International Journal of Applied Bioresearch

A Preliminary Survey of Pteridophytes from Alagar Hills, Madurai, Eastern Ghats

M.Shumuga Sundari, A. Benniamin[$], N. Siva[#], M.Maridass[≠], A. Karthick[#]**

*Department of Botany, St. Mary's College (Autonomous), Tuticorin.
[$]Botanical Survey of India, Arunachal Pradesh Regional Centre, Itanagar – 791111.
[#]Department of Botany, Thiygarajar College, Madurai- 9.
[≠]Department of Advanced Zoology and Biotechnology, Nagercoil-629 003, Tamil Nadu.

Published: 15 April, 2012; Vol. No.6:8-18; Online: www.bioresjournal.com/documents/ijab0019.

Alagar hill forms a discontinuous minor range in the Deccan plain and appears as an extension of Eastern Ghats. The present study describes the distribution of pteridophtic flora of Algar hills, Madurai district. The habitats of the concerning area and the characteristic pteridophytic species occurring have been listed. The area was surveyed in different season during the 2010-2012. Pteridophytic species of this Alagar hills need conservation ex situ, which could be achieved by identification and conservation of fern localities. Sixteen species belong to 11 genera are reported. Most important localities included in the survey of pteridophytic flora are Silambar Valley, Palamutheer solai, Nupuragangai towards Bison Valley. The present paper included comprehensive data on the current distribution of pteridophytes from Algar hills.

Diversity /Pteridophytes

Pteridophytes, the seedless vascular plants, had a very flourishing past in dominating the vegetation of the earth about 380-230 years ago (Bir, 1976; Mehra, 1967; Khare,1996). Although they are now largely replaced by the seed bearing vascular plants in the extant flora today, yet they constituent a fairly prominent part of the present day vegetation of the world. Pteridophytes form an interesting and conspicuous part of our national flora with their distinctive ecological distributional pattern. In India it is estimated that about 1050 species have been reported (Benniamin and Jenkins, 2010). The pteridophytic flora of various localitites of Tamil Nadu has been studied by many workers. Important contributions are those of Beddome, 1883; Manickam and Irudayaraj, 1992, Benniamin, 2005;2011). They survey a number of localities in Tamil Nadu. As far as Alagar hils is concerned, there is no comprehensive work on pteidophytes. In order to fulfil this lacuna the present study was undertaken. We surveyd different areas in different seasons during the year 2010-2012. The hill range has never been investigated for the presence of ferns earlier, Hence, a study was undertaken on the fern diversity of Alagar hills.

This article is IJAB direct Email Submission.
Freely available on online through the IJAB open access www.bioresjournal.com.

Received: March, February, 4, 2012
Accepted: March, 31. 2012.

**To whom correspondence may be addressed. Email immanspriya@gmail.com

This article contains supporting information online at www.bioresjournal.com/documents/ ijab0019

