Notes on Araceae in Lojing Highlands, Kelantan, Peninsular Malaysia

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Abstract. Araceae is recognized as *keladi hutan* or *ubi keladi* to the local community in Malaysia. The aim of this study is to provide an update checklist and description on ecology of Araceae in Lojing Highlands, Gua Musang, Kelantan, Peninsular Malaysia. The survey was applied the random sampling technique. The result shows that a total of 25 species from 15 genera of Araceae were revealed from the area. This figure constitutes about 17.9% out of 140 species and 53.6% of the 28 genera of Araceae documented in Peninsular Malaysia. Most of them, 23 species or 92.0% are common in tropical rainforest. However, two species which considered as rare, these are *Alocasia inornata* Hallier *f.* and *Arisaema anomalum* Hemsl.

1. Introduction

Araceae is the monocotyledonous angiosperm plant. The most common differences of morphological characteristic for Araceae as compared to other families is the occurance of inflorescences in the form of spathe-and-spadix [1, 2]. The species and genus of Araceae show lot of diverse in morphological appearances, microhabitats, lifeforms, phenology and adaptive variations for efficient pollination [3]. Beside, Araceae ocupies in multi ranges of elevations and sites. Moisture and humidity are the two most suitable conditions needed by many species of Araceae to thrive [4, 5].

To date, a total of approximately 132 genera and 5,435 species of Araceae were recorded in various regions of the world [6]. The Malesia region such as Malay Peninsula, Borneo, Sumatra and New Guinea were consideded as several centres of diversity for Araceae family. In Peninsular Malaysia, [7] was updated an account of Araceae that registered 28 genera and 140 species, including of 25 species are considered as endemic.

This article on Lojing Highlands is one of the 61 places surveyed by the main author in the state of Kelantan. This is the sixth checklist account of Araceae in Peninsular Malaysia, subsequently from the surveys in Ulu Sat [8], Pangkor Island [9], Mt. Basor [10], Mt. Chamah [11] and Kuala Koh [12]. This is also the second account of Araceae after Gunung Chamah which conducted in highland areas at elevation of more than 1,000 meters above sea level. In addition, three novel species of Araceae, *Alocasia farisii*, *Homalonema stongensis* and *H. kualakohensis* [13, 14, 15]; and two new records for Peninsular Malaysia, *Aglaonema cochinchinense* and *A. pumilum* [16] were also revealed from the project. Beside taxanomy, the project on Araceae in Peninsular Malaysia also comprised of several other studies such as on phytogeography [17], phytoremediation [18, 19], propagation [20], species utilization [21, 22] and phytochemistry [23, 24, 25].

2. Methodology

The study area, Lojing Highlands is located at the southern part of Kelantan, Peninsular Malaysia. It is laying between latitude of 4° 32' to 4° 47' N and longitude of 101° 20' to 101° 34' E. The elevation of the area is between 800 to 1,400 meters above sea level. The total land area is 23,435 ha, mostly covered by natural tropical rainforest of hill dipterocarp and sub-montane forests. There are two forest reserves, namely Lojing (14,339 ha) and Sg. Berok (4,041 ha). The highest peak is Mt. Warpu (1,864 meters) [26].

The random sampling technique as adopted from [27] was used in this study. In this technique, the sample in the population are randomly selected, hence each sample in the population has the same possibility of being collected as a sample. The surveys were done in two forested areas; Kg. Jedip and Kg. Sg. Rengit of Lojing Highlands.

During the survey, Araceae species were collected and subsequently and conserved as herbarium specimen for references. If flowers or fruits are available, they will be preserved in 70% ethanol. The position of each Araceae species was taken in longitude and latitude by using the GPS (Global Positioning System). Other physical parameters such as elevation, aspect and slope gradient were also automatically captured by GPS.

