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Species Composition and Diversity of Understorey Vegetation at Pelagat Forest Reserve, Besut, Terengganu, Peninsular Malaysia

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ABSTRACT. This study was conducted to determine the species composition and diversity of understorey vegetation in the Pelagat Forest Reserve, Besut, Terengganu. A total of 10 quadrats, each measuring 2 m × 2 m (0.004 ha), were established to assess seedlings with heights ≥ 15 cm up to 1.5 m, and quadrats of 5 m × 5 m (0.025 ha) were set up to assess saplings with a diameter at breast height (DBH) < 5 cm but with a height ≥ 1.5 m. The results showed that a total of 116 individual trees were identified, consisting of 49 individuals belonging to 20 families, 29 genera, and 33 species for the seedling category, while 67 individuals comprising 26 families, 43 genera, and 51 species were recorded for the sapling category. The total density of seedlings and saplings was 12,225 individuals/ha and 2,680 individuals/ha, respectively, with Myrsinaceae contributing the highest seedling family density at 2,250 individuals/ha, while Rubiaceae contributed the highest sapling family density at 440 individuals/ha. At the species level, *Ardisia* sp. 1 recorded the highest seedling density with 1,750 individuals/ha, while *Pentace curtisii*, *Rubroshorea ovalis*, and *Saprosma glomerulata* were the highest contributors to sapling density, with 120 individuals/ha each. The Shannon Index (H) values were 3.30 and 3.85 for seedlings and saplings, respectively, while the Shannon Evenness Index (E) values were 0.94 and 0.98 for seedlings and saplings, respectively. The Margalef Richness Index (D_{MG}) values were 8.22 and 11.89 for seedlings and saplings, respectively. A total of eight species endemic to Peninsular Malaysia were recorded in this study, comprising eight families, eight genera, and 10 individuals.

Key words: Floristic composition, understorey vegetation, saplings, seedlings, diversity, Pelagat Forest Reserve

1. INTRODUCTION

Understorey vegetation refers to plants growing beneath the forest canopy, which include seedlings, saplings, herbs, and ferns. The presence of this vegetation within the forest stand contributes positively to the balance of the ecosystem on a broader scale. These plants play an essential role in maintaining soil moisture, thereby facilitating faster decomposition processes and enhancing soil nutrient availability (Appanah & Mohd. Rasol, 1994). In the dynamic cycle of a tropical rainforest, seedlings and saplings are important because they can grow into pole, juvenile, and eventually canopy and mature trees. On the other hand, indirectly, this vegetation also provides food resources for many species of insects and animals (Wyatt-Smith, 1963). This important group of seedlings and saplings usually has received limited attention compared to tree stages (≥ 5 cm). Thus, many studies on ecology in Peninsular Malaysia focused on trees compared to understory vegetation.

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However, studies on the species composition of understorey vegetation in Peninsular Malaysia remain limited compared to research on other forest strata except for silvicultural purposes (Wyatt-Smith, 1963). The previous study that had been conducted includes Perak (Lee, 2001; Rashida, 2002; Ahmad Fitri, 2018), Johor (Julia Akmar, 2007; Nurul Husna, 2010), Pahang (Nizam, 2006), Negeri Sembilan (Nur Elia, 2011), Kelantan (Ahmad Fitri, 2020), and Selangor (Noor Aini, 2002; Ahmad Fitri, 2021). Meanwhile, in Terengganu, two studies on understorey vegetation have been reported by Tengku Nor Aslinda (2014) in Bukit Sai and Nik Hazlan (2024) in Bukit Terendak.

This study aims to evaluate the floristic composition, community structure, and diversity of seedlings and saplings in the Pelagat Forest Reserve. The information obtained is expected to contribute knowledge about community patterns of seedling and sapling species in the Pelagat forests, which is essential for sustainable management of the forest ecosystems of Terengganu. The information on seedling and sapling species composition and diversity can also provide baseline information on forest regeneration for conservation of the biodiversity of the tropical forest in this area, despite the relatively small size of the study plots (0.004 ha and 0.025 ha).

