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## THE ENDEMIC PTERIDOPHYTE FLORA OF SRI LANKA : TAXONOMY, GEOGRAPHICAL DISTRIBUTION AND CONSERVATION STATUS

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### ABSTRACT

Of 348 pteridophytes listed in the recently published *A Revised Handbook of the Flora of Ceylon* (Shaffer-Fehre, 2006a), 48 taxa (including two sub species) were identified as endemic species. 30 further species had previously been reported as endemic, but their status was doubtful or incorrect due to misidentification, or due to the occurrence of the species in South India, or sometimes in some other phytogeographically related areas of the world. These have all now been revised here. We present here a list of 47 endemic and 30 excluded taxa with their geographical distribution and conservation status.

**Key Words :** Sri Lanka, pteridophytes, endemic, distribution, conservation status.

### INTRODUCTION

Geographical isolation and a wide range of climatic, elevational and soil type variation have resulted in a high level of diversity and endemism in the flora and fauna of Sri Lanka (MFE, 1999). Currently about 348 Pteridophyte taxa from 30 families are known from Sri Lanka of which 57 species have at various times been reported to be endemic to the country (Sledge, 1982; Shaffer-Fehre, 2006a). More than 30 pteridophyte species have not been recorded from Sri Lanka during the last and present Centuries (Sledge, 1982), though there has been a serious lack of modern collection in Sri Lanka to date, which probably accounts for a good number of them. During the last decade or two, the number of endemic pteridophytes has been changed mainly due to recently conducted pteridological exploration in South India and also due to taxonomic revision of previously misidentified pteridophyte species. Sri Lankan pteridophytes have strong phytogeographical relationships with South Indian species and if the two are combined as a single phytogeographical region the number of endemics to the combined region increases very markedly. In addition both the Sri Lankan and South Indian pteridophyte floras have phytogeographical relationships with the Sino-Himalayan flora (migrating from North East India and South West China), the Malesian flora from South East Asia and also via N.E. India, and the African flora (particularly the Seychelles, Mascarenes, Madagascar and East Africa) (Fraser-Jenkins, 1984-

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2010). It is therefore not surprising that some of the Sri Lankan pteridophytes previously thought to be endemic also occur in the above regions. The present study aims to re-assess the list of endemic pteridophytes in Sri Lanka.

#### STATUS OF SPECIES

**Endemic Status :** The recently published *A Revised Handbook of the Flora of Ceylon* (Shaffer-Fehre 2006a) was used as a base-line for our study, but we have also included all the species listed as endemic in the important formative paper by Sledge (1982). The 348 pteridophytes listed in the Flora volume were assessed to identify the endemic status of each species. Information from published and unpublished literature, particularly the scholarly work of Sledge (1956 - 1982) and Manton & Sledge (1954), and from herbarium specimens was used for this purpose. Discussion with international specialists in several families was also undertaken to help clarify the taxonomic and endemic status of doubtful species. For family level classification, the system proposed by Smith *et al.* (2006) was adopted with some modifications according to Fraser-Jenkins (2010). Taxonomic concepts of Indian pteridophyte species according to Fraser-Jenkins (2006, 2008) and Fraser-Jenkins *et al.* (2015) were followed for the classification of most species and genera, while those of Parris (2006, 2007) were followed for Grammitidaceae.

**Conservation Status :** The conservation status of each taxon was identified based on the National Red List 2012 whereas the legal status of each taxon was obtained from the Fauna and Flora Protection Ordinance (FFPO) of Sri Lanka (Anon, 2009), Ekaratne *et al.* (2003) and the CITES Secretariat (2001).

**Geographical Distribution.** Information on the geographical distribution of each taxon was obtained from both published and unpublished sources, including the new Indian Checklist, Gandhi *et al. in prep.*), herbarium specimens at PDA and other Indian and British herbaria, especially K and BM, and from the field experience and knowledge of the authors, and is presented here based on the administrative districts of the country (Map 1).

**Map 1:** Twenty-five administrative districts of Sri Lanka

#### List of Species

The present list includes 47 taxa (45 species and 2 subspecies) whose taxonomic and endemic status have been thoroughly reappraised. 30 species are categorised as doubtful or rejected in their taxonomic or endemic status due to misidentification or the occurrence of the species in South India or sometimes elsewhere. Confirmed endemic species are marked with an asterisk (\*). If the species name differs from that given in the *Revised Handbook of the Flora of Ceylon* (2006), whose accounts were often written some years previously, the name given in the Flora is given in brackets.



**Map 1** : Twenty-five administrative districts of Sri Lanka

#### LYCOPODIACEAE

Philcox (2006a) has identified ten *Huperzia* species in Sri Lanka and all are protected by the FFPO.

##### 1. *Huperzia ceylanica* (Spring) Trevis.

Conservation status : Threatened and protected by the FFPO.

Distribution : Nuwara Eliya district.

Notes : Sledge (1982) mistakenly reported it as a Sri Lankan endemic. It is also present in South and N.E. India (Fraser-Jenkins, 2012).

#### SELAGINELLACEAE

Philcox (2006b) reported nine species from Sri Lanka, based on Sledge (1982). Though he listed only two as being endemic, the present revision shows that four species are endemic to Sri Lanka, with another having been reported as endemic in error.

**2. *Selaginella calostachya* (Hook. & Grev.) Alston\***

Conservation status : Least Concern and protected by the FFPO.

Distribution : Badulla, Kandy, Matale, Matara, Nuwara Eliya and Ratnapura districts.

Notes : *S. calostachya* is a locally common and widely distributed species in montane, sub montane and lowland forest areas of the country. It is a common species and we would recommend it to be taken off the FFPO list.

**3. *Selaginella cochleata* (Hook. & Grev.) Spring**

(*S. brachystachya* (Hook. & Grev.) Spring).

Conservation status : Least Concern and protected by the FFPO.

Distribution : Colombo, Galle, Kalutara, Matale, Nuwara Eliya and Ratnapura districts.

Notes : Philcox (2006b) correctly confirmed that, as suspected by Alston (1945), *S. cochleata* is merely an exposed growth form of *S. brachystachya* and is the earliest and correct name for it. He reported the existence of three sterile specimens at Kew from S. India, whose identity was confirmed in 2012 by CRFJ, who also found further and fertile S. Indian specimens of it at BM and CAL. Sledge (1982) had listed *S. brachystachya* as endemic to Sri Lanka. It is a very common and widely distributed species in the wet zone and we suggest it should be taken off the FFPO list.

**4. *Selaginella crassipes* Spring**

Conservation status : Near Threatened.

Distribution : Colombo, Kalutara, Kandy, Kurunegala, Matale, Nuwara Eliya and Ratnapura districts.

Note : Sledge (1982) and Fraser-Jenkins (2008) had listed it as a Sri Lankan endemic. Philcox (2006b), Singh *et al.* (2012) and Fraser-Jenkins have confirmed its occurrence in South India.

