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Short Communication: Assessment of Pteridophytes' composition and conservation status in sacred groves of Jhargram District, South West Bengal, India

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Abstract. *Uday UKS,* Bhakat RK.. *2021. Short Communication: Assessment of Pteridophytes' composition and conservation status in sacred groves of Jhargram District, South West Bengal, India. Biodiversitas 22: 3171-3178.* Sacred groves are significant as community-preserved areas and have contributed to the conservation of biodiversity, thereby playing a key role in environmental management. The ecological and related cultural values of the species and the activities of local communities would make it possible to understand the importance of the protection of the sacred groves and also to prepare integrated approaches to biodiversity at the ecosystem level. Thus, this study aimed to investigate the status of pteridophyte diversity in the sacred groves of Jhargram district, West Bengal, India. The study showed that 77 pteridophyte species belonging to 44 genera and 15 families were collected and described, of which nine species were classified as Lycopodiopsida and sixty-eight species as Polypodiopsida. The floristic analysis revealed the dominance of the order Polypodiales (70.13%) followed by Aspleniaceae (23.38%), and Polypodiaceae (23.38%). The results also showed the predominance of the genera *Selaginella* with five species. Of the total species, 76.62% were terrestrial species, 14.29% were epiphytes, and 9.09% were aquatic species. The highest frequency is shown by Class C (25.97%) and major pteridophyte plants (81.81%) were not been evaluated till now.

Keywords: Diversity, IUCN, Jhargram district, Raunkiaer frequency class, sacred groves

INTRODUCTION

Sacred groves are richly diverse tracts of virgin forest that have been being preserved by the local people for centuries due to taboos that the deities live in them and defend the villagers for their cultural and religious values from multiple calamities (Ramakrishnan et al. 2012). Each sacred grove holds its own stories, mythology, and myths that make up the sacred grove's integral portion (Erickson 2020). An inextricable relation in terms of ecology, history, faith, between the present society and the past; even in sacred groves, cultural heritage remains (Sangha et al. 2018). Sacred groves and diverse communities are spread all over the world. They should be recognized by encrypting separate laws for their security in various ways (Kulkarni et al. 2018).

Sacred groves are biologically significant areas that have the highest variety and wealth of biodiversity (Rath and Ormsby 2020). Besides these sacred groves, the terrestrial biome is also an important ecosystem. Here angiosperms are the abundant vegetation, mainly trees and climbers, relatively limited in the number of herbaceous forms, but this function is replaced by some pteridophytes. Large trees are dominant in some areas, whereas climbers are the majority in some other areas. The groves in Jhargram district, West Bengal, India, are uniformly distributed in the form of densely wooded natural patches, mainly of angiosperm flora with perennial water resources in the vicinity. It helps in soil and water conservation as a unique ecosystem, protecting the biological resources and the treasure house of many cryptogamic and phanerogamic plants (Nayaka and Upreti 2004).

Ferns and fern-allies, which are non-flowering, vascular and spore-bearing plants, are part of the pteridophytes. As they provide proof of vascular system evolution and show the emergence of seed habitat in plants, they form a prominent part of the earth's vegetation. The pteridophyte community thus forms a connection between plants in the lower non-vascular group and seed-bearing plants in the higher group (Malati and Rao 2020). While they had been the predominant part of the earth's vegetation 250 million years ago, they were largely replaced by seed-bearing plants afterward. There are over 300 genera and 12,000 species in the Pteridophytes distributed across the world, of which almost 1000 species are present in India. 47 species are endemic to India, some of which are included in the Rare, Endangered, and Threatened (RET) group (Pfadenhauer and Klotzli 2020). It has been stated that some of the Pteridophytes are edible, have medicinal value, the potential for use as bio-fertilizer, and ornamental plants. In India, the pteridophytes are distributed in the Eastern Ghats, the Western Ghats and the Himalaya region high altitude, high precipitation and temperate forests have confirmed the dominance of the species (Malati and Rao 2020). On the eastern coast of India, the Eastern Ghats, a discontinuous mountain range that runs through the states of West Bengal (only Binpur II block), Odisha, Andhra Pradesh, Telangana, Tamil Nadu and parts of Karnataka.

The mountain ranges run parallel to the Bay of Bengal and the west side of the Deccan plateau. Taxonomical approaches to the pteridophytic flora in sacred groves are included in this study. In sacred groves, pteridophytes thrive in good condition (Sureshkumar et al. 2018). For pteridophytes, it's watery or moisture nature is sufficient to survive. Sacred groves are the original replica of local natural forests and variations among species are prevalent. Therefore, this current study attempts to evaluate the diversity of pteridophyte species in biodiversity-rich sacred groves areas of the Jhargram district of South West Bengal, India.