2. METHODOLOGY

2.1. Study Site

The Pelagat Forest Reserve (HSP) is located approximately 22 km from the town of Jerteh, within the Besut District, Terengganu, and is classified as a lowland dipterocarp forest. The total area of HSP covers 15,585.5 ha, comprising 73 compartments (Figure 1). The topography of this primary forest is predominantly hilly terrain with slopes reaching up to 60°, and much of the area is characterised by large rocky outcrops. This study was conducted in Compartment 53, situated near the Lata Tembakah Recreational Forest, with a total area of 215 ha. The study plot was positioned at an elevation of 205 m above sea level, with coordinates of latitude 05° 35' 11" N and longitude 102° 25' 714" E, based on Global Positioning System (GPS) data. The topography of the study plot is characterised by steep slopes and rocky terrain.

2.2. Sampling design

A total of 10 quadrats were established randomly within the study area, which consists of plots measuring 50 m x 20 m. These quadrats were divided into two sizes: 2 m x 2 m (0.004 ha) for seedling assessment and 5 m x 5 m (0.025 ha) for sapling inventory. Each quadrat was marked with ropes tied to wooden stakes. Figure 2 illustrates the structure of the quadrats constructed in the study area.

2.3. Data collection and analysis

The census was made for seedlings with heights ≥ 15 cm up to 1.5 m and saplings with diameter at breast height (DBH) < 5 cm but height ≥ 1.5 m. This classification is based on the determination by the Forestry Department of Peninsular Malaysia (1997). For seedlings, assessment was conducted in 2 m x 2 m quadrats, while saplings were assessed in 5 m x 5 m quadrats. The measurement of sapling diameter is 1.3 m above ground level. During measurements, several factors have been taken into account, such as the base and the branches. Climbers, herbs, and

palms were excluded from the census. Voucher specimens with fruits and flowers (if present) for all trees were collected and labelled for identification purposes at the herbarium.

In the small quadrats, the seedlings with heights from 15 cm to 1.5 m were counted and recorded. For saplings of less than 1.0 cm DBH, only the height was measured, while for saplings ≥ 1.0 cm DBH, the diameter measurement at breast height was taken using the diameter tape. Fresh specimens collected from the censused seedlings and saplings were pressed between newspapers and then preserved in 70% alcohol. The specimens were kept in plastic bags, and they were tied in an airtight condition. In the laboratory, the specimens were transferred to dry newspapers. The pressed specimens were then oven-dried at 60ºC for seven to ten days, depending on the type, thickness of the leaves, and presence of fruits or flowers. The method used to curate the specimens was based on Forman and Bridson (1989).

Specimens were identified using the keys of Symington (2004), Whitmore (1972; 1973), Ng (1978; 1989), Corner (1988), and Turner (1995), as well as by comparing them with the herbarium specimens in the Herbarium, Universiti Kebangsaan Malaysia (UKMB) and Herbarium Forest Research Institute Malaysia (KEP). Specimens were identified up to the species, subspecies, or variety level. For certain specimens that could not be matched with herbarium specimens, they were only identified up to the genus level. Analysis of the data for this study involves several parameters, such as floristic composition, density, and abundance (Brower et al., 1997). The Shannon Diversity Index (Spellerberg and Fedor, 2003) was determined to assess the community structure of tree species in the study area.