**5. *Selaginella latifolia* (Hook. & Grev.) Spring\***

Conservation status : Endangered.

Distribution : Nuwara Eliya and Ratnapura districts.

Notes : There are no recent records since Sledge's collection in 1954. It is suggested to be protected under the FFPO.

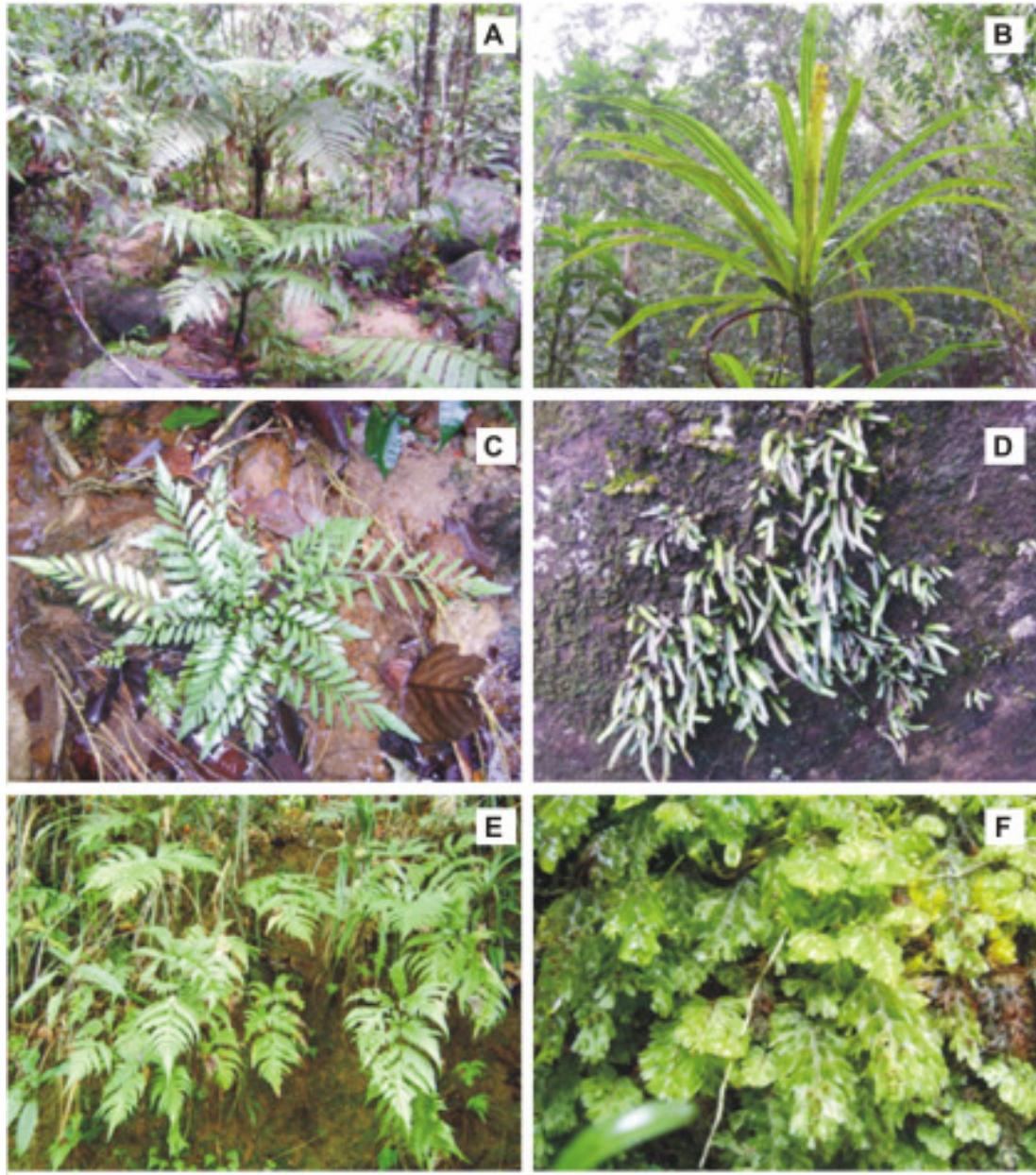
**6. *Selaginella ornithopodioides* (L.) Spring\***

(*Selaginella integerrima* (Hook. & Grev.) Spring)

Conservation status : Near Threatened.

Distribution : Colombo, Kegalle, Kurunegala, Nuwara Eliya and Ratnapura districts.

Notes : Fraser-Jenkins (2008) confirmed that Alston (1945) correctly applied the name *S. ornithopodioides* to the Sri Lankan species and showed in Chandra *et al.* (2008) that Panigrahi's (1976) lectotypification based on a Chinese plant was in error. As suspected



**Figure 1 : Six endemic fern species in Sri Lanka. A :** *Cyathea srilankensis* Ranil (Beraliya proposed forest reserve). **B :** *Cyathea sinuata* Hook. & Grev. (Sinharaja world heritage site). **C :** *Thelypteris zeylanica* Ching (Kanneliya forest reserve). **D :** *Oreogrammitis sledgei* (Parris) Parris (Sinharaja world heritage site). **E :** *Tectaria thwaitesii* (Bedd.) Ching (Kottawa forest reserve). **F :** *Hymenophyllum macroglossum* Bosch (Adam's peak wilderness).





**Figure 2 : Five endemic fern species in Sri Lanka. A :** *Pyrrosia pannosa* (Mett. ex Kuhn) Ching (Knuckles conservation forests). **B :** *Trichomanes wallii* Thwaites ex Trimen (Sinharaja world heritage site). **C :** Fertile frond of *Bolbitis subcrenata* (Hook. & Grev.) Ching (Sinharaja world heritage site). **D :** *Pyrrosia gardneri* (Mett.) Sledge (Sinharaja world heritage site). **E :** Potted plant of *Cyathea sledgei* Ranil *et al.* in the net house of the Faculty of Agriculture. **F :** Spore arrangement of *Cyathea sledgei* Ranil *et al.* (Kanneliya forest reserve).

by Alston (1945) and stated by Philcox (2006b), the report of the type from Courtallam, S. India, may have been in error, as also repeated by Dixit (1992), based on a mislabelled specimen from Sri Lanka, where it is probably endemic, though its possible presence in S. India cannot be entirely excluded.

#### 7. *Selaginella praetermissa* Alston\*

Conservation status : Near Threatened and protected by the FFPO.

Distribution : Colombo, Galle, Kandy, Kegalle, Kurunegala, Matara and Ratnapura districts.

