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DIVERSITY AND DISTRIBUTION OF FERN SPECIES IN SELECTED TRAIL IN KUANTAN PAHANG

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ABSTRACT

A study on the diversity and distribution of terrestrial and epiphytic fern in Kuantan, Pahang was conducted from January to November 2017. Fourteen species of both terrestrial and epiphytic ferns, respectively have been collected and examined from five districts of Kuantan namely Kuala Kuantan, Ulu Kuantan, Penor, Ulu Lepar and Sungai Karang. This study was carried out to examine and evaluate the distribution and to assess the abudance of epiphytic fern in Kuantan, Pahang. The materials obtained for this study were collected from sampling sites and prepared as herbarium voucher. Morphological characteristics were studied, observed and annotated. Based on this study, the terrestrial and epiphytic fern families namely Nephrolepidaceae, Gleicheniaceae, Lygodiaceae, Lindsaeceae, Woodiaceae and Thelypteridaceae, Polypodiaceae, Pteridaceae, Davalliaceae, Aspleniaceae, Blechnaceae and Cyatheaceae were recorded. It mostly can be found in the rainforest area. An updated checklist of terrestrial and epiphytic ferns has been prepared for comparison and future reference.

KEYWORDS

Diversity, Fern, Nephrolepidaceae, Gleicheniaceae, Lygodiaceae, Lindsaeceae, Woodiaceae, Thelypteridaceae, Polypodiaceae, Pteridaceae, Davalliaceae, Aspleniaceae, Blechnaceae, Cyatheaceae.

1. INTRODUCTION

According to a research, ferns or pteridophytes are abundant species that grow vigorously both at terrestrial land and place at living things such as rocks and trees which called as epiphyte [1]. Ferns are placed under division of pteridophyta which non-flowering plant with stems are, fronds, roots like others [2]. Basically, ferns and other vascular plants have major distinctive aspects that could be able to be differentiated between them [3]. Firstly, ferns do not have either seeds or flowers as they reproduce via spores. Their life cycle is characterized by gametophyte cycle which is sexual and sporophyte, asexual cycle [4].

Based on a study for epiphytic ferns, they are ferns that live on trees, rocks, old buildings and oil-palm plantation [5]. A study shows that ferns only live on the surface of the bark and has to accumulate the water with its roots and they do not harm the host except the large mass of epiphytes that may have a smothering effect or may even break a branch with its weight [6]. Epiphytic ferns are quite cut off from the ground. The root protection can be in various ways which grow along with mosses. Some of them, like the *Asplenium nidus* (birds-nest fern), *Asplenium phyllitidis*, *Platycerium coronarium* (stag's-horn fern) and *Drynaria quercifolia*, have special methods of accumulating humus [7]. *Asplenium nidus* has a great mass of roots in which the humus caught in the nest absorbs a large quantity of water during rain, and also *Platycerium* which has a slightly different method of collecting humus [5].

Leaves of fern is called frond instead of leaves. The most obvious distinct characters from other plants are the young fronds in which the new fronds are usually coiled like fiddleheads called crosiers. Other than that, ferns produced spores with different arrangement located underneath the leaves [8]. Spores are contained in cases known as sporangia. The fronds that have the spores are called fertile fronds. According to a researcher, Peninsular Malaysia was rich in pteridophytes due to its ever-wet climate [9]. A study shows that a diversity of ferns found at lower altitudes which commonly considered as plants of damp shady places [10]. Many of them are decreasing but many other ferns are adapting to exposed and less humid situations, and tropical forest [5].

From the 500 known in Peninsular Malaysia, about 50 species have been recorded in one small area. A study shows nine of these species are at the southern limit of their ranges, which lie mainly further to north [11]. As a noticed adaptation to particular habitats, 210 species of ferns are terrestrial in forest. Meanwhile, there is no updated checklist on epiphytic ferns in Kuantan, Pahang. Moreover, as stated by a researcher, the orders of pteridophytes have distinct types of spore cases, which vary considerably from family to family and within families [12]. In fact, fern families and their subdivisions down to genera and species are based primarily on the characters exhibited by their spore cases and the way these are carried.

