Conservation of endemic ferns in Western Ghats

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The Western Ghats, extending along the western coast of India, are recognized as one of the world's eight 'hottest hotspots' of biological diversity. Spanning over 1,600 km and encompassing six states, this mountain range hosts a myriad of ecosystems ranging from tropical rainforests to montane grasslands. Among its rich flora, ferns represent a significant and diverse group, thriving in the moist, shady environments fostered by the dense forests and high rainfall characteristic of the region. Ferns in the Western Ghats are adapted to various ecological niches, from the humid understory of tropical rainforests to the cooler, mist-laden cloud forests at higher altitudes. These plants are particularly abundant in areas with consistent moisture, such as along streams, waterfalls, and in shaded ravines. The unique climatic and geological conditions of the Western Ghats create ideal habitats for fern growth. The ferns of the Western Ghats are an essential component of this biodiversity hotspot. Their conservation is vital not only for maintaining ecological balance but also for preserving the rich biological heritage of the region. Continued efforts in research, habitat protection, and community involvement are crucial to ensuring the survival of these unique and diverse plants.

Key Words: Conservation**,** Pteridophytes, Western Ghats, Endemic species, Urbanization, Habitat destruction

1. Introduction

Conservation of endemic ferns is crucial to maintaining the biodiversity and ecological balance of an ecosystem. Endemic ferns are those that are native to a specific region and are

found nowhere else in the world. They often play a unique role in their ecosystem and may have specialized adaptations to their local environments. Conservation effort for endemic ferns may include protecting their natural habitats from deforestation, urbanization and other forms habitat destruction, this can involve creating protected areas, such as national parks or reserves where these ferns can thrive undisturbed.

Western ghats is one of the 34 global biodiversity hot spots and harbors a rich diversity of flora and fauna with many endemic and RET species. Along with angiosperm plants, the western ghats is also a rich repository of pteridophytic plant wealth. Nowadays western ghats experiences exceptional level of plant endemism and higher levels of habitat destruction. The rugged range of hills stretching for about 1600 km along the west coast from south of Gujarat to the end of the Peninsula is interrupted only by a 30 km break in Kerala, the Palghat gap (Santhosh et al., 2016). The Western Ghats along with the Himalayas, Eastern ghats and parts of central India forms major Centre for the distribution of the ferns and fern allies. The major families of pteridophytes found in the Western Ghats are Aspleniaceae, Polypodiaceae, Thelypteridaceae, Selaginellaceae, Pteridaceae etc. Whereas on the generic level, maximum diversity is observed in the genus *Asplenium, Selaginella, Pteris, Athyrium, Diplazium* etc. The Western Ghats also harbours endemic species like *Polystichum manickamii, Cyathea nilgiriensis, Bolbitis semicordata, Selaginella radicata* etc.

India is a mega biodiversity country having many species of vascular plants including about 1000 species of ferns and ferns allies (Benniamine et al., 2008). Around 233 species of ferns occur in southern part of India. The pteridophytes are

the nonflowering vascular plants including ferns and fern allies. They form a conspicuous element of earth's vegetation and are important for evolutionary point of view as they show the evolution of vascular system and reflect the emergence of seed habitat in the plants. About 250 million years ago, they formed the dominant part of earth's vegetation, but in present day flora, they have been largely replaced by the seed plants. They grow luxuriantly in moist tropical and temperate forests and their occurrence in different eco geographically threatened regions from sea level to the highest mountains are of much interest (Dixit et al., 1969). Conservation efforts for endemic ferns in the western ghats are crucial for preserving the unique ecological balance and biodiversity of this region.

The International Union Code of Nomenclature (IUCN) report says that in India 7.7% of the plants are under threat. In Western Ghats, a number of epiphytic and lithophytic ferns are destroyed due to various deforestation activities, and 44 threatened ferns are facing extinction and the conservation of these species is a major concern of biologists although recent studies have shown that about 18% of the approximately 270 fern species found in southern India are endemic to the region (Manickam et al., 1995). Ultimately, the conservation of endemic ferns in important not only for their intrinsic value but also for the overall health and resilience of the ecosystems they inhabit. By preserving the unique species, we can help maintain the balance and diversity of our natural world.

2. Current status of pteridophytes

India, with its diverse climatic zones and varied topography, is home to a rich array of pteridophytes (ferns and their allies). These plants are predominantly found in the humid and shaded regions of the country, such as the Western Ghats, Eastern Ghats, the Himalayas, and the northeastern states. According to the IUCN Report in 1998, there listed 770 threatened species of Pteridophytes worldwide. Singh et al. (2015) had been reported 17 rare and endangered species of pteridophytes from India. The World Conservation Monitoring Centre at Cambridge, England, listed 1650 threatened species of Pteridophytes world-wide, under the following categories: Presumed Extinct - 20, Endangered - 67, Vulnerable - 91 and Rare - 354. India's pteridophyte diversity is significant, with around 70 genera and 1,200 species. However, these plants face various threats that require comprehensive conservation efforts. By protecting habitats, supporting research, and involving local communities, India can ensure the preservation of its rich pteridophyte heritage for future generations.