The data on habitats of Araceae was also taken. These descriptive parameters are forest floor conditions (dry and moist), the microhabitats (flat area, on-ridge, on-slope, streambank and in-stream), the lifeforms (mesophytes, hemiepiphytes, lithophytes, rheophytes, helophytes and geophytes). The geological data were also noted such as clastic sediment, granite, limestone, metasediment, schist and volcanic. The photography of habitat and morphological characters were also taken such as inflorescence, infructescence, leaf, stem and root.

3. Results and discussion

The result shows that a total of 25 species from 15 genera of Araceae were documented in Lojing Highlands as tabulated in Table 1. From the total, 23 species were considered as common and only two species were noted as rare. Based on our earlier studies of Araceae in Kelantan, the number of Araceae species collected will indicate the status of forest in a particular area as shown in Table 2. According to the hypothesis, Lojing Highlands was classified as good forest or recovered disturbed area.

In general, the forested area in Lojing is still regarded as one of the pristine natural areas in Kelantan which many parts are still covered by hill dipterocarp and sub-montane forests. However, the areas surveyed are slightly disturbed due to frequent visits by tourists and proximity to the indigenous villages. The occurance of *Rafflesia kerri* Meijer [28, 29], the gigantic flower in Lojing Highlands has attracted many tourists especially international tourists to visit this area [30].

The most diverse species of Araceae collected in Lojing Highlands is from the category of lianescent or climbing herb. They are hemiepiphytic plants, begin their survives on the forest floor (on soil or rock) and then climb and colonize the tree trunks where they become adults. A total of eleven species of climbing Araceae from six genera were recorded in Lojing Highlands; *Amydrium* Schott, *Anadendrum* Schott, *Epipremnum* Schott, *Pothos* L., *Rhaphidophora* Schott and *Scindapsus* Schott. As usually, *Amydrium medium* (Zoll. & Moritzi) Nicolson and *Epipremnum giganteum* (Roxb.) Schott were always seen creeping on big trees up to emergent strata. Meanwhile, *Anadendrum microstachyum* de Ver & Becker and *Pothos scandens* L. were colonized on shrub and understory stratum. In Lojing Highlands, these said species were prominent in steep slope, on ridge and dry areas at an altitude of 600-1,000 meters above sea level (a.s.l.).

Three species of *Rhaphidophora* Schott were noted during the sampling. *Rhaphidophora korthalsii* Schott is one of the common species and widely distributed in the tropical rainforest of Peninsular Malaysia. In Lojing Highlands, the species was observed on flat area and gentle slope at an altitude of 1,000 meters a.s.l. They usually found thriving on the rocks and stem trees of medium to bigger sizes. The juvenile stage of *R. korthalsii* Schott is a shingle liana with oblong-elliptic to ovate, more or less falcate upwards pointing leaves overlying in the manner of roof tiles. Therefore, *R. maingayi* Hook.*f.*

was also conquered on rocks and climbed on medium size of trees of dry ridge areas at an altitude of 900 meters a.s.l. Meanwhile, *R. puberula* Engl. also thrived on rocks and trees in dry area but frequently spoted on flat areas at an altitude of 800-900 meters a.s.l.

Table 1. Checklist of Araceae recorded in Lojing Highlands, Kelantan, Peninsular Malaysia

