



## Pteridophytes of Pachaimalai Hills from Eastern Ghats of Tamil Nadu, India

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### Abstract

The current study enumerates the Pteridophytes in Pachaimalai hills, a rich biodiverse region in Eastern Ghats situated in Turaiyur taluk of Tiruchirappalli district. The distribution is associated with varied climatic condition, habitat, vegetation, light, temperature, moisture, soil, topography and monsoon. This study accounts 21 species from 17 genera belonging to 9 families and deals with their ecology and their habitat ranges from terrestrial, epiphytic or lithophytic.

**Keywords:** pteridophyte diversity, Pachaimalai Hills, Eastern Ghats

### Introduction

The biodiversity of the Indian subcontinent is one among the richest globally due to its huge geography, with different topography and climate, and with a number of biogeographical regions (Kaveriappa and Shetty, 2001) [5]. Among the various regions, the Western Ghats and Northeast Himalayas are noteworthy. Owing to the global importance of Western Ghats hotspots there are number of studies on floristic study (Nair and Daniel, 1986; Matthew, 2001; Kumar *et al.*, 2005) [9, 5] and biodiversity of flowering plants of Western Ghats (Ganesh *et al.*, 1996; Pascal and Pelissier, 1996; Sivadasan and Mathew, 1999; Kaveriappa and Shetty, 2001; Johnsingh, 2001; Ramesh, 2001) [2, 10, 13, 5, 4, 12]. Floristic, distributional and ecological studies in Pteridophytes are a few like that of Manickam and Irudayaraj (1992) [8] and Rajagopal and Bhat (1998) [11]. However, studies on angiosperms and other lower groups of plants in Eastern Ghats are not given much importance. Besides, the uses of ferns in terms of genetic resources and their importance in pharmacognosy are very much neglected. There are only a few studies on the medicinal uses of ferns (Francisco and Cooper-Driver, 1984; Khan and Shaheen, 1998; Goswami *et al.*, 2016) [1, 6, 3] and other lower plants from this region. Bryophytes and Pteridophytes have been collected and documented from Kalrayan hills (Subramanian, 2007a) [15] and seashore areas of Cuddalore, Villupuram districts (Subramanian, 2007b) [15] of Tamil Nadu. The floristic study is important in that it helps to measure the volume of genetic resource available to us. Hence, the present study aims at making a general floristic study on the Pteridophytes in Pachaimalai hills, a part of Eastern Ghats of Tamil Nadu.

### Materials and Methods

#### Study Area

The Pachaimalai hills are located on the northern part of Turaiyur, a taluk in Tiruchirappalli district and situated at latitudes 11° 09' 00" to 11° 27' 00" N and longitudes 78° 28' 00" to 78° 49' 00" E. The area of these hills is about 527.61 sq. km. The altitude ranges from 160 to 1072 m. The

Pachaimalai hills pertain a sub-tropical climate. The temperatures varies between 25°C and 31°C with an annual precipitation of about 800 to 900 mm. Dominant plant species are *Albizia amara*, *Aglaia elaeagnoides*, *Chloroxylon swietenia*, *Celtis philippensis*, *Commiphora berryi*, *C. caudata*, *Cipadessa baccifera*, *Carissa carandas*, *Diospyros ferrea*, *Glycosmis mauritiana*, *Nothopegia colebrookiana*, *Tarenna asiatica* and *Pterolobium hexapetalum*. Some significant species found here are *Santalum album*, *Canarium strictum* and *Cycas circinalis*.

### Methods

Periodical field surveys (10 field days) were undertaken for the collection of pteridophytes from different habitats of Pachaimalai Hills. The specimens collected were processed following standard field herbarium techniques and stored in the Department of Botany, St. Joseph's College (Autonomous), Tiruchirappalli. For the identification of the dried specimens, 'Pteridophyte Flora of the Western Ghats of South India' (Manickam and Irudayaraj, 1992; Rajagopal and Bhatt, 1998) [8] was used. They were also compared with authenticated specimens deposited in Madras Herbarium, Botanical Survey of India, Coimbatore. During present study 21 species of Pteridophytes that belongs to 17 genera from 9 families were collected and documented here following PPG-1 along with recent nomenclature, full description, ecological notes, distribution and uses.

### Selaginellaceae

*Selaginella tenera* (Hook. & Grev.) Spring in Bull. Ac. Brux. 10 (144):232. 1843; Dixit, Cens. Ind. Pterid. 17. 1984; Manickam & Irudayaraj, Pterid. Fl. W. Ghats S. India 41. 1992; Fras-Jenk., *Taiwania*. 53: 269. 2008; (Fig.1-G).

Rhizome erect, rooting at the base only, 20-30 cm long. Fronds dimorphic, contiguous on the branches, lateral fronds spreading, 3 × 1.5 mm, oblong-ovate, obtuse or subacute, denticulate on the acroscopic margin, entire on the rest, base unequal; median fronds ovate, 1 × 0.5 mm, arista under half the length of the leaf, margin dentate, cones dorsiventral, about 1 × 0.25 cm; sporophylls dimorphic,

sporophylls – lateral ones bear megasporangia, others bear microsporangia; microspores, brick red in mass, 20 µm in diameter, thick wavy leasura; megasporangia upto 150 µm.