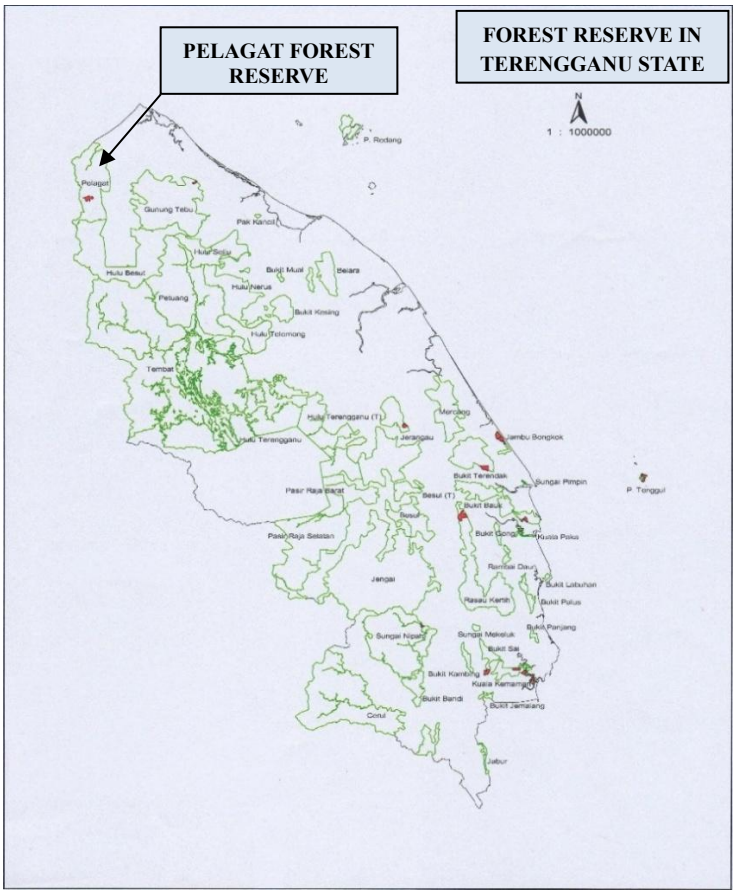

Figure 1. Location of the Pelagat Forest Reserve in Terengganu state

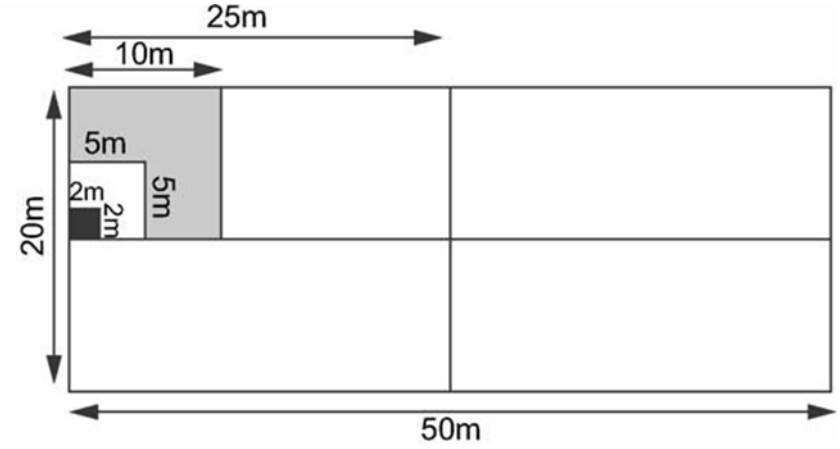

Figure 2. Design of quadrats for seedling (2 m x 2 m) and sapling (5 m x 5 m) assessment in compartment 53 at Pelagat Forest Reserve, Besut, Terengganu

3. RESULTS AND DISCUSSION

3.1. Floristic composition of seedlings and saplings

From the inventory, there were a total of 116 individuals, consisting of 30 families, 57 genera, and 77 species for the seedlings (≥ 15 cm to 1.5 m high) and saplings (< 5 cm but ≥ 15 cm high).