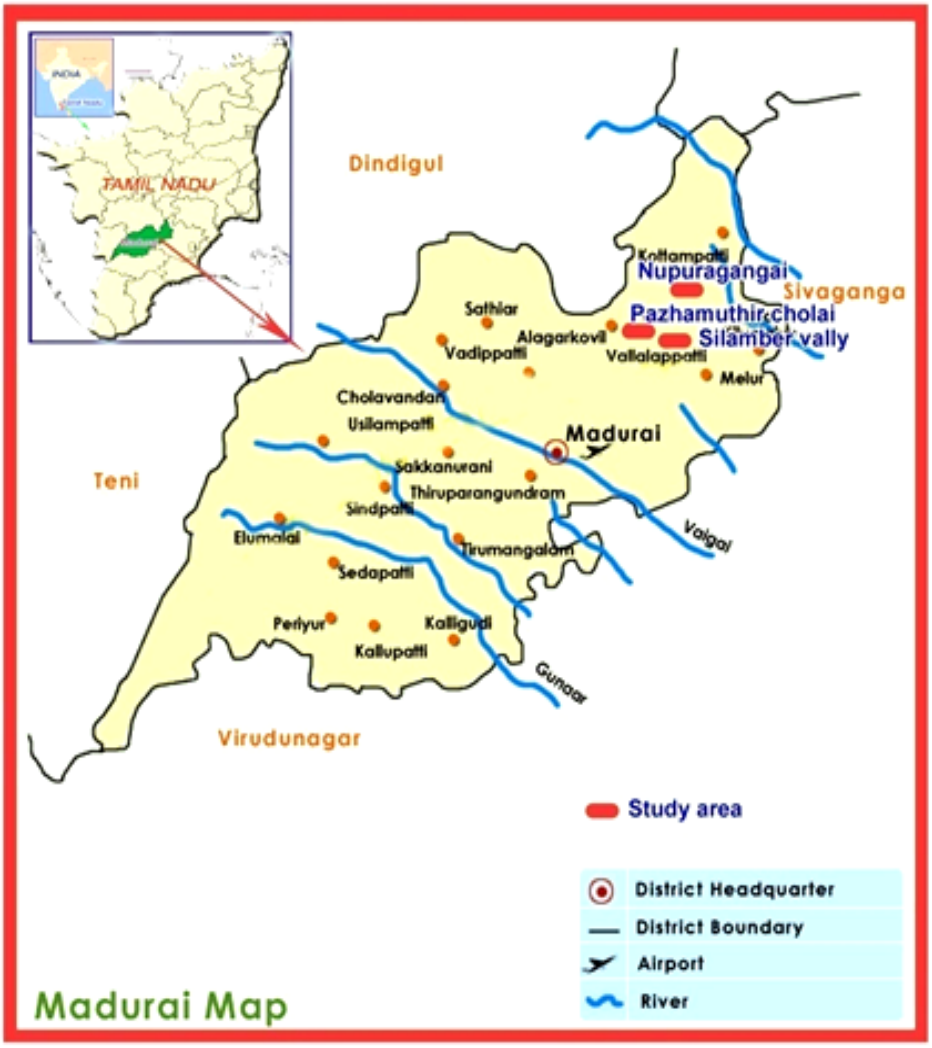

Fig.1: Study Area Map of Alagar hills

Study Area

Alagar hill forms a discontinuous minor range in the Deccan plain and appears as an extension of Eastern Ghats. It is located 22 kms north east of Madurai city (Lat. 12°18° N; Long. 76°42° E; Alti. 600 m above mean sea level). The dry deciduous forest of Alagar hill is composed of both highly disturbed and protected vegetation, which varies with topography of the area and degree of anthropogenic pressure. Sriganesan (1984; 1987) described the vegetation and soil characteristics of this forest. Three different altitudes viz., 275m, (foot-hill - Silambar Valley), 350m (mid-hill - Palamutheer solai - middle of Silambar Valley) and 550m (top-hill–above Nupuragangai towards Bison Valley) were selected to study the disturbances to this dry deciduous forest. The present study was carried out during post monsoon (October-November) seasons of 2010 and 2011 and summer (March-May) season of 2011.

The data set on ferns used in this work is based on the ferns inventories carried out in forest sites of Fig. 1 and 2. Map showing location of all the three study sites in Alagar hills. All localities which are ideally favorable for growth of fern flora were observed. Every possible area which could support the growth

of fern in the hills was visited between July 2010- March 2012 in different seasons. The specimens collected were identified and are preserved in Herbarium, P.G. Department of Botany, Thiagarajar College, Madurai (TCH) (Fig.3,4&5).

