

**STUDIES ON THE PTERIDOPHYTIC FLORA OF AGAMALAI HILLS,  
SOUTHERN WESTERN GHATS**

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## INTRODUCTION:

The Western Ghats in India is one of the 34 Global Biodiversity Hotspots and harbors a rich diversity of flora and fauna with many endemic and RET (Rare Endangered Threatened) species. The vascular cryptogams, lycophytes and ferns, form a conspicuous element of the earth's vegetation and are important from evolutionary point of view as they show the evolution of vascular system and reflect the emergence of seed habit in the plants. Modern molecular studies have proved that the horsetails (*Equisetum* sp.) and ferns are a monophyletic group and the closest living relatives to seed plants (Pryer *et al.*, 2001). But today there is only one genus of living horsetail i.e. *Equisetum*, the living fossil. Thus Pteridophytes are evolutionarily important group of plants on the earth and the research works on such an evolutionarily important group of plants are very meager when compared to flowering plants. It is remarkable to note that country wise world fern statistics made by Michael Hassler with minor tweaking by Brian Swale shows that although modern checklists are available in India, modern flora is only partially available. As far as floristic survey is concerned with various phytogeographical regions of India, South India have somewhat been thoroughly explored for pteridophytes. But due to the occurrence of more problematic species complexes with hybrids, the identification and delimitation of taxa is the major problem due to which correct number of lycophytes and ferns from South India is not available. Although modern Flora is not completed on South Indian pteridophytes, several experimental studies, particularly in relation to medicinal aspects of South Indian lycophytes and ferns are available.

General floristic and cytological survey on lycophytes and ferns of Southern Western Ghats has been made by Beddome (1864), Manickam (1986) and Manickam and Irudayaraj (1988, 1992, 2003). As discussed above, the Western Ghats in India is a complex mountainous tract with a major Palghat Gap, minor Shencottah gap and with some minor and major eastward offshoots, like Palni Hills, Agamalai, Meghamalai etc. the distribution of flora and fauna in these regions will be peculiar and it has to be studied in detail in such eastward branches of the Western Ghats. Although, the Western Ghats and Eastern Ghats of India meet on the Nilgirs, the major or minor eastward branches of the Western Ghats may have several interesting species of plants with phytogeographical importance. As Agamalai is topographically important and floristically an unexplored, short eastward branch of the Western Ghats, besides the long eastward branch, the Palni Hills, the present study was aimed to make a general floristic survey of lycophytes and ferns of Agamalai Hills with the following objectives.

#### **Study Objectives:**

- To make intense floristic survey on lycophytes and ferns from Agamalai Hills, South India and to analyse them phytogeographically in comparison with the adjacent hills in South India.
- To make cytological study on lycophytes and ferns of Agamalai Hills, South India in order to find out any species with cytological variant.
- To make ethnomedicinal survey on lycophytes and ferns of Agamalai Hills, South India.

## **METHODOLOGY**

### **(i) Taxonomical Studies:**

An extensive and intensive field study was carried out between 2016 to 2019 with the permission granted by Principal Chief Conservator of Forest Chennai. During field visits, the plant specimens were collected with their fertile part to prepare herbarium specimens and to authenticate their correct identity. The preserved specimens were identified using keys and description from taxonomic literature with the help of floras such as Manickam and Irudayaraj (1992) and Khullar (1994).

### **(ii) Cytological Studies:**

For cytological studies young sporophylls for meiosis and croziers young leaf tips for mitosis were fixed in Carnoy's fluid (Absolute Alcohol: Chloroform: Acetic Acid 6:3:1). To observe both mitotic and meiotic chromosomes the routine Acetocarmine squash technique was followed

### **(iii) Ethnobotanical studies:**

The fieldwork in the tribal settlements of Agamalai hills was commenced from July 2017 to March 2018. Western Ghats (Kanagavel & Pandya, 2013). The tribal settlements were located through a number of field surveys and there were 8 informants between the ages of 25 and 80. They were consulted to gather ethnobotanical information and the way of acquiring knowledge was as per the methodology (Plates 6, 7) suggested by Jain (1987). The information was collected

through questionnaire, interviews and discussion among the tribal people in their local language, Tamil.

**(iv) Classification:**

The “*Community - derived classification for extant lycophytes and ferns*” developed by the Pteridophyte Phylogeny Group has been followed in the present study.

## **RESULT AND DISCUSSION**

With the aims to study the taxonomy, cytology and ethnobotany of lycophytes and ferns from the Agamalai Hills of the Western Ghats, South India, intense field studies were carried out in different seasons from 2016 to 2019. After completing the first phase of taxonomical studies during the first year, cytological studies were carried out during 2018-2019. Ethnobotanical study was also carried out during the first phase along with the taxonomical studies.

**(i) Taxonomical Studies:**

A general floristic survey, on lycophytes and ferns of unexplored Agamalai Hills, which is a part of eastward offshoot of the Western Ghats, was undertaken along with cytological and ethnobotanical studies. From the floristic survey, two lycophytes and forty eight ferns were recorded from the study area. In the present study the recent PPG I - Community derived classification for extant lycophytes and ferns, has been followed PPG I, 2016) and the nomenclatural changes given by Fraser-Jenkins (2008) have also been incorporated. A total of fifty lycophytes and ferns under 33 genera and 15 families are reported for the first time for the Agamalai

Hills. Dominant family is Pteridaceae with twelve species under seven genera followed by Thelypteridaceae and Polypodiaceae with six species under five genera in the former and six species under four genera.

