



Diversity and Potential Uses of Pteridophytes in Nelliampathy Hills, Kerala, India

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Authors' contributions

This work was carried out in collaboration among all authors. Author AKR designed and performed the study and wrote the first draft of the manuscript. Others authors managed the analyses and finalized the manuscript. All authors read and approved the final manuscript.

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ABSTRACT

Aims: To document the pteridophytic diversity of Nelliampathy hills bordering the southern part of the Western Ghats in Palakkad district Kerala and to analyze their habitat, conservation status, and their applications in day-to-day lives.

Study Design: The pteridophytic diversity in the Nelliampathy hills of Kerala was documented by the collection of the pteridophytic species and their preservation. Specimen identification was done with the help of previous literatures and local people were approached to understand more about the applications of the collected species in day-to-day lives.

Place and Duration of Study: The study was conducted at ten regions of nelliampathy hills in Palakkad district namely; Pothundy, Kaikatty, Kundrachola, Noorady, Karappara, Seetharkundu, Kesavanpara, Pulayanpara, Anamada, and Karasoori.

Methodology: The collection of pteridophytic specimens from hillsides, roadsides, footpaths, and rocks was done from the study area which was gathered and preserved in 4% formalin solution

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according to standard taxonomic procedures. The specimen identification was carried out with the help of the literature and their floristic, habitat analysis, and conservation status were analyzed. Applications in livelihood were also listed.

Results: A series of floristic surveys conducted at ten selected sites during different seasons of the year recorded and vouchered 61 species, 35 genera, and 19 families of pteridophytes of which Pteridaceae dominates with 11 species (19%) followed by Polypodiaceae with 8 species (13%), Thelypteridaceae and Woodsiaceae with 6 species (9%). The majority of the species collected were terrestrial, followed by lithophytic, epiphytic, semi-aquatic, and aquatic species as per the habitat analysis. Five endangered species and two endemic species were also present in the study area. Many of the species possess medicinal and ornamental values which is beneficial to mankind.

Conclusion: The current survey contributes to the information on the diversity, distribution, and potential applications of pteridophytes in the Nelliampathy hills which can be a reference for future conservation strategies and operations.

Keywords: Pteridophytes; Nelliampathy hills; Western Ghats; pteridophytic diversity.

1. INTRODUCTION

Pteridophytes, also called fern and fern allies, horsetails, and club mosses, are non-flowering plants with a well-developed vascular system called vascular cryptogams. Pteridophytes are named after their feather-like leaf fronds or pinnate fronds. Pteron refers to a feather and phyton refers to a plant [1]. Pteridophytes dominated the earth's vegetation in the prehistoric past, 280 and 230 million years ago. Despite being overtaken by Spermatophytes in today's flora, they play a crucial role in the evolution of the plant kingdom. They have a long history of fossilization. Their earlier traces were discovered in the late Paleozoic Silurian era; about 400 million years ago. During the Devonian, Mississippian, and Pennsylvanian eras, they thrived. Late Paleozoic epochs are known as the age of Pteridophyta [2]. During ancient times, they had a crucial role in the establishment of plants on land. Pteridophytes speedily colonized seashores, riverbanks, and other regions with little disruption due to their great reproductive capacity and composition [3]. The marshy environments of ancient times were dominated by tree ferns, huge horsetails, and arborescent lycopods. Although they are no longer the dominating vegetation in any place on the planet, their profuse development in forest floors as well as forest trees gives the area a particular physiognomy character [4,5]. Pteridophytes of today have managed to maintain their ancestor's size, variety, and splendor. Horticulturists, botanists, and Nature enthusiasts have long been drawn to the pteridophytes. Many pteridophytes are kept as ornamentals in gardens and fern homes, as well as being utilized as food and medicinal plants. They are also said to play an essential part in

bioremediation processes. *Salvinia* an aquatic fern can remove numerous toxins from wastewater, including heavy metals. Ferns are also proven to be beneficial for soil development and conservation [2]. *Azolla*, a water fern can be used as a biofertilizer.