**Ecology:** Collected along stream banks, shady forest floor and rarely along shaded roadsides and waysides.



**Fig 1:** A: *Cyclosorus interruptus*; B: *Ceratopteris thalictroides*; C: *Adiantum caudatum*; D: *Drynaria quercifolia*; E: *Asplenium polyodon* var. *bipinnatum*; F: *Asplenium aethiopicum*; G: *Selaginella tenera*; H: *Pityrogramma calomelanos*; I: *Pteris argyraea*; J: *Hemionitis arifolia*; K: *Doryopteris concolor*; L: *Cheilosoria mysurensis*.

### Salviniaceae

*Azolla pinnata* subsp. *asiatica* R.M.K. Saunders & K. Flower, Bot. J. Linn. Soc. 109(3): 349.1992.

Rhizome creeping, slender, branched profusely, zig-zag, bearing roots that are covered compactly with lengthy hairs. Fronds aerial, alternate, more or less rectangular, arise on dorsal lobe, up to 1 × 0.75 mm, sessile, margin entire with narrow whitish, transparent membranous border, grey-green, thick, encompassing large mucilage filled cavities that harbour blue-green algae, upper surface of the aerial lobe has dense, short, blunt, whitish trichomes or with their traces; veins indistinct; ventral lobes submerged, broadly ovate, up to 1 × 1 mm, base cuneate, margin entire, veins distinct, copiously anastomosing, lobes thin, brownish, membranous, transparent, glabrous; microsporocarps globose, 1mm in diameter, two layered wall, brown; microsporangia numerous, rise from central columella; megasporocarp smaller than microsporocarp, ovate; megasporangium single, enclosed by megasporocarp.

**Ecology:** Free floating, aquatic plants at sea level and plains.

### Marsileaceae

*Marsilea minuta* L. Mant. Pl. 308. 1771; Dixit, Cens. Ind. Pterid. 85. 1984; Manickam & Irudayaraj, Pterid. Fl. W. Ghats S. India 142. 1992; Fras-Jenk., *Taiwania*. 53: 279. 2008.

Rhizome subterranean, long creeping, branched, about 30 cm long, up to 2mm thick, green, covered by about 5 × 0.25 mm, whitish, soft, covered by slender hairs sparsely to densely throughout; roots arise from on nodes generally and from internodes rarely. Stipes slender, up to 16 cm long, generally green, hardly pale or brownish, terete, glabrous or with few hairs as in rhizome. Fronds quadrifid, obtriangular or wedge-shaped, each lobe 2.5 × 2 cm, base cuneate, outer margin usually entire, lateral margin entire, rarely subcrenate; veins different above and below, flabellately branched, connected rarely by lateral veins. Sporocarps arise at the nodes, in alternate clusters, 5 per cluster, peduncle 7 × 1 mm; sporocarps adnate to the peduncle laterally and perpendicularly, bearing a teeth, darkish brown, very hard, densely hairy when young, sparsely or rarely hairy when mature. Microspores yellowish-brown, globose, 40 µm in diameter with different intine and exine; megasporangia ovate, up to 0.6–0.5 mm, apex small, pale brown papilla, basal region of the megasporangia filled with coarse, starchy granules and numerous oval-shaped oil globules.

**Ecology:** Frequent at canals of paddy fields and marshy places.

### Pteridaceae

*Actiniopteris radiata* (Sw.) Link, Fil. Spec. 80. 1841. 80. 1841; Nayar & Kaur, Comp. Beddome Handb. 47. 1974; Dixit, Cens. Ind. Pterid. 68. 1984; Manickam, Fern Fl. Palni Hills. 27. 1986; Manickam & Irudayaraj, Pterid. Fl. W. Ghats S. India 81. 1992.

Rhizome suberect, 1-2 cm thick, densely protected by scales; scales lanceolate, 7 × 1 mm, dark at the centre, pale brown at the periphery, apex acuminate, pointed, margin entire. Stipes numerous, tufted, pale brown at the base, pale green above, up to 16 cm long in fertile fronds; up to 10.5 cm long in sterile ones, up to 2 mm thick, deeply grooved abaxially, adaxially rounded, edges of the groove reflexed; soft, thin, transparent scales distributed on the stipes sparsely all over. Lamina semicircular or wedge-shaped, up to 3.5 × 5.5 cm, repeatedly, dichotomously separated up to six times; segments rachiform, up to 2 mm wide, apex acute, margin entire; veins obscure in mature frond, somewhat different in younger ones, sub-parallel; costa and veins indistinct; lamina pale green; surface coriaceous; pale brown, soft, scales dispersed compactly in younger lamina, meagrely in older ones mainly at the basal part. Sporangia, borne in intramarginal ridges all over, covered by reflexed margin of the segments.

**Ecology:** It is a low altitude (400-500 m), terrestrial or lithophytic fern grows as large colony along roadsides in fully exposed dry slopes. Frequent lithophyte at lower altitudes (400-500 m), forms large colonies along roadside on exposed places.