Notes : Philcox (2006b) listed *S. praetermissa* from India, but agreed with Alston (1945), who had pointed out that the Indian specimen (Assam, *F. Jenkins s.n.*, K) was an erroneous localisation, as frequently occurs with old material at Kew. Dixit's (1992) report of *S. praetermissa* from Arunachal Pradesh (Rotung, *I.H. Burkill* 37368, 24.12.1911, CAL) was found by CRFJ in 2012 to be an error for *S. megaphylla* Baker, and Dixit's consequent acceptance of the Assam locality was also in error. Fraser-Jenkins (2008) and Chandra *et al.* (2008) therefore concluded that this species is indeed endemic to Sri Lanka.

### OSMUNDACEAE

The family Osmundaceae is represented by a single indigenous genus and single species in Sri Lanka (Sledge, 1981a). *Todea barbara* (L.) T.Moore, treated by Jayasekara (2006a) is an exotic species of the family which is only cultivated in the Hakgala Botanic Garden.

#### 8. *Osmunda collina* Sledge

Conservation status : Critically Endangered and protected by the FFPO.

Distribution : Nuwara Eliya district.

Notes : This species was tentatively identified as a Sri Lankan endemic by Sledge (1981a) and was listed as endemic by Jayasekara (2006a). But Chandra *et al.* (2008) and Fraser-Jenkins (2008) followed indications of doubt by Sledge in suggesting that *O. collina* may be a synonym of *O. angustifolia* Ching and this is confirmed here. It occurs in Thailand and South East China and was at one time cultivated in South India (*Gen. Johnstone*). It has a very narrow distribution in Sri Lanka, confined to restricted distribution of montane and sub-montane forests in Nuwara Eliya district.

### HYMENOPHYLLACEAE

Jayasekara (2006b) listed 18 Sri Lankan species under nine genera. Smith *et al.* (2006) and Chistehusz *et al.* (2011) found that the family consists of two clades corresponding to the classical genera *Hymenophyllum* and *Trichomanes*. The latter had been divided into eight genera (Ebihara *et al.* 2006), of which Sri Lankan species belong to four, *Abrodictyum*, *Crepidomanes*, *Didymoglossum* and *Hymenophyllum* (A. Ebihara, pers. comm. 2013), however the splitting of *Trichomanes* but not *Hymenophyllum* into genera is



inconsistent and is mainly due to historical reasons in Japan. Fraser-Jenkins (1997, 2008, 2010, 2012 *etc.*) has not accepted the splinter genera on morphological grounds given their close similarity, and due to the illogicality of separating them but not those of *Hymenophyllum*.

**9. *Hymenophyllum gardneri* Bosch**

(*Mecodium gardneri* (Bosch) Jayasek.)

Conservation status : Least Concern.

Distribution : Badulla and Nuwara Eliya districts.

Notes : This rather common species of upper-mid and higher altitude forests was listed as endemic by Sledge (1982), but also occurs fairly commonly in S. India (Fraser-Jenkins 2008). It is close to but consistently somewhat distinct from the Indian *etc. H. exsertum* Wall. ex Hook., as treated by Sledge (1968), Manickam & Irudayaraj (1991), Jayasekara (2006b) and Fraser-Jenkins (2008), in contrast to Hameed *et al.* (2003), who combined them.

**10. *Hymenophyllum macroglossum* Bosch\***

(*Meringium macroglossum* (Bosch) Copel.).

Conservation status : Least Concern.

Distribution : Galle, Kandy, Matale, Monaragala, Nuwara Eliya and Ratnapura districts.

Notes : *H. macroglossum* is a rather common and widespread species, but is highly sensitive to changes in the micro-climatic environment.

**11. *Trichomanes wallii* Thwaites ex Trimen\***

(*Didymoglossum wallii* (Thwaites ex Trimen) Copel.).

Conservation status : Endangered and protected by the FFPO.

Distribution : Colombo, Galle and Ratnapura districts.

Notes : *T. wallii* is confined to a few localities in lowland rain forests in Sri Lanka and there are few modern collections. It has also been reported from a single collection on Hainan Island, China, by Chu & Zhou (Act. Bot. Yunnan. 16: 125. 1994) and thence repeated in the Flora of China (2013), but we have not assessed or verified this unlikely sounding report.

**CYATHEACEAE**

Largely following Tryon (1970), Smith *et al.* (2006) and Christenhusz *et al.* (2011) recognised four or five genera in this family. But there has been little consensus of opinion and due to their closeness we recognise a single genus, following the arguments of Holttum (1965) and Kramer (1990), and as followed by Philcox (2006c) and Fraser-Jenkins (2010).

**12. *Cyathea hookeri* Thwaites\***

Conservation status : Critically Endangered and protected under CITES Appendix II and the FFPO.

Distribution : Galle, Kalutara, Matara and Ratnapura districts.

Notes : Confined to lowland rainforests. Kanneliya MAB reserve (Galle district) and Sinharaja World Heritage Site (Matara and Ratnapura district) were the only known localities for *C. hookeri*. But the present Sri Lankan authors now report *C. hookeri* anew from Beraliya Proposed Forest Reserve and Hiniduma Forest Reserve in Galle district and Runakanda Proposed Forest Reserve in Kalutara district which are far from previous localities.

**13. *Cyathea sinuata* Hook. & Grev.\***

Conservation status : Endangered and protected under CITES Appendix II and the FFPO.

Distribution : Galle, Kalutara, Matara and Ratnapura districts

Notes : This species is confined to lowland rainforests. It usually occurs along with *C. hookeri* and is found at Sinharaja World Heritage Site (Matara and Ratnapura district), Kanneliya MAB Reserve, Beraliya Proposed Forest Reserve and Hiniduma Forest Reserve in Galle district and Runakanda Proposed Forest Reserve in Kalutara district.

**14. *Cyathea sledgei* Ranil, Pushpakumara & Fraser-Jenk.\***

Conservation status : Critically Endangered and protected under CITES Appendix II and the FFPO.

Distribution : Galle and Ratnapura districts.

Notes : This species was reported from Sri Lanka as a putative hybrid by Sledge (1982). But Philcox (2006c) omitted it probably due to lack of information and uncertainty as to its taxonomic status. Ranil *et al.* (2010a) described it as a new species after further study of its morphology, reproductive biology and population. It was probably derived as a direct fertile hybrid between *C. sinuata* and *C. hookeri* which has thus speciated, a phenomenon known to occur in *Cyathea*.

**15. *Cyathea srilankensis* Ranil\***

Conservation status : Critically Endangered and protected under CITES Appendix II and the FFPO.

Distribution : Galle and Ratnapura districts.

Notes : This species is confined to lowland rainforests and had been recorded only from a few locations in Sinharaja, World Heritage Site, where it was considered as a point-endemic species (Ranil *et al.* 2010b). But a further population was recently discovered by the present Sri Lankan authors at Beraliya Proposed Forest Reserve in Galle district.

**16. *Cyathea walkeri* Hook.\***

Conservation status : Vulnerable and protected under CITES Appendix II and the FFPO.