MATERIALS AND METHODS

Study area

The study area included sacred groves located in the plains and hilly areas of the Jhargram district of West Bengal in India, at 36 forest beats. Jhargram district, under the 'Jungal Mahal', is located in the southern part of West Bengal, India (Figure 1). The geographical location comes under the middle tribal zone of India. On the north, it is bordered by the districts of Purulia and Bankura, and on the east, it is bordered by the river Kangsabati (from the western border of West Midnapore district) and partly by the river Subarnarekha from the western border of West Midnapore district. It has common borders with the state of Odisha in the south and the west with the Jharkhand state. The main vegetation types of sacred groves are *Shorea robusta* C.F.Gaertn., *Buchanania cochinchinensis* (Lour.) M.R.Almeida, *Butea monosperma* (Lam.) Kuntze, *Lannea coromandelica* (Houtt.) Merr., *Pterocarpus marsupium* Roxb., *Semecarpus anacardium* L.f., *Terminalia anogeissiana* Gere & Boatwr. and *Terminalia elliptica* Willd.

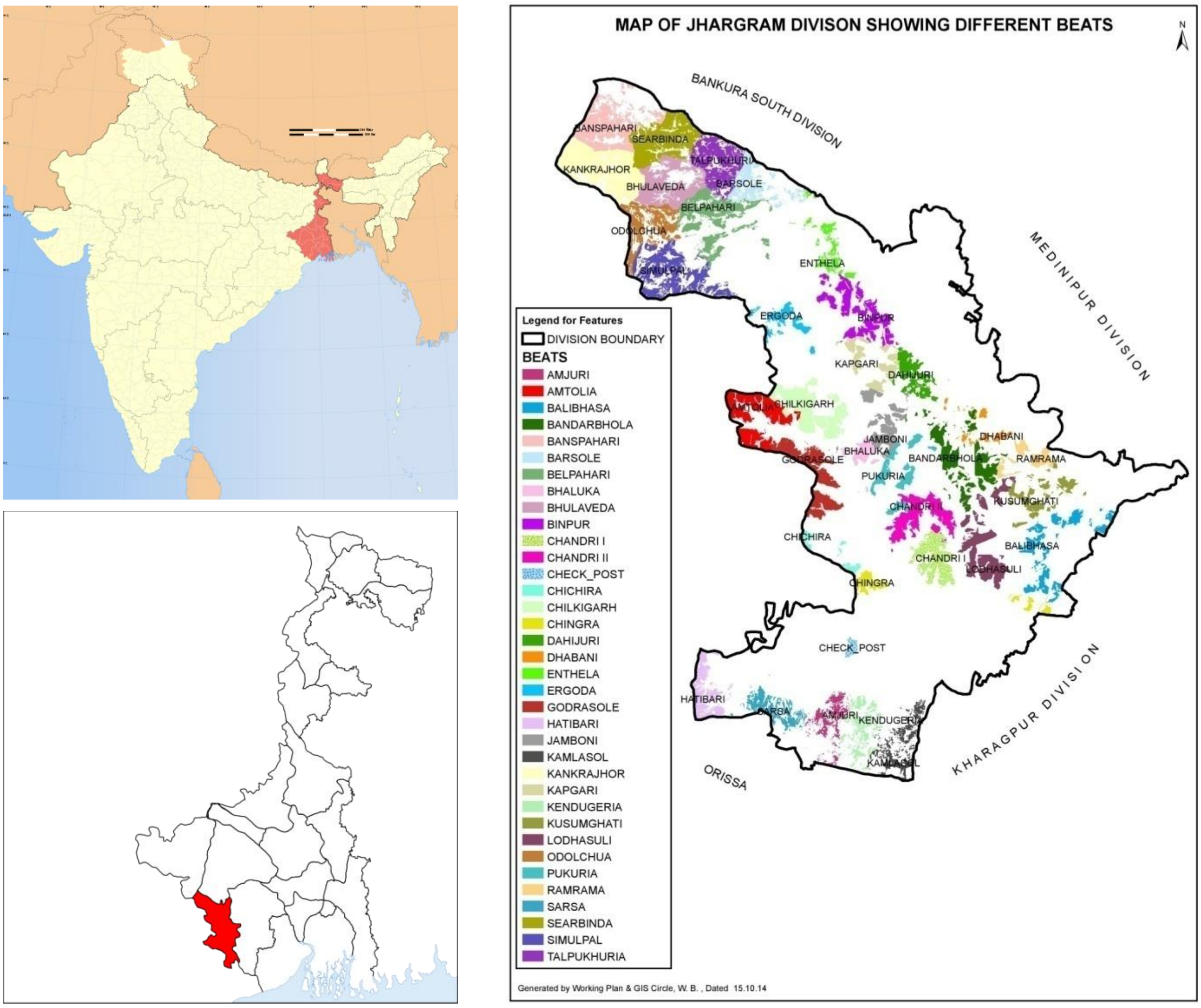

Figure 1. The study area (colored portion shows the forested area of different forest beats with adjoining sacred groves)

Jhargram district covers an area of 3037.64 km^2 with a population of 1,136,548 according to the census in 2011. 96.52% of the total population was rural and only 3.48% was urban population. Of the total population, 20.11% belonged to scheduled castes and 29.37% belonged to scheduled tribes. Its population growth rate was 10.9% over the 2001-2011 decade. In 2011, the literacy rate was 72%, with a male literacy rate of 81% and 64% for women. The sex ratio was 979 women per 1000 men (Anon 2011). The language of the inhabitants was Bengali in the local dialect. Each of the villages had 1-3 sacred groves. These comprised patches of old-growth forest or woodland. Most groves were located in plain terrain and others were on the top of the hillock. Since they were used as worshipping places they were all located close to the roads. Sacred groves possessed higher spiritual value for people and they were, therefore, typically larger and better preserved. So, the sacred groves were formally in public ownership. Such type of places was typically surrounded by grazing land, farmland, forests, and inhabited areas.