No.	Genus	Species	Lifeform	Habitat	Voucher No.	Remarks
1.	*Aglaonema* Schott	*nitidum* (Jack) Kunth	Mesophytes	Streambank, on slope, moist area	UMK00277	C
2.	*Alocasia* (Schott) G. Don	*inornata* Hallier *f.*	Mesophytes	On slope, dry areas	UMK00289	R
		longiloba Miq.	Mesophytes	Flat area, on slope, moist and dry areas	UMK00288	C
3.	*Amorphophallus* Blume	*prainii* Hook.*f.*	Geophytes	On slope, moist and dry areas	UMK00162	C
4.	*Amydrium* Schott	*medium* (Zoll. & Moritzi) Nicolson	Hemiepiphytes	On ridge, on slope, dry area	UMK00164	C
5.	*Anadendrum* Schott	*microstachyum* de Vr. & Becker	Hemiepiphytes	On slope and dry area	UMK00170	C
6.	*Apoballis* Schott	*mutata* (Hook.*f.*) S.Y.Wong & P.C.Boyce	Mesophytes	In colony, shady moist area, on-slope	UMK00179	C
7.	*Arisaema* Mart.	*anomalum* Hemsl.	Mesophytes	On slope, on rock, shady and moist areas	UMK00270	E, R
8.	*Colocasia* Schott	*esculenta* (L.) Schott	Mesophytes, Helophytes	Streambank, moist area	UMK00244	C
9.	*Epipremnum* Schott	*giganteum* (Roxb.) Schott	Hemiepiphytes	Flat, on rigde, dry area	UMK00276	C
10.	*Homalomena* Schott	*curvata* Engl.	Mesophytes	On slope, ridge, close canopy area	UMK00131	C
		pontederifolia Griff. ex. Hook.*f.*	Mesophytes	Flat area, on ridge, dry area	UMK00005	C
		wallichii Hook.*f.*	Mesophytes	Flat area, on slope, dry and moist areas	UMK00018	C
11.	*Piptospatha* N. E. Br.	*perakensis* (Engl.) Engl.	Rheophytes	Stream margin, on rock, moist area	UMK00291	C
12.	*Pothos* L.	*scandens* L.	Hemiepiphytes	Flat area, on ridge, dry area, often on medium trees.	UMK00085	C
13.	*Rhaphidophora* Hassk.	*korthalsii* Schott	Hemiepiphytes	On slope, on rock and tree, dry and moist areas	UMK00038	C
		maingayi Hook.*f.*	Hemiepiphytes	Flat area, on slope, on rock and tree, dry area	UMK00045	C
		puberula Engl.	Hemiepiphytes	Flat area, on slope, on rock and tree, dry area	UMK00052	C
14.	*Schismatoglottis* Zoll. & Morritz.	*brevicuspis* Hook.*f.*	Mesophytes	Shady moist area, colonial on muddy and sandy stream banks	UMK00292	C
		calyptrata (Roxb.) Zoll. & Moritzi	Mesophytes, Rheophytes	Stream margin, on slope, on rock and soil, moist area	UMK00295	C
		scortechinii Hook.*f.*	Mesophytes	On slopes, shady moist areas, stream margins	UMK00056	C
15.	*Scindapsus* Schott	*perakensis* Hook.*f.*	Hemiepiphytes	Shady moist area, on rocks, trees and soil	UMK00311	C
		pictus Hassk.	Hemiepiphytes	Shady moist area, on slopes, ridge areas, on trees and soil	UMK00297	C
		scortechinii Hook.*f.*	Hemiepiphytes	Flat area, on slope, on tree, dry area	UMK00316	C
		treubii Engl.	Hemiepiphytes	Flat area, on slope, on tree, dry area	UMK00320	C

E = Endemic; R = Rare Species, C = Common Species.

Table 2. Association between no. of Araceae species and status of forest condition in Kelantan, Peninsular Malaysia

No. of Araceae species	Status / Condition of forest
1 to 10	Poor / very disturbed forest
11 to 20	Moderate / less disturbed forest
21 to 30	Good / recovered disturbed forest
30 & above	Very good / virgin forest

Four species of *Scindapsus* Schott. were collected during the survey, namely *Scindapsus perakensis* Hook.*f*., *S. pictus* Hassk., *S. scortechinii* Hook.*f*. and *S. treubii* Engl. The most noticible species is *S. pictus* Hassk. usually thrive at higher altitude of shady moist and undisturbed forest on soil slopes area. In Lojing Highlands, this species was spoted at an altitude of 1,050 meters a.s.l. This species also has a great potential to be develop as in-door ornamental plant due to the attractive color of the leaves and ability to grow under relatively low light, humid environment and easily to maintain [31].

