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Species Composition of Saplings in Pelangai Forest Reserve, Kuala Pilah, Negeri Sembilan

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ABSTRACT. A study on the species composition and diversity of saplings (diameter at breast height ≥ 1.0–4.9 cm) was conducted in a regenerating lowland dipterocarp forest at Pelangai Forest Reserve, Kuala Pilah, Negeri Sembilan. The aim of this preliminary study is to know how good the regeneration process is in this forest, as no research has ever been conducted in this forest, either for big trees or saplings. Four quadrats of 5 m x 5 m (0.01 ha) were established in the big tree plot (25 m x 20 m). The floristic composition of saplings was represented by 48 individuals consisting of 34 species, 30 genera, and 20 families. Phyllanthaceae was the largest family in terms of the number of species, with five taxa. *Diospyros* has recorded the highest total number of species with three taxa. Only one endemic species to Peninsular Malaysia was recorded, namely *Diospyros singaporensis*. The total basal area for all trees was 3.03 m²/ha. At the family level, Ebenaceae contributed the highest basal area of 0.67 m²/ha, and at the species level, *Diospyros singaporensis* (Ebenaceae) contributed the highest basal area of 0.53 m²/ha (17.37%). Sapling density in the study plot was 4,800 individuals/ha, with Ebenaceae the densest family, with 900 ind/ha, while *Diospyros singaporensis* (Ebenaceae) represents the densest species, with 700 individuals per hectare. Despite the time constraints and the establishment of relatively small quadrats, this study provided preliminary data on the floristic composition and abundance of saplings in the remaining regenerating lowland dipterocarp forest in Negeri Sembilan. At present, the biodiversity of the flora is still preserved, as the forest was handed to UiTM and is free from any development.

Key words: Pelangai Forest Reserve, sapling, lowland forest, endemic

1. INTRODUCTION

Primary mixed lowland and hill dipterocarp forests in Malaysia harboured more species of plants compared to other forest types. For instance, in the 50-ha plot of primary lowland dipterocarp forest at Pasoh Forest Reserve, Negeri Sembilan, there were 820 species represented by 294 genera and 78 families of trees with a diameter ≥ 1.0 cm DBH (Kochummen et al., 1990). Meanwhile, in the primary mixed hill dipterocarp forest of the 52-ha plot in Bukit Lambir National Park, Sarawak, a total of 1,182 species from 287 genera and 83 families of trees with a diameter ≥ 1.0 cm

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DBH were found (Lee et al., 2002). However, in the logged-over forest, most studies focused on trees, especially those with a diameter at breast height (DBH) of 5 cm and above. On the other hand, the saplings (diameter at breast height ≥ 1.0-4.9 cm) have usually received limited attention compared to tree stages (≥ 5.0 cm DBH or ≥ 10.0 cm DBH). In fact, saplings are also an important component for the sustainability of forests because they can grow to become the big trees. According to Tchouto et al. (2006), saplings contributed a high percentage of total diversity in the African tropical forests.

In Negeri Sembilan, several studies involving trees with DBH ≥ 5.0 cm and ≥ 10.0 cm were carried out, for example, in Angsi Forest Reserve (Nizam et al., 2010), Kenaboi Forest Reserve (Nizam et al., 2014), Sungai Menyala Forest Reserve (Manokaran and Swaine, 1994; Manokaran and Kochummen, 1987; 1990; 1992), and Pasoh Forest Reserve (Manokaran and Kochummen, 1990; 1992; Manokaran and Swaine, 1994). However, studies on saplings with DBH less than 5.0 cm are still lacking except for silvicultural purposes (Wyatt-Smith, 1963). Only several studies were conducted for the trees with DBH 1.0 cm and above, such as in Pasoh Forest Reserve (Davies et al., 2003) and in Sungai Menyala Forest Reserve (Ahmad Fitri et al., 2023; Mohd Shafiq et al., 2023). This plant group is often ignored, but it's vital to the rainforest strata.

This paper reports the results obtained during the scientific expedition organised by UiTM Kuala Pilah Campus in June and December 2023. The objective of this study was to determine the floristic composition of sapling species that are recorded in the Pelangai Forest Reserve. The information obtained is expected to enhance the existing flora databases for possible forestry management and conservation purposes of Pelangai Forest Reserve in the future. The presence of many sapling species, especially from the emergent and main canopy groups, such as dipterocarps, as well as the endemic and other unique tree species, showed the regenerating process is in good condition.