Field survey and data collection

The study area was thoroughly investigated during the year 2015-2020 in three seasons such as summer (March-May), rainy (June-October), and winter (November-February). It presented a prospect of composting plant compilation and field interpretation during the maximum species quantity. Phytosociological data were collected by laying 1m×1m for pteridophytic species richness. A brief floristic survey was carried out on a “spot identification” basis. The specimens were processed, preserved, poisoned, and mounted on sheets of herbarium (Bridson and Forman 1998). For some of the common, locally uncommon, endemic, and valuable species of pteridophyte in the sacred grove, photographs were taken. By matching properly annotated materials available at the Herbarium Section of Vidyasagar University and Botanical Survey of India, the herbarium sheets were described. For identification purpose, different relevant catalog (Pichi Sermolli 1970), regional floras (Dixit 1984, 2000; Dixit and Vohra 1984; Singh 2005), monographs (Fraser-Jenkins 1989), revision works (Fraser-Jenkins 2008, 2012; Fraser-Jenkins et al. 2017, 2018, 2019; Singh et al. 2017), and other literature (Padhy et al. 2016; Sureshkumar et al. 2018; Kumar and Kanwar 2020; Muhammad et al. 2020) were consulted. Five points scale such as frequency class A (rare, 0-20% of frequency), class B (seldom, 21-40% frequency), class C (common, 41-60% frequency), class D (frequent, 61-80% frequency), and class E (very much frequent, 81-100% frequency) were followed for denoting the distribution pattern (Raunkiaer 1918). The plant’s scientific name was checked with the World Checklist of Vascular Plant (WCVP 2021) website and confirmed only accepted name.

Analysis of vegetation

The floristic list was taxonomically arranged by class, order, and family according to Pteridophyte Phylogeny Group, or PPG I (2016). For each species voucher specimen number, habit, IUCN status (IUCN 2021) and frequency class in the groves were inferred (Table 1). The resulting frequency class distribution was subsequently compared to the standard distribution of Raunkiaer (Raunkiaer 1918).

RESULTS AND DISCUSSION

Taxonomic composition

A total of 77 taxa (species and subspecies) belonging to 44 genera distributed in 15 families from 10 orders under two classes were recorded. The approximately genus and species ratio was 1:1.7, while the family and genus ratio was 1:2.9. More than 85% of the species were represented by Class Polypodiopsida and only less than 11% by Lycopodiopsida. The most six represented orders (≥2 species) were from Polypodiales (70.13%), Salviniales (7.79%), Selaginellales (6.49%), Lycopodiales (3.9%), Ophioglossales (3.9%), and Schizaeales (2.6%) (Table 1 and 2, Figure. 2).