3. Pteridophyte diversity in the states traversed by the Western Ghats

Kerala, located in the southwestern corner of India, is bordered by the Western Ghats on the east and the Arabian Sea on the west. The state covers a geographical area of 38,852 km², with 20,321 km² of forest cover characterized by significant heterogeneity, resulting in various vegetation patterns. These patterns range from scrub forests in the rain shadow regions and plains to tropical deciduous forests and rainforests up to an elevation of 1,500 m, and shola forests

above 1,500 m (Nayar, 2010). The diverse terrains and an average annual rainfall of 2,990 mm make Kerala a suitable habitat for pteridophytes. The Palghat Gap, in particular, is highly diverse, supporting 239 species of ferns and fern allies (Manickam and Irudayaraj, 1992). Muktesh (1998) recorded 159 species of ferns and fern allies belonging to 70 genera and 29 families, noting that species once abundant in the Munnar forest, such as *Osmunda hugelina, Angiopteris evecta, Cyathea* spp., *Diplazium* spp., and *Polystichum* spp., have been observed. Kavitha et al. (2015) studied the diversity of pteridophytes in the Ponmudi hills, which are covered by thick tropical forests, and documented 28 species. Additionally, Joseph and Thomas (2015) collected 15 chasmophytic pteridophyte species from the Urumbikkara hills in the Idukki district, identifying species from 11 families and 11 genera.

Joseph et al. (2017) conducted a study on the pteridophyte flora of Dr. Salim Ali Bird Sanctuary in Thattekad, Ernakulam, documenting the presence of 30 species of ferns and fern allies belonging to 23 genera. Rekha and Athira (2017) investigated the pteridophyte diversity of Akamala forest station in the Thrissur district of Kerala, identifying 24 species of pteridophytes. Among these, 2 species were classified as 'endangered,' 4 as 'rare,' and 1 as 'at risk.' Tamil Nadu, with a geographical area of 130,060 km² and a forest cover of 26,281 km² (20.2% of the state's total area), features four major geographical divisions: the Eastern and coastal plains, central uplands, western Karnataka plateau, and the central Eastern Ghats (Ruma, 2018). The state hosts nine types of forests, with tropical dry deciduous forests

comprising 46.98% of the total forest area. The average annual rainfall in Tamil Nadu ranges from 3,000 to 5,000 mm. The presence of both the Western Ghats and the Eastern Ghats in Tamil Nadu contributes to its rich pteridophyte flora. Sukumaran et al. (2009) recorded 24 species of pteridophytes in the miniature sacred forests of the Kanyakumari district in the Southern Western Ghats, including 3 endemic species, 3 endangered species, and 8 rare species. Abraham and Ramachandran (2013) added six species to the pteridophyte flora of the Nilgiris: *Asplenium bipinnatum* (Aspleniaceae), *Cheilanthes viridis* (Pteridaceae), *Huperzia phlegmaria* (Lycopodiaceae), *Selaginella ciliaris* (Selaginellaceae), *Selaginella intermedia* (Selaginellaceae), and *Trichomanes bipunctatum* (Hymenophyllaceae). Sathish and Vijayakanth (2016) also contributed to the fern flora of Kolli hills in Tamil Nadu by adding six fern species: *Adiantum latifolium*, *Oleandra musifolia*, *Diplazium cognatum*, *Bolbitis appendiculata*, *Leptochilus thwaitesianus* and *Phymatosorus membranifolium*. In 2017, Vijayakanth et al. reported two new ferns to the fern flora of Tamil Nadu: *Athyrium parasnathense* (Athyriaceae) and *Leptochilus metallicus* (Polypodiaceae). Kumari and Jeeva (2018) studied the pteridophytes along the Thamiraparani River in Tamil Nadu, identifying 65 species, of which 33% were terrestrial, 12% aquatic, 11% lithophytes, and 13.8% epiphytes.

Alagesaboopathi et al. (2018) documented 14 species of pteridophytes from the Kanjamalai Hills in Salem District. Packiaraj and Suresh (2019) studied the pteridophyte diversity of the Kilavarai freshwater river in Kodaikanal, reporting 36 species belonging to 25 genera and distributed among 19

families. The dominant species were from the Adiantaceae, Polypodiaceae, Pteridaceae and Cheilanthaceae families. Karnataka, which encompasses a significant portion of the Central Western Ghats, is known for its pteridophyte diversity and endemism. Most pteridophyte species in Karnataka are found in the Central Western Ghats (Rajagopal and Bhat, 1998). The study of pteridophyte diversity in Karnataka began with Blatter and Dalmeida's "Ferns of Bombay" (1922), which recorded 75 species. Subsequent studies included Alston's (1945) documentation of four *Selaginella* species, Kammathy et al.'s (1967) listing of 25 species, and Holttum's (1976) inclusion of 10 fern species from the Thelypteridaceae family in the "Flora of Hassan District". Yoganarasimham et al. (1981) added 12 species in the "Flora of Chikmangalur District." Matchperson (1986) recorded 90 fern species from the North Canara district.

After a significant time gap, more research was conducted to provide detailed data on the pteridophyte diversity of Karnataka. Deepa et al. (2013) studied the distribution of pteridophytes in the Kigga forest of the Central Western Ghats in Karnataka. The species diversity was calculated using Shannon's diversity index and Simpson's diversity index, with *Aleuritopteris anceps* (Blanf.) Panigrahi being the most abundant species in the studied area. Later, Deepa et al. (2017) enumerated 23 pteridophytes in the Madhuguni forest of the Central Western Ghats in Karnataka. The majority of the pteridophyte species were terrestrial, with exceptions including two epiphytes, one aquatic, and one climbing fern. Ashwini and Parashurama (2014) documented the pteridophyte composition of the Banjalaya forest region,

identifying 19 pteridophyte species belonging to 11 families. *Athyrium hohenackeranum* (Kunze) T. Moore was found to be the most abundant species. Dudani et al. (2014) surveyed the wet evergreen forests of Sakleshpur, considered the 'hottest hotspot of biodiversity,' and reported a total of 45 species of pteridophytes from this region. Parashurama et al. (2016) assessed the pteridophyte diversity in Mudigere Taluk, Central Western Ghats, Karnataka, documenting 26 species of pteridophytes belonging to 17 families, with 22 species recorded as terrestrial. Maharashtra, with a geographic area of 307,713 km², has a forest cover of 21% and features mountain ranges with tropical rain forests. 17% of the state consists of deciduous forests. The state has 3 game reserves, 5 national parks, and 24 bird sanctuaries (Shelar and Madhuri, 2016). Sixty-four fern species have been reported from Maharashtra, most of which are confined to the northern Western Ghats (Manickam and Irudayaraj, 2003). A new addition to the flora of Maharashtra was made by Sachin et al. (2016). Goa has a geographical area of 3,702 km², with 2,229 km² designated as forest area. Due to the presence of four wildlife sanctuaries, 95% of its forest area holds 'protected area' status. Datar and Laksminarasimham (2010) compiled data on the pteridophyte diversity of Goa and concluded that the state has a pteridophyte flora comprising 47 species, belonging to 32 genera under 20 families.