3.2. Seedlings

A total number of seedlings counted in the study plot were 49 individuals, consisting of 20 families, 29 genera, and 33 species. The findings were considered low and are similar to those reported by Nik Hazlan et al. (2024) in their study at the peat swamp forest in Bukit Terendak, Terengganu, where a total of 13 families, 15 genera and 19 species were recorded from 76 individuals. Of the total 10 quadrats, only quadrats 4 and 10 did not show the presence of seedlings, while quadrat 3 recorded the largest number of individuals, i.e., nine seedlings. Rubiaceae has the largest number of genera and species (five), followed by Annonaceae with four species and genera. There were two families with two genera and species, viz. Fabaceae and Olacaceae (Table 1). Some previous studies in Peninsular Malaysia also showed Rubiaceae as the largest family, such as in Krau Wildlife Reserve, Pahang (Mohd Sanusi, 2014), and in Chini Forest Reserve, Pahang (Nizam et al., 2006). However, different results indicated that Euphorbiaceae was the largest family in Sungkai Wildlife Reserve, Perak (Rashida, 2002; Nizam et al., 2005). Myrsinaceae recorded the highest number of individual seedlings (nine individuals or 18.37%), followed by Rubiaceae (seven individuals or 14.29%) and Myrtaceae (five individuals or 10.2%). At the species level, *Ardisia* sp. 1 recorded the highest number of seedlings, with seven individuals (14.29%). Following this, the species of *Pentace curtisii*, *Psychotria* sp., and *Sindora coriacea* each had three individuals (6.12%). The other remaining species had fewer than three individuals (Table 2).

Table 1. List of all families with the total number of genus, species and individuals of seedlings in 0.004 ha at Pelagat Forest Reserve, Terengganu.

No.	Family	Genus	Species	Individuals	% of individuals
1	Anisophylleaceae	1	1	1	2.04
2	Annonaceae	4	4	4	8.16
3	Burseraceae	1	1	1	2.04
4	Connaraceae	1	1	1	2.04
5	Ebenaceae	1	1	1	2.04
6	Euphorbiaceae	1	1	1	2.04
7	Fabaceae	2	2	4	8.16
8	Lauraceae	1	1	2	4.08
9	Loganiaceae	1	1	1	2.04
10	Meliaceae	1	1	1	2.04
11	Meliosmaceae	1	1	1	2.04
12	Myristicaceae	1	1	1	2.04
13	Myrsinaceae	1	2	9	18.37
14	Myrtaceae	1	3	5	10.20
15	Olacaceae	2	2	2	4.08
16	Rubiaceae	5	5	7	14.29
17	Thymelaeaceae	1	1	1	2.04
18	Tiliaceae	1	1	3	6.12
19	Verbenaceae	1	2	2	4.08
20	Violaceae	1	1	1	2.04
	Total	**29**	**33**	**49**	**100**

Table 2. List of species with the total number of individual seedlings in 0.004 ha at Pelagat Forest Reserve, Terengganu.

Species	Family	Individuals	%
Actinodaphne sp.	Lauraceae	2	4.08
Aglaia argentea	Meliaceae	1	2.04
Anisophyllea disticha	Anisophylleaceae	1	2.04
Ardisia sp. 1	Myrsinaceae	7	14.29
Ardisia sp. 2	Myrsinaceae	2	4.08
Callerya atropurpurea	Fabaceae	1	2.04
Canarium sp.	Burseraceae	1	2.04
Connarus monocarpus ssp. *malayensis*	Connaraceae	1	2.04
Disopyros buxifolia	Ebenaceae	1	2.04
Fissistigma sp.	Annonaceae	1	2.04
Goniothalamus tapis	Annonaceae	1	2.04
Gonystylus affinis	Thymelaeaceae	1	2.04
Ixora grandifolia var. *grandifolia*	Rubiaceae	1	2.04
Knema kunstleri	Myristicaceae	1	2.04
Lasianthus sp.	Rubiaceae	1	2.04
Mallotus penangensis	Euphorbiaceae	1	2.04
Meliosma lanceolata	Meliosmaceae	1	2.04
Ochanostachys amentacea	Olacaceae	1	2.04
Pentace curtisii	Tiliaceae	3	6.12
Polyalthia sp.	Annonaceae	1	2.04