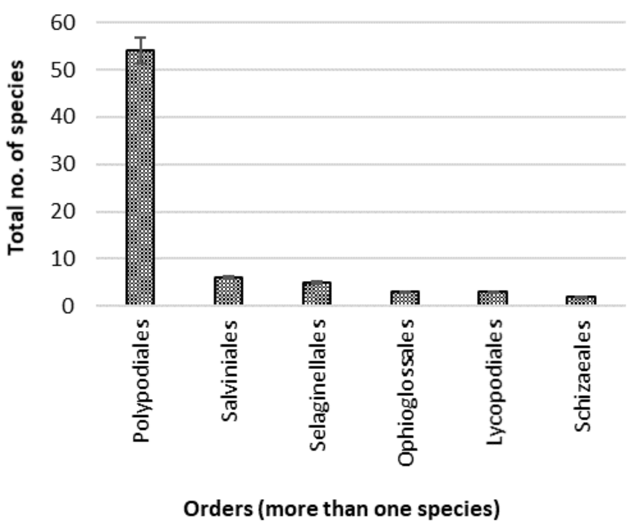

Figure 2. Dominant orders

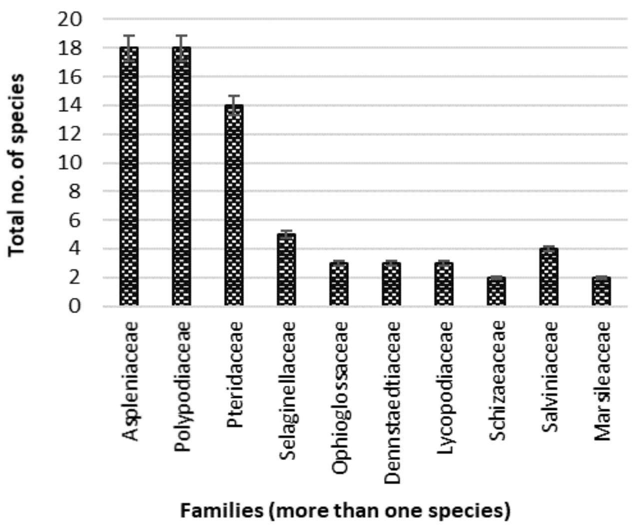

Figure 3. Dominant families

The best-represented five families (with ≥4 species) were Aspleniaceae (23.38%), Polypodiaceae (23.38%), Pteridaceae (18.18%), Selaginellaceae (6.49%) and Salviniaceae (5.19%). Whereas three families Dennstaedtiaceae, Lycopodiaceae, and Ophioglossaceae contained three species each (3.9%), and two families Marsileaceae and Schizaeaceae contained two species each (2.6%). Another five families Equisetaceae, Hymenophyllaceae, Isoetaceae, Lindsaeaceae, and Psilotaceae each carried only a single species (Table 1 and 2, Figure. 3).

The six dominant plant families encompassed more than 83% genera with descending numbers (≥2 genera) were Polypodiaceae (25%), Aspleniaceae (22.73%), Pteridaceae (15.91%), Ophioglossaceae (6.82%), Lycopodiaceae (4.55%), and Salviniaceae (4.55%). Only nine families, Dennstaedtiaceae, Equisetaceae, Hymenophyllaceae, Isoetaceae, Lindsaeaceae, Marsileaceae, Psilotaceae, Schizaeaceae, and Selaginellaceae each carried a single genus respectively (Table 1 and 2).

The most represented genera were *Selaginella* (5 species); three genera (*Asplenium*, *Hemionitis* and *Thelypteris*) containing four species each, six genera (*Adiantum*, *Bolbitis*, *Leptochilus*, *Microlepia*, *Pteris*, and *Salvinia*) containing three species each, and eight genera (*Athyrium*, *Dryopteris*, *Huperzia*, *Lygodium*, *Macrothelypteris*, *Marsilea*, *Nephrolepis*, and *Pyrrosia*) held two species each. Another twenty-six species contained a single genus respectively (Table 1).

Habitat

Fifty-nine pteridophyte plants (76.62%) went through their life cycle in terrestrial conditions in the sacred grove. Eleven epiphytic species (14.29%) whose life cycle covered the trunk and branches of the tree or liana, and seven aquatic species (9.09%) that could survive and remain alive in the water (Table 1; Figure. 4).

Raunkiaer frequency class

In the case of Raunkiaer frequency class (1918), class C showed the highest frequency (25.97%), followed by class D (22.08%), class E (19.48%), class B (16.88%), and class A (15.58%) respectively (Table 1; Figure 5).

IUCN status

The regional IUCN conservation status assessment on global observation revealed that 18.18% of the total species reported in the Jhargram district were evaluated as Least Concerned (LC), and 81.82% were not evaluated (NE) in the red list version 2020-3 of the IUCN (Table 1).

Discussion

Using the global distribution for species reported in Jhargram district of southwest Bengal in India, the preliminary conservation status uncovers the current status of pteridophyte species, i.e. 1% of global pteridophytes and 12% of Indian pteridophytes diversity, and the priority regions for sustainable management and conservation planning (Khine and Schneider 2020). The first attempt to analyses pteridophytes shows priority regions at provincial scales for counties, states, and local-scale regions.

Priority regions and conservation gap assessment on indices of diversity and priorities, i.e. species richness, species composition, and IUCN status assessment are important as conservationists and decision-makers were unable to rely on data from one index for countrywide assessment due to low sampling intensity (Heywood 2017). For example, political instability, civil conflict, and taboos, especially in sacred groves regions, and low budget allocation for environmental protection resulted in a huge data gap under-sampling due to topographic accessibility (Mutekwa and Gambiza 2016).

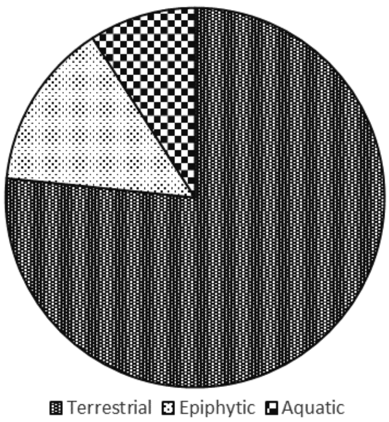

Figure 4. Habitats of the pteridophytes

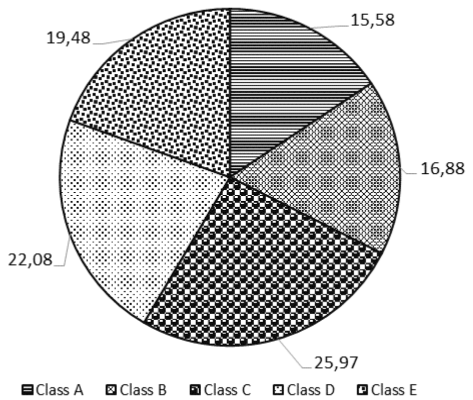

Figure 5. Raunkiaer frequency classes of pteridophyte vegetation

Table 1. Pteridophyte species diversity in sacred groves of Jhargram district in West Bengal according to PPG I.