Gujarat, with a land area of 196,244 km² and a forest cover of 14,757 km², has seen various studies on its pteridophyte diversity (Ruma, 2018). The Gujarat Ecological Commission documented 16 pteridophyte species from different parts of Gujarat in 1996. Subsequent studies by Patel et al. (2010),

Dabgar (2012) and Modi and Dudani (2013) contributed further insights. In 2015, Modi published a paper documenting the presence of 16 pteridophyte species in Gujarat. Rajput et al. (2016) conducted a three-year field study to assess the pteridophyte diversity of Gujarat, collecting 23 species. The study noted that *Equisetum debile* was extinct in the wild and *Isoetes coromandeliana* was on the verge of extinction. Additionally, eight species were recorded for the first time in the state. Dudani et al. (2014) highlights the diversity of pteridophytes in the wet evergreen forests of Sakleshpur taluk in Hassan district, central Western Ghats. This area, particularly the Gundia river catchment, is noted as a significant biodiversity hotspot, hosting numerous endemic and threatened species. The survey conducted in various macro and micro habitats within this region documented 45 species of pteridophytes from 19 families. Key findings include the presence of South Indian endemics such as *Cyathea nilgirensis, Bolbitis subcrenatoides, B. semicordata* and *Osmunda huegeliana,* which emphasize the region's critical role in pteridophyte diversity. However, the rich biodiversity is under threat due to proposed hydro-electric projects targeting the perennial streams of the Western Ghats for irrigation and power. The diversity of pteridophytes in the shola forests of Kerala, part of the Western Ghats, has been relatively underexplored. This study focuses on assessing the pteridophyte diversity in Pampadum Shola National Park. A total of 44 species of pteridophytes, spanning 24 genera and 16 families, were documented in this region. Specifically, the findings include: Ferns: 14 families, 22 genera, and 39 species, Fern allies: 2 families, 4 genera, and 5 species. Notably, six species were newly recorded in this region, underscoring the

significance of this study in contributing to the understanding of pteridophyte diversity in the shola forests of Kerala (Subina et al., 2021).

Table 1: State wise distribution of pteridophytes in Western Ghats and their conservation status (Kridhnan and Rekha, 2021)

Sl. No.	Name of the species	Distribution in each state('+' denotes presence)						IUCN status
		Kerala	Tamil Nadu	Karnataka	Maharashtra	Goa	Gujarat	
1	*Abrodictyum obscurum* (Blume) Ebihara & K. Iwats.	+		+				
2	*Acrostichum aureum* L.	+	+			+		LC
3	*Actiniopteris radiata* (J. Koenig ex Sw.) Link	+			+		+	
4	*Actinostachys digitata* (L.) Wall. ex C. F. Reed	+						EN
5	*Adiantum capillus veneris* L.	+	+	+	+	+		LC
6	*Adiantum caudatum* L.		+					
7	*Adiantum concinnum* Humb. & Bonpl. ex Willd.		+	+				
8	*Adiantum hispidulum* Sw.	+	+					
9	*Adiantum incisum* Forssk.		+	+	+		+	
10	*Adiantum incisus* subsp. *indicum* (Ghatak) Fraser-Jenk.	+						
11	*Adiantum latifolium* Lam.	+	+	+				
12	*Adiantum monochlamys* Eaton	+						

13	*Adiantum nagnum*		+					
14	*Adiantum peruvianum* Klotzsch					+		
15	*Adiantum philippense* L.	+			+	+		
16	*Adiantum philippense* subsp. *philippense*	+	+			+		
17	*Adiantum poiretii* Wikstr.	+	+		+			
18	*Adiantum raddianum* C. Persl	+	+	+	+			
19	*Adiantum soboliferum* Wall.	+	+	+	+		+	CR
20	*Adiantum tenerum* Sw.	+						
21	*Adiantum unilateral* var. birii	+	+					
22	*Adiantum venustum* D.Don	+						
23	*Adiantum zollingeri* Mett. ex Kuhn		+					
24	*Aglaomorpha quercifolia* (L.) Hovenkamp & S. Linds.	+		+		+		
25	*Aleuritopteris albomarginata* (C.B. Clarke) Ching				+	+		
26	*Aleuritopteris anceps* (Blanf.) Panigrahi			+	+			
27	*Aleuritopteris bicolor* (Roxb.) Fraser-Jenk.		+	+	+		+	
28	*Aleuritopteris farinosa* (Forsk.) Fée	+	+			+	+	
29	*Aleuritopteris formosana* (Hayata) Tagawa		+					
30	*Aleuritopteris tenuifolia* (Burm. f.) Sw.			+				
31	*Alsophila gigantea* Wall. ex Hook.	+	+	+		+		
32	Alsophila nilgirensis (Holttum) R.M.Tryon	+	+	+				LC

