

CYATHEA NILGIRENSIS HOLTUM (CYATHEACEAE: PTERIDOPHYTA): A THREATENED TREE FERN FROM CENTRAL WESTERN GHATS, INDIA

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The Western Ghats of the Indian peninsula constitute one of the 34 global biodiversity hotspots along with Sri Lanka, on account of exceptional levels of plant endemism and by serious levels of habitat loss (Conservation International 2005). It straddles through the states of southern Gujarat, Maharashtra, Goa, Karnataka, Tamil Nadu and Kerala, practically forming an unbroken relief dominating the west coast, for almost 1600km from the mouth of Tapti River to the tip of southern India. The complex physiography of the rugged mountain chain, the general elevation varying from 400–500 m to exceptionally high peaks exceeding over 2500m, especially in the Nilgiris and Anamalais, and rainfall ranging from 1000–6000 mm are major reasons for its rich biodiversity and high endemism. There are about 2015 endemic flowering plant taxa in peninsular India, of which about 1600 are confined to the Western Ghats (Chandran et al. 2010). The overall latitudinal and altitudinal gradients, rainfall patterns brought in by the south-west and north-east monsoons, reduction in number of rainy months progressively towards northern latitudes and towards the leeward side of mountains

and variations in soils and rocks coupled with over three millennia of vegetation changes caused by humans have resulted in a mosaic of ecological islands, niches and refugia favouring with varied degrees of endemism that reach highest in rare stands of relic forests having conservation histories since time immemorial.

Several studies have been carried out on flowering plants of the Western Ghats. However, the lower vascular plants, and in particular pteridophytes have not received much attention. Pteridophytes including ferns and fern-allies (lycophytes) are the earliest of the vascular plants on earth that heralded the arrival of an advanced vascular system with xylem for water and phloem for food transport respectively. They grow luxuriantly in moist tropical and temperate forests from sea level to the high mountains. The pteridophytes among the vascular plants with about 12,000 species are next only to the angiosperms in the world. More than 1,200 species of pteridophytes have been reported from India (Dixit 1984; Chandra 2000). However, due to the presence of many doubtful species this seems to be an overestimate hence, the actual number of pteridophytes species are estimated to be 900–1000 (Chandra et al. 2008). The undulating terrain of the Western Ghats supports about 320 species of pteridophytes (Dudani et al. 2011).

Prospecting for rare vegetation and their specific kinds of habitats, based on flowering plant communities, might lead to the discovery of some rare ferns as well. For instance *Cyathea crinita* Copel., the Endangered tree fern is found only in the cooler shola and other



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high altitude (>1500m) evergreen forests of southern Western Ghats especially alongside shaded streams (Irudayaraj 2011). Similarly, *Lycopodium wightianum* (Wall. ex Hook. & Grev.) Holub, a southern Indian species, considered to be Near Threatened (Chandra et al. 2008), has its specific habitats in higher altitudes (1800–2400 m) on exposed slopes and grasslands (Manickam & Irudayaraj 1992).

While studying some of the exclusive and threatened swamps overgrown with wild nutmeg trees (*Myristica* swamps), in the Kathalekan forest of Uttara Kannada in central Western Ghats (Image 1), several sensitive fern species were found in association with rare community of evergreen trees like *Myristica magnifica* Bedd. (Endangered), *Dipterocarpus indicus* Bedd. (Endangered), *Gymnacranthera canarica* (King) Warb. (Vulnerable), *Syzygium travancoricum* Gamble (Critically Endangered), *Semecarpus kathalekanensis* Dassapa & Swaminath (newly discovered tree species of mango family, assessed as Critically Endangered) and scores of other canopy and understory endemic flowering plants. Mention may be made of southern Indian endemics like *Bolbitis subcrenatooides* Fras.-Jenk., *B. semicordata* (Bak.) Ching and others like the tree fern *Cyathea gigantea* (Wall. ex Hook.) Holttum, *Pteris quadriaurita* Retz., *Leptochilus axillaris* (Cav.) Kaulf, etc. Among the many climax forest relics, Kathalekan (*Kathale* = dark; *kan* = sacred forest) relic forest in Uttara Kannada District, of central Western Ghats in Karnataka is a repository of rare biota including 35 species of amphibians from an area of 2.25km² (Chandran et al. 2010).

Cyathea nilgirensis Holttum, a southern Indian endemic tree fern (Fraser-Jenkins 2008) was seen growing in the deep shade of the swampy forest of Kathalekan in Uttara Kannada. This is a new report of its distribution anywhere from north of 14° latitude in the Western Ghats (Image 2). Tree ferns of the genus *Cyathea* belong to the family Cyatheaceae which has 241 species and four hybrids distributed throughout the mountainous regions of the world (Khare & Srivastava 2009). India has 11 species of *Cyathea* (Dixit, 1984) of which *C. nilgirensis* was listed 'Endangered' (Walter & Gillett 1998), but subsequently brought into the category of 'Least Concern' (Irudayaraj 2011).