Classification to family level			Species	Voucher specimen	Habit	Frequency class	IUCN red list status
Class	**Order**	**Family**					
Lycopodiopsida Bartl.	Lycopodiales DC. ex Bercht. & J.Presl	Lycopodiaceae P.Beauv.	*Huperzia hamiltonii* (Spreng.) Trevis.	USLY1	E	A	NE
			Huperzia squarrosa (G.Forst.) Trevis.	USLY2	T	A	NE
			Lycopodiella cernua (L.) Pic.Serm.	USLY3	T	B	NE
	Isoetales Prantl	Isoetaceae Dumort.	*Isoetes coromandelina* L.f.	USIS1	T	A	LC
	Selaginellales Prantl	Selaginellaceae Willk	*Selaginella bryopteris* (L.) Baker	USSE1	T	C	NE
			Selaginella ciliaris (Retz.) Spring	USSE2	T	D	NE
			Selaginella repanda (Desv.) Spring	USSE3	T	E	NE
			Selaginella reticulata (Hook. & Grev.) Spring	USSE4	T	E	NE
			Selaginella vaginata Spring	USSE5	T	E	NE
Polypodiopsida Cronquist, Takht. & W.Zimm.	Equisetales DC. ex Bercht. & J.Presl	Equisetaceae Michx. ex DC.	*Equisetum ramosissimum* Desf.	USEQ1	T	A	NE
	Psilotales Prant	Psilotaceae J.W.Griff. & Henfr.	*Psilotum nudum* (L.) P.Beauv.	USPS1	E	A	NE
	Ophioglossales Link	Ophioglossaceae Martinov	*Botrychium daucifolium* Wall. ex Hook. & Grev.	USOP1	T	C	NE
			Helminthostachys zeylanica (L.) Hook.	USOP2	T	D	NE
			Ophioglossum reticulatum L.	USOP3	T	C	NE
	Hymenophyllales A.B.Frank	Hymenophyllaceae Mart	*Hymenophyllum exsertum* Wall. ex Hook.	USHY1	T	B	NE
	Schizaeales Schimp.	Schizaeaceae Kaulf	*Lygodium flexuosum* (L.) Sw.	USSC1	T	E	NE
			Lygodium microphyllum (Cav.) R.Br.	USSC2	T	E	LC
	Salviniales Link	Salviniaceae Martinov	*Azolla pinnata* subsp. *asiatica* R.M.K.Saunders & K.Fowler	USSA1	A	E	NE
			Salvinia cucullata Bory	USSA2	A	E	LC
			Salvinia molesta D.Mitch.	USSA3	A	E	NE
			Salvinia natans (L.) All.	USSA4	A	C	LC
		Marsileaceae Mirb.	*Marsilea minuta* L.	USMA1	A	E	LC
			Marsilea quadrifolia L.	USMA2	A	D	LC
	Polypodiales Link	Lindsaeaceae C.Presl ex M.R.Schomb.	*Lindsaea ensifolia* Sw.	USLI1	T	A	NE
		Pteridaceae E.D.M.Kirchn.	*Acrostichum aureum* L.	USPT1	T	B	LC
			Actiniopteris radiata (Sw.) Link	USPT2	T	B	NE
			Adiantum capillus-veneris L.	USPT3	T	E	LC
			Adiantum incisum Forssk.	USPT4	T	E	NE
			Adiantum philippense L.	USPT5	T	E	NE
			Antrophyum reticulatum (G.Forst.) Kaulf.	USPT6	E	B	NE
			Ceratopteris thalictroides (L.) Brongn.	USPT7	A	B	LC
			Hemionitis anceps (Blanf.) Christenh.	USPT8	T	B	NE
			Hemionitis bicolor (Roxb.) Christenh.	USPT9	T	A	NE
			Hemionitis concolor (Langsd. & Fisch.) Christenh.	USPT10	T	C	NE
			Hemionitis tenuifolia (Burm.f.) Christenh.	USPT11	T	C	NE
			Pteris arisanensis Tagawa	USPT12	T	C	NE
			Pteris cretica subsp. *laeta* (Wall. ex Ettingsh.) Fraser-Jenk.	USPT13	T	E	NE
			Pteris vittata L.	USPT14	T	E	LC
		Dennstaedtiaceae Lotsy	*Microlepia marginata* (Panz.) C.Chr.	USDE1	T	E	NE
			Microlepia platyphylla (D.Don) J.Sm.	USDE2	T	D	NE
			Microlepia speluncae (L.) T.Moore	USDE3	T	D	NE
		Aspleniaceae Newman	*Asplenium aethiopicum* (Burm.f.) Becherer	USAS1	T	D	NE
			Asplenium formosum Willd.	USAS2	T	C	LC