*Adiantum caudatum* L. Mant. 308. 1771; Clarke, Trans. Linn. Soc. Lond. II Bot. 1: 453. 1880 pro parte; Bedd, Handb. Ferns Br. India. 83, t. 44. 1883; Nayar & Kaur, Comp. Beddome Handb. 23. 1974; Dixit, Cens. Ind. Pterid. 74. 1984; Manickam & Irudayaraj, Pterid. Fl. W. Ghats, S. India 96. 1992; Fras-Jenk., *Taiwania*. 53: 278. 2008 (Fig.1-C).

Rhizome erect, covered by dense scales; scales, lanceolate, up to 3 × 0.25 mm, darkish brownish in the middle,

increasingly turning into pale brown near margin, opaque, acuminate, entire. Stipes numerous, tufted, about  $15 \times 0.15$  cm, darkish brown, round below, ridged above, compactly covered with long, multicellular, uniseriate, pale brown, slender hairs; fronds generally proliferate. Lamina oblong-lanceolate around  $40 \times 3$  cm, apex acuminate, pinnate simple; pinnae about 40 pairs, alternate, sessile or subsessile, up to 1 cm apart, basal a few pairs somewhat deflexed and reduced; largest pinna  $1.5 \times 0.5$  cm, dimidiate, lower half entirely excised, base truncate, upper margin lobed at middle or towards the lower margin, apex sub-acute or rounded; veins mostly similar above and below, branched dichotomously, nearing the margin; pinnae, pale green; surface herbaceous; soft, long, pale brownish trichomes lightly disbursed on the intervenal area above and below as well; trichomes short, densely disbursed throughout the lower surface leaving veins; rachis tightly covered by long and short hairs throughout. Margin of sori is reniform or orbicular, around 1 mm in diameter.

**Ecology:** Found exposed fully along the roadsides, clearings or dry regions of the study area.

*Ceratopteris thalictroides* (L.) Brongn. Bull. Soc. Philom. 186. 1821; Bedd, Handb. Ferns Br. India, t. 75. 1864; Dixit, Cens. Ind. Pterid. 84. 1984; Manickam, Fern Fl. Palni Hills. 31. 1986; Manickam & Irudayaraj, Pterid. Fl. W. Ghats S. India 91. 1992 (Fig.1-B).

Aquatic; rhizome, erect or suberect, bearing, fleshy or thick fibrous; roots, long, dense on the abaxial surface, apex covered by scales; scales soft, equally pale brown, around  $2 \times 4$  mm, entire, acute, ovate, encompassing small, curved cells throughout. Fronds organized in rosette; stipes up to  $20 \times 1.5$  cm, fleshy, pale green, terete, densely grooved throughout with few scales dispersed. Lamina glabrous, dimorphic, pale green, soft herbaceous; lamina sterile, ovate, bipinnatifid or tripinnate, about  $32 \times 20$  cm, acute, cuneate; primary pinnae about five pairs, somewhat ascending, alternate, up to 8 cm apart, distinctly stalked, up to  $10 \times 6$  cm, secondary pinnae around four pairs, alternate, shortly stalked, ovate or broadly deltoid, about  $4 \times 4$  cm, pinnatifid around 2-3 mm to the costa, uppermost lobes linear, oblong or differently shaped, about  $1.5 \times 0.7$  cm, apex acute, margin entire; veins somewhat different, copiously anastomosing to form rectangular to hexagonal, stretched areoles of up to  $0.5 \times 2$  mm. Fertile lamina ovate, up to  $40 \times 23$  cm, tripinnate, uppermost segment needle-like, up to  $6 \times 0.2$  cm, acute, margin reflexed and entirely enclosing the lower surface on which two rows of larger sporangia are borne; spores trilete,  $120 \mu\text{m}$  in diameter, pale green, exine thick dense with convex ridges (Plate 2).

**Ecology:** Frequent in completely open streams, ponds, paddy fields and other swampy regions between 200–800 m.

*Doryopteris concolor* (Langsd. & Fisch.) Kuhn in V. Decken, Reisen Ost-Afrika 3(3): 19. 1879; Bedd, Handb. Ferns Br. India, 100. 1883; Manickam, Fern Fl. Palni Hills, 30. 1986; Manickam & Irudayaraj, Pterid. Fl. W. Ghats S. India 83. 1992 (Fig.1-K).

Rhizome erect to suberect, up to 1.5-2 cm thick, scales lanceolate,  $3.5 \times 1$  mm, pale brown, opaque at centre, transparent at periphery, apex acuminate, margin entire. Lamina simple cordiform, ternate, pedate, tip to  $8 \times 16$  cm:

primary lobes broad lanceolate bipinnatifid or pinnatifid, lateral lobes longer than the median lobe: terminal segments up to 12 pairs, ovate lanceolate, up to  $2.5 \times 0.5$  cm, obtuse, sinuses: costa distinct, dark, polished and raised below, indistinct, pale brown and grooved above; veins indistinct both above and below; pinnae darkish green, glabrous above and below as well; sori continuous, marginal, about 2 mm wide, concolorous with the lamina surface; spores trilete, globose, perine with minute triangular flaps.