1.1 Biogeography

Pteridophytes are most common in wet and seasonally mild tropical mountains. Though angiosperms have replaced pteridophytes, they still play a major role in biodiversity at the species level. Globally there are about 12000 species of reported pteridophytes of which 97% are ferns and 3% are fern allies or lycophytes. Pteridophytes show the greatest diversity in two large centers of the world; America and South Eastern Asia [6].

1.2 Pteridophytic Vegetation

Fern and fern allies thrive in damp and shady environments. Tropical, sub-tropical, and wet deciduous are the most prevalent types of forest that provide habitat for pteridophytes. Ferns can be seen from sea level to the highest mountains geographically [7]. Pteridophytes are very sensitive to microclimate conditions so even little changes in climatic and other environmental variables might result in their extinction. As a result, pteridophytes are highly reliant on the presence of these forests [8]. They play a vital role in the forest community's ground vegetation. Some of them are beneficial while others are harmful [9].

Such that the diversity and beneficial pteridophytes can be identified and made use of from the study area which is the Nelliampathy hills in the Palakkad district of Kerala.

2. MATERIALS AND METHODS

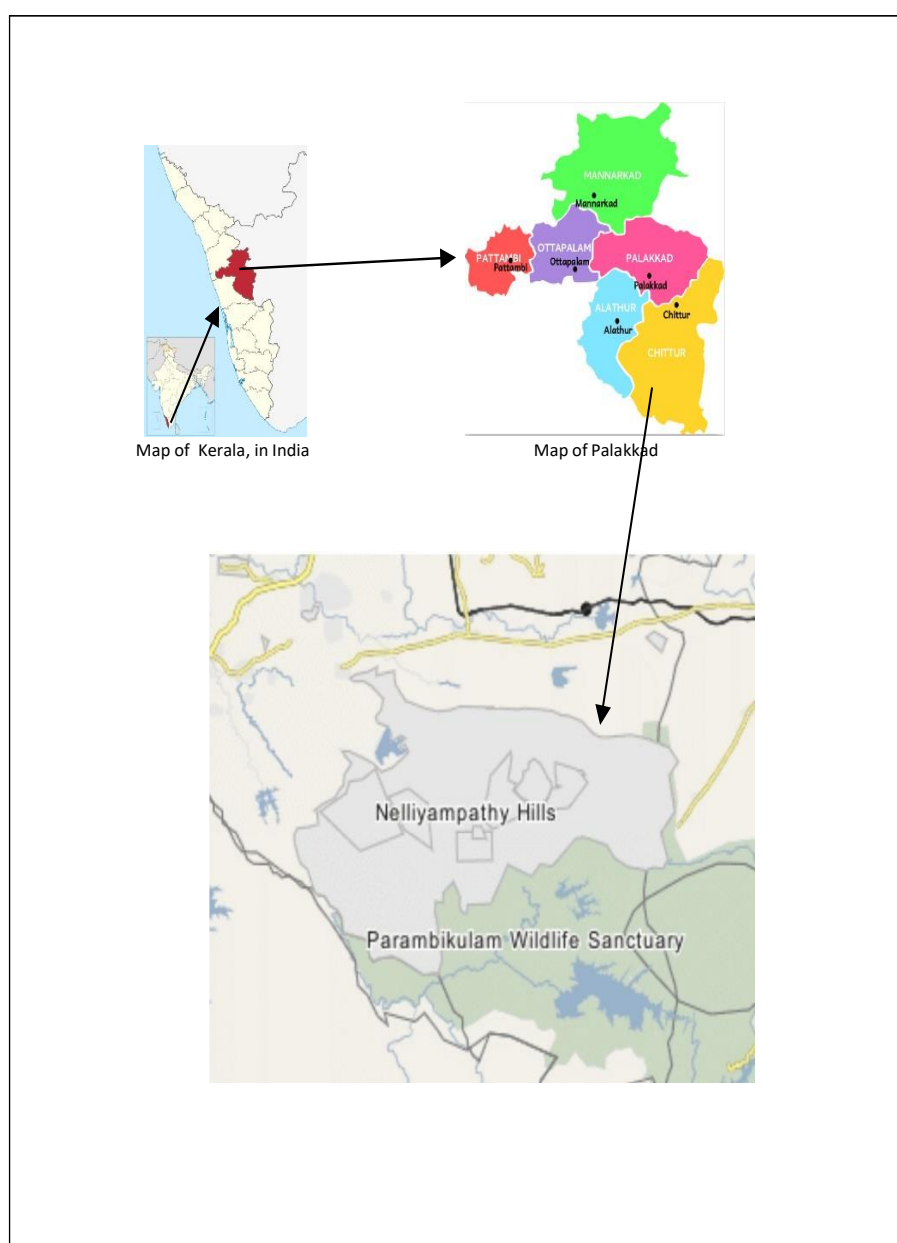
2.1 Study Area

The Nelliampathy Hills, in Kerala's Palakkad district (Southern Western Ghats), span 285 km² and are located between 10.53°N latitude and 76.68°E longitude. Palakkad is one of Kerala's richest districts in terms of flora and faunal diversity. Nelliampathy hills are much more diverse when compared to other regions of the Western Ghats. Geographic, climatic, and edaphic variables all contribute to the diversity of the vegetation of Nelliampathy hills. The study

areas include ten regions of Nelliampathy hills: Pothundy, Kaikatty, Kundrachola, Noorady, Karappara, Seetharkundu, Kesavanpara, Pulayanpara, Anamada, and Karasoori.

2.2 Survey Methodology

Field explorations were carried out in Nelliampathy Hills during different seasons from December 2021 to March 2022, to document and collect Pteridophytes. Specimens from hillsides, roadsides, footpaths, and rocks were considered for collection.