As in most countries in Asia, traditional medicines are widely used in Malaysia, especially among the rural population [13]. According to a researcher, human utilize ferns for medicine, food, agriculture and horticulture [14]. Because of there might be an updated number of species found up to this year to be revealed especially in the areas of four *mukims* around Kuantan, Pahang, Malaysia from time to time as the numbers of fern will be varying in terms of the abundance of species in different areas in Kuantan [15]. Thus, objectives of this study were to describe the morphological variation among the terrestrial and epiphytic ferns in Kuantan, Pahang and to assess their abundance and distribution in Kuantan, Pahang.

2. METHODOLOGY

2.1 Sampling Site

The collection of plant specimens were focused in the Kuantan district which consist of a total of 5 subdistricts or *mukims* (Kuala Kuantan, Penor, Ulu Kuantan, Sungai Karang and Ulu Lepar). The specimen collection had covered in 3 trails in each mukim. Each trails was estimated around 1.5-2 km in radius and it was random sampling method. The sampling site had been done only in 5 mukims and have been determined which the research was done in several places such as Air Terjun Sg.Pandan, Felda Bukit Sagu and Felda in wilayah Kuantan, Sg.Lembing, IIUM Kuantan Campus, Institute of Oceanography And Maritime Studies (INOCEM) and also Pantai Cherating (mangrove area).

2.2 Sample collection

For each area of sampling covering a five km radius, a total of at least three samples of each species were taken. Only specimens considered as structurally complete with rhizome, stalk, frond and spores were collected. The selected specimens were in good condition without insect-damaged plants.

The plant specimens were taken using a shovel to collect until the base and put into plastic bags and secured with plastic ropes. This was followed by tagging of the plants bearing the collection number before transferring them for herbarium voucher in laboratory. After process of collection, the specimens were then cleaned immediately by draining them in tap water to remove all dirt of root. Data were taken based on their length, width and the days.

2.3 Herbarium voucher

The collected plant consisted of stem, leaves and roots. The plant that showed a morphological variation in term of leaf, stem and root had been chosen. Each collection that has one replication was sent for herbarium process and for species identification. Additionally, the plant collected must be free from insect damage and a good condition. The collected specimens were arranged within two sheets of newspaper with no overlapping of specimens to ensure a high quality in collection. The long specimens were folded into 'V' shape fits the size of newspaper while for the large samples, they were cut into smaller parts signed as A, B and C by using secateurs and placed in between two newspapers before tiding up using a plastic rope and putting them in a clean plastic bag. This was followed by applying Methyl Spirit which consist of 95 % ethanol and water with a ratio of 1:1 for preservation purpose to prevent from growing fungus or bacteria. Then, the plastic bag was tightly tied and leaf them for around three days.

After the process of preservation, samples were pressed by using a pressor which consisted of a wooden frame for rigidity, cardboard ventilators or box to allow air to flow through press and folded paper typically a newspaper to absorb moisture and to contain plant material. The specimens were folded properly to make sure that all structures of the species can be seen. Ferns should be pressed flatly during this process. Then, the pressed specimens were stacked together vertically and tied using ropes or straps. The specimen was dried after the pressing process in the oven with suitable temperature between 45-55ºC. Then, specimens have been kept two to three weeks until fully dried. The dried specimens were mounted on herbarium board of standard size of 41 x 29 cm. Mounting processes was done by using a needle and thread for sewing the specimen on mounting board for identification or research purposes later on.

A label was pasted or printed on the lower right hand corner. The label should indicate the information about the locality, altitude, habit, date and lime of collection, name of collector, common name and a complete scientific name. Lastly, the specimens were deposited in Herbarium of Kulliyyah of Science, IIUMK. The dried plants assisted for the data analysis as the plants were already preserve from dying or any adverse effect of the parts of plants.