**Ecology:** This is occasionally noticed from the present study area. It is found in forest floor under tree shade as terrestrial or lithophytes.

*Hemionitis arifolia* (Burm. f.) T. Moore, Index Fil. 114. 1859; Bedd, Handb. Ferns Br. India 413. t. 245. 1883; Nayar & Kaur, Comp. Beddome Handb. 97. 1974; Dixit, Cens. Ind. Pterid. 79. 1984; Manickam, Fern Fl. Palni Hills 34. 1986; Manickam & Irudayaraj, Pterid. Fl. W. Ghats S. India 93. 1992 (Fig.1-J).

Rhizome erect while young, creeping while mature, up to 2 cm thick, compactly enclosed by scales; scales ovate-lanceolate,  $3.5 \times 0.5$  mm. Stipes dense, numerous, blackish to darkish brown, brittle, glossy, up to 33 cm long in fertile fronds, up to 23 cm in sterile fronds, up to 2 mm thick, terete, compactly scaly throughout while young, sparse while mature. Lamina simple, cordiform, dimorphic, up to  $9 \times 6$  cm, fertile ones up to  $7 \times 10$  cm, entire, deltoid, trilobed; costa raised below, ridged above, thickly scaly below; veins obscure above and below as well, anastomosing nearer, areoles seen as grooves in dry fronds; lamina pale green; surface chartaceous; long, soft, pale brown scales dispersed throughout the lower surface of the sterile laminae, not common on adaxial side of fertile and sterile laminae. Sori continuous throughout the veins filling the complete surface of the lamina while mature, intermixed with scales and hairs; spores trilete, spherical, about  $45 \mu\text{m}$  in diameter.

**Ecology:** Low attitude fern frequently seen along roadsides and clearings in completely open dry places.

*Hemionitis opposita* (Kaulf.) Christenh, Global Fl. 4: 18. 2018. *Oosporangium elegans* (Poir.) Fraser-Jenk. & Pariyar, An Annt. Checklist of Ind. Pterid. 256.2017. *Cheilosoria mysurensis* (Wall. ex Hook.) Ching & K.H. Shing, Fl. Fujianica 1: 84. 1985. *Cheilanthes mysurensis* Wall. ex Beddome. Ferns S. India, t. 190. 1864 (Fig.1-L).

Rhizome erect, up to 2.5 cm thick, scales linear-lanceolate,  $2.5 \times 0.5$  mm, uniformly darkish brown, margin entire, apex acuminate. Stipes tufted, up to 6.5 cm long, 2 mm thick, castaneous, brittle, glossy, compactly scaly at the base, rarely with persistent bases of scales, flattened above, rounded below with a narrow wing at both edges. Lamina linear-lanceolate,  $35 \times 4$  cm, narrow towards both ends, bipinnatifid; pinnae up to 25 pairs, opposite, up to 1.5 cm apart, few pairs of basal pinnae reduced to deflexed auricles; largest pinnae  $2 \times 1$  cm, ovate, sessile, apex acute or rounded, base truncate; pinnules up to seven pairs, alternate up to  $5 \times 3$  mm, apex rounded. Sori somewhat different along the margins of lobes. Spores tetrahedral, yellowish, with size about  $50 \mu\text{m}$ .

**Ecology:** Found growing in drier slopes especially at the cervices of rock and road cuttings.

*Pityrogramma calomelanos* (L.) Link. Handb. Erken. Gewäsche 3: 20. 1833; Manickam, Fern Fl. Palni Hills 33. 1986; Manickam & Irudayaraj, Pterid. Fl. W. Ghats S. India 94. 1992 (Fig.1-H).

Rhizome erect, around 3 cm thick, compactly scaly at the apex; scales lanceolate, about  $8 \times 1$  mm uniformly yellowish-brown or darkish brown, apex long, acuminate, margin entire; stipes tufted, about  $20 \times 0.25$  cm, darkish brown or black, scaly at the base, glossy and glabrous above, abaxially rounded, slightly ridged above. Lamina lanceolate, about  $20 \times 8$  cm, bipinnate, apex acute or acuminate, base mostly cuneate; pinnae about 12 pairs, increasingly condensed nearer to apex, opposite or subopposite, 2 cm apart, shortly stalked, ovate-lanceolate, about  $7 \times 2$  cm, apex acuminate, acroscopic; base cuneate or truncate, basiscopic base decurrent; pinnules about 10 pairs, ovate, about  $1 \times 0.4$  cm, adnate with the costa, apex acute, margin entire; few pairs of basal pinnules auricled on the acroscopic base; veins obscure, marked by shallow ridges above, forked once or twice, reaching the margin; pinnae darkish green, glossy and glabrous above, enclosed by silver coloured waxy dusty residue below; surface thin or thick herbaceous. Sori covers entire surface along the veins when mature; spores triangular,  $50 \mu\text{m}$ .

**Ecology:** It is said to be terrestrial, in the present study it frequently inhabited close to the water source.

*Pteris argyraea* T. Moore, Gard. Chron. 1859: 671 (1859); Dixit, Cens. Ind. Pterid. 68. 1984; Manickam, Fern Fl. Palni Hills, 23. 1986; Manickam & Irudayaraj, Pterid. Fl. W. Ghats S. India 78. 1992. (Fig.1-I).