Distribution : Badulla, Galle, Kalutara, Kegalle, Kandy, Matale, Matara, Nuwara Eliya, Ratnapura districts.

Notes : *C. walkeri* is widely distributed in the montane, submontane and lowland zones (60-1600 m). A report of *C. walkerae* from S. India by Chandra (2000) was in error for *C. nilgirensis* Holtt. (Fraser-Jenkins, 2008).

**17. *Cyathea walkeri* Hook. var. *tripinnata* Hook. & Baker**

Conservation status : Not evaluated.

Distribution : Unknown.

Notes : *C. walkeri* var. *tripinnata* is known only from the type collection at Kew and is presumed here to be extinct. From its morphology it almost certainly represents a mere individual foliose and lobed plant of *C. walkeri* and is therefore placed here in its synonymy, not being of taxonomic significance. Philcox (2006c) treated it as if an endemic variety.

**DENNSTAEDTIACEAE****18. *Microlepidia majuscula* (E.J.Lowe) T.Moore**

Conservation status : Critically Endangered (possibly Extinct).

Distribution : Nuwara Eliya district.

Notes : This rare species is only known from a couple of localities in upper-mid altitude forests. It was erroneously thought to be endemic by Sledge (1982) and thus by Zink (2006a), who also thought this distinctive species was dubious due to lack of knowledge of the genus. But its type was clearly recorded from S. India, from where there are several modern collections (Fraser-Jenkins 2008) and it was properly recorded in detail and illustrated by the late Father Manickam (1986) and in his well known and definitive work (Manickam & Irudayaraj 1991), later than Sledge's work, specimens confirmed by CRFJ at K, RHT and XCH.

**LINDSAEACEAE**

Lindsaeaceae was included within Dennstaedtiaceae by Zink (2006a), following Kramer (1990), though he stated that it might deserve recognition as distinct, but it is maintained here as a separate family, following Smith *et al.* (2006), Fraser-Jenkins (2010) and Christenhusz *et al.* (2011).

**19. *Lindsaea caudata* Hook.\***

Conservation status : Vulnerable.

Distribution : Galle, Kalutara, Kandy, Kegalle and Ratnapura districts.

Notes : Relatively common species with rather many widespread collections occurring in moist, shaded places in low altitude areas in the southern part of the island.

**20. *Lindsaea schizophylla* (Baker) Christ\***

Conservation status : Critically Endangered.

Distribution : Ratnapura district.

Notes : There are only two collections from last Century, both from Adam's Peak, while 19<sup>th</sup> Century collections are unlocalised, but probably also from the same locality. One specimen of *L. schizophylla* collected by *G.H.K. Thwaites* 3903, 1870 (E) was labelled as if from India referring to the whole Indian region, but was from Sri Lanka as confirmed by the duplicate specimen at K. It is recommended to be protected under the FFPO.

**PTERIDACEAE**

This is a large family which includes Adiantaceae and several other less significant groups sometimes treated as families, but better regarded as subfamilies. Its genera predominantly have marginal sori protected by the down-folded marginal pseudindusium, though in a few genera the sori have spread inwards along the veins or covering the whole lamina beneath and no longer have a pseudindusium.

**21. *Coniogramme serrulata* (Blume) Fée**

Conservation status : Vulnerable

Distribution : Badulla, Ratnapura and Nuwar Eliya districts.

Note : Sledge (1982) referred *C. serrulata* its synonym, *C. serra* Fée. It is not endemic and is a widespread and common species in Asia, including India.

**22. *Pteris gongalensis* T.G.Walker**

Conservation status : Critically endangered and protected by the FFPO.

Distribution : Kandy, Nuwara Eliya and Ratnapura districts.

Note : Walker *et al.* (2006) identified this species as a Sri Lankan endemic. Nair & Ghosh (1976), Fraser-Jenkins (2008, 2012) and Sreenivas *et al.* (2013) have confirmed its occurrence in South India.

**23. *Pteris praetermissa* T.G.Walker**

Conservation status : Vulnerable.

Distribution : Kandy, Matale, Nuwara Eliya districts.

Note : Walker *et al.* (2006) identified this species as a Sri Lankan endemic. Nair & Ghosh (1976), Fraser-Jenkins (2008) and Sreenivas *et al.* (2013) have confirmed its occurrence in South India.

**24. *Pteris quadriaurita* Retz.\*?**

Conservation status : Least concerned.

Distribution : Anuradhapura, Badulla, Kandy and Matale districts.

Note : probably endemic, only doubtfully known from S. India, perhaps in error for more regular plants of *P. otaria*, or if present there then very rare (see Fraser-Jenkins, 2012).

**25. *Pteris reptans* T.G.Walker**

Distribution : Badulla and Nuwara Eliya districts.

Note : Walker *et al.* (2006) identified this species as a Sri Lankan endemic. Fraser-Jenkins (2012), Sreenivas & Madhusoodanan (2012) and Sreenivas *et al.* (2013) have confirmed its occurrence in South India.

**VITTARIACEAE**

Although placed by Smith *et al.* (2006) and subsequent cladonomic workers within Pteridaceae, we follow Kramer & Green (1990) and Fraser-Jenkins (2010) in maintaining this family taxonomically, considering its very distinct morphology and that it was also joined with the erstwhile Adiantaceae, which has no taxonomic relationship with it. We do not recognise the cladonomic splinter-genus, *Haplopteris*, as worthy of generic distinction.

**26. *Vittaria microlepis* Hieron.**

Conservation status : Near threatened.

Distribution : Kalutara, Nuwara Eliya and Ratnapura districts.

Note : *V. microlepis* was listed by Sledge (1982) as a Sri Lankan endemic, but it was subsequently found in S. India by Manickam and Irudayaraj (1992). Shaffer-Fehre (2006b) and Fraser-Jenkins (2008) have also confirmed its occurrence in South India.

**THELYPTERIDACEAE**

Sledge (1981b) and thence Shaffer-Fehre (2006c) followed Holttum and Ching's much split up classification into 16 genera based mainly on obscure microcharacters, but Shaffer-Fehre ignored the widespread modern recognition of only 5 genera (Smith 1990, Smith *et al.* 2006, Christenhusz *et al.* 2011 and other modern Floras *etc.*), of which only three genera occur in Sri Lanka. However Fraser-Jenkins (2008, 2010) argued that the 5 genera are all very close morphologically and the main distinguishing character of anastomosing versus free veins entirely breaks down concerning Sect. *Pseudocyclosorus* and *Trigonospora*, which were placed molecularly and cladonomically within *Cyclosorus* with anastomosing veins. While these various erstwhile closely interrelated genera might well have diverged genetically some time ago, significant morphological divergence has not occurred in the group and an attempted circumscription of a genus *Cyclosorus* in the sense of Smith is effectively impossible. Three other genera under his system are mainly distinguished only by chromosome base-number. While the most recent molecular work since 2011 and by Smith *et al.* in prep. has come to various different cladonomic conclusions, we follow the alternative taxonomic treatment proposed by Iwatsuki, Reed, Fraser-Jenkins and others, in recognising only a single genus, *Thelypteris*, which was also mentioned by Holttum as the only logical alternative treatment to splitting more genera in his greatly experienced view. Shaffer-Fehre (2006c) also included a number of erroneous reports of hybrids and misidentified specimens, particularly in Sect. *Christella*, in her account.