Three species of *Schismatoglottis* Zoll. & Moritzi were found in Lojing Highlands. *Schismatoglottis brevicuspis* Hook.*f*., *S. calyptrata* (Roxb.) Zoll. & Moritzi, *S. scortechinii* Hook.*f.* are commonly found in stream margins and shady moist areas at an altitude of 600-1,000 meters a.s.l. All of them are mesophytic plants, however, *S. calyptrata* (Roxb.) Zoll. & Moritzi also was noted as rheophytes that thrive in fast moving water currents clinging on river bedrock and rocky streams. In addition, *Apoballis mutata* (Hook.*f*.) S.Y. Wong & P.C. Boyce also grow in moist, damp and shady areas. As typical, *Piptospatha perakensis* (Engl.) Ridl. was noted as rheophytes herb in clearwater rapids, streams and main rivers of Sg. Dekong. The presence of this species became as bioindicator for clean water, less sediment and pollution in the river.

Homalomena Schott is one of the most diverse genera in the tropical rainforest. However, from a total of evelen species recorded in Kelantan, only three species were noted in Lojing Highlands at an altitude of 650-950 meters a.s.l. *Homalomena curvata* Engl. was observed thriving on the slope and ridge of close canopy areas. Meanwhile, *H. wallichii* Schott was spoted on a flat or steep slope of moist and dense forest canopy. Therefore, *H. pontederiifolia* Griff. ex. Hook.*f*., the largest species in Peninsular Malaysia was noted along the trails, on ridge and dry areas.

Two species of *Alocasia* (Schott) G. Don were collected during the sampling. *Alocasia longiloba* Miq. was found in scattered, both in dry and moist areas, on slope and ridge of sparse canopy areas at an altitude of 600-900 meters a.s.l. Meanwhile, *A. inornata* Hallier *f.* (Figure 1), a robust herb up to 80 cm tall is considered a rare species in Peninsular Malaysia. This species was noted along the tracking trail near to bamboo colonies, on the dry slopes and ridges at an altitude of 890 meters a.s.l. Therefore, only one spesies from the genus *Colocasia* Schott was observed in this area, *Colocasia esculenta* (L.) Schott was spoted as helophytic plant in large colony of shallow pondy area at an altitude of 870 meters a.s.l. *C. esculenta* (L.) Schott is a non-indigenous species and had been utilised for decade by local Malay as a food crop [21]

Lastly, one species each from the genera of *Aglaonema* Schott, *Amorphophallus* Blume and *Arisaema* Mart. were collected from Lojing Highlands. *Aglaonema nitidum* (Jack) Kunth. is widely distributes on forest slope, streambank and moist areas at an elevation of 650 meters a.s.l. Meanwhile, the geophytes plant, *Amorphophallus prainii* Hook.*f*. was spoted thrive on a slope, moist and dry areas at an altitude of 650-850 meters a.s.l. The most exciting Araceae species revealed from Lojing Highlands is *Arisaema anomalum* Hemsl. (Figure 2) which considered rare and endemic for Peninsular Malaysia. This species is the highlander plant which only found at an altitude more then 1,000 meters a.s.l. The species also a new record for Kelantan after earlier report by [32] Gusman & Gusman (2006) in Perak and Selangor. The species was noted in moist shady sites, on rocks and over deep soil of granitic area.