Rhizome suberect or erect, 2.5 cm thick; scales lanceolate,  $4 \times 0.5$  mm, pale brown, transparent and membranous at the margin, darkish brown, thick and opaque at the centre. Lamina broadly ovate or deltoid,  $40 \times 24$  cm, bipinnatifid; pinnae 5-10 pairs, opposite, lanceolate,  $14 \times 2.5$  cm, apex acuminate, base usually cuneate; basal pinnae branched once at the base; pinnae lobed up to 2-3 mm to the costa; lobes oblong,  $2 \times 0.3$  cm, apex rounded, margin entire; up to 1 mm long setae present at the junction of the costa and costules; veins pinnate, distinct below, forked once; pinnae dark green. Spores  $40 \mu\text{m}$ , triangular, brown, exine reticulate.

**Ecology:** This is species is common in shaded forest floor in all kinds of habitats.

#### Aspleniaceae

*Asplenium aethiopicum* (Burm. f.) Bech. in Candollea 6:22. 1935; Nayar & Kaur, Comp. Beddome Handb. 38. 1974; Dixit, Cens. Ind. Pterid. 116. 1984; Manickam, Fern Fl. Palni Hills. 97. 1986; Manickam & Irudayaraj, Pterid. Fl. W. Ghats S. India 228. 1992 (Fig.1-F).

Rhizome erect or suberect, 1.5-3.5 cm in diameter, densely clothed by scales intermingled with long woolly hairs; scales linear-lanceolate, up to  $6.5 \times 0.6$  mm hair pointed, margin toothed. Stipes tufted, up to  $43 \times 0.4$  cm, darkish brown, abaxially rounded, deeply ridged above, tightly clothed by scales and hairs. Lamina ovate-lanceolate, up to  $59 \times 12$  cm, bipinnate; primary pinnae up to 25 pairs, alternate or subopposite, up to  $10 \times 3.5$  cm, apex with long serrate pinnule; pinules up to 12 pairs, sessile, alternate, obovate or oblong, trilobed, margin serrate, costules close,

flabellate, forked twice or thrice; pinnae pale green; texture subcoriaceous; abaxial and adaxial side of the pinnae and rachis densely covered by long, slender, soft scales. Sori up to 1cm long. Spores reniform,  $40 \mu\text{m}$  with irregularly folded perispore.

**Ecology:** It was seen along roadside on full or partial-shaded stream banks or at the forest edges.

*Asplenium mysoreense* Roth. Nov. Pl. Sp. 395. 1821. *Asplenium polyodon* G. Forst. var. *bipinnatum* (Sledge) Sledge, Bot. J. Linn. Soc. 84(1): 6. 1982; Manickam & Irudayaraj, Pterid. Fl. W. Ghats S. India 219. 1992; Salgado, A.E. & Fraser-Jenkins, C.R. Fern Gaz. 19(6):227. 2013 (Fig.1-E).

Rhizome suberect, about 3 cm thick, tightly scaly throughout; scales linear-lanceolate, about  $10 \times 1$  mm, uniformly darkish brown, long acuminate, entire. Stipes tufted, about  $28 \times 0.4$  cm, darkish brown to black, smooth below, ridged above, scaly at the base, glabrous above. Lamina oblong-lanceolate, about  $50 \times 20$  cm, acuminate, broadly cuneate, primary pinnae approximately 10 pairs, patent to somewhat ascending, subopposite, up to 1 cm long petiole, basal pinnae not reduced; largest pinna  $12 \times 4$  cm, lanceolate, acuminate, cuneate, one-third to half distal part of the primary pinna shallowly lobed without bearing distinct pinnules, sessile, alternate, up to 1-5 cm apart, obovate or wedge-shaped, about  $3 \times 1.5$  cm, base cuneate, apex rounded and irregularly incised; veins marked by striations above, slightly distinct below, copious, forked two or three times, free, parallel towards the margin, pinnae glabrous, pale green above and below as well; surface subcoriaceous; few so linear, dark brown scales borne on main rachis especially at the junction primary pinnae. Sori numerous, all along the veins except the extreme apex, about  $10 \times 1$  mm.

**Ecology:** Found growing in cervices of rocks around 600 m altitude.

#### Thelypteridaceae

*Christella parasitica* (L.) H.Lév, Fl. Kouy-Tcheou 475. 1915; Nayar & Kaur, Comp. Beddome Handb. 208. 1974; Dixit, Cens. Ind. Pterid. 106. 1984; Manickam, Fern Fl. Palni Hills, 80. 1986; Manickam & Irudayaraj, Pterid. Fl. W. Ghats S. India 195. 1992.