**27. *Thelypteris arthurii* Fraser-Jenk.**

(*Trigonospora angustifrons* Sledge).

Conservation status : Endangered and protected by the FFPO, but would require removal from the list if it is not a separate species.

Distribution : Ratnapura district.

Notes : This taxon may either be a distinct species, or as tentatively suggested by Fraser-Jenkins (2008), might represent a narrow-fronded and more glabrous island race of *T. calcarata* (Blume) Ching. It is confined to lowland rainforest in Ratnapura district. Further investigation is required as to its status and relationship.

**28. *Thelypteris dassanayakei* Fraser-Jenk.\***

(*Metathelypteris flaccida* (Blume) Ching var. *repens* Sledge).

Conservation status : Not evaluated pending finalisation of its identity, but it is rare and endangered in Sri Lanka.

Distribution : Badulla and Nuwara Eliya districts.

Notes : *Metathelypteris flaccida* (Blume) Ching var. *repens* Sledge was renamed *T. dassanayakei* by Fraser-Jenkins (1997) and represents a different species from *T. flaccida*. Fraser-Jenkins (2008: 593) thought it might perhaps belong to *T. gracilescens* (Blume) Ching (Fraser-Jenkins 2008: 593), pending further study, but since studying that species, it is now confirmed that it is clearly quite distinct. *T. dassanayakei* is endemic to Sri Lanka, where it is confined to high elevation forests in Badulla and Nuwara Eliya districts.

**29. *Thelypteris gardneri* (Holttum) Panigrahi\***

(*Pronephrium gardneri* Holttum).

Conservation status : Critically Endangered (possibly Extinct) and protected by the FFPO.

Distribution : Kandy district.

Notes : This species has only been collected from one known locality in the Hantane mountain range in Kandy district and it has not been collected again since the mid 19<sup>th</sup> Century. There are no specimens in PDA and its only known locality is now highly disturbed and degraded. It is therefore presumed to be most probably extinct.

**30. *Thelypteris oppositifolia* (C.Chr.) Ching**

(*Amauropelta hakgalensis* Holttum).

Conservation status : Least Concern and protected by the FFPO.

Distribution : Kalutara, Nuwara Eliya and Ratnapura districts.

Notes : While Sledge (1981b) listed *A. hakgalensis* as “endemic? or possibly introduced”, Fraser-Jenkins (2008) put forward the presumptive adventive nature of this species, which by 2000 had spread rapidly from its original, presumed introduction at Hakgala Botanical Garden and now occurs quite commonly along roadsides and in secondary places in higher parts of Nuwara Eliya *etc.* He concluded that it belongs to the African *T.*

*bergiana* (Schlecht.) Ching group and thought it might be either that species or *T. knysnaensis* N.C. Anthony & Schelpe. But following further research at Kew in 2013, he has found that it matches quite well larger, more luxuriant plants of another closely similar species in the group, *T. oppositifolius* (C. Chr.) Ching, with straight hairs and scattered yellow glands beneath the lamina. *T. oppositifolius* has a wider range in Africa than the other species, from N.E. to southern Africa. Shaffer-Fehre (2006c) has recently recorded it from a more lowland area (Kalutara district) in Sri Lanka, though not citing Fraser-Jenkins' collections at K. In view of this we recommend that it is taken off the FFPO list.

**31. *Thelypteris obtusiloba* (Sledge) Fraser.-Jenk.**

(*Trigonospora obtusiloba* Sledge).

Conservation status : Least Concern and protected by the FFPO.

Distribution : Badulla, Colombo, Kandy, Matale, Monaragala, Nuwara Eliya and Ratnapura districts.

Notes : *T. obtusiloba* is almost certainly a synonym of *T. caudipinna* Ching (Fraser-Jenkins 2008), differing slightly in having a smaller frond, which, however, also occurs in *T. caudipinna* in S. and N.E. India. Such plants grow commonly in forests throughout the wet zone in Sri Lanka. We therefore recommend that it is taken off the FFPO list.

**32. *Thelypteris ratnapuræ* Fraser.-Jenk.**

(*Trigonospora glandulosa* Sledge).

Conservation status : Endangered and protected by the FFPO.

Distribution : Kalutara and Ratnapura districts.

Notes : *T. ratnapuræ* is a *nom. nov.* for *T. glandulosa* (Fraser-Jenkins 1997), but Fraser-Jenkins (2008) found that it is probably only a glandular and more densely hairy form of *Thelypteris calcarata* (Blume) Ching, which is confirmed here, this type of local polymorphism between different populations being a common feature among island species. It is confined to lowland rainforests in Kalutara and Ratnapura district.

**33. *Thelypteris srilankensis* Panigrahi**

(*Christella zeylanica* (Fée) Holttum).

Conservation status : Critically Endangered (possibly Extinct) in Sri Lanka and protected by the FFPO.

Distribution : Kegalle district.

Notes : *T. srilankensis* was a *nom. nov.* for *Nephrodium zeylanicum* Fée, which was preoccupied in *Thelypteris*. However Fraser-Jenkins has recently found that it is conspecific with and thus a synonym of the N.E. Indian, Myanmar and S.E. Asian species, *T. semisagittata* (Roxb.) C.V. Morton. The supposed difference of shorter auricles on the lower pinnae in *T. srilankensis* is only a question of size of the plant and occurs variably in smaller N.E. Indian plants as well, the few Sri Lankan collections mostly being of smallish size. *C. zeylanica* was also identified correctly from the Nicobar Islands by Holttum (in

Sledge 1981b) and thence reported by Shaffer-Fehre (2006c), though his report was overlooked in the rather less exhaustive account by Dixit & Sinha (2001), who listed it as doubtful only because they had not seen the specimen; it was also inadvertently overlooked by Fraser-Jenkins in Ebihara *et al.* (2012).

The species was only known from one locality in Sri Lanka and has not been collected there since the 19<sup>th</sup> Century; it is presumed to be extinct in the island.

#### 34. *Thelypteris sledgei* Fraser-Jenk.\*

(misapplied name : *Christella taprobanica sensu* Holttum, *non* (Panigrahi) Holttum).

*Conservation status*: Endangered.

*Distribution* : Badulla and Nuwara Eliya districts.