33	*Alsophila nllgirensls var. lobatus*		+					
34	*Alsophila spinulosa* (Wall. ex Hook.) R. M. Tryon	+	+	+		+		
35	*Alsophila walkerae* (Hook.) J. Sm.		+					
36	*Ampelopteris prolifera* (Retz.) Copel			+		+		
37	*Anemia schimperiana* subsp. *wightiana* (Gardner) Fraser-Jenk.		+					EN
38	*Anemia tomentosa* (Sav.) Sw.	+	+					
39	*Angiopteris evecta* (G. Forst.) Hoffm.	+	+			+		
40	*Angiopteris helferiana* C. Presl.	+		+	+			
41	*Anisocampium cumingianum* C. Persl	+	+					
42	*Anogramma leptophylla* (L.) Link	+			+			EN
43	*Antrophyum plantagineum* (Cav.) Kaulf	+		+				
44	*Antrophyum reticulatum* (G. Forst.) Kaulf.		+					
45	*Arachniodes amabilis* (Blume) Tindale	+						
46	*Arachniodes aristata* (G. Forst.) Tindale	+	+	+				
47	*Arachniodes coniifolia* (T. Moore) Ching		+					
48	*Arachniodes sledgei* Fraser-Jenk.			+				
49	*Arachniodes tripinnata* (Goldm.) Sledge	+		+				

50	*Arthropteris palisotii* (Desv.) Alston		+					CR
51	*Asplenium* aequibasis(C.Chr.) J.P.Roux		+	+				LC
52	*Asplenium aethiopicum* (Burm.f.) Bech.	+		+				VU
53	*Asplenium affine* Sw.		+					EN
54	*Asplenium auritum* Sw.	+	+					CR
55	*Asplenium bipinnatifidum* Baker		+					
56	*Asplenium cheilosorum* Kunze ex Mett.	+	+	+				
57	*Asplenium crinicaule* Hance	+	+	+				
58	*Asplenium decrescens* Kunze	+	+	+	+			
59	*Asplenium ensiforme* Wall.			+				
60	*Asplenium exiguum* Bedd.	+	+					EN
61	*Asplenium fissum* Willd.	+	+					NT
62	*Asplenium formosum* Willd.	+	+	+		+		LC
63	*Asplenium grevillei* Wall.	+						VU
64	*Asplenium hindusthanensis* Bir.		+					
65	*Asplenium inaequilaterale* Bory ex Willd.	+	+	+	+			
66	*Asplenium indicum* Sledge	+						
67	*Asplenium mysorense* Roth	+	+	+				NT
68	*Asplenium nidus* L.	+	+					
69	*Asplenium normale* D. Don		+					
70	*Asplenium phyllitidis* D.Don	+		+				
71	*Asplenium polyodon* G. Forst.	+	+		+			
72	*Asplenium scalare* Rosenst.	+						CR

73	*Asplenium semcula* Fee.	+						
74	*Asplenium tenerum* G. Forst.	+						NT
75	*Asplenium trichomanes* L.	+						LC
76	*Asplenium unilateral* Lam.	+	+			+		
77	*Asplenium yoshinagae* Makino subsp. *indicum* (Sledge) Fraser-Jenk.			+	+			
78	*Asplenium zenkerianum* Kunze	+						
79	*Athyrium anisopterum* Christ		+					
80	*Athyrium dubium* Ching		+					
81	*Athyrium falcatum* Bedd.		+	+	+			
82	*Athyrium filix-femina* (L.) Roth	+						LC
83	*Athyrium ghost*	+						
84	*Athyrium hohenackeranum* (Kunze) T. Moore	+		+	+	+	+	
85	*Athyrium micropterum* Fraser-Jenk.				+			
86	*Athyrium parasnathense* (C. B. Clarke) Ching ex Mehra & Bir		+		+			
87	*Athyrium pectinatum* (Wall. ex Hope) C. Presl		+		+			
88	*Athyrium praetermissum* Sledge		+					
89	*Athyrium puncticaule*(Blume) Moore		+					
90	*Athyrium schipmeri* Moug.ex Fee.		+					
91	*Athyrium solenopteris* (Kunze) T. Moore		+	+			+	LC
92	*Athyrium tozanense* (Hayata) Hayata	+	+					

93	*Austroblechnum colensoi* (Hook. fil.) Gasper & V. A. O. Dittrich		+					
94	*Azolla microphylla* Kaulf.		+					LC
95	*Azolla pinnata* R.Br.	+	+	+	+		+	LC
96	*Blechnopsis orientalis* (L.) C. Presl	+	+	+	+	+		
97	*Bolbitis* × *terminans* (Wall.) Gandhi & Fraser-Jenk.			+	+	+		
98	*Bolbitis angustipinna* (Hayata) H. Itô.		+		+	+		
99	*Bolbitis appendiculata*(Willd.) Iwatsuki	+	+	+		+		LC
100	*Bolbitis asplenifolia* (Bory) K. Iwats.			+	+	+		DD
101	*Bolbitis prolifera* (Bory) C. Chr. & Tardieu ex Tardieu & C. Chr.		+	-	+			
102	*Bolbitis repanda* (Blume) Schott	+	+	+	+			NT
103	*Bolbitis semicordata* (Moore) Ching	+	+	+	-	+		VU
104	*Bolbitis subcrenata*(Hook & Grev.) Ching	+						LC
105	*Bolbitis thommankunthiana*		+					
106	*Bolbitis virens* (Wall. *ex* Hook. and Grev.) Schott		+		+			
107	*Bosmania membranacea* (D. Don) Testo	+	+	+	+	+		
108	*Ceratopteris thalictroides* (L.) Brongn.	+	+	+	+	+	+	LC
109	*Cheilanthes viridis* (Forsk.) Sw.		+					
110	*Cheilanthes tenuifolia* (Burm.	+	+	+	+	+		

