural communities, *B. multiplex* is known as an ornamental bamboo. Hence, its distribution is mostly in settlements in the lowlands of Weh Island.

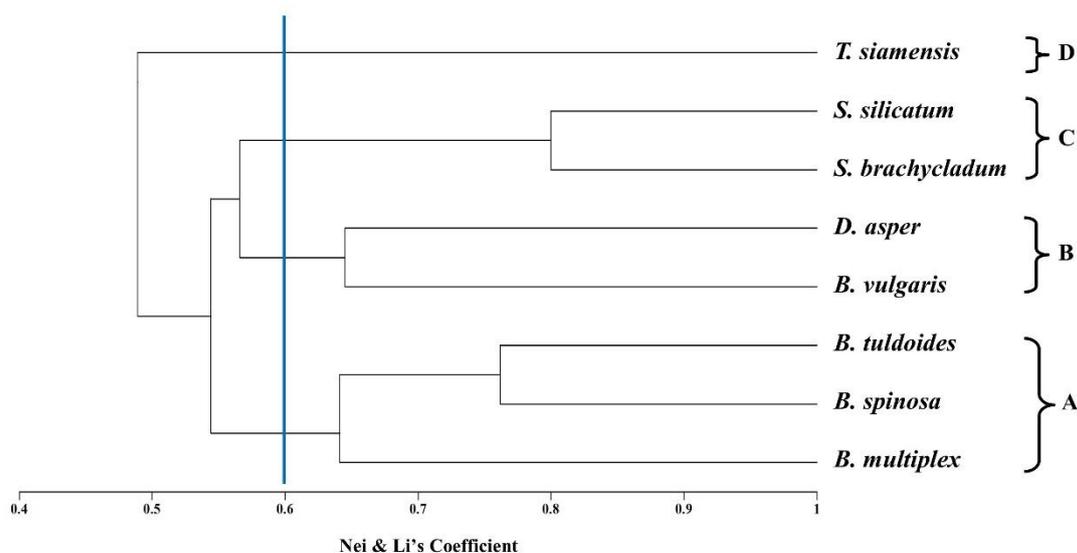
After analyzing the similarity of 28 morphological characters (Table 2) using UPGMA and Nei & Li's coefficient, bamboo on Weh Island can be clustered into four groups (A, B, C, and D) with a similarity value of 0.6 or 60%, as displayed in Figure 9's dendrogram. *Bambusa* species, except for *B. vulgaris*, such as *B. multiplex*, *B. spinosa*, and *B. tuldooides*, are clustered in group A, while *B. vulgaris* is grouped with *D. asper* in group B. *Schizostachyum* species, including *S. brachycladum* and *S. silicatum*, cluster in group C, and *T. siamensis* stands alone in group D. *T. siamensis* is distinctly different from other

species because of its morphology, such as culm-sheath auricles without bristles and linear leaves, whereas other species typically have auricles with bristles on their culm-sheaths and lanceolate to oblong leaves. *Schizostachyum* can be quickly identified by its branch complements, which consist of several sub-equal branches, while *Bambusa*, *Dendrocalamus*, and *Thyrsostachys* have one dominant branch and several smaller branches. Therefore, *S. brachycladum* and *S. silicatum* are separate from other species and grouped together in group C.

On the other hand, while many species of *Bambusa* are grouped together, not all of them belong in the same cluster. For instance, *B. vulgaris* and *D. asper* are grouped together (group B). *Bambusa* and *Dendrocalamus* are reported to be closely related sister genera that are difficult to separate phylogenetically (Goh et al. 2010). However, both genera can be distinguished morphologically from each other. *Bambusa* culms, particularly young culms, are somewhat zigzagged and have branches growing close to the ground, and aerial roots only emerge from a few culm nodes close to the ground. In contrast, *Dendrocalamus* culms are relatively straight, with branches starting from higher up on the culm, and aerial roots emerge from almost all culm nodes. *B. vulgaris* and *D. asper* are classified together due to certain morphological characteristics, such as culm  $\geq 10$  m tall, culm-sheath ligules are toothed, culm-sheath  $\geq 15$  cm length, and leaf-blade  $\geq 30$  cm length. In the field, *B. multiplex* and *B. tuldooides* are often found less than 10 m tall. Both species are often used as ornamental plants or grown in pots (Widjaja 2001), resulting in stunted growth due to pruning or growing in small pots with low nutrient. However, *B. multiplex* reportedly can grow up to 7 m tall (Dransfield and Widjaja 1995a) and *B. tuldooides* can reach 10 m tall (But and Chia 1995), and the author (IPGPD) once found *B. multiplex* growing up to 6 m tall in the "Eka Karya" Bali Botanic Garden. *Bambusa* species that cluster together (*B. multiplex*, *B. spinosa*, and *B. tuldooides*; group A) share the same morphological characters, such as green culm, culm-sheath less than 30 cm width, culm-sheath blades less than 5 cm width, and leaf-blade less than 30 cm length.



**Figure 8.** A. Overlapping map of altitude and species distribution (made using QGIS software with modification). B. Altitude distribution of bamboo species on Weh Island



**Figure 9.** Dendrogram of bamboo species on Weh Island based on UPGMA and Nei & Li's Coefficients

It can be concluded that there are eight species of bamboo on Weh Island, namely *B. multiplex*, *B. spinosa*, *B. tuldooides*, *B. vulgaris*, *D. asper*, *S. brachycladum*, *S. silicatum*, and *T. siamensis*. *B. vulgaris* is most abundant and widespread on Weh Island, meanwhile, *B. multiplex* and *B. tuldooides* are the least common. The presence of *S. silicatum* on Weh Island and Bangka Island was additional information on the expansion of these species distributions outside the mainland of Sumatra. Bamboos on Weh Island were found around settlements, plantations, and forests at 1-212 m asl. Bamboo species on Weh Island can be clustered into four groups based on their morphological characteristics.

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