		Asplenium inaequilaterale Willd.	USAS3	E	D	NE
		Asplenium yoshinagae subsp. *indicum* (Sledge) Fraser-Jenk.	USAS4	E	D	NE
		Athyrium falcatum Bedd.	USAS5	T	A	NE
		Athyrium parasnathense (C.B.Clarke) Ching ex Mehra & Bir	USAS6	T	C	NE
		Blechnum orientale L.	USAS7	T	B	NE
		Deparia petersenii (Kunze) M.Kato	USAS8	T	A	NE
		Diplazium esculentum (Retz.) Sw.	USAS9	T	C	LC
		Hymenasplenium unilaterale (Lam.) Hayata	USAS10	E	D	NE
		Macrothelypteris ornata (J.Sm.) Ching	USAS11	T	C	NE
		Macrothelypteris torresiana (Gaudich.) Ching	USAS12	T	C	NE
		Stenochlaena palustris (Burm.f.) Bedd.	USAS13	E	D	NE
		Thelypteris dentata (Forssk.) E.P.St.John	USAS14	T	D	NE
		Thelypteris falciloba (Hook.) Ching	USAS15	T	C	NE
		Thelypteris nudata (Roxb.) C.V.Morton	USAS16	T	C	NE
		Thelypteris prolifera (Retz.) C.F.Reed	USAS17	T	C	NE
		Woodwardia unigemmata (Makino) Nakai	USAS18	T	A	NE
	Polypodiaceae J.Presl & C.Presl	*Bolbitis appendiculata* (Willd.) K.Iwats.	USPO1	T	B	LC
		Bolbitis costata (C.Presl) Ching	USPO2	T	B	NE
		Bolbitis sinensis (Baker) K.Iwats.	USPO3	T	C	NE
		Davallodes pulchra (D.Don) M.Kato & Tsutsumi	USPO4	E	B	NE
		Drynaria quercifolia (L.) J.Sm.	USPO5	E	B	NE
		Dryopteris cochleata (D.Don) C.Chr.	USPO6	T	C	NE
		Dryopteris sparsa (D.Don) Kuntze	USPO7	T	D	NE
		Lepisorus nudus Ching	USPO8	T	C	NE
		Leptochilus decurrens Blume	USPO9	T	D	LC
		Leptochilus hemionitideus (C.Presl) Noot.	USPO10	T	D	NE
		Leptochilus pedunculatus (Hook. & Grev.) Fraser-Jenk.	USPO11	T	D	NE
		Leucostegia truncata (D.Don) Fraser-Jenk.	USPO12	T	B	NE
		Nephrolepis biserrata (Sw.) Schott	USPO13	T	C	NE
		Nephrolepis cordifolia (L.) C.Presl	USPO14	T	A	NE
		Phymatosorus membranifolius (R.Br.) S.G.Lu	USPO15	T	A	NE
		Pyrrosia adnascens (Sw.) Ching	USPO16	E	D	NE
		Pyrrosia lanceolata (Wall.) Farw.	USPO17	E	C	NE
		Tectaria polymorpha (Wall. ex Hook.) Copel.	USPO18	T	D	NE

Note: Habit: A: Aquatic; E: Epiphytic; T: Terriestrial. Frequency class: A: 1-20%; B: 21-40%; C: 41-60%; D: 61-80%; E: 81-100%. IUCN red list status: LC: Least Concerned; NE: Not Evaluated

Table 2. Summary of the pteridophyte taxa

Classification to family level			Habit			Genus/ genera	Species	Total
Class	**Order**	**Family**	**A**	**E**	**T**			
Lycopodiopsida Bartl.	Lycopodiales DC. ex Bercht. & J.Presl	Lycopodiaceae P.Beauv.		1	2	2	3	3
	Isoetales Prantl	Isoetaceae Dumort.			1	1	1	1
	Selaginellales Prantl	Selaginellaceae Willk			5	1	5	5
Polypodiopsida Cronquist, Takht. & W.Zimm.	Equisetales DC. ex Bercht. & J.Presl	Equisetaceae Michx. ex DC.			1	1	1	1
	Psilotales Prant	Psilotaceae J.W.Griff. & Henfr.		1		1	1	1
	Ophioglossales Link	Ophioglossaceae Martinov			3	3	3	3
	Hymenophyllales A.B.Frank	Hymenophyllaceae Mart			**1**	**1**	**1**	**1**
	Schizaeales Schimp.	Schizaeaceae Kaulf			**2**	**1**	**2**	**2**
	Salviniales Link	Salviniaceae Martinov	4			2	4	4
		Marsileaceae Mirb.	2			1	2	2
	Polypodiales Link	Lindsaeaceae C.Presl ex M.R.Schomb.			1	1	1	1
		Pteridaceae E.D.M.Kirchn.	1	1	11	7	14	14
		Dennstaedtiaceae Lotsy			3	1	3	3
		Aspleniaceae Newman		4	14	10	18	18
		Polypodiaceae J.Presl & C.Presl		4	14	11	18	18
Total			7	11	59	44	77	77

Oosting (1956) illustrated several graphs of frequency and contrasts them with the normal distribution of Raunkiaer. A frequency diagram is generally indicative of a stand's homogeneity because floristic uniformity differs directly from class A to E' proportionate size scale. The heterogeneous population was found in our sample. The general principle is that higher homogeneity is shown in the highest frequency by a relatively large number of species (Ramírez-Barahona et al. 2020). Because of the irregular and heterogeneous existence of the ecosystem (Swaine 1996) within the communities due to natural and anthropogenic destruction, the relatively low number of shared species among the communities is not surprising (Mwavu 2007). Owing to similar ecological conditions, some populations are homogenous. These ecologically related communities provide environments for herbaceous pteridophyte plants with a similar composition (Durrani et al. 2010).