2. METHODOLOGY

2.1. Study Site

Pelangai Forest Reserve was gazetted as a forest reserve on 1st December 1936 and is located in the Kuala Pilah district, Negeri Sembilan (Figure 1). This forest covers an area of 6,630 ha (Anon. 2017). Approximately 400 ha were allocated to Universiti Teknologi MARA (UiTM) Kuala Pilah Campus, with portions of the area developed for campus infrastructure and related facilities. This forest has been logged with the presence of skid trails, and the big trees are scarce. This forest is classified as the regenerating lowland dipterocarp forest and is still rich with dipterocarp species, especially from the species of *Dipterocarpus*, *Richetia* and *Rubroshorea*. For undergrowths, the common species are the stemless palm, *Eugeissona tristis*, and *Johannesteijsmannia altifrons*.

2.2. Methods

In this study, four quadrats with the dimension of 5 m x 5 m each (0.0025 ha) were established in a big tree plot (25 m x 20 m) at Pelangai Forest Reserve, covering an area of 0.01 ha. All saplings with a diameter ≥ 1.0–4.9 cm were marked and measured using DBH tape. Specimens (fruit and flowers, if present) for each sapling were collected for identification. Then, the specimens were curated and processed by the methods of Bridson and Forman (1992) and

kept in the oven for one week at the temperature of 60 °C. Species identification was done by using the keys in the books of the local flora (Corner, 1988; Kiew et al., 2010, 2011, 2012, 2013, 2015, 2017, 2018; Ng, 1978a, 1989; Symington, 2004; Whitmore, 1972a, 1973a) and in comparison with herbarium specimens at Herbarium of Universiti Kebangsaan Malaysia (UKMB) and Herbarium of Forest Research Institute Malaysia (KEP).

2.3. Data analysis

Analysis of the data for this study involves a number of parameters, such as floristic composition, density, abundance and basal area (Brower et al., 1997).

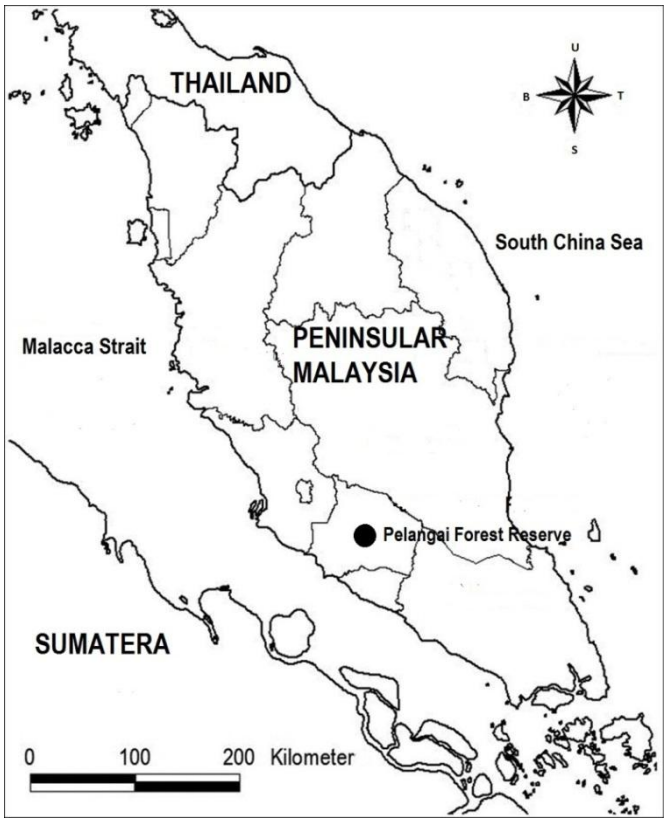

Figure 1. Location of Pelangai Forest Reserve, Kuala Pilah, Negeri Sembilan

i) Floristic composition

All specimens that were identified were then tabulated and summarized into family, genus and species representing the floristic composition of the forest area.

ii) Density (d)

Density (d) is the number of trees per unit area or unit volume

$$d = n_i/A$$

where,

n_i = the total number of individuals counted for species *i*

A = total area sampled.

iii) Basal Area (BA)

Basal area (BA) is the proportion of ground covered by tree stems. It is the cross-section of the stem at a point where the DBH is measured.