2.4 Data collection of species identification

A sampling record was jotted down in a small, pocket sized notebook. Date of collection, location (name of place or distance from definite point), collection number, if possible, name of the specimen, and description of the floral parts that may change after drying were noted down [16]. A research shows that topographic map is also essential for the location. It was a necessity to examine the floral parts carefully, if the floral parts are small then use magnifying lens for small parts [17]. The characters should tally with the literature and pictures from the data collected. The reproductive structures were photographed from various angles [18]. The range, latitude and longitude as well the ecology of plant, needed to be written down by GPS (Global Positioning System) and eyesight vision [19]. Finally, the distribution status of plant was mentioned, either they were rare, frequent, common, locally common or occasional. Duplicate specimens of a species, collected on the same date and site were given the same collection number.

Some of parameters that have been recorded were ferns general information such as their habitat, fertility, habit and environment condition. Other than that, samples' parts such as height, width, diameter and colour were also kept recorded. Regarding the rhizome parts, type of roots, colour, its surface condition and sizes were noted. For leaves morphology, the shape, margin, leaf surface, pinnate or non-pinnate, leaf arrangement, leaf apex, abaxial and adaxial, texture and venation were taken. A study shows, spores from samples also play important roles because they differentiate the ferns species by measuring and observing their arrangement, shape and fertility [20]. Thus, all of these aspects must be measured in order to identify the samples and for an optimum analysis.

3. RESULT AND DISCUSSION

The total number of fertile terrestrial ferns and epiphytic ferns collected at 5 *mukim*s of Kuantan are same which are 14 species. In which represented by 12 families for terrestrial and 8 families for epiphytic ferns. Among the families of terrestrial ferns found are Nephrolepidaceae, Gleicheniaceae, Lygodiaceae, Polypodiaceae, Blechnaceae, Pteridaceae, Lindsaeceae, Woodiaceae and Thelypteridaceae while families of epiphytic ferns are Pteridaceae, Polypodiaceae, Davalliaceae, Aspleniaceae, Nephrolepidaceae, Cyatheaceae, Blechnaceae and Gleicheniaceae. All the collected species of terrestrial and epiphytic ferns were summarizing in table 1 and 2 respectively. According to a study, the most abundant species of terrestrial ferns found in Kuantan are *Nephrolepis exaltata* (Figure 1) and *Dicranopteris linearis* (Figure 3) which were found in most of studies areas [21].

Figure 1 *: Nephrolepis exaltata*

Figure 2 *: Dicranopteris*

Whilst, the most common species of epiphytic ferns found in this study are Davallia denticulata (Figure 3) and Pyrrosia pillosilloides (Figure 4).

Figure 3: *Davallia denticulata*

Figure 4: *Pyrrosia pillosilloides*

However, the least species of terrestrial fern found in Kuantan were *Cyclosorus opulentus* (Figure 5), *Taenitis dimorpha* (Figure 6), *Pyrrrosia longifolia* (Figure 7), *Pteris tripartita* (Figure 8), *Lindsaea heterophylla* (Figure 9) and *Diplazium crenatoserratum* (Figure 10) as they only found only in one study area.

Figure 5: *Cyclosorus opulentus*

Figure 6: *Taenitis dimorpha*

Figure 7: *Pyrrrosia longifolia*

Meanwhile, the rare species of epiphytic ferns that were found within studies areas were *Cyathea dealbata* (Figure 11), *Haplopteris ensiformis* (Figure 12) and *Adiantum pedatum* (Figure 13).