*Notes* : *T. sledgei* is a *nom. nov.* for the endemic *Christella papilio* (C.Hope) Holttum var. *repens* Sledge. When Panigrahi unauthorisedly attempted to name Holttum and Sledge's species himself he cited the material at Kew, but as he did not know the species, he chose the wrong specimen as holotype which was merely a specimen of *T. dentata* (Forssk.) E.P.St.John (as explained by Sledge, 1981b and Fraser-Jenkins, 1997), thus his *T. taprobanica* was only a synonym of *T. dentata* and is not endemic as he thought. *T. sledgei* is distributed in high altitude forests in central parts of the island, where it is rare and endangered. It is recommended to be protected by the FFPO.

#### 35. *Thelypteris stipitata* Fraser-Jenk.

(*Stegnogramme pozoi* (Lag.) K.Iwats. var. *petiolata* (Ching) Sledge).

*Conservation status* : Least Concern.

*Distribution* : Nuwara Eliya district.

*Notes* : *T. stipitata* is a *nom. nov.* for *Leptogramme petiolata* Ching (Fraser-Jenkins 1997, 2008) and is not endemic to Sri Lanka as thought by Sledge (1981b). It occurs in Sri Lanka and S.E. Asia (Java and probably elsewhere), but is replaced in India by *T. mollissima* (Kunze) N.Thapa. It is common in higher altitude forests in central Sri Lanka.

#### 36. *Thelypteris taprobanica* Panigrahi

(*Thelypteris dentata* (Forssk.) E.P.St.John).

*Conservation status* : Not evaluated.

*Distribution* : Badulla, Galle, Hambantota, Kalutara, Kandy, Matale, Monaragala, Nuwara Eliya and Ratnapura districts.

*Notes* : Panigrahi (1976) was attempting to provide his own new name for Sledge's *Christella papilio* var. *repens*, but as he had no knowledge of the species and did not consult with Sledge or Holttum, he mistakenly chose a specimen of *T. dentata* as the type, since that also has a horizontal rhizome. The totally erroneous species, *T. taprobanica*, is therefore not endemic to Sri Lanka as thought.

#### 37. *Thelypteris thwaitesii* (Hook.) C.F.Reed\*

(*Pronephrium thwaitesii* (Hook.) Holttum).

Conservation status : Presumed Extinct

Distribution : Kandy, Ratnapura and Matale districts.

Notes : Although intermediate in morphology between *T. triphylla* (Sw.) K.Iwats. and either *T. parasitica* (L.) Tardieu, *T. dentata* or *T. subpubescens* (Blume) Holttum (or related species), Sledge has pointed out that it has good spores; it is thus apparently not a sterile F1 hybrid, but more likely to be an allopolyploid species. It therefore differs from similar plants in S. India first found by Beddome and more recently by Geevarghese, which Fraser-Jenkins (1997, 2008) has confirmed to have abortive spores and has reidentified as the hybrid *T. x insularis* (K.Iwats.) K.Iwats. *T. thwaitesii* is thus endemic to Sri Lanka (overlooked by Shaffer-Fehre 2006c), as so far known, where it is very rare, confined to three known localities and has not been seen again since the 19<sup>th</sup> Century. It is probable that it may be extinct, pending further search. The listing from Assam by Chandra *et al.* (2008) was in error for a fairly common species or hybrid near to *T. triphylla* (Sw.) K.Iwats. (Fraser-Jenkins in Ebihara *et al.*, 2012), which may be the same as *T. parishii* (Bedd.) Panigrahi.

### 38. *Thelypteris zeylanica* Ching\*

(*Trigonospora zeylanica* (Ching) Sledge)

Conservation status : Vulnerable and protected by the FFPO.

Distribution : Kalutara, Ratnapura, Galle and Matara districts.

Notes : Although at first sight a very distinct taxon, it was suggested by Fraser-Jenkins in Ebihara *et al.* (2012) and Fraser-Jenkins (2012) that the Sri Lankan plant might be a depauperate form of *T. calcarata*, though he listed it at too high an IUCN category as “?CR”. He has since found that it merely represents typical narrow-segmented morphology of a rheophytic ecotype of *T. calcarata*, rather than a distinct species. The almost exactly similar form from Arunachal Pradesh, N.E. India, suggested by Fraser-Jenkins to belong to *T. caudipinna*, is now confirmed here from its hairy axes and costae to be a rheophytic form, but of *T. tenera* (Roxb.) C.V.Morton ex Fraser-Jenk., and is not *T. calcarata* ‘forma *zeylanica*’. A further Arunachal collection of it was misreported by Singh & Panigrahi (2005) as a new record of *T. zeylanica* from India, overlooked by Shaffer-Fehre (2006c). However ‘forma *zeylanica*’ is now understood to be endemic to Sri Lanka, though it should also be searched for by stream-beds in South India. It is recommended to be protected by the FFPO.

## ASPLENIACEAE

Although *Hymenasplenium* and *Neottopteris* have sometimes been separated from *Asplenium* there are no convincing taxonomic grounds for doing so and we follow the widely accepted concept of a single genus here. *Hymenasplenium* has no points of distinction from the rest of *Asplenium* and is best treated as a section of the latter. Three species have been reported by Sledge (1965, 1982), followed by Philcox (2006d) as

endemic to Sri Lanka.

**39. *Asplenium disjunctum* Sledge\***

Conservation status : Critically Endangered and protected under the FFPO.

Distribution : Badulla and Monaragala districts.

Notes : *A. disjunctum* is only known from three 19<sup>th</sup> Century collections from two localities and is generally thought to be most probably extinct. The last known record was from Mandagala (Monaragala district) in 1885. It was inadvertently mentioned from India without locality or documentation by Dixit (1984) in error.

**40. *Asplenium gardneri* Baker**

Conservation status : Vulnerable.

Distribution : Matale, Matara, Nuwara Eliya and Ratnapura districts.

Notes : Sledge (1965) and thence Philcox (2006d) reported the occurrence of *A. gardneri* in Sri Lanka and Sumatra, but the latter locality was inadvertently overlooked by Fraser-Jenkins in Ebihara *et al.* (2012). It is therefore not endemic to Sri Lanka as stated there. Furthermore the differences between *A. gardneri* and the Chinese and Myanmar *etc. A. trapezoideum* Ching, which almost certainly includes the N.E. Indian *A. khasianum* Sledge, are minute and only concern a slight difference in perispore and in length of the cells in the stipe-scales, the latter appearing to be rather variable. Further study and cytotaxonomic investigation is required before *A. trapezoideum* can be accepted as a distinct species from *A. gardneri* rather than just slight local variation. *A. gardneri* occurs in lowland rainforest in central and southern Sri Lanka, where it is uncommon and restricted.

**41. *Asplenium longipes* Fée\***

Conservation status : Endangered and protected under the FFPO.

Distribution : Nuwara Eliya district.

Notes : This species is confined to high altitude forests in Nuwara Eliya district, where it occurs commonly.