Map. 1. Map of nelliampathy hills

2.3 Preservation and Identification

Plant specimens with sporophylls were gathered with the rhizome component and stored in a 4% formalin solution. The specimens were gathered and preserved by standard taxonomic procedures. With the aid of the literature “Ferns and Fern allies of Nilgiris, Tamil Nadu [1] and “Pteridophytes of Karnataka state, India [2] the collected specimens were identified. With some modifications regarding their accurate nomenclature and classification of fern allies, all the detected fern specimens have been classified in accordance with Fraser- Jenkins [10].

3. RESULTS AND DISCUSSION

The current study focuses on the diversity of pteridophytes in the Nelliampathy hills of Kerala's Southern Western Ghats. Field explorations have resulted in the documentation of 61 pteridophytes spreading over 35 genera belonging to 19 families. About 57 of the specimens from the present study area have been documented out of 227 pteridophytes in Fern and Fern allies of the Nilgiri district [1]. Of the total number of pteridophytes identified, 34 are ferns and 6 are fern allies. Among the pteridophytes, the family Pteridaceae dominates with 11 species under 6 genera followed by Polypodiaceae with 8 species under 5 genera, Thelypteridaceae with 6 species under 4 genera, Woodsiaceae with 6 species under 3 genera. Pteridophytic species were collected from a variety of environments, including damp and dry rocks, tree trunks, ponds, lakes, forest floors,

grasslands, and sunny meadows. According to their habitat among the 61 pteridophytes, 43 are terrestrials, 23 are lithophytes, 13 are epiphytes, 2 are semiaquatic and 1 is aquatic.

3.1 Conservation Status

Two species among the 61 pteridophytes collected fell into the ‘at risk’ category, the other two in the ‘rare’ category and one species fell into the ‘near threatened’ category. Two of the 61 pteridophytic specimens (0.03%) collected were endemic to the Nelliampathy hills and their presence calls for the conservation of the study area. About 19 species are listed by Trevor [11] as endemics which accounts for only less than 10% of the total 270 ferns collected from Jamaica.