	fil.) Sw.							
111	*Christella meeboldii* (Rosenst.) Holttum					+		
112	*Christella papilio* (C. Hope) Holttum		+			+		
113	*Christella parasitica* (L.) K. Iwats.	+	+	+		+		EN
114	*Christella quadrangularis* (Fée) Holttum		+	+				
115	*Crepidomanes bipunctatum* (Poir.) Copel.		+					
116	*Crepidomanes campanulatum* (Roxb.) Panigrahi & Sarn. Singh	+		+				
117	*Crepidomanes christii* (Copel.) Copel.	+						
118	*Crepidomanes intramarginale* (Hook. & Grev) Copel	+	+	+		+		EN
119	*Crepidomanes latealatum* (Bosch) Copel.				+			
120	*Crepidomanes minutum* (Blume) K. Iwats.	+		+				
121	*Crepidomanes proliferum var.prollferum*		+					
122	*Cyathea crinita* Copel.	+						EN
123	*Cyclosorus ciliatus* (Wall. ex Benth.) Panigrahi		+					LC
124	*Cyclosorus interruptus* (Willd.) H. Itô	+	+	+		+	+	LC
125	*Cyrtomium caryotideum* (Wall. ex Hook. & Grev.) C. Presl		+					
126	*Cyrtomium micropterum* (Kunze) Ching		+					EN
127	*Davallia bullata* Wall.	+	+					

128	*Davallia denticulata* (Burm. fil.) Mett. ex Kuhn	+						VU
129	*Davallia hymenophylloides* (Blume) Kuhn	+	+					EN
130	*Davallia pulchra* D. Don	+		+	+	+		
131	*Davallia repens* (L. fil.) Kuhn		+					VU
132	*Deparia lancea* (Thunb.) Fraser-Jenk.		+					
133	*Deparia petersenii* (Kunze) M. Kato		+		+			
134	*Dicranopteris linearis* (Burm.f) var. *sebastiana* Panigrahi & Dixit		+					
135	*Dicranopteris linearis* (Burm.f) var. *tenuis* Manickam & Irudayaraj		+					
136	*Dicranopteris linearis* (Burm.f.) Underwood.	+	+	+		+		LC
137	*Didymoglossum bimarginatum* (Bosch) Ebihara & K. Iwats.	+	+					
138	*Didymoglossum exiguum* (Bedd.) Copel.		+					EN
139	*Didymoglossum henzaianum* (Parish ex Hook.) Mazumdar	+						EN
140	*Didymoglossum mindorense* (Christ) K. Iwats.	+						CR
141	*Didymoglossum sublimbatum* (Müll. Berol.) Ebihara & K. Iwats.	+		+				VU
142	*Diphasiastrum wightianum* (Wall. ex Hook. & Grev.) Holub	+	+					
143	*Diplazium beddomei* C. Chr.	+	+					CR
144	*Diplazium brachylobum*			+				

	(Sledge) Manickam & Irudayaraj							
145	*Diplazium dialatulum* Bl.	+						
146	*Diplazium esculentum* (Retz.) Sw.	+	+	+	+	+		LC
147	*Diplazium leptophyllum* Christ	+	+					VU
148	*Diplazium muricatum* (Mett.) Alderw.	+						
149	*Diplazium polypodioides* Blume	+	+	+				
150	*Diplazium sylvaticum* (Bory) Sw.	+						
151	*Diplazium travancoricum* Bedd.	+	+					NT
152	*Doodia dives* Kunze.		+					
153	*Doryopteris concolor* (Langsd. & Fisch.) Kuhn	+	+	+				
154	*Dryopteris atrata* (Wall) Ching	+	+					
155	*Dryopteris austroindica* Fraser-Jenk.			+				EN
156	*Dryopteris cochleata* (D. Don) C. Chr.	+	+	+	+			
157	*Dryopteris deparioides* subsp. *concinna* (Bedd.) C. Chr.		+					CR
158	*Dryopteris hirtipes* (Blume) Kuntze	+		+				
159	*Dryopteris juxtaposita* Christ		+	+				
160	*Dryopteris macrochlamys* (Fée) Fraser-Jenk.		+					
161	*Dryopteris odontoloma* (Moore) C. Chr.	+	+					NT
162	*Dryopteris scabrosa* (Kunze) Kuntze	+	+					VU

163	*Dryopteris sledgei* Fraser-Jenk.		+					EN
164	*Dryopteris sparsa* (D. Don) Kuntze		+	+	+			
165	*Elaphoglossum beddomei* Sledge	+	+					NT
166	*Elaphoglossum commutatum* (Mett. ex Kuhn) Alderw.		+					
167	*Elaphoglossum nilgiricum* Krajina ex Sledge	+	+	+				EN
168	*Elaphoglossum stelligerum*(Wall. ex Baker) T.Moore ex Alston & Bonner		+					LC
169	*Elaphoglossum stigmatolepis* (Fee) Moore		+	+				EN
170	*Equisetum ramosissimum* Desf.	+	+		+		+	LC
171	*Glaphyropteridopsis erubescens* (Wall. ex Hook.) Ching			+				
172	*Haplopteris elongata* (Sw.) E. H. Crane	+	+	+				
173	*Haplopteris ensiformis* (Sw.) E. H. Crane		+			+		VU
174	*Haplopteris flexuosa* (Fée) E. H. Crane		+					
175	*Haplopteris microlepis* (Hieron.) Mazumdar	+	+			+		EN
176	*Helminthostachys zeylanica* (L.) Hook.	+	+					
177	*Histiopteris incisa* (Thunb.) J. Sm.		+					
178	*Huperzia serrata* (Thunb.) Trevis.	+						