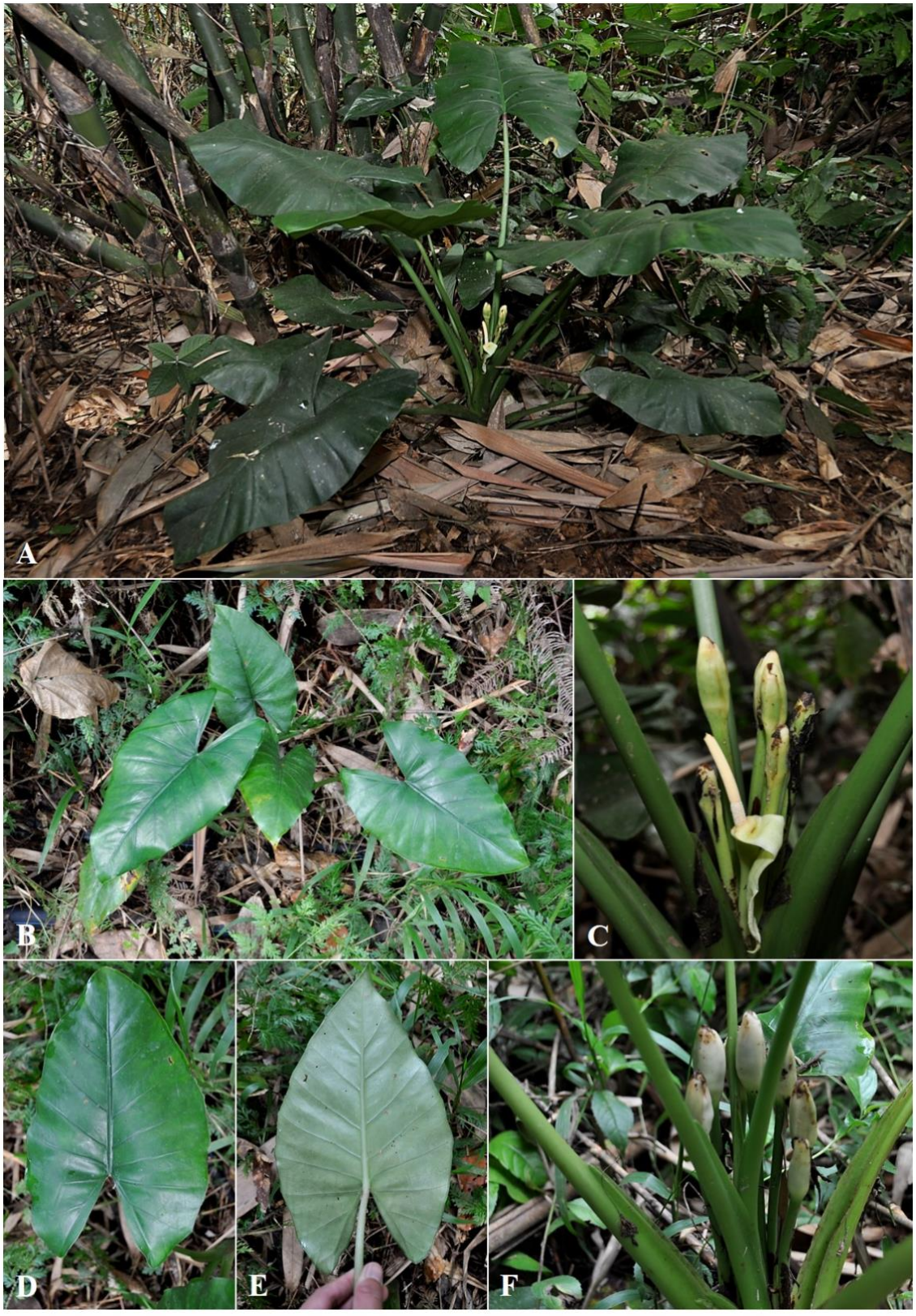

Fig. 1. *Alocasia inornata* Hallier *f.* **A** & **B** – Plants in habitat, mesophytic. **C** – Inflorescence and early stage of infructescences. **D** – Leaf-blade, adaxial surface. E – Leaf-blade, abaxial surface. F – Infructescences. Images © Zulhazman H.

Fig. 2. *Arisaema anomalum* Hemsl. **A** – Plant in habitat, lithophytic. **B** – Variation in colour of leaf-blade, adaxial surface. **C** – Inflorescence at female anthesis. **D** – Detail of spadix, spathe artifically removed. **E** – Unripe infructescence. Images © Zulhazman H.

4. Conclusion

The study has listed 25 species from 15 genera of Araceae from Lojing Highlands, Guan Musang , Kelantan, Peninsular Malaysia. All collections are common species except two species which considered as rare, these are *Alocasia inornata* Hallier *f.* and *Arisaema anomalum* Hemsl. The results indicated that this area is diverse with Araceae species. Further studies are needed in order to better understanding the diversity and ecology of Araceae in this area.

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