Although the Jhargram district is smaller than other districts, the wealth and diversity of pteridophytic species are very high because of its topography and altitudinal variance. In the sacred groves of the Binpur II block in the Jhargram district, the pteridophytic species is dissimilar to other blocks. Since, in the Binpur II block, the northern part of the Eastern Ghats is distributed. Therefore, more than 75% of the species is similar to the Jharkhand (Bharti and Pravesh 2010), and Odisha (Mandal et al. 2020) pteridophyte flora.

Jhargram district's sacred groves are abundant in pteridophyte vegetation. These forest patches are ideal for the ecological and geographical growth of ferns and their allies. But there is still no complete checklist of the pteridophyte flora of Jhargram or South West Bengal. We have, however, made an effort to explore the pteridophytic flora of the unique sacred groves maintained locally, but investigations are still needed in many areas. The present study is so confined to humid suitable habitats of pteridophytes, the researchers and the Forest and Environment Department will be motivated by this current study. The government should launch immediate protection measures for this oldest community of vascular plants.

In conclusion detailed survey on the pteridophyte flora of a particular region becomes significant only if it can do any good to the conservation practices of these endangered plants. One of the key reasons for neglect faced by pteridophyte is a lack of knowledge or interest among botanists. So it is a way out of the near endangered status of these plants to familiarise this group and include them with almost equal meaning to the Angiosperms. Sacred groves and pteridophytes, in the modern sense, need immediate attention. This is the first study to measure regional diversity in sacred groves of the Jhargram district with species richness trends of vascular cryptogamic flora thus accounting for sampling effort. Due to its abundance in different ecosystems, the high diversity of pteridophyte in the district results from an expanded altitudinal range with a perpetual rise in rainfall at higher elevations. More comprehensive assessments such as growth mode and seasonal growth pattern, evapotranspiration rate, moisture index, and light intensity within the sacred forest areas need further attention in addition to the analysis, which may help address ecological issues in tropical plant populations, especially for groups of cryptogamic plants.

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REFERENCES

Anon. 2011. District Human Development Report. Development and Planning Department, Government of West Bengal. Paschim Medinipur, Kolkata, India.

Bharti M, Pravesh R. 2010. Diversity, distribution and conservation priorities for pteridophytic flora of Ranchi and Latehar district of Jharkhand, India. Bioscan 1: 123-133.

Bridson D, Forman L. 1998. The herbarium handbook. Royal Botanic Gardens, Kew, London.

Dixit RD. 1984. A census of the Indian pteridophytes. Botanical Survey of India, Howrah, India.

Dixit RD. 2000. Conspectus of pteridophytic diversity in India. Indian Fern Journal 17: 77-91.

Dixit RD, Vohra JN. 1984. A dictionary of the pteridophytes. Flora of India series-4, BSI, Howrah, India.

Durrani MJ, Razaq A, Muhammad SG, Hussain F. 2010. Floristic diversity, ecological, characteristics and ethnobotanical profile of plants of Aghberg rangelands, Balochistan, Pakistan. Pak J Plant Sci 16: 29-36.

Erickson R. 2020. Shimmering through a Christian Prism: Integration through covenant, ritual and mediation in the myths of Finn Mac Cumhaill and Siguror, facilitating their acquisitions of otherworldly knowledge. [Thesis]. University of Oslo, Oslo, Norway.

Fraser-Jenkins CR. 1989. A monograph of Dryopteris (Pteridophyta: Dryopteridaceae) in the Indian subcontinent. Bull Brit Mus (Nat Hist) Bot 18 (5): 323-477.

Fraser-Jenkins CR. 2008. Taxonomic revision of three hundred Indian subcontinental pteridophytes with a revised census list. Bishen Singh Mahendra Pal Singh, Dehra Dun, India.

Fraser-Jenkins CR. 2012. Rare and threatened pteridophytes of Asia 2. Endangered species of India - The higher IUCN categories. Bull Nati Mus Nat Sci 38(4): 153-181.

Fraser-Jenkins CR, Gandhi K, Kholia BS. 2019. An annotated checklist of Indian Pteridophytes. Bishen Singh Mahendra Pal Singh, Dehra Dun, Uttarakhand, India.

Fraser-Jenkins CR, Gandhi KN, Kholia BS. 2018. An annotated checklist of Indian Pteridophytes. Bishen Singh Mahendra Pal Singh, Dehra Dun, Uttarakhand, India.

Fraser-Jenkins CR, Gandhi KN, Kholia BS, Benniamin A. 2017. An annotated checklist of Indian Pteridophytes. Bishen Singh Mahendra Pal Singh, Dehra Dun, Uttarakhand, India.

Heywood VH. 2017. Plant conservation in the anthropocene–challenges and future prospects. Plant Divers 39 (6): 314-330. DOI: 10.1016/j.pld.2017.10.004.