Figure 8: *Pteris tripartita crenatoserratum*

Figure 9: *Lindsaea heterophylla*

Figure 10: *Diplazium*

Figure 11: *Cyathea dealbata*

Figure 12: *Haplopteris ensiformis*

Figure 13: *Adiantum pedatum*

Table 1: Collected species of terrestrial and epiphytic ferns

No.	Species	Description	Distribution	Ecology
1.	*Nephrolepis exaltata*	Simple pinnate fronds, hair-like scales of rachis, circular sori and arranged in 2 rows near the margins of the pinnae	IIUMK, Sg. Panching, INOCEM and Sg. Lembing	Shaded forest, exposed area and BRIS soil
2.	*Dicranopteris linearis*	Bipinnate fronds, main rachis divided into two distinct rachis and further divided into two branched of leafy branches, yellow single-pointed sori like shape around each subleaflets of frond along its vein	IIUMK, Sg. Panching, INOCEM and Sg. Lembing	Shaded forest, exposed area and BRIS soil
3.	*Blechnum orientale*	Simple pinnate, large lamina, stipe covered with hairs, sori are aligned midrib	IIUMK, Sg. Panching and Sg. Lembing	Shaded forest and exposed area
4.	*Lygodium microphylum*	Climbing fern, creeping rhizome with hairy-scales and blackish-brown, sterile leaflets with the entire unlobed margin, Fertile pinnules has sporangia along its lobed margin	IIUMK, Sg. Panching and INOCEM	Shaded forest, exposed area and BRIS soil
5.	*Acrosticum Aureum*	Mangrove fern, scaly stipe, reddish brown sporangia for whole upper pinna except the midrib	INOCEM	Mangrove area
6.	*Cyclosorus opulentus*	Pinnatifid fronds, Sori are small circular arranged side by side along the margin of pinnules	IIUMK	Shaded forest

7.	*Lindsaea ensifolia*	Simple pinnate, marginal sori	IIUMK	Shaded forest and exposed area
8.	*Taenitis dimorpha*	Bipinnate fronds, sori linear like a thread between midrib and margin	IIUMK	Shaded forest
9.	*Taenitis blechnoide*	Simple pinnate frond, fertile fronds are narrower than the sterile fronds, sori linear and forming a narrow longitudinal band between midrib and margin	IIUMK and Sg. Panching	Shaded forest
10.	*Lindsaea heterophylla*	Simple pinnate, marginal sori	Sg. Panching	Exposed area and riverside
11.	*Diplazium crenatoserratum*	Simple pinnate, scaly at the base of stipe, Sori are near the base of pinna towards apex	Sg. Panching	Shaded forest
12.	*Thelypteris oppositipinna*	Simple pinnate, circular sori near the base of pinna towards apex	Sg. Panching	Shaded forest
13.	*Pyrrosia longifolia*	Simple leaves type, fleshy blade, circular sori in several rows between midrib and margin	INOCEM	BRIS soil
14.	*Pteris tripartita*	Tripinnate fronds, tiny continuous sori along each side of lobes of pinnules.	FELDA Kuantan	Shaded forest and agriculture land

Table 2: Collected species of epiphytic ferns in Kuantan, Pahang

No.	Species	Description	Distribution	Ecology
1.	*Pteris vittata*	Rhizome, erect, form a clump, **Foliage** pinnae, single pinnate,non- branched pinnae, **Sorus**; present of spore, along the edge of each pinna,.	IIUM Kuantan Campus and Sg. Panching	Epiphyte which is located at rock and tree, shady and open area
2.	*Pyrrosia longifolia*	**Root**; rhizome which is thick, long-creeping, sub-erect, **Foliage**; simple, absence of trichome, pinnae, unbrached, entire, cuneate, acuminate,coriaceaous.	IIUM Kuantan Campus, INOCEM, Sg. Panching and Cherating.	The species is epiphyte and shady or open area.
3.	*Drynaria quercifolia*	**Root**; thick rhizome, erect, **Foliage**;simple, single pinnae, pinnatifid, **Sorus**; round shape, random arrangement.	IIUM Kuantan Campus, Sg. Panching, Cherating.	epiphyte and shady area
4.	*Davallia denticulata*	**Root**; long-creeping rhizome, thick rhizome, **Foliage**; tripinnatifid, **Sorus**; circular shape, near the margins of the pinnule blades.	Sg. Panching and Cherating.	Epiphyte and shady or open area. Found on rock, tree and palm-oil tree.
5.	*Adiantum pedatum*	Root; rhizome, erect, Foliage; single marginal edge. pinnae, branched, crenate, truncate, acute-obtuse, glabrous texture,	IIUM Kuantan Campus	shady-area and epiphyte
6.	*Nephrolepsis exaltata*	**Root**; rhizome, sub-erect, **Foliage**; single pinnae, unbranched, rounded base, entire-toothed margin, cuspidate,**Sorus**; presence, between margin and midrib.	Felda Tasek Chini.	Epiphyte and shady or open area.
7.	*Haplopteris ensiformis*	**Root**; short-creeping rhizome,erect, **Foliage**; not branched, single pinnae, green fertile and red sterile,**Sorus**;found along the leaf margin, line shape spore, red-brownish colour.	Felda Tasek Chini, Kuantan.	epiphyte and shady-area.