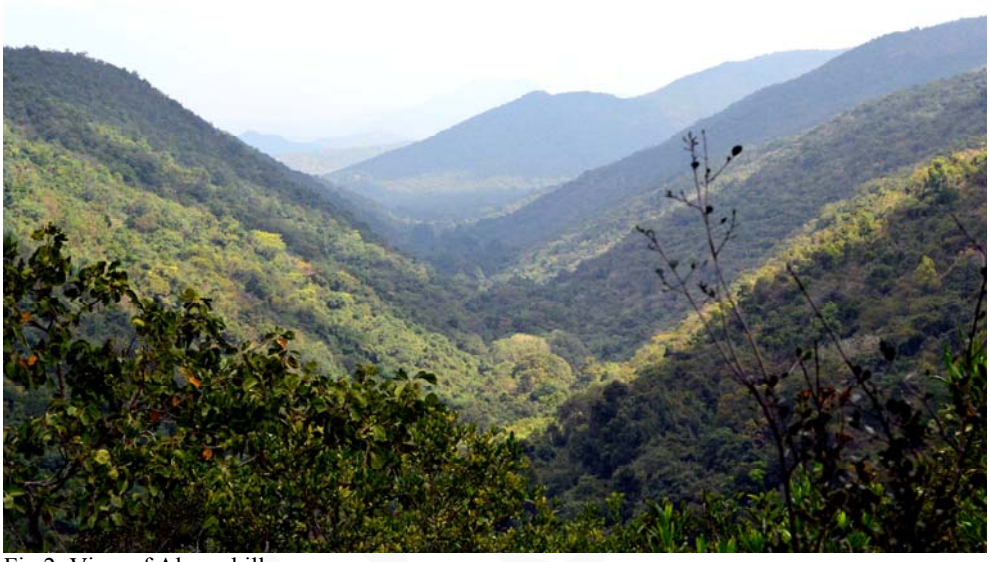

Fig.2: View of Alagar hills

Enumeration of the Species:

1. ***Actiniopteris radiata*** (Sw.) Link, Fil. Sp. Hort Ref. Bot. Berol. 80 (1841) **(Actiniopteridaceae)**

Rhizome suberect, subglobose densely covered by scales; scales lanceolate, Stipes numerous, tufted, up to 16cm long in fertile fronds, up to 10.5cm long in sterile ones, pale green above; pale brown, soft, thin, transparent scales distributed on the stipes sparsely all over. Laminae flabellate, semicircular or wedge-shaped, up to 3.5x5.5 cm, repeatedly, dichotomously divided up to six times; segments rachiform, lamina pale green; texture coriaceous; soft, pale brown, Sporangia borne in intramarginal grooves throughout, protected by the reflexed margin of the segments; spores trilete.(plate 1 a)

Ecology: lithophytic fern grows as large colony along roadsides in fully exposed dry places on rock crevices between 300-500m

Specimen examined: India, Tamil Nadu, Madurai, Alagar hills, SIVA, 12, 11.02.12, TCH.

2. ***Adiantum incisum*** Forskal, Fl. Aeg. Ar. 187. 1775; Pichi Sermolli in Webbia 12: 669, f.6. 1957**(Adiantaceae)**

Rhizome ascending, short, covered with dense roots and scales. Scales linear-lanceolate, Stipe closely clumped on rhizome, 2.5-9 cm long, dense scaly at base, acicular reddish hairy upwards. Lamina simple pinnate, terminating to a cuneate pinna, with firm rachis similar to stipe. Pinnae 15-40 pairs, alternate, close or subpectinate, sessile, lowest pinna slightly reduced, middle ones largest, apex bluntly round, outer edge slightly curved, shallowly incised into 4-5 broad lobules, terminal pinna flabellate, shallowly 3-lobed, both sides copiously hirsute with setaceous hairs. Veins distinct on both surface, flabellate. Sori 3-4 in each pinna, round, small. Indusium orbicular tooblong, dark brown, densely hirsute.(Plate 1 c)

Ecology: It grow as terrestrial and lithophytes in interior forest area between 400-600m

Specimen examined: India, Tamil Nadu, Madurai, Alagar hills, SIVA, 14, 11.02.12, TCH.