Chandra et al. (2008) carried out extensive work on the distribution and nomenclature of pteridophytes in India and consider that the threat categorization by IUCN of the pteridophytes of India are based on often erroneous names, taxonomic misunderstandings, and insufficient studies on distribution. This has necessitated a fresh look on this subject. As Chandra et



Image 1. Kathalekan Sacred grove in Uttara Kannada District, Karnataka

al. (2008) is a convincingly good approach towards threat categorization, until a revision happens in IUCN's Red Listing of Indian pteridophytes and as a lone population of few individuals of *C. nilgirensis* survives precariously in the threatened swamps of Kathalekan in Uttara Kannada, the northernmost range of its distribution in the Western Ghats, we felt it reasonable to endorse its Near Threatened status.

The fern is also, notably, listed in the Appendix-II of CITES (Convention of International Trade in Endangered Species of Wild Fauna and Flora) (Sanjappa & Lakshminarasimhan 2011). It is distributed in restricted pockets in the shady and damp streamside forests of Kerala, Karnataka, Tamil Nadu and Andhra Pradesh. It was reported from Kemmangundi and Charmadi Ghats of Chikmagalur District, Mercara-Bhagamandala-Talacauveri stretch in Kodagu District and in Sakleshpur and Devalkere in Hassan District (Rajagopal & Bhat 1998) and now from south of Uttara Kannada, central Western Ghats. In Kathalekan, the species exists precariously, with merely four individuals left, obviously the last relics of what would have been once a primeval forest before the introduction of agriculture and forestry operations by humans.



Image 2. Threatened tree fern *Cyathea nilgirensis* Holttum in the swamp forest of Kathalekan

***Cyathea nilgirensis* Holttum**

in Kew Bull. 19: 468. 1956; Nayar & Kaur, Comp. (syn.: *Alsophila nilgirensis* (Holttum) R. Tyron) is noted for unbranched trunk of 2–4 m height, 12–13 cm in diameter; bearing crown of fronds at the apex and scales densely covering the younger fronds. Stipes swollen at base, bearing small hairs. Lamina bipinnate, oblong-lanceolate, pinnae about 12 pairs, alternate, distinct petiolate, pale green below, dark green above, texture herbaceous. Pinnules acuminate, margin pinnatifid up to the costa; ultimate lobes about 15 pairs, alternate, oblong, 1.5x0.4 cm, margin crenate. Sori situated on the vein forks of the lower half of the segments, exindusiate, paraphyses intermingled with sporangia, spores trilete. Grows as terrestrial species along shaded stream banks (Manickam & Irudayaraj 1992). This can be easily differentiated from the other commonly occurring species *C. gigantea* which has a characteristic “V” shaped soral arrangement in each pinnule lobe and margin of pinnae lobed 2–5 mm towards the costa.

C. nilgirensis prefers habitat with relatively higher moisture content such as *Myristica* swamp. With their little known biota, the *Myristica* swamps are virtually live museums of ancient life of great interest to biologists.

Such swamps of high watershed value and evolutionary significance (the *Myristicas* are considered among the most primitive flowering plants) have been practically on the road to extinction due to neglect and need for industrial softwoods and agricultural expansion. These swamps were reported for the first time from the Travancore region (Krishnamoorthy 1960) and classified under a category called ‘*Myristica* Swamp Forests’ under the sub-group 4C by Champion & Seth (1968). The dipterocarp forests of Kathalekan, laced with *Myristica* swamps were considered significant areas for conservation because of their primeval characters (Chandran & Mesta 2001; Chandran et al. 2010). Over the last few centuries, most of the *Myristica* swamps that normally occur along sluggish streams in primeval forests favored habitats of ferns like *C. nilgirensis*, have unfortunately given way to secondary forests, savannas, monoculture tree plantations, cash crops such as tea, coffee, arecanut and rubber, rice fields etc. (Chandran & Mesta 2001; Gururaja et al. 2007).

The swamps of Kathalekan are seriously threatened habitats because of stream diversions to adjoining cultivation areas, depriving many downstream species including the sensitive fern community of the much needed water for summer survival. Trampling of ground vegetation by domestic cattle from adjoining villages has suppressed the regeneration of the tree ferns. Moreover, the proposed widening of Honavara-Bengaluru National Highway passing adjacent to Kathalekan could as well be disastrous to tree ferns including *C. nilgirensis*, some of the last relics of the Mesozoic tree ferns.

The Biodiversity Act (2002), of the Government of India has provisions enough to declare such important biodiversity areas like *Myristica* swamps with their endemism rich biological community as ‘Biodiversity Heritage Sites’. However, the initiatives are yet to be taken by the State Biodiversity Board and the Forest Department of Karnataka. The Department however has taken some steps to remove encroachments from swamps while also creating awareness on these threatened habitats and making efforts to restore swamp habitats through involvement of scientists and local village communities. Such actions, if coupled with introduction of the seedlings of these ferns in suitable habitats and botanical gardens and attempts to conserve the germplasm of it through mapping and conservation of all its habitats and application of tissue culture techniques for its rapid multiplication can be definitely helpful for the future of this fern.

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