Basal area $= \pi r^2$

$= \pi DBH^2/4$

$= 0.00007854 \times DBH\ (m^2)$

3. RESULTS AND DISCUSSION

3.1. Floristic composition

A total of 48 individual saplings with DBH (1.0-4.9 cm) were enumerated in a 0.01 ha quadrat at Pelangai Forest Reserve. The floristic composition consists of 34 species from 30 genera and 20 families. Table 1 shows the list of families with the number of genera, species and individuals present in the study quadrat.

Table 1. List of all families with the total number of genus, species and individuals of sapling in 0.01 ha quadrats at Pelangai Forest Reserve, Kuala Pilah, Negeri Sembilan.

No.	Family	Total number of genus/genera	Total number of species	Total number of individuals
1	Anisophylleaceae	1	1	1
2	Annonaceae	1	1	2
3	Burseraceae	2	2	2
4	Calophyllaceae	2	2	2
5	Dipterocarpaceae	2	2	3
6	Ebenaceae	1	3	9
7	Fabaceae	1	1	1
8	Lamiaceae	2	2	2
9	Lauraceae	1	1	1
10	Malvaceae	1	2	2
11	Meliaceae	1	1	1
12	Myristicaceae	1	1	1
13	Olacaceae	1	1	3
14	Pandaceae	1	1	1
15	Phyllanthaceae	4	5	7
16	Putrajivaceae	1	1	1
17	Rubiaceae	4	4	5
18	Salicaceae	1	1	1
19	Sapindaceae	1	1	2
20	Sapotaceae	1	1	1
	Total	30	34	48

The family with the highest total number of genera were Phyllanthaceae and Rubiaceae, with four taxa each, followed by Burseraceae, Calophyllaceae, Dipterocarpaceae and Lamiaceae, with two genera each. For the most speciose family, Phyllanthaceae and Rubiaceae have five and four species, respectively.

Although the size of the quadrat is relatively small (0.01 ha), the total number of sapling species is considered high. Other studies also showed similar findings or a higher total number of species. For instance, in the Temengor Forest Reserve in Perak, Ahmad Fitri et al. (2018) reported 42 families, 101 genera, and 163 species from a total of 344 individuals collected in 0.192 ha transects.

For the most speciose family, notably Euphorbiaceae, the results obtained in this study were also similar to other studies in Peninsular Malaysia. For example, Fadilah (2007) reported that both Euphorbiaceae and Annonaceae were the most speciose families in riparian and secondary forest plots at Krau Wildlife Reserve, Pahang. In addition, the important timber family of Dipterocarpaceae was also present, comprised of two species and three individuals. Such diversity is very important for this family to maintain its survival in the future with the presence of many stocks of saplings.

3.2. Genus composition

At the genus level, *Diospyros* (Ebenaceae) was the most speciose genus, with three species. Another two genera, namely *Baccaurea* (Phyllanthaceae) and *Pentace* (Malvaceae), were represented by two species. Table 2 shows the seven most speciose genera in the study quadrats. The remaining 27 genera were comprised of a single species.

Table 2. Three most speciose genera of sapling in in 0.01 ha quadrats at Pelangai Forest Reserve, Kuala Pilah, Negeri Sembilan.

Genus	Family	Total number of species	Total number of individuals
Diospyros	Ebenaceae	3	9
Baccaurea	Phyllanthaceae	2	3
Pentace	Malvaceae	2	2

This study revealed that no one genus of pioneers was encountered, especially from the fast-growing species of *Balakata*, *Macaranga*, *Mallotus*, *Polycias*, and *Triadica*. In general, all these genera are usually found in the new large forest gap and in the secondary forest in Peninsular Malaysia. All of these pioneers can only be found in large forest gaps and in the forest fringe in Pelangai Forest Reserve.

For the biggest genus, the findings in this study are different from other studies. Ahmad Fitri et al. (2018), in their study at Temengor Forest Reserve, Perak, found *Syzygium* as the most speciose genus with 12 species. Jeffri (2005), in his study in two lowland forests at Endau Rompin State Park, Pahang, and Bukit Bauk Forest Reserve, Terengganu, also found different largest genera. In the former, he stated *Shorea* as being the largest genus of tree saplings with

eight species, followed by *Garcinia* and *Aglaia* with six species each, and *Syzygium* came next with four species. In the latter, *Diospyros* was represented by seven species, and *Syzygium* was at the second rank with four species.