179	*Hymenasplenium hondoense* (N. Murak. & Hatan.) Nakaike	+	+					NT
180	*Hymenasplenium obscurum* (Blume) Tagawa	+	+	+				
181	*Hymenasplenium rivulare* (Fraser-Jenk.) Viane & S. Y. Dong	+	+					NT
182	*Hymenophyllum acanthoides* (Bosch.) Rosenst.	+						CR
183	*Hymenophyllum denticulatum* Sw.			+				
184	*Hymenophyllum exsertum* Wall. ex Hook.	+						
185	*Hymenophyllum gardneri* Van. Den. Bosch.			+				
186	*Hymenophyllum javanicum* Spreng.					+		
187	*Hypodematium crenatum* (Forsk.) Kuhn		+		+			
188	*Hypolepis resistens* (Kunze) Hook.	+						
189	*Isoetes coromandelina* L.f.	+	+	+	+		+	LC
190	*Isoetes panchganiensis* G.K.Srivast., D.D.Pant & P.K.Shukla				+			EN
191	*Isoetes udupiensis* P. K.Shukla, G. K. Srivast., S. K. Shukla & P.K. Rajagopal			+				DD
192	*Japanobotrychum lanuginosum* (Wall. ex Hook. & Grev.) M. Nishida ex Tagawa	+	+	+	+			
193	*Lastreopsis tenera* (R. Br.) Tindale	+	+					VU

194	*Lepisorus amaurolepidus* (Sledge) Bir & Trikha	+	+	+				
195	*Lepisorus nudus* (Hook.) Ching	+	+	+	+	+		
196	*Leptochilus axillaris* (Cav.) Kaulf.	+	+	+				
197	*Leptochilus decurrens* Blume.	+	+	+	+	+		LC
198	*Leucostegia truncata* (D. Don) Fraser-Jenk.		+	+	+			
199	*Lindsaea ensifolia* Sw.	+	+	+	+	+		
200	*Lindsaea heterophylla* Dryand.		+	+	+	+		
201	*Lindsaea malabarica* Baker	+	+					NT
202	*Lindsaea venusta* Kaulf. ex Kuhn	+						EN
203	*Loxogramme chinensis* Ching		+					
204	*Loxogramme cuspidata* (Zenker) M. G. Price		+					
205	*Loxogramme involuta* (D. Don) C. Presl	+		+				
206	*Loxogramme parallela* Copel.	+						
207	*Lycopodiella cernua* (L.)Pic.Serm.	+	+	+		+		LC
208	*Lycopodium clavatum* L.	+	+					LC
209	*Lycopodium japonicum* Thunb.		+			+		
210	*Lygodium flexuosum* (L.) Sw.	+	+	+	+	+	+	
211	*Lygodium longifolium* (Willd.) Sw.	+						NT
212	*Lygodium microphyllum* (Cav.) R. Br.	+	+	+		+		LC
213	*Macrothelypteris ornata* (J. Sm.) Ching		+					
214	*Macrothelypteris torresiana*	+		+		+		

	(Gaudich.) Ching							
215	*Marsilea crenata* C.Presl		+					LC
216	*Marsilea minuta* L.	+	+	+	+		+	LC
217	*Marsilea quadrifolia* L.		+					LC
218	*Metathelypteris flaccida* (Blume) Ching		+					
219	*Mickelopteris cordata* (Hook. & Grev.) Fraser-Jenk.	+	+	+				
220	*Microlepia majuscula* (E. J. Lowe) Moore	+	+					EN
221	*Microlepia platyphylla* (D. Don) J. Sm.		+					
222	*Microlepia speluncae* (L.) Moore	+	+	+	+			
223	*Microlepia strigosa* (Thunb.) C. Presl	+						
224	*Microsorum linguaforme* (Mett.) Copel	+						
225	*Microsorum pteropus* (Blume) Copel.	+		+	+			LC
226	*Microsorum punctata* (L.) Copel.	+	+	+				
227	*Neolepisorus zippelii* (Blume) Li Wang			+				
228	*Nephrolepis auriculata* (L.) Trimen	+	+	+		+		
229	*Nephrolepis biserrata* (Sw.) Schott	+	+					
230	*Nephrolepis brownii* (Desv.) Hovenkamp & Miyam.	+	+	+		+		
231	*Nephrolepis cordifolia* (L.) C.Presl	+	+	+	+			
232	*Nephrolepis exaltata* (L.)				+			

	Schott.							
233	*Nephrolepis falcata* (Cav.) C.Chr.					+		
234	*Nephrolepis undulata* (Afzel. *ex* Sw.) J.Sm.			+	+			LC
235	*Odontosoria chinensis* (L.) J. Sm.	+	+	+				
236	*Odontosoria chinensis* subsp. *chinensis*			+				
237	*Odontosoria chinensis* subsp. *tenuifolia* (Lam.) Fraser-Jenk. & Kandel			+				
238	*Oeosporangium elegans* (Poir.) Fraser-Jenk. & Pariyar		+					
239	*Oeosporangium elegans* (Poir.) Fraser-Jenk. & Pariyar	+	+					
240	*Oeosporangium thwaitesii* (Mett. ex Kuhn) Fraser-Jenk.		+					
241	*Oleandra musifolia* (Blume.) C. Presl.	+	+	+				
242	*Ophioglossum costatum* R. Br.	+		+	+		+	VU
243	*Ophioglossum gramineum* Willd.	+	+	+	+	+	+	LC
244	*Ophioglossum lusitanicum* L.				+			CR
245	*Ophioglossum nudicaule* L. f.		+	+	+		+	VU
246	*Ophioglossum parvifolium* Hook. & Grev.				+		+	LC
247	*Ophioglossum petiolatum* Hook.		+		+			CR
248	*Ophioglossum polyphyllum* A. Braun		+					DD
249	*Ophioglossum reticulatum* L.	+	+	+	+		+	LC
250	*Ophioglossum vulgatum* L.		+	-	-		+	LC