Popowia sp.	Annonaceae	1	2.04
Psychotria sp.	Rubiaceae	3	6.12
Rinorea horneri	Violaceae	1	2.04
Saprosma glomerulata	Rubiaceae	1	2.04
Scorodocarpus borneensis	Olacaceae	1	2.04
Sindora coriacea	Fabaceae	3	6.12
Strychnos sp.	Loganiaceae	1	2.04
Syzygium sp. 1	Myrtaceae	1	2.04
Syzygium sp. 2	Myrtaceae	2	4.08
Syzygium sp. 3	Myrtaceae	2	4.08
Urophyllum sp.	Rubiaceae	1	2.04
Vitex gamosepala	Verbenaceae	1	2.04
Vitex pinnata	Verbenaceae	1	2.04

3.3. Saplings

The total number of saplings counted in the study plot was 67 individuals, represented by 26 families, 43 genera, and 51 species. The relatively small size of the quadrat (0.025 ha) contributed to the low total number of sapling species observed. Other studies showed findings with a higher total number of species. For instance, in Temengor Forest Reserve, Perak, Ahmad Fitri et al. (2017) listed 42 families, 101 genera, and 163 species from 344 individuals in 0.192 ha transects. Of the total 10 quadrats, there were nine that indicated the presence of saplings. Quadrat 7 recorded the largest number of individuals (17), while quadrat 10 had not shown any saplings. Rubiaceae is the largest family with six genera and seven species, followed by Annonaceae with five genera and five species. There are three families with two genera and two species each: Euphorbiaceae, Clusiaceae, and Verbenaceae. Regarding the most speciose family, the results obtained in this study were different from 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. The number of saplings with 11 individuals (16.42%) was recorded by Rubiaceae, followed by Dipterocarpaceae (7 individuals or 10.45%) and three families recorded with 5 individuals (7.46%): Annonaceae, Euphorbiaceae, and Clusiaceae. The other families only had less than five individuals (Table 3). At the species level, *Pentace curtisii, Rubroshorea ovalis*, and *Saprosma glomerulata* recorded the highest number of saplings, with three individuals (4.48%). The other species had fewer than three individuals (Table 4).

Table 3. List of all families with the total number of genus, species and individuals of saplings in 0.025 ha at Pelagat Forest Reserve, Terengganu.

No.	Family	Genus	Species	Individuals	% of individuals
1	Anacardiaceae	1	1	1	1.49
2	Anisophylleaceae	1	1	1	1.49
3	Annonaceae	5	5	5	7.46
4	Apocynaceae	1	1	1	1.49
5	Burseraceae	1	1	1	1.49
6	Clusiaceae	2	4	5	7.46
7	Dipterocarpaceae	4	4	7	10.45
8	Ebenaceae	1	1	1	1.49

9	Elaeocarpaceae	1	1	1	1.49
10	Euphorbiaceae	2	3	5	7.46
11	Fabaceae	1	1	1	1.49
12	Lauraceae	3	4	4	5.97
13	Meliaceae	1	3	4	5.97
14	Meliosmaceae	1	1	1	1.49
15	Moraceae	1	2	2	2.99
16	Myristicaceae	1	1	1	1.49
17	Myrtaceae	1	1	1	1.49
18	Ochnaceae	1	1	1	1.49
19	Olacaceae	1	1	2	2.99
20	Pandaceae	1	1	1	1.49
21	Polygalaceae	1	1	1	1.49
22	Rubiaceae	6	7	11	16.42
23	Sapindaceae	1	1	1	1.49
24	Tiliaceae	1	1	3	4.48
25	Verbenaceae	2	2	3	4.48
26	Violaceae	1	1	2	2.99
	Total	**43**	**51**	**67**	**100**

Table 4. List of species with the number of total individual saplings in 0.025 ha at Pelagat Forest Reserve, Terengganu.