#### WOODSIACEAE

Although Pichi-Sermolli, Ching and others had accepted Alston's family Athyriaceae, Kramer & Green (1990) and Smith *et al.* (2006) placed it within Woodsiaceae, which is accepted here as a more appropriate treatment for this group of interrelated genera, and was followed by Fraser-Jenkins (1997, 2008, 2010) and Fraser-Jenkins & Zink (2006). Recent molecular cladonomic findings by Christenhusz *et al.* (2011), Christenhusz & Chase (2014) and Sundue & Rothfels (2013) are not accepted here as being convertible into taxonomic classification, as they attempted to separate several obviously athyroid genera into undefinable small groups of pointless micro-families of no significance.

*Athyrium* has no endemic species in Sri Lanka, but two F1 sterile hybrids occur



there which have not been recorded from S. India, which is the only other possible area of occurrence, given the distribution of *A. praetermissum* Sledge, **Athyrium x mantoniae** Fraser-Jenk. (*A. praetermissum* x *A. solenopteris* (Kunze) T.Moore), and **Athyrium x sledgei** Fraser-Jenk. (*A. praetermissum* x *A. puncticaule* (Blume) T.Moore agg. [Sledge's "*A. macrocarpum*", *non* (Blume) Bedd. [= *A. puncticaule*]]) (Fraser-Jenkins 2008).

**42. *Deparia polyrhiza* (Baker) Seriz.\***

Conservation status : Critically Endangered and protected by the FFPO.

Distribution : Nuwara Eliya district

Notes : The endemic status of this species may perhaps be subject to revision as a very similar species, illegitimately named *D. concinna* (Z.R.Wang) M.Kato, *non* Baker, from China and Nepal (see Fraser-Jenkins 2008: 608), appears to be almost identical to the Sri Lankan plant, though cytotaxonomic investigation has not yet been carried out on it, while *D. polyrhiza* is tetraploid. Further study and comparison is required before its status can be decided.

This very rare species is confined to high altitude forest (at c. 2000 m) in Nuwara Eliya district, where it is only known from a single locality. It was inadvertently omitted by Fraser-Jenkins in Ebihara *et al.* (2012). The collection, CRFJ 20178-9 (FN 426-7) from Farr Inn, cited as this species by Fraser-Jenkins & Zink (2006), has been reidentified by CRFJ in 2011 as *D. japonica* (Thunb.) M.Kato, but belonging to the more densely scaly Sri Lankan form of that species, which was named *Diplazium thwaitesii* (A.Braun ex Mett.) Klotsch ex T.Moore. This latter taxon is yet to be investigated cytologically, but may perhaps represent a distinct species close to *D. japonica* (see Fraser-Jenkins 2008).

**43. *Deparia thwaitesii* (A.Braun ex Mett.) Fraser-Jenk.\***

Conservation status : Critically Endangered.

Distribution : Ratnapura district.

Notes : This critical species is related to *D. japonica*, but has noticeably more scaly axes and appears to be a distinct taxon. It is recommended to be protected by the FFPO.

**44. *Deparia zeylanica* (Hook.) M.Kato\***

Conservation status : Critically Endangered (possibly Extinct) and protected by the FFPO.

Distribution : Ratnapura and Nuwara Eliya districts.

Notes : This species is intermediate in morphology between *D. lancea* (Thunb.) Fraser-Jenk. and *D. petersenii* (Kunze) M.Kato and has been thought to be a hybrid, but the spores of the Sri Lankan plant are not abortive, so it is more likely to be an allopolyploid species, though its cytotype has never been investigated and the spores are not very large. The Sri Lankan and S. Indian hexaploid *D. petersenii* subsp. *sledgei* Fraser-Jenk. should be investigated as one of the possible ancestral species. Reports of "*D. x zeylanica*" (being *D. lancea* x *D. petersenii* subsp. *petersenii* (4x)) from C. Nepal, where

subsp. *sledgei* is absent, refer to a closely similar tetraploid hybrid, *D. x nakaikeana* Fraser-Jenk. (2008), thus *D. zeylanica* as so far known is endemic to Sri Lanka.

It is a very rare species in grave danger of extinction or already extinct (Fraser-Jenkins in Ebihara *et al.* 2012), with only one collection in 1968 from Adam's Peak area, known since the 19<sup>th</sup> Century.

**45. *Diplazium beddomei* C.Chr.**

Conservation status : Near Threatened.

Distribution : Kandy, Nuwara Eliya and Ratnapura districts.

*Notes:* This species was known to Sledge (1962, 1982) as endemic to Sri Lanka, but has since been found by Manickam (Manickam & Irudayaraj 1992 *etc.*), determined by Sledge and confirmed by CRFJ, in S. India, which was overlooked by Zink in Fraser-Jenkins and Zink (2006). It is an uncommon species of upper-mid altitudes on the island.

**46. *Diplazium cognatum* (Hieron.) Sledge**

Conservation status : Endangered and protected by the FFPO.

Distribution : Badulla, Matale and Nuwara Eliya districts.

*Notes :* This rare and little collected species was known to Sledge (1962, 1982) as endemic to Sri Lanka, but has since been found by Manickam (Manickam & Irudayaraj 1991 *etc.*) in S. India (see Fraser-Jenkins 2012), which was overlooked by Zink in Fraser-Jenkins and Zink (2006). In addition Fraser-Jenkins (2008) and in Ebihara *et al.* (2012) reported it as probably a synonym of *D. leptophyllum* Baker, from N.E. India, China and Myanmar, which is further confirmed here.

**47. *Diplazium decurrens* Bedd.\***

Conservation status : Near Threatened.

Distribution : Kandy, Kegalle, Nuwara Eliya and Ratnapura districts.

*Notes :* This endemic species is scattered throughout central parts of the island at mid altitudes. Its collection in Sri Lanka in 1993 by CRFJ (K) was overlooked by Zink in Fraser-Jenkins and Zink (2006).

**48. *Diplazium paradoxum* Fée\***

Conservation status : Endangered and protected by the FFPO.

Distribution : Kandy and Matale districts.

*Notes :* This rare species occurs in a few localities at mid altitude in central Sri Lanka. It was only collected once last Century, and otherwise in the 19<sup>th</sup> Century and has not been collected since 1954.

**DRYOPTERIDACEAE**

Although Smith *et al.* (2006) and later molecular workers separated Tectariaceae from Dryopteridaceae, but not including *Ctenitis*, or even, recently (Zhang & Zhang 2012) *Pleocnemia*, obviously very close to *Tectaria*, such dispositions are opposed to

overwhelming and fundamental morphological evidence, and are not accepted taxonomically here. Zhang (2012) also synonymised *Dryopsis* (among other genera) within *Dryopteris*, in serious conflict with its morphology and hairs. Additionally Christenhusz *et al.* (2011) and Christenhusz & Chase (2014) transferred *Bolbitis* and *Elaphoglossum* from their long standing place in Lomariopsidaceae to Dryopteridaceae or “Subfam. Dryopteridoideae”, disregarding their very distinct morphology which they arbitrarily guessed to be a secondary derivation of less significance. These cladonomic considerations are not accepted here to be directly related to taxonomic classification and such taxonomic conclusions are unable to be drawn from that type of work. They are not followed here.