3. ***Cheilanthes mysurensis*** Wall. Ex Beddome, Ferns S. India, t. 190 (1864) **(Sinopteidaceae)**

Rhizome erect, up to 2.5cm thick, densely scaly at the apex; scales linear-lanceolate, 2.5x0.5mm, uniformly dark brown, opaque with indistinct cells, margin entire, apex acuminate. Stipes tufted, up to 6.5cm long, 2mm thick, castaneous, glossy, brittle, densely scaly at the base, sparsely above with persistent bases of scales, rounded below, flattened above with a narrow wing at both edges. Lamina linear-lanceolate, 35x4cm, narrowed towards both ends, bipinnatifid; pinnae up to 25 pairs, opposite, up to 1.5cm apart, few pairs of basal pinnae reduced to deflexed auricles; largest pinna 2x1 cm, ovate, sessile, apex acute or rounded, base truncate; pinnules up to seven pairs, alternate up to 5x3mm, oblong, adnate with the costa, apex rounded, margin lobed more or less half way to the costule; apex of the lobe truncate, margin entire; veins indistinct above, very slightly distinct below, repeatedly forked, free, not reaching the margin; pinnae dark green, glabrous above and below; texture herbaceous; rachis sparsely covered by dark brown, linear scales and persistent bases of scales. Sori semicircular, up to 0.75mm, solitary or in pairs on the margin of each lobe, protected by reflexed margin of the lobe; spores monolete, globose, 45□m in diameter, yellowish-brown, exine smooth or faintly granulose (Plate 1 b).

Ecology: Gregarious in fully exposed canals at foothills between 200-450m.

Specimen examined: India, Tamil Nadu, Madurai, Alagar hills, SIVA, 17, 11.02.12, TCH.

4. ***Lygodium microphyllum*** (Cavanilles) R.Brown, Prodr. Fl. Nov. Holl. 162. 1810. **(Schizaeaceae)**

Ferns with twining rachis and rachis branches, glabrous. Pinnae in pairs arising from short alternate branches, articulate, pinnate, bearing 4-5 pinnules on either sides of the costae. Pin-nules 1.5-3.5 cm long, ovate to ovate-oblong, cordate at base, rounded at apex, entire, often with 1 or 2 small lobes at base, basal pinnule smaller than the next upper ones. Fertile pinnules slightly reduced in shape and size. Spikes cylindrical, bearing glabrous involucre. (Plate 1 d)

Ecology: Grows climbing on bushes along road sides and forest margins in open places as well as along shady stream-banks

Speciemen examined: India, Tamil Nadu, Madurai, Alagar hills, SIVA, 16, 11.02.12, TCH.

5. ***Macrothelypteris torresiana*** (Gaudichaud Beaupré) Ching, Acta Phytotax. Sin. 8: 310. 1963. **(Thelypteridaceae)**

Rhizome stout, short creeping. Stipes upto 40 cm tall, pale glau-cous, the base swollen and fleshy, covered with numerous narrow, brown, setose scales, smooth above. Lamina 50-70 cm long, 25-30 cm wide, deltoid-ovate, tripinnatifid, with largest basal pinnae. Pinnae upto 20 cm long, 8-9 cm wide, deltoid, pinnate, with all the pinnules except the lowest adnate to a winged rachis; pinnules upto 5 cm long, acuminate, margin cut almost to the costa into oblique segments; costae and costules covered with scattered, pale, stiff hairs; under surface of lamina covered with short unicellular, capitate hairs. Sori round , small with a very small indusium; sporangia with 2-3 short, capitate hairs .(Plate 1 e)

Ecology: Usually grows along dry and exposed jhum fallows at lower elevation

Speciemen examined: India, Tamil Nadu, Madurai, Alagar hills, SIVA, 32, 11.02.12, TCH.

6. ***Microlepia speluncae*** (Linnaeus) Moore, Index Fil. 43. 1857. **(Dennstaedtiaceae)**

Rhizome covered with short hairs. Stipe up to 50 cm long, purplish green, short hairy throughout. Lamina50-60 cm long, tripinnate, bearing several alternate pinnae, the basal pinnae generally reduced. Ultimate pinnule small, more or less oblique, remote, apex blunt, sides deeply lobed in larger ones and crenate in smaller ones;texture thin membranaceous, costae and costules hairy, veins with dense hairs. Sori submarginal with eliptic or half-cup shaped, lobed indusium.