Species	**Family**	**Individuals**	**%**
Aglaia argentea	Meliaceae	2	2.99
Aglaia elliptica	Meliaceae	1	1.49
Aglaia sp. 2	Meliaceae	1	1.49
Alseodaphne sp.	Lauraceae	1	1.49
Alstonia macrophylla	Apocynaceae	1	1.49
Anisophyllea corneri	Anisophylleaceae	1	1.49
Aporosa arborea	Euphorbiaceae	2	2.99
Aporosa microstachya	Euphorbiaceae	1	1.49
Callicarpa maingayi	Verbenaceae	1	1.49
Campylospermum serratum	Ochnaceae	1	1.49
Cinnamomum mollissimum	Lauraceae	1	1.49
Diospyros clavigera	Ebenaceae	1	1.49
Dipterocarpus grandiflorus	Dipterocarpaceae	1	1.49
Elaeocarpus polystachyus	Elaeocarpaceae	1	1.49
Enicosanthum cupulare	Annonaceae	1	1.49
Ficus glandulifera	Moraceae	1	1.49
Ficus schwarzii	Moraceae	1	1.49
Garcinia cf bancana	Clusiaceae	2	2.99
Garcinia urophylla	Clusiaceae	1	1.49
Goniothalamus macrophyllus	Annonaceae	1	1.49
Hopea griffithii	Dipterocarpaceae	1	1.49
Horsfieldia sp.	Myristicaceae	1	1.49
Instia palembanica	Fabaceae	1	1.49
Ixora lobbii var. *lobbii*	Rubiaceae	1	1.49
Lasianthus constrictus	Rubiaceae	1	1.49
Litsea castanea	Lauraceae	1	1.49

Litsea sessiliflora	Lauraceae	1	1.49
Mallotus penangensis	Euphorbiaceae	2	2.99
Melanochyla caesia	Anacardiaceae	1	1.49
Meliosma sumatrana	Meliosmaceae	1	1.49
Mesua grandis	Clusiaceae	1	1.49
Mesua racemosa	Clusiaceae	1	1.49
Microdesmis caseariifolia	Pandaceae	1	1.49
Orophea sp.	Annonaceae	1	1.49
Pavetta graciliflora	Rubiaceae	1	1.49
Pentace curtisii	Tiliaceae	3	4.48
Popowia pisocarpa	Annonaceae	1	1.49
Pseuduvaria macrophylla var. *macrophylla*	Annonaceae	1	1.49
Psychotria malayana	Rubiaceae	2	2.99
Psychotria sp.	Rubiaceae	2	2.99
Rennellia elliptica	Rubiaceae	1	1.49
Rinorea anguifera	Violaceae	2	2.99
Rubroshorea ovalis	Dipterocarpaceae	3	4.48
Santiria rubiginosa var. *rubiginosa*	Burseraceae	1	1.49
Saprosma glomerulata	Rubiaceae	3	4.48
Scorodocarpus borneensis	Olacaceae	2	2.99
Shorea collina	Dipterocarpaceae	2	2.99
Syzygium glaucum	Myrtaceae	1	1.49
Vitex gamosepala	Verbenaceae	2	2.99
Xanthophyllum wrayi	Polygalaceae	1	1.49
Xerospermum noronhianum	Sapindaceae	1	1.49

One of the characteristics of tropical rainforests is the abundance of seedlings and saplings of species that form the main canopy, typically observed in gap areas (Richards, 1981). However, within the study plot at the Pelagat Forest Reserve, this phenomenon was not prominently observed. The presence of seedlings and saplings in canopy gaps was minimal. This phenomenon is likely because most of the trees surrounding the plot area are large, resulting in the absence of significant canopy openings. According to Whitmore (1984), seedling regeneration commonly occurs when gaps are formed. Furthermore, environmental factors may also influence the regeneration of seedlings in the Pelagat Forest Reserve, where the steep terrain and abundance of large rock outcrops across the area hinder both seed germination and the growth of seedlings and saplings.