IUCN 2021. The IUCN Red List of Threatened Species. https://www.iucnredlist.org

Khine PK, Schneider H. 2020. First assessment of pteridophytes composition and conservation status in Myanmar. Glob Ecol Conserv 22 (1): e00995. DOI: 10.1016/j.gecco.2020.e00995.

Kulkarni A, Upadhye A, Dahanukar N, Datar MN. 2018. Floristic uniqueness and effect of degradation on diversity: a case study of sacred groves from northern Western Ghats. Trop Ecol 59 (1): 119-127.

Kumar SV, Kanwar S. 2020. Medicinal pteridophytes used in the treatment of various diseases by the inhabitants of Sarkaghat Tehsil, Mandi District, Himachal Pradesh. Intl J Pharm Sci Res 12 (3): 360-364.

Malati SNLS, Rao GMN. 2020. Distribution of pteridophytes along the Eastern Ghats of India-A Review. Intl J Phar Biol Sci 15(2): 43-45. DOI: DOI:10.9790/3008-1502044345.

Mandal KK, Kar T, Pattanaik C, Reddy CS. 2020. A census of pteridophytes in Eastern Ghats, India. Trop Plant Res 7 (1): 117-125. DOI: 10.22271/tpr.2020.v7.i1.016.

Muhammad M, Ismail ZS, Schneider H, Hawkins JA. 2020. Medicinal use of ferns: an ethnobotanical review. Sains Malays 49 (5): 1003-1014.

Mutekwa VT, Gambiza J. 2016. Assessment of governance principles application in forest protected areas: the case of six state forests in western Zimbabwe. Intl For Rev 18 (4): 466-484. DOI: 10.1505/146554816820127613.

Mwavu EN. 2007. Human impact, plant communities, diversity and regeneration in Budongo Forest Reserve, north-western Uganda. [Dissertation]. University of the Witwatersrand, Johannesburg, SA.

Nayaka S, Upreti DK. 2004. Scope for cryptogamic studies in sacred groves - A case study of Lichens from Maharashtra. J Econ Taxon Bot 28 (1): 209-212.

Oosting HJ. 1956. The study of plant community: An introduction to plant ecology. 2nd ed. W.H. Freeman & Co., San Francisco.

Padhy R, Dash SK, Padhy S. 2016. Pteridophyta diversity of South Odisha, India, with special reference to medico folklore claims: A brief review. J Biodivers 7 (1): 25-32. DOI: 10.1080/09766901.2016.11884757.

Pfadenhauer JS, Klotzli FA. 2020. Global vegetation: Fundamentals, ecology and distribution. Springer Nature, Switzerland.

Pichi Sermolli RE. 1970. A provisional catalogue of the family names of living pteridophytes. Webbia 25 (1): 219-297. DOI: 10.1080/00837792.1970.10669935.

PPG I. 2016. A community-derived classification for extant lycophytes and ferns. J Syst Evol 54: 563-603. DOI: 10.1111/jse.12229.

Ramakrishnan PS, Rao KS, Chandrashekara UM, Chhetri N, Gupta HK, Patnaik S, Saxena KG, Sharma E, 2012. South Asia. In: Parrotta JA, Trosper RL (eds.). Traditional Forest-Related Knowledge: Sustaining Communities, Ecosystems and Biocultural Diversity. Springer, Dordrecht.

Ramírez-Barahona S, Sauquet H, Magallon S. 2020. The delayed and geographically heterogeneous diversification of flowering plant families. Nat Ecol Evol 4 (9): 1232-1238. DOI: 10.1038/s41559-020-1241-3

Rath S, Ormsby AA. 2020. Conservation through traditional knowledge: A review of research on the sacred groves of Odisha, India. Human Ecol 48 (4): 455-463. DOI: 10.1007/s10745-020-00173-1.

Raunkiaer C. 1918. Recherches statistiques sur les formations vegetales. Biol Med 1: 1-80.

Sangha KK, Preece L, Villarreal-Rosas J, Kegamba JJ, Paudyal K, Warmenhoven T, Rama Krishnan PS. 2018. An ecosystem services framework to evaluate Indigenous and local people's connections with nature. Ecosyst Serv 31: 111-125. DOI: 10.1016/j.ecoser.2018.03.017.

Singh AP, Johari D, Khare PB. 2017. A checklist of the pteridophytes (ferns and fern-allies) of Uttar Pradesh, India. J Bombay Nat His Soc. DOI: 10.17087/jbnhs/2017/v114/121628.

Singh S. 2005. Pteridophytic flora of Central India. [Dissertation]. Dr. Hari Singh Gour University, Sagar, India.

Sureshkumar J, Silambarasan R, Bharati KA, Krupa J, Amalraj S, Ayyanar M. 2018. A review on ethnomedicinally important pteridophytes of India. J Ethnopharmacol 219: 269-287. DOI: 10.1016/j.jep.2018.03.024.

Swaine MD. 1996. Rainfall and soil fertility as factors limiting forest species distributions in Ghana. J Ecol 84: 419-428. DOI: 10.2307/2261203.

WCVP. 2021. World Checklist of Vascular Plants, version 2.0. Facilitated by the Royal Botanic Gardens, Kew. Published on the Internet; http://wcvp.science.kew.org/ [7 March 2021].