Ecology : Grows along shady and moist slopes inside forest (Plate 2 f)

Speciemen examined: India, Tamil Nadu, Madurai, Alagar hills, SIVA, 18, 11.02.12, TCH.

7. Nephrolepis auriculata (L.) Trimen, Journ. Linn. Soc. London Bot. 24:152 (1887) **(Oleandraceae)**

Rhizome erect, densely scaly all over; scales lanceolate, uniformly pale brown; rhizome bearing thick wiry roots, spherical, fleshy, densely scaly tubers. Stipes tufted, densely scaly below, glabrous or sparsely scaly above, lamina linear-oblong-lanceolate, Pinnae about 30 pairs, spreading, alternate, sessile, largest pinna up to 3.5x1cm, along, apex subacute or rounded, base unequal, cordate, acroscopic base auricled and overlapping the rachis and adjacent pinna, margin crenate; costa and veins distinct above and below; veins forked once, free not reaching the margin, pinnae pale green, glabrous above and below; texture herbaceous; soft, linear, pale brown hairs sparsely distributed all over the rachis. Sori submarginal in two rows, indusia reniform, spores reniform or planoconvex, yellowish-brown, exine granulose.

Ecology: Epiphytes or lithophytes along fully shaded stream banks or way sides from 300-700m.

Specimen examined: India, Tamil Nadu, Madurai, Alagar hills, SIVA, 21, 11.02.12, TCH.

8. ***Nephrolepis multiflora*** (Roxb.) Jarret in Morton, Contrib. U.S. Nat. Herb. 38:309 (1974) **(Oleandraceae)**

Rhizome erect or subecrect, Stipes tufted, grey-brown when dry, abaxially rounded, adaxially grooved, densely scaly at the base, sparsely scaly above. Lamina narrowly deltoid or oblong-lanceolate, about 80x13cm, simply pinnate; pinnae about 25 pairs, spreading, subopposite or alternate, about 2cm apart, sessile; basal few pairs progressively reduced and deflexed; largest pinna 10x1.5cm, oblong lanceolate, acute or acuminate, costa slightly raised above and below; Lamina pale green; texture herbaceous to characeous; pale brown, linear, fimbriate scales mixed with hair distributed sparsely all over the lamina. Sori submarginal at the vein end, one per two or three veinlets, distributed all over the pinna: spores reniform or planoconvex 35x20□m, Yellowish-brown, exine granuloe .(Plate 2 g)

Ecology: Terrestrial, gregarious along fully exposed on the forest floor.

Speciemen examined: India, Tamil Nadu, Madurai, Alagar hills, SIVA, 25, 11.02.12, TCH.

9. ***Parahemionitis arifolia*** (Burm.) Moore, Ind. Fil. 114 (1859) **(Hemionitidaceae)**

Rhizome erect when young, short, creeping when mature, up to 2cm thick, densely covered by scales; scales ovate-lanceolate; Stipes compact, numerous, black or dark brown; polished, brittle, up to 33cm long in fertile fronds, up to 23cm in sterile ones, Lamina simple, dimorphic, cordiform, deltoid, trilobed, entire; costa raised below, grooved above, densely scaly below; veins obscure both above and below, grooved above, densely scaly below; veins obscure both above and below, anastomosing closely, areoles seen as depressions in dry fronds; lamina pale green; vegetative buds present on middle of pinnae, texture chartaceous; long, soft; Sori continuous along the veins filling the entire surface of the lamina when mature, intermixed with hairs and scales; spores trilete, spherical .(Plate 1 i)

Ecology: It grows as terrestrial near the roadside of forest area between 300-500m.

Speciemen examined: India, Tamil Nadu, Madurai, Alagar hills, SIVA, 28, 11.02.12, TCH.