3.4. Density

Total seedling density per hectare was 12,250 individuals/ha, in which Myrsinaceae recorded the highest density of 2,250 individuals/ha, followed by Rubiaceae with 1,750 individuals/ha and Myrtaceae with 1,250 individuals/ha (Table 5). Meanwhile, at the species level, *Ardisia* sp. 1 recorded the highest density of 1,750 individuals/ha, followed by *Pentace curtisii*, *Psychotria* sp., and *Sindora coriacea* with 750 individuals/ha. Table 6 shows the eight leading species of seedlings with the highest density in a 0.004 ha quadrat at Pelagat Forest Reserve, Terengganu.

Table 5. The nine leading families of seedlings with the highest density in a 0.004 ha quadrat at Pelagat Forest Reserve, Terengganu.

No.	Family	Total individuals	Density (individuals/ha)
1	Myrsinaceae	9	2250
2	Rubiaceae	7	1750
3	Myrtaceae	5	1250
4	Annonaceae	4	1000
5	Fabaceae	4	1000
6	Tiliaceae	3	750
7	Lauraceae	2	500
8	Olacaceae	2	500
9	Verbenaceae	2	500

Table 6. The eight leading species of seedlings with the highest density in a 0.004 ha quadrat at Pelagat Forest Reserve, Terengganu.

No.	Species	Total individuals	Density (individuals/ha)
1	*Ardisia* sp. 1	7	1,750
2	*Pentace curtisii*	3	750
3	*Psychotria* sp.	3	750
4	*Sindora coriacea*	3	750
5	*Actinodaphne* sp.	2	500
6	*Ardisia* sp. 2	2	500
7	*Syzygium* sp. 2	2	500
8	*Syzygium* sp. 3	2	500

For saplings, the total density per hectare was 2,680 individuals/ha, in which Rubiaceae recorded the highest density of 440 individuals/ha, followed by Dipterocarpaceae with 280 individuals/ha and Annonaceae, Euphorbiaceae and Clusiaceae with 200 individuals/ha. Table 7 shows the nine leading families of saplings with the highest density in a 0.025 ha quadrat at Pelagat Forest Reserve, Terengganu. Meanwhile, at the species level, *Pentace curtisii*, *Saprosma glomerulata* and *Rubroshorea ovalis* recorded the highest density at 120 individuals/ha (Table 8).

Table 7. The nine leading families of saplings with the highest density in a 0.025 ha quadrat at Pelagat Forest Reserve, Terengganu.

No.	Family	Total individuals	Density (individuals/ha)
1	Rubiaceae	11	440
2	Dipterocarpaceae	7	280
3	Annonaceae	5	200
4	Euphorbiaceae	5	200
5	Clusiaceae	5	200
6	Lauraceae	4	160
7	Meliaceae	4	160
8	Tiliaceae	3	120
9	Verbenaceae	3	120

Table 8. The thirteen leading family of saplings with the highest density in a 0.025 ha quadrat at Pelagat Forest Reserve, Terengganu.

No.	Species	Total individuals	Density (individuals/ha)
1	*Pentace curtisii*	3	120
2	*Saprosma glomerulata*	3	120
3	*Rubroshorea ovalis*	3	120
4	*Aglaia argentea*	2	80
5	*Aporosa arborea*	2	80
6	*Garcinia cf bancana*	2	80
7	*Mallotus penangensis*	2	80
8	*Psychotria malayana*	2	80
9	*Psychotria* sp.	2	80
10	*Rinorea anguifera*	2	80
11	*Scorodocarpus borneensis*	2	80
12	*Shorea collina*	2	80
13	*Vitex gamosepala*	2	80