8.	*Platycerium coronarium*	**Root**; rhizome, erect. **Foliage**; simple, green, fertile frond is staghorn-like, **Sorus**; located within the bowl- like, fully cover the bowl.	INOCEM and IIUM Kuantan Campus.	Epiphyte, found on large tree and shady-area.
9.	*Cyathea dealbata*	Root; rhizome, scaly at the apex, erect,Foliage; pinnae, bipinnatifid,	Felda Tasek Chini.	Epiphyte and shady and open area. Found oil-palm's tree trunk.
10.	*Dicranopteris linearis*	**Root**; rhizome, short creeping rhizome, **Foliage**; bipinnatifid, green, oblique base, entire, acuminate apex.	Located in riverside and rainforest area.	Epiphyte and shady or open area. Found at rock.
11.	*Stenochlaena palustris*	Root; rhizome, long creeping rhizome, Foliage; pinnae,young frond is red in colour while fertile frond green in colour, ovate-lanceolate shape.	IIUM Kuantan Campus and Felda Tasek Chini.	Epiphyte and shady. Found at rock and palm tree
12.	*Phlebodium aureum*	**Root**; rhizome,short-creeping rhizome, sub-erect, **Foliage**; pinnae, pinnatifid, unbranced basal pinna, **Sorus**; located at adaxial surface, randomly at the margin and midrib of the leaf.	Felda Tasek Chini.	Epiphyte, usually found on palm-oil and large tree and shady area.

The most abundant species distributed were in Sungai Panching and IIUMK. The number of terrestrial and epiphytic ferns species distributed in each study areas of Kuantan, Pahang were tabulated in table 3. Whilst, the number of distributed terrestrial and epiphytic ferns found in the area of Kuantan, Pahang according to ecology were summarized in table 4 in which most species found in this study were in the ecology of shaded area of rainforest.

Table 3: Number of species distributed in each area of Kuantan, Pahang.

Study areas	Total number of species	
	Terrestrial	Epiphytic
IIUM Kuantan	8	9
Sungai Panching	9	9
INOCEM	5	6
Sungai Lembing	4	3
FELDA Kuantan	1	7
Cherating	0	7

Table 4: Number of distribution of terrestrial ferns found in the area of Kuantan, Pahang according to ecology.

Ecology	Number of species	
	Terrestrial	Epiphytic
Rainforest	10	10
Exposed area	4	1
Riverside	2	3
Mangrove	1	5
BRIS soil	5	4
Agricultural land	1	6

4.CONCLUSION

An updated checklist of 14 species of terrestrial and epiphytic ferns have been presented in this study. The study of diversity of terrestrial ferns in Kuantan, Pahang has provided a number of collection with morphological characteristics that are useful to help in recognizing and distinguishing between the species.

Since previous studies had never specified the collection and distribution of terrestrial ferns in Kuantan, Pahang, thus, the new checklist of terrestrial and epiphytic ferns in Kuantan, Pahang were provided confining selected 6 areas which are IIUMK, Sungai Panching, INOCEM, Sungai Lembing, Cherating and Felda in Wilayah Kuantan.

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