Rhizome long creeping, 0.5-1 cm thick; rhizome scales linear-lanceolate up to  $10 \times 15$  mm, margin entire or rarely with tiny hairs, apex acuminate. Stipes separated by about 2.5 cm, up to 44 cm long, 4 cm thick, greyish-green, scaly at the base, enclosed by some short or long hairs on the top, rest glabrous. Lamina deltoid, mostly ovate or cordate,  $25-29 \times 13-14$  cm; rachis profusely covered by long and short hairs, pinnae up to 13-20 pairs, opposite at the base, subopposite or alternate at the distal part, basal pinnae up to 3cm apart, not or slightly reduced, usually deflexed; pinnae up to  $11 \times 1.3$  cm linear-lanceolate, sessile, base broadly cuneate or truncate, apex acuminate, margin lobed one- to two-third to costa; lobes up to 20 pairs slightly slanting basal acroscopic lobe somewhat larger than the others; costa densely enclosed by long and short hairs on both surfaces; veins up to 8 pairs, basal veins of opposite lobes connecting to form an excurrent vein passing to the base of sinus, next pair reaching at or above the base of sinus; intervenal areas

covered by short acicular or glandular hairs of about 1 mm long; thick, elongate, orange colour glandular hairs dispersed on the lower surface of the costules and veins, pinnae pale green on median or submarginal on the veins, up to 5 pairs with about 1 mm in diameter, usually lower most vein bearing sori indusia compactly hairy; spores bean-shaped, 40  $\mu$ m.

**Ecology:** It is found in shaded places of shola forests.

*Thelypteris dentata* (Forssk.) E.P.St.John, Amer. Fern J. 26(2): 44. 1936. *Christella dentata* (Forssk.) Brownsey & Jermy, Brit. Fern Gaz. 10(6): 338. 1973; Nayar & Kaur, Comp. Beddome Handb. 207. 1974; Dixit, Cens. Ind. Pterid. 104. 1984; Manickam, Fern Fl. Palni Hills 83. 1986; Manickam & Irudayaraj, Pterid. Fl. W. Ghats S. India 199. 1992.

Rhizome climbing or suberect, up to 1cm thick, sparsely scaly; scales lanceolate, 9  $\times$  1.5 mm, pale brown, apex acuminate, margin entire, hairy; stipes up to 2 cm apart, 70 cm long, pale brown to darkish brown, base scaly, glabrous as well as glossy above. Lamina 90  $\times$  20 cm, oblong-lanceolate; pinnae up to 20 pairs, basal pinnae 2-3 pairs slightly shortened, reduced basal pinnae opposite or subopposite, separated by up to 9 cm, unreduced pinnae alternate climbing or suberect; 5 cm apart; largest pinnae 19  $\times$  2 cm, apex acuminate, base broad cuneate, basal ones sessile, upper ones sessile, margin lobed about half way to the costa; lobes up to 35 pairs, 3.5 mm wide; veins up to 8 pairs, free, one and half pairs of basal veins anastomosing to form an excurrent vein when nearing the base, 2 mm wide sinus; membrane of the sinus generally absent; 1 mm long, unicellular, slender, up to six pairs, up to 1.25 mm in diameter; indusia with short hairs, spores planoconvex or reniform, 35  $\mu$ m, brownish, exine elongate, thick ridges.

**Ecology:** It is found growing at clearings, roadsides and stream banks that are partially or fully exposed.

*Thelypteris interrupta* (Willd.) K.Iwats, J. Jap. Bot. 38: 314. 1963. *Cyclosorus interruptus* (Willd.) H. Itô, Bot. Mag. (Tokyo) 51(608): 714. 1937; Nayar & Kaur, Comp. Beddome, Handb. 65. 1974; Dixit, Cens. Ind. Pterid. 108. 1904; Manickam, Fern Fl. Palni Hills 74. 1986; Manickam & Irudayaraj, Pterid. Fl. W. Ghats S. India 187. 1992 (Fig.1-A).

Rhizome creeping, abundantly branched. 0.5 cm dense, apex scaly; scales 3  $\times$  1.5 mm, ovate; apex acuminate, margin entire, glabrous above and below as well; stipes 5 cm apart, 70 cm long, 0.5 cm thick, blackish and base scaly, pale brown and glabrous, ridged above, flattened below. Lamina elliptic, lanceolate, up to 85  $\times$  20 cm, simply pinnate; pinnae up to 27 pairs, subopposite or alternate, 5 cm apart, sessile or very shortly stalked, ascending, basal pinnae not reduced, few pairs of pinnae in the distal region of the lamina is rather sharply reduced. Largest pinna 18  $\times$  1.2 cm, oblong-linear-lanceolate, base broadly cuneate, apex acuminate, margin lobed one-third to half way to the costa; lobes 3  $\times$  4 mm, deltoid slightly oblique, apex rounded with a short acumen, costa somewhat raised above and below as well, flattened below, ridged above, costules different below, obscure above; veins different below, indistinct above, up to 11 pairs, simple, very rarely branched once, reaching the margin, basal one or one and half pairs of acroscopic and

basisopic veins of subsequent lobes joining to form an excurrent vein reaching the base of 1 mm long, opaque sinus membrane; lower surface of rachis, costa, costules, veins and intervenal regions closely enclosed by long, soft aricular or capitate hairs, upper surface of the pinnae broad, glabrous, pale brown, ciliated scales borne on lower surface of rachis and costa; surface chartaceous; lamina pale green; sori median on the veins, up to 8 pairs in 2 rows arranged in V-shape; sori up to 1m in diameter, indusiate, indusia hairy, sporangial stalk bearing capitate hairs; spores ellipsoid, monolete, pale brown, exine finely spinulose, 54  $\mu$ m.