10. Pteris tripartita Sw., Schrad.Journ.Bot.1800 (2):67.1801; Ellis in J.Andaman Sci.Assoc.3 (2):78.1987. **(Pteidaceae)**

Terrestrial herbs. Rhizome short scaly. Stipes ca 5 feet long .Fronds tripartite; the middle branch deeply bipinnatifid; lateral branches as long as the middle branch, each with large secondary bipinnatifid branch on lower side towards base; the lowest basal pinnae on this branch bearing several Pinnatifid leaflets on its lower side; lamina on its upper side lobed; basal ones reduced, texture thin;

veins distinct, copiously anastomosing. Sori continuous along each side of the lobes or the margin from base to midway or sometimes to apical part of segments, spores dark brown, tetrahedral .(Plate 1 j)

Ecology: It grow as terrestrial nearby the streams between 450-700m

Specimen examined: India, Tamil Nadu, Madurai, Alagar hills, SIVA, 29, 11.02.12, TCH.

Note: New record for Eastern Ghats (Benniamin 2011)

11. Pteris quadriaurita Retz., Obs. Bot. 6:38 (1971) **(Pteidaceae)**

Rhizome suberect or erect, thick; scales lanceolate, pale brown, transparent and membranaceous at the periphery, dark brown, thick and opaque at the center, apex acuminate, margin with long, thin hairs; pale brown, stramineous or pale green, glabrous, glossy above. Lamina deltoid or broadly ovate, bipinnatifid; pinnae 5-10 pairs, opposite, 5cm apart, lanceolate, with caudate, acuminate apex, base broadly cuneate; basal pinnae forked once at the base; pinnae lobed up to 2-3mm to the costa; lobes oblong, apex rounded, margin entire; upto 1mm long spinules borne at the junction of the costa and the rachis and the rachis and at the junction of costa and costules; veins pinnate, distinct below, forked once; pinnae dark green; texture thick herbaceous to subcoriaceous; spores with verrucate exine.(Plate 2 h)

Ecology: It grows as terrestrial in interior forest area between 500-700m.

Specimen examined: India, Tamil Nadu, Madurai, Alagar hills, SIVA, 35, 11.02.12, TCH.

12. *Thelypteris truncata* (Poir.) K. Iwats. Mem. Coll. Sci. Kyoto Imp. Univ., ser. B, Biol. 31:33. 1964. **(Thelypteridaceae)**

Rhizome semi erect to erect, thick. Stipes upto 40 cm long, erect, stout, stramineous, covered with broad, lanceolate, brown scales; scales glabrous. Lamina ca 80 cm long, abruptly reduced to auricles, apex pinna-like; auricles up to 1.5 cm long, oblong to ovate, unlobed. Oblong-lanceolate, base truncate, both sides equal, apex narrowly acuminate, lobed upto half way to the costae; lobes entire, apex finely crenate with 3-4 minute pointed apices. Costae sparsely covered with brown, short hairs on upper surface, glabrous below; costules and surface glabrous. Basal pair of vein unite to form excurren vein-let, next second pair reaching below the sinus membrane. Sori globose, large, medial. Indusia small, glabrous, often deciduous on maturity.

Ecology: Grows along the bank of streams.

Specimen examined: India, Tamil Nadu, Madurai, Alagar hills, SIVA, 31, 11.02.12, TCH.

13. *Stenochlaena palustris* (Burmann) Beddome, Ferns Brit. India Suppl. 26. 1876. **(Blechnaceae)**

Rhizome climbing on tree trunks, bearing sterile fronds towards base and fertile ones towards apex. Stipe upto 50 cm long, grooved along dorsal surface, grooves continuous into the rachis. Lamina often upto 100 cm long, simple pinnate, terminating with a pinna at apex; sterile pinnae 15-25 cm long, lanceolate-acuminate, short stalked, cuneate at base, margin cartilaginous, sharply serrate. Fertile pinnae 20-25 cm long, linear, drooping. (Plate 3 k)

Ecology: Grows profusely an the base of tree trunk, often covering the entire trunk; throughout the state this species is very common at lower altitude along out skirt of forests and become scarce inside forest

Speciemen examined: India, Tamil Nadu, Madurai, Alagar hills, SIVA, 29, 11.02.12, TCH.