Rare ferns like *Psilotum nudum* (L.) P. Beauv., *Lastreopsis tenera* (R. Br.) Tindale and *Pleopeltis macrocarpa* (Bory de Saint-Vincent ex Wild.) Kaulf. have been recorded from the present study area and Agamalai Hills is the new distributional area for these ferns. Besides these rare ferns, endemic species like *Selaginella tenera* (Hook. & Grev.) Spring and *Cyathea nilgirensis* Holttum have also been collected from Agamalai Hills. Some ferns like, *Pteris confusa* T. G. Walker, *Cheilanthes opposita* Kaulf. (*C. mysorensis* Wall. ex Beddome) and *Lepisorus amaurolepidus* (Sledge) Bir & Trikha which are confined to South India and Sri Lanka have also been recorded in the present study area.

A general key has been given for all the 34 genera of Lycophytes and ferns of Agamalai Hills. Species key has also been given for genus with more than one species.

## (ii) Cytological Studies:

Cytological study was carried out on more than thirty samples of sporophylls and or croziers of different ferns. Nearly 15 samples (50%) of nine species and a hybrid yielded good results. All the results, except one (crozier - *Athyrium boryanum* (Willd.) Tagawa) are meiotic chromosomes in spore mother cells of young sporangia. Both mitotic and meiotic chromosome counts have been made in the crozier and spore mother cells of *Athyrium boryanum* (Willd.) Tagawa and *Pteris confusa* T. G. Walker and both the species are confirmed to be of apogamous taxa. Regular meiosis

was observed in seven species while irregular meiosis was observed in two species (*Adiantum raddianum* Presl, *Pseudocyclosorus ochthodes* (Kunze) Holttum and in a hybrid (*Pteris confusa* complex). The *Psilotum nudum* (L.) P. Beauv. With  $n=ca. 153$  is a new hexaploid sexual cytotype. In *Pseudocyclosorus ochthodes* (Kunze) Holttum both regular meiosis with 35 regular bivalents and several cells with irregular meiosis was observed. This is the first report for the irregular meiosis along with regular (ca. 1:1 ratio) meiosis in this species. It is interesting to note that the apogamous and sexual taxa are almost equal in number (5+5=10). There are only two (20%) diploids and remaining eight (80%) are polyploids

### (iii) Ethnobotanical studies:

Ethnomedicinal information was gathered from the local tribals of Agamalai for one lycophyte and fourteen ferns. Thus nearly 30 % of lycophytes and ferns of Agamalai are utilized as medicinal plants by local tribals for the last fifty years. It is remarkable to note that except one rare species (*Pleopeltis macrocarpa*) all the other fourteen species are the common species. In majority of cases whole plant (32%) or leaves (31%) are used followed by rhizome (19%). Other parts like tubers and spores are used rarely (6% each). Majority of the ferns are used as antimicrobials or anti-inflammatory agents along with other uses like anti-fertility, anthelmintic and cooling agents. Interestingly the decoction of the leaves of *Christella parasitica* is used to clean the hair.

## SUMMARY AND CONCLUSION

- With an aim to make floristic study on lycophytes and ferns of topographically important region of the Western Ghats, the Agamalai Hills, intensive field works were carried out along with cytological study and ethnomedicinal survey from 2016 to 2019. Totally fifty species (two lycophytes and forty eight ferns) were recorded from the above study area, the Agamalai Hills and all the species are reported for the first time for this area. They have been classified on the basis of PPG I classification.
- The present study has resulted in the report of new or extended area of distribution for rare/threatened lycophytes and ferns like *Selaginella tenera* (Hook. & Grev.) Spring, *Psilotum nudum* (L.) P. Beauv., *Lastreopsis tenera* (R. Br.) Tindale and *Pleopeltis macrocarpa* (Bory ex Willd.) Kaulf.
- Cytological studies on ten ferns showed the presence of one hexaploid sexual (*Psilotum nudum* (L.) P. Beauv.), two tetraploid sexuals (*Adiantum raddianum* C. Presl, *Christella dentata* (Forsk.) Brownsey & Jermy ), one diploid apogamous (*Pteris confusa* T. G. Walker), tow diploid sexuals (*Adiantum incisum* Forssk., *Pseudocyclosorus ochthodes* (Kunze) Holttum) and four triploid apogamous (*Actiniopteris radiata* (Sw.) Link, *Pteris confusa* ? Hybrid, *Parahemionitis cordifolia* (Roxb.) Fraser-Jenk., *Deparia boryana* (Willd.) M. Kato subsp. *austroindica* Fraser-Jenk.). In total, out of ten species, there are five sexuals and five apogamous species. Hexaploid cytotype with regular meiosis and diploid cytotype with regular and irregular meiosis are reported for the first time in *P.*



*nudum* and *Pseudocyclosorus ochthodes* respectively.

- The rare occurrence of 16 spores has been reported for the first time in a leptosporangiate spleenwort, *Asplenium falcatum* Lam. in which the mode of reproduction is yet to be studied since the present study raised a new question for the earlier reports of sexual mode of reproduction in this spleenwort.
- In general, Agamalai Hills, serve as the junction point or transition zone between the Western Ghats and the Eastern Ghats through Palni Hills for the distribution of several lycophytes and ferns of South India. The present study along with previous literature show that the species complexes with more than one cytotypes and mixed mode of reproduction, like *Psilotum nudum* (L.) P. Beauv. show the random or irregular pattern of distribution in contrast to species with uniform cytotype and mode of reproduction, like the diploid apogamous *Pteris confusa* T. G. Walker.
- From the present ethnomedicinal survey, ethnomedicinal information for two lycophytes and fourteen ferns of Agamalai Hills was gathered from local Tribals (Paliyar). Majority of the species are used as wound healers and some are used as anti-fertility, anthelmintic and antimicrobial agents. Usually whole plants are used and in some cases rhizome and rarely spores are used for medicinal uses.