**Ecology:** It is seen often as large colonies in exposed swampy places, walls, lakes and on the sides of paddy fields.

*Thelypteris ochthodes* (Kunze) Ching, Bull. Fan Mem. Inst. Biol. Bot. 6: 300 (1936). *Pseudocyclosorus ochthodes* (Kunze) Holttum in Nayar & Kaur, Comp. Beddome Handb. 204. 1974; Dixit, Cens. Ind. Pterid. 1: 12. 1984; Manickam, Fern Fl. Palni Hills 91. 1986; Manickam & Irudayaraj, Pterid. Fl. W. Ghats S. India 176. 1992; Fras-Jenk., *Taiwania*. 53: 284. 2008.

Rhizome creeping or suberect, rarely erect, up to 6 cm thick in erect ones; scales broadly ovate, about 4  $\times$  5 mm, uniformly pale brown, apex acuminate, margin entire or with few small elongate outgrowths. Stipes up to 105  $\times$  1 cm, darkish brown and base lightly scaly, grey brown or purple-brown, glabrous and ridged above, rounded below, three or four pairs of 2-3 mm long, darkish brown aerophores found along either side of the stipe. Lamina ovate or lanceolate, up to 115  $\times$  38 cm, ending having a pinnae with larger lobes at the base, acuminate; pinnae up to 35 pairs, sessile, subopposite or alternate, up to 3.5 cm apart, up to 10 pairs of basal pinnae abruptly reduced to tubercles. Next two or third pairs somewhat reduced, pinnae in the distal part of the lamina increasingly reduced about 2 mm long, darkish brown aerophores present on lower side of the junction of each pinna and rachis; rachis somewhat tetragonal, ridged on either side excluding the lower flattened side; largest pinnae 19  $\times$  1.5cm, linear lanceolate, few pairs of unreduced pinnae in the base of the lamina perpendicular to the rachis, other gradually ascending towards distal part of the lamina; apex acuminate, base truncate or subtruncate, margin lobed 1-1.5mm to the costa; lobes up to 50 pairs, oblong, up to 8  $\times$  2.5 mm, somewhat ascending and oblique, apex acute or rounded, margin entire; costa distinctly raised and rounded below, somewhat ascending towards distal part of the lamina; apex acuminate, base truncate or subtruncate, margin lobed 1-1.5 mm to the costa, apex acute or rounded, margin entire; costa noticeably raised and rounded below, somewhat raised and ridged above; costules and veins somewhat raised below; veins up to 15 pairs, basal acroscopic vein reaching the base of the sinus; pinnae darkish green above, pale green below; texture subcoriaceous, soft, long, slender, pale brown acicular hairs compactly spread throughout the rachis, upper and lower side of costa and costules, slightly on lower surface of veins, margin of the lobes bears few short, stiff acicular hairs. Spores up to 30  $\mu$ m, yellowish-green, exine densely, coarsely tuberculate.

**Ecology:** It grows along partially or fully exposed stream banks, roadsides and clearings.

**Dryopteridaceae**

*Dryopteris hirtipes* (Bl.) Kuntze, Revis. Gen. Pl. 2: 813. 1891; Nayar & Kaur, Comp. Beddome Handb. 55. 1974; Manickam, Fern Fl. Palni Hills. 135. 1986; Manickam & Irudayaraj, Pterid. Fl. W. Ghats S. India 277. 1992.

Rhizome erect, up to 15 cm thick, densely enclosed by scales all over; scales oblong or linear-lanceolate, up to  $2 \times 0.5$  cm, uniformly pale brown, apex acuminate and margin entire. Stipes tufted, up to  $50 \times 0.6$  cm. grey-brown or stramineous, compactly scaly at the base, slightly scaly above. Lamina oblong-lanceolate, up to  $80 \times 40$  cm, apex acute, base cuneate of truncate, simply pinnate with caudate apex; pinnæ up to 25 pairs, spreading, subsessile or sessile, subopposite, up to 6 cm apart; largest pinna  $23 \times 3$  cm, oblong-lanceolate, distal half progressively narrowed towards apex, base broadly cuneate, apex acuminate, margin lobed one-third way to the costa; lobes oblong or deltoid, apex subacute or rounded, slightly oblique, margin entire or crenulate; costa noticeably raised and rounded below, somewhat raised and ridged above; costules and veins somewhat different above, well distinct below; veins up to seven pairs, pinnate. Sori median on the veins, borne on three pairs of basal veins in the unlobed region of pinna, up to 1.5 mm in diameter. Spores up to 45  $\mu$ m, brownish, tuberculate.

**Ecology:** It is a terrestrial plants frequently seen along fully or partially exposed streams and stream banks.

**Nephrolepidaceae**

*Nephrolepis auriculata* (L.) Trimen, J. Linn. Soc. Bot. 24: 152. 1887; Sledge, Bot. J. Linn. Soc. 84: 20. 1982; Manickam & Irudayaraj, Pterid. Fl. W. Ghats S. India 140. 1992.