14. Pityrogramma calomelanos (L.) Link. var. *calomelanos* Handb. Gew. 3:20 (1833) **(Hemionitidaceae)**

Rhizome crect, about 3cm thick, densely scaly at the apex; scales lanceolate, apex long acuminate, margin entire; stipes tufted, dark brown or black, scaly at the very base, glabrous and glossy above, abaxially rounded, shallowly grooved above. Lamina lanceolate, bipinnate, apex acute or acuminate, base broadly cuneate; pinnae about 12 pairs,

progressively reduced towards apex, opposite or subopposite, shortly stalked, ovate-lanceolate, apex acuminte, acroscopic base truncate or cuneate, basiscoic base decurrent; pinnules about 10pairs, ovate, adnate with the costa, apex acute, margin entire; pinnae dark green, glabours and glossy above, covered by silver coloured waxy powder below; texture thin or thick herbaceous. Sori along veins, covered by entire surface when mature; spores trilete, honey coloured, exine densely, minutely papillose.

Ecology: Usually terrestrial, rarely lithophytes along roadsides in fully exposed dry places.

Specimen examined: India, Tamil Nadu, Madurai, Alagar hills, SIVA, 36, 11.02.12, TCH.

15. *Thelypteris dentata* (Forsskål) E. P. St. John, Amer. Fern J. 26: 44. 1936. **(Thelypteridaceae)**

Rhizome short creeping, apex ascending to suberect, bearing close stipe bases. Stipe clumped, 30-35 cm long, slender, covered with short hairs throughout, compactly scaly at base only; scales lanceolate, thich, dark brown, hairy along margins. Lamina 60-65 cm long, broadly lanceolate, with densely pubescent rachis. Pinnae 18-22 pairs, sessile, opposite and remote towards base, alternate upwards, basal pair reduced to auricle, upto 3 cm long, deeply crenate; largest pinnae 9-12 cm long, upto 2 cm broad, lanceolate, acuminate, slightly narrowed at base, unequal, oblique, margins deeply lobed more than half way to costae, along upper half of pinnae lobation is reduced to crenate margin; lobes slightly oblique, margin finely crenate, apex rounded. Costae, costules and veins covered with short hairs mixed with sparse long hairs on lower surface, surface between veins covered with short acicular hairs, costae on upper surface with dense, long pale hairs. Veins 7-11 pairs, basal pair of lateral veins anastomose with an excurrent veinlet, next pair end just below the sinus or often join at the tip of excurrent veinlet. Sori medial, reniform. Indusium small, uniformly hairy with glandular hairs. Sporangial stalk with acicular unicellular hairs (Plate 3 l).

Ecology: Terrestrials. Grow on humus rich forest floor as well as along stream-side slopes in patches

Specimen examined: India, Tamil Nadu, Madurai, Alagar hills, SIVA, 38, 11.02.12, TCH.

16. ***Thelypteris parasitica*** (L.)K.Iwats.J. Jap.Bot.38 (10):315.1963 **(Thelypteridaceae).**

Rhizome long creeping, rarely erect, rhizome scales linear - lanceolate up to 10x1.5mm, margin entire or with very few minute hairs, apex acuminate. Stipes, up to 44 cm long, 4cm thick, grey-green, scaly at the base, covered by few short or long hairs at the top, the rest glabrous. Lamina deltoid, broadly ovate or cordate; rachis copiously covered by long and short hairs; pinnae up to 13-20 pairs, opposite at the base, sub opposite or alternate at the distal part, basal pinnae up to 3cm apart, not or slightly reduced, usually deflexed; pinnae up to 13-20 pairs, opposite at the base, sub opposite or alternate at the distal part, basal pinnae up to 3cm apart, not or slightly reduced, usually deflexed; linear-lanceolate, sessile, base truncate or very broadly cuneate, apex acuminate, margin lobed one-third to two-third to the costa; lobes up to 20 pairs, oblique, basal acroscopic lobe slightly larger than the others; costa densely covered by long and short hairs above and below; veins up to eight pairs, next pair reaching at or above the sinus base; upper and lower surface of the costules, veins, intervenal areas covered by short acicular or glandular hairs of about 1mm long; thick, elongate, orange coloured glandular hairs distributed on the lower surface of the costules and veins; pinnae pale green. Sori median or submarginal on the veins, indusia densely hairy; spores bean-shaped, exine irregularly granulose.