3.5. Species diversity

The Shannon Diversity Index (H) recorded in this study was 3.85 for saplings and 3.30 for seedlings. These values are in the normal range for tropical rainforests. The H value in this study is similar to those in other studies in Peninsular Malaysia. For instance, in studies at Pulau Besar Forest Reserve by Shahdan (2012) and at Pulau Tinggi Forest Reserve by Noor Azilah (2012), the H values were reported as 3.74 and 3.79, respectively. Meanwhile, the value of the Shannon Evenness Index (E) was 0.94 for seedlings and 0.98 for saplings. The value of the Shannon Evenness Index in this study is considered similar to most previous studies in Peninsular Malaysia. For example, a study by Lyana Athirah (2011) in Jengka Forest Reserve, Pahang, had an E value of 0.90, and Tengku Nor Aslinda (2014) in Bukit Sai Forest Reserve had an E value of 0.94. Table 9 shows the values of the diversity index of saplings and seedlings in the quadrats at Pelagat Forest Reserve. The Margalef Richness Index (D_{MG}) values for seedlings and saplings were relatively low, with values of 8.22 and 11.89, respectively.

Table 9. Diversity index of seedlings and saplings in the quadrats at Pelagat Forest Reserve, Terengganu.

Index	Seedlings	Saplings
Shannon Index, H	3.30	3.85
Shannon Evenness Index, E	0.94	0.98
Margalef Index, D_{MG}	8.22	11.89
Simpson Index	0.95	0.98

3.6. Endemic species

Ng et al. (1990) reported a total of 2,830 tree species in Peninsular Malaysia, represented by 532 genera and 100 families, of which 746 species are endemic to the region. A comparison of the species identified within the study plot with this checklist revealed that the plot contained eight species endemics to Peninsular Malaysia, representing eight families, eight genera, and a total of 10 individual trees. The list of endemic species recorded in this study is shown in Table 10.

Table 10. List of endemic species found in the seedlings and saplings quadrats at Pelagat Forest Reserve, Terengganu.

Species	Distribution in Peninsular Malaysia*
Callicarpa maingayi	Tg, Pn, Pk, Ph, Sl, Ml, Kd, Kl, NS, Jh; endemic
Cinnamomum mollissimum	Pn, Kl, Tg, Pk, Ph, Sl, NS, Ml, Jh; endemic.
Diospyros clavigera	Pn, Tg, Pk, Ph, Sl, NS, Ml, Jh, Sp; endemic
Elaeocarpus polystachyus	Kl, Tg, Pk, Ph, Sl, NS, Jh, Sp; endemic
Enicosanthum cupulare	Tg, Pk; endemic
Mallotus penangensis	Tg, Pn, Pk, Ph, Sl, Ml, Kd, Kl, NS, Jh; endemic.
Saprosma glomerulata	Tg, Pk, Ph, Sl, NS, Ml, Jh, Sp; endemic.
Shorea collina	East Coast, Tg southwards; endemic.

4. CONCLUSION

This study indicates that the understory vegetation in the Pelagat Forest Reserve, Besut, Terengganu, has moderate species diversity, although it is considered lower compared to other studies conducted across various forest types in Peninsular Malaysia. A total of 77 species, 57 genera, and 30 families from 116 individual trees were recorded. Rubiaceae recorded the highest total number of genera and species for both seedlings (5 genera; 5 species) and saplings (6 genera; 7 species), respectively. This study provides the baseline data for management purposes in the future.

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AUTHOR CONTRIBUTIONS

Nik Hazlan Nik Hashim – conceptualisation, data curation, supervision, writing – review & editing; Ahmad Fitri Zohari – supervision, writing – review & editing; Ahmad Fauzi Awang – data collection; Khairunnisaa Abd. Rasid – conceptualisation, data curation; Nur Hannani Abdul Latif – writing – review & editing; Amran Shafie – data collection; Junaiza Ahmad Zaki – conceptualisation, data curation; Norashikin Kamarudin – 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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