Rhizome erect, approximately 2 cm thick, compactly scaly throughout; scales lanceolate, about  $5 \times 1$  mm, uniformly pale brown, acuminate, margin fimbriate; rhizome bearing thick wiry roots which bears about 1 cm diameter, spherical, fleshy, compactly scaly tubers. Stipes tufted, about  $20 \times 0.3$  cm, compactly scaly below, glabrous or slightly scaly above. Lamina linear-oblong, about  $65 \times 7$  cm, progressively narrowed towards base and apex. Pinnæ around 30 pairs, alternate, spreading, sessile, about 1 cm apart; largest pinna up to  $3.5 \times 1$  cm, along, apex subacute or rounded, base not equal, cordate, acroscopic base auricled and overlying on the rachis and adjacent pinna, margin crenate; costa and veins different on both sides; veins branched once, free, not reaching the margin, with a hydralhode at the end, pinnæ pale greenish, glabrous above and below; surface herbaceous; soft, linear, pale brown hairs slightly dispersed throughout the rachis. Sori submarginal in two rows, about 10 pairs, seated on the acroscopic veinlets, reniform, up to 1 mm in diameter, indusia reniform, darkish brown at the cordate base, pale brown towards the edge, entire. Spores 20  $\mu$ m, yellowish, granulose.

**Ecology:** It is an epiphyte or lithophyte along fully shaded stream banks from. It has been collected only one place (Kannimar sholai) from the present area.

**Polypodiaceae**

*Drynaria quercifolia* (L.) J. Sm. in Hook. J. Bot 3:398. 1841; Beddome, Ferns S. India 341, t.191. 1883; Nayar & Kaur, Comp. Beddome Handb. 82. 1974; Satija & Bir,

Polyp. Ferns India, 88. 1985; Manickam & Irudayaraj, Pterid. Fl. W. Ghats S. India 313. 1992 (Fig.1-D).

Rhizome thick, creeping, up to 4.5 cm thick, compactly covered by scales; scales linear-lanceolate, about  $12 \times 2$  mm, equally pale brown to darkish brown, apex long acuminate, margin dentate-ciliate; nested leaves ovate up to  $24 \times 17$  cm, apex acute, margin slightly lobed, midrib and primary veins significantly elevated above and below, secondary and tertiary veins somewhat elevated above and below, veins interconnected; stipes up to  $22 \times 0.7$  cm, greyish-brown, abaxially smooth, adaxially ridged, slightly winged on both side, glabrous throughout. Lamina oblong, up to 77 cm, pinnately lobed, ended by a pinnule same as lateral ones, base decurrent; lobes up to 15 pairs, basal pairs much reduced; largest lobe up to  $25 \times 5$  cm, oblong-lanceolate, margin entire, apex acute, base decurrent; costa and veins elevated above and below, interconnected with veinlets, areoles free from any included veinlets; pinnæ pale greenish, glabrous, surface coriaceous. Sori seated at the interval of veins, somewhat along two rows on each primary vein. Spores brownish, spinulose, 50  $\mu$ m.

**Ecology:** It is found as epiphytes or lithophytes in fully or partially shaded places.

*Lepisorus contortus* (Christ) Ching, Bull. Fan Mem. Inst. Biol. 4: 90. 1933. *Lepisorus amaurolepidus* (Sledge) Bir and Trikha, J. Bombay Nat. Hist. Soc. 68: 192. 1971; Nayar & Kaur, Comp. Beddome Handb. 84. 1974; Dixit, Cens. Ind. Pterid. 39. 1984; Satija & Bir, Polyp. Ferns India, 19. 1985; Manickam & Irudayaraj, Pterid. Fl. W. Ghats S. India 335. 1992.

Rhizome creeping, short, up to 3 mm thick, compactly covered by scales: scales peltate, about  $2 \times 0.75$  mm, significantly bicolorous, darkish brown with thick walled cells at the centre, pale brown with thin walled cells towards periphery, apex acuminate and margin dentate. Stipes crowded, up to 5 mm apart, up to  $1 \times 0.15$  cm, pale or grey-brown when dry, rounded abaxially, grooved adaxially, scaly at the very base, glabrous above. Lamina simple, elliptic-lanceolate, up to  $15 \times 2$  cm, progressively narrowing from the middle towards base and apex, base narrowly cuneate and decurrent, apex usually acute or acuminate, rarely subacute, margin entire; midrib somewhat raised and rounded above and below as well, veins immersed, indistinct above and below, copiously anastomosing, lamina dark green, glabrous above and below; surface herbaceous to chartaceous. Sori superficial, probably one per primary areole, arranged in two rows.

**Ecology:** Found growing on bark of trees as epiphytes in dry evergreen forest.

**Summary**

Pachaimalai hills, of Eastern Ghats are little studied in terms of angiosperms and other lower groups of plant. In the current study, 21 species belonging to 17 genera from 9 families were collected. Among the 21 species one is endemic to South India. Nineteen species were collected and reported from these hills. Pteridaceae is the dominant family with 8 species that is followed by Thelypteridaceae having 4 species followed by Aspleniaceae and Polypodiaceae with 2 species each.

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