Ecology: It grows along fully shaded stream banks gregariously between 400-600m.

Specimen examined: India, Tamil Nadu, Madurai, Alagar hills, SIVA, 39, 11.02.12, TCH.


a
b
Actiniopteris radiata (Sw.) Link
Cheilanthes mysurensis Wall. ex Bedd.
c
Adiantum inclsum Forsskal
d
e
Lygodium microphyllum (Cavanilles) R.Brown
Macrothelypteris torresiana (Gaud.) Ching

Plate-1

Microlepia speluncae (Linn.) Moore

Nephrolepis multiflora (Roxb.) Jarret

Pteris quadriaurita Retz

Parahemionitis arifolia (Burm.) Moore

Plate-2

Pteris tripartita Sw.

Stenochlaena palustris (Burm.)Bedd.

Thelypteris dentata (Forsskål) E. P. St. John

Plate-3

Conclusion:

Exhaustive systematic surveys of all pteridophytic localities of Alagar hills during different season of the year during the last 2 years by the authors have revealed the occurrence of sixteen species belonging to 12 genera and seven families were recorded from various localities of the Alagar hills. Out of the 12 genera of Pteridophytes collected from Alagar hills during these survey ten genera *Lygodium, Actiniopteris, Cheilanthes, Paraheminitis, Pityrogramma, Adiantum, Microlepia, Stenochalena* and *Macrothelypteris* were represented by a single species each. Genera *Pteris, Thelypteris and Nephrolepis* were represented by two species. Endangered pteridophytes are *Pteris tripartita*, *Adiantum incisum* and *Parahemionitis arifolia* has been reported to this region. *Pteris tripartita* which is reported as new record for Eastern Ghats by Benniamin (2011). Excess felling of ferns for various purposed had adverse effects on the fern habitat which is the main cause for disappearance of many moisture loving and sciophytic fern taxa of Alagar hills. Population density of many ferns of Alagar hills have decreased due to several factors. Main caused of threat to these species may attributed to sudden and accelerated changes in natural ecosystem in recent times due to man and his anthropogenic associates and other factor or practices which have constantly been hostile to pteridophytic growth and spread.

Acknowledgements

Authors are highly thankful to DST and UGC for providing financial assistance and Principal, Thiygarajar College for providing laboratory facilities.

References

Beddome RH. 1883A. Hand book to the ferns of British India, Ceylon and Malaya peninsula. Calcutta: Thacker Spink & company.

Benniamin A. 2005. Fern diversity of the Western Ghats, India, PhD Thesis (Awarded), in Manonmanium Sundarnar University, Tirunelveli.

Benniamin A. 2011. *Pteris tripartita* Sw. New record for Eastern Ghats. *Inter. Jour. Biol.Tech.*,2: 14-15.

Bir SS. 1976a. Taxonomy of Indian Pteridophytes. In Kachroo, P. (Ed.) *Recent Advances in Botany*. Bishen Singh and Mahendrapal Singh, Dehradun, pp.70-115.

Khare PB. 1996. Ferns and Fern allies their significance and fantasies, Applied Botany. Abstracts. *NBRI,*16(1): 50-61.

Manickam and Irudayaraj, 1992. Pteridophyte flora of Western Ghats, South India. Today's B.I Publications, New Delhi.

Mehra PN. 1967. Conquest of land and evolutionary patterns in early land plants. 15th Seward memorial lecture delivered at Birbal Sahni Institute of Palaeobotany, Lucknow. Nov. 14: 1-27.

Sriganesan T. 1984. Flora of Alagar Hills. Ph.D. Thesis, Madurai Kamaraj University, Madurai, India.

Sriganesan T. 1987. On the biological spectrum of Alagar hill complex. *Science Literature Arts Search.*,6: 18-23.