3.2 Uses of Collected Pteridophytes

Among the pteridophytic specimens collected almost all of them were found to be having potential uses in livelihood. 15 of them have therapeutic importance of which the Pteridaceae species are higher in number. Bhaskaran *et al* reported the dominance of Pteridaceae followed by Polypodiaceae, and Adiantaceae in exhibiting significant medicinal activity [12]. Similarly, Pteridaceae was recorded with the highest number of medicinally important species followed by Polypodiaceae, and Thelypteridaceae among the ethnobotanical records of 283 species obtained from different states of India [13]. Some of the collected species are used as ornamentals and two of them; *Diplazium esculentum* and *Marsilea minuta* were found to be edible.

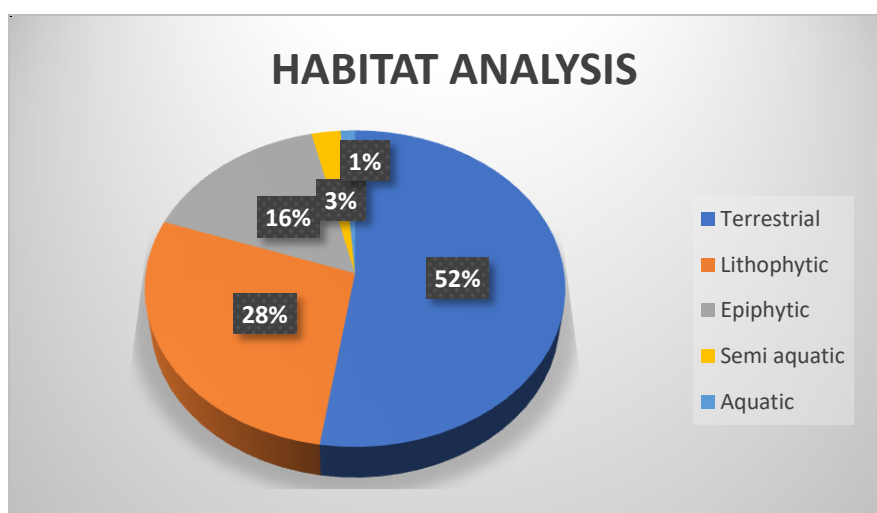


Fig. 1. Habitat analysis of the pteridophytes in nelliampathy Hills

Table 1. List of pteridophytes in nelliampathy hills

Sl. No.	Species	Family	Habitat
1	<i>Adiantum caudatum</i> L.	Pteridaceae	T
2	<i>Adiantum raddianum</i> C.Presl		T, L
3	<i>Adiantum latifolium</i> Lam.		T
4	<i>Adiantum philippense</i> L.		T
5	<i>Parahemionitis cordata</i> (Roxb. Ex Hook. &Grev.) Fraser-Jenk.		T, L
6	<i>Doryopteris concolor</i> (Langsd. & Fisch.) Kuhn		T, L
7	<i>Cheilanthes bullosa</i> Kunze.		T, L
8	<i>Pityrogramma calomelanos</i> (L.)Linkvar.Calomelanos		T, L
9	<i>Pityrogramma austroamericana</i> Domin		T
10	<i>Pteris stenophylla</i> Wall. Ex Hook. & Grev.		T
11	<i>Pteris arisanensis</i> Tagawa		T
12	<i>Pteris multiurita</i> J.Agardh.		T
13	<i>Drynaria quercifolia</i> (L.) J.Sm.	Polypodiaceae	E, L
14	<i>Lepisorus nudus</i> (Hook.) Ching		E, L
15	<i>Leptochilus lanceolatus</i> Fee		L, E
16	<i>Pyrrosia heterophylla</i> (L.) M.G.Price		E
17	<i>Pyrrosia lanceolata</i> (L.) Farwell.		E, L
18	<i>Pyrrosia porosa</i> (C.Presl) Hovenkamp		E, L
19	<i>Microsorium pteropus</i> (Blume) Copel		L
20	<i>Microsorium punctatum</i> (L.) Copel		E, L
21	<i>Cyclosorus interrupts</i> (Willd.) H.Ito	Thelypteridaceae	S
22	<i>Christella dentata</i> (Forssk.) Brownsey & Jermy		T
23	<i>Cyclosorus terminans</i> (J.Sm. ex Hook.) K.H.Shing.		T