3.3. Endemic species

Only one endemic species to Peninsular Malaysia was recorded in this study, namely, *Diospyros singaporensis*. This species occurs in Kedah, Perak, Pahang, Selangor, Negeri Sembilan, Melaka and Johor (Ng, 1978b; Turner, 1995). This species is among the main canopy trees, which can attain 25 meters in height in the forest. The presence of many saplings of this species showed the regeneration process of the densest species in good condition.

3.4. Abundance

i) Basal area

The total basal area for all saplings was 3.03 m²/ha. At the family level, Ebenaceae contributed the highest basal area of 0.67 m²/ha (22.10%), followed by Phyllanthaceae with 0.37 m²/ha (12.20%) and Sapindaceae with 0.25 m²/ha (8.31%). Table 3 shows the basal areas of all families of saplings in the study quadrats at Pelangai Forest Reserve.

Table 3. Basal area of all families of sapling in 0.01 ha quadrats at Pelangai Forest Reserve, Kuala Pilah, Negeri Sembilan

Family	Basal area per hectare (m^2/ha)	Percentage (%)
Ebenaceae	0.67	22.10
Phyllanthaceae	0.37	12.20
Sapindaceae	0.25	8.31
Rubiaceae	0.20	6.68
Dipterocarpaceae	0.19	6.42
Lamiaceae	0.17	5.50
Fabaceae	0.16	5.25
Putrajivaceae	0.16	5.25
Burseraceae	0.14	4.78
Myristicaceae	0.14	4.57
Annonaceae	0.13	4.37
Lauraceae	0.13	4.36
Olacaceae	0.10	3.17
Malvaceae	0.09	3.11
Sapotaceae	0.03	1.04
Anisophylleaceae	0.03	0.84
Salicaceae	0.03	0.84
Calophyllaceae	0.02	0.70
Meliaceae	0.01	0.26
Pandaceae	0.01	0.26
Total	3.03	100

At the genus level, *Diospyros* (Ebenaceae) contributed the highest total basal area of 0.67 m^2/ha (22.10%) followed by *Lepisanthes* (Sapindaceae) with 0.25 m^2/ha (8.31%) and *Aporosa* (Phyllanthaceae) with 0.18 m^2/ha (6.00%). The

basal area of all leading genera in the study quadrats is shown in Table 4.

Table 4. Basal area of all genera of saplings in 0.01 ha quadrats at Pelangai Forest Reserve, Kuala Pilah, Negeri Sembilan.

Genus	Family	Basal area per hectare (m^2/ha)	Percentage (%)
Diospyros	Ebenaceae	0.67	22.10
Lepisanthes	Sapindaceae	0.25	8.31
Aporosa	Phyllanthaceae	0.18	6.00
Richetia	Dipterocarpaceae	0.18	5.98
Drypetes	Putrajivaceae	0.16	5.25
Koompassia	Fabaceae	0.16	5.25
Baccaurea	Phyllanthaceae	0.14	4.58
Knema	Myristicaceae	0.14	4.57
Huberantha	Annonaceae	0.13	4.37
Cryptocarya	Lauraceae	0.13	4.36
Canarium	Burseraceae	0.11	3.74
Teijsmanniodendron	Lamiaceae	0.11	3.74
Strombosia	Olacaceae	0.10	3.17
Pentace	Malvaceae	0.09	3.11
Aidia	Rubiaceae	0.08	2.53
Adina	Rubiaceae	0.07	2.18
Clerodendrum	Lamiaceae	0.05	1.75
Cleistanthus	Phyllanthaceae	0.04	1.37
Dacryodes	Burseraceae	0.03	1.04
Payena	Sapotaceae	0.03	1.04
Urophyllum	Rubiaceae	0.03	1.04
Timonius	Rubiaceae	0.03	0.94
Anisophyllea	Anisophylleaceae	0.03	0.84
Casearia	Salicaceae	0.03	0.84
Kayea	Calophyllaceae	0.01	0.44
Vatica	Dipterocarpaceae	0.01	0.44
Aglaia	Meliaceae	0.01	0.26
Calophyllum	Calophyllaceae	0.01	0.26
Galearia	Pandaceae	0.01	0.26
Phyllanthus	Phyllanthaceae	0.01	0.26
Total		3.03	100

At the species level, *Diospyros singaporensis* (Ebenaceae) contributed the highest basal area of 0.53 m^2/ha (17.37%), *Lepisanthes senegalensis* (Sapindaceae) is in the second rank with 0.25 m^2/ha (8.31%) while *Aporosa microstachya* (Phyllanthaceae) is in the third rank with 0.18 m^2/ha (6.00%). Table 5 shows the basal area of all leading species in the study quadrats at Pelangai Forest Reserve.