251	*Oreogrammitis attenuata* (Kunze) Parris	+	+					EN
252	*Oreogrammitis austroindica* (Parris) Parris		+					CR
253	*Oreogrammitis medialis* (Baker) Parris		+	+				
254	*Oreogrammitis pilifera* (Ravi & J. Joseph) Parris.	+						VU
255	*Osmolindsaea odorata* (Roxb.) Lehtonen & Christenh.	+						
256	*Osmunda hilsenbergii* Hook. & Grev.			+				
257	*Osmunda hugeliana* C.Presl	+	+	+	+	+		LC
258	*Osmunda regalis* L.			+				LC
259	*Parathelypteris beddomei* (Baker) Chin	+						CR
260	*Pellaea boivinii* Hook.	+	+					VU
261	*Pellaea falcata* (R. Br.) Fée	+						NT
262	*Pellaea longipilosa* Bonap.	+	+	+				CR
263	*Phlebodium aureum* (L.) J. Sm.		+					
264	*Phlegmariurus ceylanicus* (Spring)	+						
265	*Phlegmariurus hamiltonii* (Spreng.) Á. Löve & D. Löve	+	+	+	+			
266	*Phlegmariurus niligaricus* (Spring) A. R. Field & Bostock	+	+					VU
267	*Phlegmariurus phlegmaria* (L.) Holub	+	+					
268	*Phlegmariurus phyllanthus* (Hook. & Arn.) R. D. Dixit	+	+	+				
269	*Phlegmariurus squarrosus* (G. Forst.) Á. & D. Löve	+		+				

270	*Phlegmariurus vernicosus* (Hook. & Grev.) Á. & D. Löve	+						CR
271	*Phymatosorus cuspidatus* subsp. *cuspidatus*	+						
272	*Phymatosorus longissimus* (Blume) Pic. Serm.	+						VU
273	*Phymatosorus membranifolium* (R. Br.) S. G. Lu		+					
274	*Phymatosorus membranifolius* (R.Br) Tindale	+	+					
275	*Pityrogramma calomelanos* (Sw.) Link	+	+	+	+	+		
276	*Pityrogramma calomelanos* var. *aureoflava* (Hook.) Weath. ex Bailey			+				
277	*Pneumatopteris truncata* (Poir.) Holttum		+					
278	*Polystichum anomalum* (Hook. et Arn.) J. Sm.	+	+					EN
279	*Polystichum auriculatum* (L.) C. Presl		+					
280	*Polystichum harpophyllum* (Zenker ex Kunze) Sledge	+	+					
281	*Polystichum manickamianum*Benniamin, Fraser-Jenk. & Irudayaraj		+					CR
282	*Polystichum molluccense*		+					
283	*Polystichum mucronifolium* (Blume) B. K. Nayar & Kaur		+					
284	*Polystichum squarrosum* (D. Don) Fée		+					
285	*Polystichum subinerme* (Kunze) Fraser- Jenk.	+	+					

286	*Polystichum subinerme* var. *orbiculata*	+	+					EN
287	*Pronephrium articulatum* (Houlston & Moore) Holttum	+	+	+				
288	*Pronephrium triphyllum* (Sw.) Holttum	+	+					
289	*Prosaptia alata* (Blume) Christ		+					CR
290	*Prosaptia contigua* (G. Forst.) C. Presl	+	+					CR
291	*Prosaptia obliquata* (Blume) Mett.	+	+					EN
292	*Pseudocyclosorus ochthodes* (Kunze) Holttum			+				
293	*Pseudocyclosorus octhodes* var. *annamalaiensis*		+					
294	*Pseudocyclosorus octhodes* var. *palniensis*		+					
295	*Pseudocyclosorus tylodes* (Kunze) Ching	+	+	+				
296	*Psilotum nudum* (L) P. Beauv.	+	+					CR
297	*Pteridium aquilinum* subsp. *wightianum* (Wall. ex J. Agardh) W. C. Shieh	+		+	+	+		
298	*Pteridium* pinetorumC.N.Page & R.R.Mill	+	+			+		LC
299	*Pteridrys cnemidaria* (Christ) C. Chr.	+						EN
300	*Pteridrys syrmatica* (Willd.) C. Chr. et Ching	+	+					CR
301	*Pteris argyraea* T. Moore	+	+	+				
302	*Pteris arisanensis* Tagawa			+				
303	*Pteris aspericaulis* Wall. ex J. Agardh		+			+		

304	*Pteris biaurita* L.	+	+		+	+		
305	*Pteris biaurita* L. subsp. *walkeriana* Fraser- Jenk. & Dom. Rajkumar			+				
306	*Pteris blumeana* J. Agardh	+		+	+			
307	*Pteris confusa* T.G.Walker	+	+	+		+		
308	*Pteris cretica* L.		+					LC
309	*Pteris cretica* subsp. *cretica*		+					
310	*Pteris ensiformis* Burm.		+					
311	*Pteris geminata* Wall.	+	+					EN
312	*Pteris gongalensis* T.GWalker	+	+					
313	*Pteris heteromorpha* Fee.				+	+		
314	*Pteris hookeriana* J. Agardh	+						CR
315	*Pteris longifolia* L.	+	+			+		
316	*Pteris longipes* D.Don	+						
317	*Pteris mertensioides* Willd.	+	+					CR
318	*Pteris multiaurita* J. Agardh		+					
319	*Pteris multifida* Poir.	+						
320	*Pteris otaria* Bedd.	+	+					
321	*Pteris pellucida* C.Presl	+		+	+	+		
322	*Pteris praetermissa* T.GWalker	+	+					
323	*Pteris quadriaurita* Retz.		+	+		+		
324	*Pteris scabripes* Wall.	+	+	+				
325	*Pteris tripartita* Sw.		+					EN
326	*Pteris venusta* Kunze			+	+			
327	*Pteris vittata* L.	+	+	+	+	+	+	LC
328	*Pyrrosia ceylanica* (Giesenh.) Sledge	+						EN