24	<i>Glaphyopteridopsis erubescens</i> (Wall. ExHook.) Ching.		T
25	<i>Pseudophegopteris pyrrorachis</i> (Kunze) Ching,sub. <i>distans</i> (Mett.) Fraser-Jenk.		T
26	<i>Trigonospora caudipinna</i> (Ching) Sledge		T, L
27	<i>Athyrium anisopterum</i> Christ in Bull.	Woodsiaceae	T
28	<i>Athyrium cumingianum</i> C.Presl		T
29	<i>Athyrium hoheneckerianum</i> (Kunze) T.Moore		T
30	<i>Deparia petersenii</i> (Kunze) M.Kato		T
31	<i>Diplazium esculentum</i> (Retz.) Sw.		T
32	<i>Diplazium polypodoides</i> Blume		T
33	<i>Selaginella delicatula</i> (Desv. Ex Poir.) Alston	Sellaginellaceae	T
34	<i>Selaginella intermedia</i> (Blume) Spring		T
35	<i>Selaginella involvens</i> (Sw.) Spring		L, E
36	<i>Selaginella tenera</i> (Hook. & Grev.) Spring		T
37	<i>Selaginella chrysorrhizos</i> Spring		T
38	<i>Arachniodes sledgei</i> Fraser-Jenk.	Dryopteridaceae	T
39	<i>Bolbitis appendiculata</i> (Willd.) Iwatsukiss		T, L
40	<i>Bolbitis asplenifolia</i> (Bory) K. Iwats.		T, L
41	<i>Bolbitis semicordata</i> (Baker) Ching		T, L
42	<i>Bolbitis subcrenatooides</i> Fraser-Jenk.		T, L
43	<i>Asplenium formosum</i> Willd.	Aspleniaceae	T, L
44	<i>Asplenium phyllitidis</i> D..Don		T, E, L
45	<i>Asplenium yoshinagae</i> Makino subsp. Indicum (Sledge) Fraser-Jenk.		E, L
46	<i>Asplenium inaequilaterale</i> Willd.		T
47	<i>Nephrolepis cordifolia</i> (L.) C.Presl	Lomariopsidaceae	E, L
48	<i>Nephrolepis multiflora</i> (Roxb.) F.M. Jarrett ex C.V. Morton		E, L

Sl. No.	Species	Family	Habitat
49	<i>Tectaria coadunata</i> (J.Sm.) C.Chr.	Tectariaceae	T, E, L
50	<i>Tectaria polymorpha</i> (Wall. ex Hook.) Copel.		T
51	<i>Microlepia speluncae</i> (L.) T.Moore	Dennstaedtiaceae	T
52	<i>Pteridium aquilinum</i> (L.) Kuhn		T
53	<i>Huperzia phlegmaria</i> (L.) Rothm	Lycopodiaceae	E
54	<i>Angiopteris helferiana</i> C.Presl	Marattiaceae	T
55	<i>Trichomanes latealatum</i> (Bosch) Christ	Hymenophyllaceae	L
56	<i>Dicranopteris linearis</i> (Burm.f.) Underw.	Gleicheniaceae	T
57	<i>Lygodium flexuosum</i> (L.)	Lygodiaceae	T
58	<i>Marselia minuta</i> L.	Marseliaceae	S
59	<i>Salvinia molesta</i> D.Mitch	Salviniaceae	A
60	<i>Cyathea gigantea</i> (Wall.ex. Hook.)	Cyatheaceae	T
61	<i>Blechnum orientale</i> L.	Blechnaceae	T