Table 5. Basal area of all species of saplings in 0.01 ha quadrats at Pelangai Forest Reserve, Kuala Pilah, Negeri Sembilan.

Species	Family	Basal area per hectare (m^2/ha)	Percentage (%)
Diospyros singaporensis Bakh.	Ebenaceae	0.53	17.37
Lepisanthes senegalensis (Poir.) Leenh.	Sapindaceae	0.25	8.31
Aporosa microstachya (Tul.) Müll.Arg.	Phyllanthaceae	0.18	6.00
Richetia multiflora (Burck) P.S.Ashton & J.Heck.	Dipterocarpaceae	0.18	5.98
Drypetes longifolia (Blume) Pax & K.Hoffm.	Putrajivaceae	0.16	5.25
Koompassia malaccensis Maingay	Fabaceae	0.16	5.25
Knema stenophylla (Warb.) J.Sinclair	Myristicaceae	0.14	4.57
Huberantha jenkinsii (Hook.f. & Thomson) Chaowasku	Annonaceae	0.13	4.37
Cryptocarya ferrea Blume	Lauraceae	0.13	4.36
Baccaurea brevipes Hook.f.	Phyllanthaceae	0.13	4.32
Canarium patentinervium Miq.	Burseraceae	0.11	3.74
Teijsmanniodendron coriaceum (C.B.Clarke) Kosterm.	Lamiaceae	0.11	3.74
Diospyros buxifolia (Blume) Hiern.	Ebenaceae	0.10	3.36
Strombosia ceylanica Gardner	Olacaceae	0.10	3.17
Aidia densiflora (Wall.) Masam.	Rubiaceae	0.08	2.53
Adina eurhyncha (Miq.) Å.Krüger & Löfstrand	Rubiaceae	0.07	2.18
Clerodendrum laevifolium Blume	Lamiaceae	0.05	1.75
Pentace triptera Mast.	Malvaceae	0.05	1.62
Pentace strychnoidea King	Malvaceae	0.05	1.49
Cleistanthus ellipticus Hook.f.	Phyllanthaceae	0.04	1.37
Diospyros sp.	Ebenaceae	0.04	1.37
Dacryodes rostrata (Blume) H.J.Lam	Burseraceae	0.03	1.04
Payena lucida A. DC.	Sapotaceae	0.03	1.04
Urophyllum glabrum Jack ex Wall.	Rubiaceae	0.03	1.04
Timonius wallichianus Valeton	Rubiaceae	0.03	0.94
Anisophyllea corneri Ding Hou	Anisophylleaceae	0.03	0.84
Casearia clarkei King	Salicaceae	0.03	0.84
Kayea kunstleri King	Calophyllaceae	0.01	0.44
Vatica pauciflora (Korth.) Blume	Dipterocarpaceae	0.01	0.44
Aglaia sp.	Meliaceae	0.008	0.259
Baccaurea parviflora (Müll.Arg.) Müll.Arg.	Phyllanthaceae	0.008	0.259
Calophyllum ferrugineum Ridl. var. *oblongifolium* (T. Anderson) P.F. Stevens	Calophyllaceae	0.008	0.259
Galearia fulva (Tul.) Miq.	Pandaceae	0.008	0.259
Phyllanthus oxyphyllus Miq.	Phyllanthaceae	0.008	0.259
Total		3.03	100

ii) Density

The density of saplings in the study plot was 4,800 ind/ha. Ebenaceae has the highest density with 900 individuals per hectare followed by Phyllanthaceae with 700 individuals per hectare and Rubiaceae with 500 individuals per hectare (Table 6).