329	*Pyrrosia heterophylla* (L.) M. G. Price	+	+					
330	*Pyrrosia lanceolata* (L.) Farw.	+	+	+	+	+		
331	*Pyrrosia piloselloides* (L.) M. G. Price	+	+					
332	*Pyrrosia porosa* (C.Presl) Hovenkamp	+	+	+				
333	*Salvinia minima* Baker	+						
334	*Salvinia* x *molesta* D.S. Mitch.	+	+	+	+	+	+	
335	*Sceptridium daucifolium* (Wall. ex Hook. & Grev.) Lyon	+		+				
336	*Schizaea dichotoma* (L.) Sm.	+						VU
337	*Selaginella bryopteris* (L.) Baker	+						
338	*Selaginella cataractarum* Alston.	+	+					CR
339	*Selaginella ciliaris* (Retz.) Spring.	+	+	+	+		+	
340	*Selaginella crassipes* Spring.				+			
341	*Selaginella delicatula* (Desv. *ex* Poir.) Alston.	+		+	+	+	+	
342	*Selaginella ganguliana* R.D. Dixit	+						
343	*Selaginella inaequalifolia* (Hook. Gerv) Spring	+	+					
344	*Selaginella intermedia* (Blume) Spring		+			+		
345	*Selaginella involuens* (SW.) Spring	+	+					
346	*Selaginella keralensis* R.D. Dixit	+						
347	*Selaginella kraussiana*	+						LC

	(Kunze) A.Braun							
348	*Selaginella microdendron* Baker		+					
349	*Selaginella miniatospora* (Dalzell) Baker.		+	+	+	+		NT
350	*Selaginella monospora* Spring.			+				
351	*Selaginella plana* (Desv. ex Poir) Hieron.			+				
352	*Selaginella proniflora* (Lam.) Baker			+		+		
353	*Selaginella radicata* (Hook.and grev) Spring		+			+		
354	*Selaginella repanda (Desv. ex Poir.) Spring.*			+	+		+	
355	*Selaginella tamariscina (P.Beauv.) Spring*		+					
356	*Selaginella tenera (Hook. &Grev.) Spring*	+	+		+	+		
357	*Selaginellavaginata Spring*		+					
358	*Selaginella vogelii Spring*		+					
359	*Selaginella wightii Hieron.*		+					
360	*Selaginella willdenowii (Desv. ex Poir.) Baker*	+						
361	*Selliguea hastata (Thunb.) Fraser-Jenk.*			+				
362	*Selliguea lehmannii (Mett.) X. C. Zhang & L. J. He*		+					EN
363	*Selliguea montana (Sledge) Hovenkamp*	+						
364	*Selliguea oxyloba (Wall. ex. Kunze) Fraser-Jenk.*			+				
365	*Sphaerostephanos arbusculus subsp. arbusculus*			+				

366	*Sphaerostephanos subtruncatus (Bory) Holttum*		+					
367	*Sphaerostephanos unitus (L.) Holttum*		+					
368	*Stenochlaena palustris (Burm.fil.) Bedd.*	+	+			+		
369	*Tectaria cicutaria (L.) Copel.*					+	+	
370	*Tectaria coadunata (Wall. ex Hook. and Grev.) C. Chr.*	+	+	+	+	+	+	
371	*Tectaria fuscipes (Wall.) C. Chr.*			+				
372	*Tectaria paradoxa (Fee) Sledge*	+	+	+	+			
373	*Tectaria polymorpha (Wall. ex Hook.) Copel.*			+				
374	*Tectaria trimenii (Bedd.) C. Chr.*	+						CR
375	*Tectaria wightii (C. B. Clarke) Ching*	+	+	+				
376	*Tectaria zeilanica (Houtt.) Sledge*	+	+					EN
377	*Thelypteris confluens (Thunb.) C.V.Morton*		+					CR
378	*Thelypteris dentata (Forssk.) H.St. John*	+	+	+		+		LC
379	*Thelypteris pozoi(Lag.) C.V.Morton*	+						LC
380	*Thelypteris tetragona (Sw.) Small*			+				LC
381	*Tomophyllum subfalcatum (Blume) Parris*	+	+					
382	*Trigonospora caudipinna (Ching)Sledge*		+	+				
383	*Trigonospora tenera (Roxb.)*	+	+			+		

	Mazumdar							
Total number of species in each state		**227**	**249**	**148**	**82**	**73**	**27**	

4. Conclusion

The conservation of endemic ferns in the Western Ghats is crucial for preserving the unique biodiversity and ecological balance of this region. Endemic ferns play a significant role in the ecosystem by providing habitat and food sources for numerous species, contributing to soil health, and maintaining overall ecosystem resilience. Efforts to conserve endemic ferns in the Western Ghats should focus on habitat protection, restoration, and sustainable management practices. This includes establishing protected areas, conducting research on fern populations, raising awareness about their importance, and engaging local communities in conservation efforts. By safeguarding endemic ferns in the Western Ghats, we not only protect these species themselves but also help to maintain the health and integrity of the entire ecosystem. Conservation actions taken today will have long-lasting benefits for future generations and ensure the continued existence of these unique and valuable plants in this biodiverse hotspot.

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