T-Terrestrial, L-Lithophytic, E-Epiphytic, A-Aquatic, S-Semiaquatic

Table 2. Occurrence of threatened plants in nelliampathy hills

Sl no	Species	IUCN Category
1	<i>Athyrium cumingianum</i> Pr. Ex Milde	At risk
2	<i>Bolbitis appendiculata</i> (Willd.)	At risk
3	<i>Asplenium phyllitidis</i> D. Don	Near Threatened
4	<i>Bolbitis semicordata</i> (Baker) Ching	Rare
5	<i>Huperzia phlegmaria</i> Rothm.	Rare

Table 3. Medicinally important pteridophytes and their uses

Sl no	Plant species	Part(s) used	Uses
1	<i>Selaginella delicatula</i>	Plant juice	Antibacterial, for healing wounds
2	<i>Selaginella involvens</i>	Whole plant	To rejuvenate life, also used in the prolapse of the rectum, prevents cough, bleeding piles, and gravel amenorrhea and as antibacterial
3	<i>Dicranopteris linearis</i>	Rhizome Fronds	Antihelminthic For Asthma
4	<i>Marsilea minuta</i>	Whole plant	Cough, spastic condition of leg muscles, insomnia; act as sedative, antirheumatic diuretic; whole plant is antifungal, antibacterial, refrigerant, resolvent and used in abscess, back ache, snake bite, boils, diarrhea, dislocation, fracture, inflammation, menorrhagia, sore and trauma
5	<i>Microlepia speluncae</i>	Leaves	Used in fever
6	<i>Pteridium aquilinum</i>	Rhizome Whole plant	Astringent, anthelmintic Antidiarrheal, anti-inflammatory, antibacterial, carcinogenic, mutagenic, vermifuge and used for snake bite, fever, gastritis, hypertension, inflammation, sclerosis and as poison.
7	<i>Adiantum philippense</i>	Leaf and root	Leaf and root decoction is used for the treatment of chest complaints
8	<i>Parahemionitis cordata</i>	Fronds Rhizome	Treatments of aches and as a vermifuge Antibacterial property

SI no	Plant species	Part(s) used	Uses
9	<i>Pityrogramma calomelanos</i>	Whole plant Rhizome Frond	Plant decoction is used for kidney trouble Antihelminthic Tea prepared out of the frond is used as a cure for flu, hypertension, fever and cough, asthma
10	<i>Pteris multiurita</i>	Fronds	Antibacterial agent; Fronds made into a paste is applied in wounds
11	<i>Diplazium polypodioides</i>	Fronds	Used in piles
12	<i>Blechnum orientale</i>	Rhizome	Used as anthelmintic, as cure for intestinal worms, bladder complaints and as diaphoretic, aromatic, aperitive
13	<i>Nephrolepis auriculata</i>	Rhizome Pinnae	Antibacterial and is used in rheumatism, chest congestion, nose blockage and loss of appetites Antitussive, styptic, antifungal used for the treatment of jaundice, fresh fronds decoction is given as a drink
14	<i>Tectaria coadunata</i>	Whole plant	Antibacterial; used in asthma, bronchitis, stings of honeybee. Cooked tender portion is used for curing stomach trouble
15	<i>Microsorium punctatum</i>	Leaves	Leaf juice is used as purgative, diuretic, s and for healing wound

4. CONCLUSION

The findings of the present study indicate that the pteridophytic species in the Nelliampathy Hills is indeed very diverse. It led to the documentation of 61 pteridophytes spanning over 19 families and 34 species. Many of the pteridophytic species collected in total have been found to have edible, decorative, and therapeutic uses that can be explored by mankind. As their traditional uses are still being neglected this survey helps to escalate their uses in day-to-day lives. On the other hand, the existence of threatened species is a major concern since it might result in their extinction as human exploration progresses. Therefore, it will be essential to effectively manage conservation strategies like in-situ and ex-situ procedures to safeguard particular species.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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