Table 6. Density for all families of saplings in 0.01 ha quadrats at Pelangai Forest Reserve, Kuala Pilah, Negeri Sembilan

Family	Total number of individuals	Density (ind/ha)
Ebenaceae	9	900
Phyllanthaceae	7	700
Rubiaceae	5	500
Dipterocarpaceae	3	300
Olacaceae	3	300
Burseraceae	2	200
Calophyllaceae	2	200
Lamiaceae	2	200
Malvaceae	2	200
Annonaceae	2	200
Sapindaceae	2	200
Anisophylleaceae	1	100
Fabaceae	1	100
Lauraceae	1	100
Meliaceae	1	100
Myristicaceae	1	100
Pandaceae	1	100
Putrajivaceae	1	100
Salicaceae	1	100
Sapotaceae	1	100
Total		4800

At the genus level, *Diospyros* (Ebenaceae) had recorded the highest density with 900 individuals/ha, followed by *Baccaurea* (Phyllanthaceae) and *Strombosia* (Olacaceae) with 300 individuals/ha) each. Six genera namely, *Aidia* (Rubiaceae), *Aporosa* (Phyllanthaceae), *Huberantha* (Annonaceae), *Lepisanthes* (Sapindaceae), *Pentace* (Malvaceae) and *Richetia* (Dipterocarpaceae) were represented by 200 individuals per hectare. Table 7 shows the density of all genera in the study quadrats in Pelangai Forest Reserve.

Table 7. Density for all genera of saplings in 0.01 ha quadrats at Pelangai Forest Reserve, Kuala Pilah, Negeri Sembilan.

Genus	Family	Total number of individuals	Density (ind/ha)
Diospyros	Ebenaceae	9	900
Baccaurea	Phyllanthaceae	3	300
Strombosia	Olacaceae	3	300
Pentace	Malvaceae	2	200
Aidia	Rubiaceae	2	200
Aporosa	Phyllanthaceae	2	200
Huberantha	Annonaceae	2	200
Lepisanthes	Sapindaceae	2	200

Richetia	Dipterocarpaceae	2	200
Adina	Rubiaceae	1	100
Aglaia	Meliaceae	1	100
Anisophyllea	Anisophylleaceae	1	100
Calophyllum	Calophyllaceae	1	100
Canarium	Burseraceae	1	100
Casearia	Salicaceae	1	100
Cleistanthus	Phyllanthaceae	1	100
Clerodendrum	Lamiaceae	1	100
Cryptocarya	Lauraceae	1	100
Dacryodes	Burseraceae	1	100
Drypetes	Putrajivaceae	1	100
Galearia	Pandaceae	1	100
Kayea	Calophyllaceae	1	100
Knema	Myristicaceae	1	100
Koompassia	Fabaceae	1	100
Payena	Sapotaceae	1	100
Phyllanthus	Phyllanthaceae	1	100
Teijsmanniodendron	Lamiaceae	1	100
Timonius	Rubiaceae	1	100
Urophyllum	Rubiaceae	1	100
Vatica	Dipterocarpaceae	1	100

Meanwhile, at the species level, *Diospyros singaporensis* (Ebenaceae) was the densest species, represented by 700 ind./ha, followed by *Strombosia ceylanica* (Olacaceae) with 300 ind./ha. Another six species, namely *Aidia densiflora* (Rubiaceae), *Aporosa microstachya* (Phyllanthaceae), *Baccaurea brevipes* (Phyllanthaceae), *Huberantha jenkinsii* (Annonaceae), *Lepisanthes senegalensis* (Sapindaceae) and *Richetia multiflora* (Dipterocarpaceae) with 200 ind./ha. The density of all species in the study quadrats is shown in Table 8.

Table 8. Density for all species of saplings in 0.01 ha quadrat at Pelangai Forest Reserve, Kuala Pilah, Negeri Sembilan

Species	**Family**	**Total number of individuals**	**Density (ind/ha)**
Diospyros singaporensis Bakh.	Ebenaceae	7	700
Strombosia ceylanica Gardner	Olacaceae	3	300
Aidia densiflora (Wall.) Masam.	Rubiaceae	2	200
Aporosa microstachya (Tul.) Müll.Arg.	Phyllanthaceae	2	200
Baccaurea brevipes Hook.f.	Phyllanthaceae	2	200
Huberantha jenkinsii (Hook.f. & Thomson) Chaowasku	Annonaceae	2	200
Lepisanthes senegalensis (Poir.) Leenh.	Sapindaceae	2	200
Richetia multiflora (Burck) P.S.Ashton & J.Heck.	Dipterocarpaceae	2	200
Adina eurhyncha (Miq.) Å.Krüger & Löfstrand	Rubiaceae	1	100
Aglaia sp.	Meliaceae	1	100

Anisophyllea corneri Ding Hou	Anisophylleaceae	1	100
Baccaurea parviflora (Müll.Arg.) Müll.Arg.	Phyllanthaceae	1	100
Calophyllum ferrugineum Ridl. var. *oblongifolium* (T. Anderson) P.F. Stevens	Calophyllaceae	1	100
Canarium patentinervium Miq.	Burseraceae	1	100
Casearia clarkei King	Salicaceae	1	100
Cleistanthus ellipticus Hook.f.	Phyllanthaceae	1	100
Clerodendrum laevifolium Blume	Lamiaceae	1	100
Cryptocarya ferrea Blume	Lauraceae	1	100
Dacryodes rostrata (Blume) H.J.Lam	Burseraceae	1	100
Diospyros buxifolia (Blume) Hiern	Ebenaceae	1	100
Diospyros sp.	Ebenaceae	1	100
Drypetes longifolia (Blume) Pax & K.Hoffm.	Putrajivaceae	1	100
Galearia fulva (Tul.) Miq.	Pandaceae	1	100
Kayea kunstleri King	Calophyllaceae	1	100
Knema stenophylla (Warb.) J.Sinclair	Myristicaceae	1	100
Koompassia malaccensis Maingay	Fabaceae	1	100
Payena lucida A. DC.	Sapotaceae	1	100
Pentace strychnoidea King	Malvaceae	1	100
Pentace triptera Mast.	Malvaceae	1	100
Phyllanthus oxyphyllus Miq.	Phyllanthaceae	1	100
Teijsmanniodendron coriaceum (C.B.Clarke) Kosterm.	Lamiaceae	1	100
Timonius wallichianus Valeton	Rubiaceae	1	100
Urophyllum glabrum Jack ex Wall.	Rubiaceae	1	100
Vatica pauciflora (Korth.) Blume	Dipterocarpaceae	1	100

The densest family in this study is relatively different from other studies in Peninsular Malaysia. For instance, a study by Noor Azilah (2012) in an insular forest of Pulau Tinggi Forest Reserve, Johor, has reported Euphorbiaceae and *Dipterocarpus grandiflorus* as the densest family and species, with 450 ind/ha and 190 ind/ha, respectively. On the other hand, Ahmad Fitri et al. (2021) reported Euphorbiaceae as the densest family (550 ind/ha) in the logged-over lowland dipterocarp forest at Ma'okil Forest Reserve, Muar, Johor. At the genus level, both *Syzygium* (Myrtaceae) and *Pimelodendron* (Euphorbiaceae) have recorded the highest density with 225 individuals/ha, respectively. Meanwhile, *Pimelodendron griffithianum* (Euphorbiaceae) was the densest species, represented by 225 individuals/ha. The densest taxa are relatively different in various studies depending on forest types, disturbance and edaphic factors.

4. CONCLUSION

This study reports that, despite the relatively small plot size of 0.01 ha, the number of sapling species remains high. A total of 48 individuals, consisting of 34 species from 30 genera and 20 families, were recorded. Phyllanthaceae was the largest family in terms of the number of species, with five taxa. Diospyros recorded the highest total number of species with three taxa. The total basal area for all saplings in the study plot was 3.03 m²/ha, while the density was 4,800 individuals per hectare. This study provided preliminary data on the sapling's floristic composition and abundance, as well as the endemic taxon. Dipterocarpaceae was also present among the 20 families, which are

comprised of two species. There is no pioneer species recorded in the quadrats, although certain species were found outside, either in forest gaps or in the forest fringe. Further study is needed in the large scale of quadrats to achieve a better understanding of floristic composition and conservation status.

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AUTHOR CONTRIBUTIONS

Ahmad Fitri Zohari – conceptualisation, data curation, supervision, writing – review & editing; Mohamad Sobre Zohari – data collection; Nik Hazlan Nik Hashim – supervision, writing – review & editing; Nik Norafida Nik Ali – conceptualisation, data curation; Nur ‘Aqilah Mustafa Bakray – writing – review & editing; Mohamad Khairul Faizi Zulkifli – data collection; Khairunnisaa Abd Rasid - writing – review & editing; Wan Norilani Wan Ismail – conceptualisation, data curation; Mazlin Kusin – data collection; Engku Azlin Rahayu Engku Ariff – writing – review & editing & A. Latiff – supervision, writing – review & editing.

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Not applicable.

COMPETING INTEREST

The authors declare that they have known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

COMPLIANCE OF ETHICAL STANDARDS

Not applicable.

SUPPLEMENTARY MATERIAL

Not applicable.

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