**49. *Dryopsis obtusiloba* (Baker) Holttum & P.J. Edwards\***

(*Ctenitis obtusiloba* (Baker) Ching).

Conservation status : Vulnerable.

Distribution : Badulla, Kandy and Nuwara Eliya districts.

Notes : This species is fairly common but scattered in higher altitude forests in the centre of the island. Its collection from Ramboda Pass by CRFJ in 1993 (K) was overlooked by Zink (2006b). The South Indian *Dryopsis ferruginea* (Baker) Holttum & P.J. Edwards is evidently a slightly separate vicariant species.

**50. *Ctenitis thwaitesii* Holttum\***

Conservation status : Endangered.

Distribution : Kandy, Matale and Nuwara Eliya districts.

Notes : This is a rare endemic species of upper-mid altitude forests; there are no records since 1954. It was reported from India by Chandra (2000) in error for *C. subglandulosa* (Hance) Ching. It is recommended to be protected by the FFPO.

**51. *Dryopteris deparioides* (T. Moore) Kuntze subsp. *ambigua* (Sledge) Fraser-Jenk.\***

(*Dryopteris ambigua* Sledge).

Conservation status : Critically Endangered.

Distribution : Badulla and Nuwara Eliya districts.

Notes : This taxon is a glandular form of the rather polymorphic *D. deparioides*. It is near to subsp. *concinna* C. Chr., and can either be treated as a form of it, sunk within it (Fraser-Jenkins 2006, Fraser-Jenkins in Ebihara *et al.* 2012) or as a separate subspecies of *D. deparioides*, as here (and Fraser-Jenkins 1989, 2008). Bearing in mind its more acutely angular, narrower segments and glandulosity, it is treated here as an endemic subspecies. It is only known from two localities in higher altitude forests and has not been collected since 1954. It is recommended to be protected by the FFPO.

**52. *Dryopteris deparioides* (T. Moore) Kuntze subsp. *concinna* C. Chr.**

Conservation status : Critically Endangered.

Distribution : Ratnapura district.

Notes : This subspecies has only been recorded at low altitude from Sinharaja forest

in the Southern part of the island and has not been collected there since 1954. It is not endemic as it also occurred in S. India in the 19<sup>th</sup> Century, though it may well be extinct there now. It is recommended to be protected by the FFPO.

**53. *Dryopteris deparioides* (T.Moore) Kuntze subsp. *deparioides*.\***

Conservation status : Critically Endangered.

Distribution : Kandy, Nuwara Eliya, Ratnapura and Galle districts.

Notes : A very rare low altitude forest subspecies, known only from four localities and not collected again since 1951. It is recommended to be protected by the FFPO.

**54. *Dryopteris deparioides* (T.Moore) Kuntze subsp. *gracillima* (Ching) Fraser-Jenk.**

(*D. gracillima* Ching, and var. *gracillima*, var. *prolongata* Sledge and var. *triangularis* Sledge).

Conservation status : Not assessed.

Distribution : Matale, Kandy and Nuwara Eliya districts.

Notes : *D. gracillima* consists of various small, precociously fertile growth-stages, several treated as separate varieties of *D. gracillima* by Sledge (1973a), though not recognised here. Although Sledge treated them as a separate, endemic species allied to *D. deparioides*, he cautioned that they might be precociously fertile stages of that species and they were so treated by Fraser-Jenkins (1989). But following field study in 1993, Fraser-Jenkins (2006) found that it is connected by intermediate stages to what he then called *D. macrochlamys* (Fée) Fraser-Jenk., at that time traditionally including *D. undulata* (Bedd.) Kuntze, so did not separate it as a subspecies. Following this Fraser-Jenkins in Widén *et al.* (2001) and Fraser-Jenkins (1997, 2008) separated *D. undulata*, including *D. gracillima* as a synonym, from *D. macrochlamys*. *D. gracillima* is therefore a synonym of *D. undulata* and is no longer treated as if a distinct endemic subspecies.

**55. *Dryopteris macrochlamys* (Fée) Fraser-Jenk.\***

(*Dryopteris obtusissima* (Mett.) Christ).

Conservation status : Least Concern.

Distribution : Kandy, Nuwara Eliya, Ratnapura and Badulla districts.

Notes : This is a fairly common, endemic species of upland forests in central Sri Lanka. Sledge (1973a) overlooked the name or identity of *D. macrochlamys* and treated the species under the name *D. obtusissima*. He also followed the traditional placement of *D. undulata* as a form within it, as did Fraser-Jenkins (1989, 2006), but following field-study in 1993, Fraser-Jenkins (1997, 2008) and Fraser-Jenkins in Widén *et al.* (2001) separated *D. undulata* from *D. macrochlamys*.

**56. *Dryopteris srilankensis* Fraser-Jenk.**

(*Dryopteris simulans* Ching, *non* (Baker) Kuntze).

Conservation status : Not assessed.

Distribution : Matale, Kandy, Nuwara Eliya and Ratnapura districts.

Notes : This taxon appears at first sight to be a distinct species and was treated as such by Sledge (1973a) under the later homonym, *D. simulans*, and thence by Fraser-Jenkins (1989) as *D. srilankensis*. However Fraser-Jenkins (2006) treated it as one of the island forms of *D. macrochlamys*, at that time including *D. undulata*, but Fraser-Jenkins (1997, 2008) then separated *D. undulata* from *D. macrochlamys* with *D. srilankensis* being a synonym of *D. undulata*, of which it represents the “normal” form.

**57. *Dryopteris undulata* (Bedd.) Kuntze\***

(*Rumohra zeylanica* Ching, *Dryopteris srilankensis* Fraser-Jenk., *Dryopteris gracillima* Ching).

Conservation status : Vulnerable.

Distribution : Matale, Kandy, Nuwara Eliya and Ratnapura districts.

Notes : Although *D. undulata* represents an abnormal form, it is the correct name for this endemic species. Sledge (1973a) and Fraser-Jenkins (1989, 2006) followed earlier authors in sinking it into what is now called *D. macrochlamys*, but later Fraser-Jenkins in Widén *et al.* (2001) and Fraser-Jenkins (1997, 2008) separated it from *D. macrochlamys* as being an abnormal form of *D. srilankensis*, and thus the earliest and correct name for it. Like some other Sri Lankan *Dryopteris* species, *D. undulata* has a confusing array of slightly different island forms within it. It is scattered but not particularly rare in mid-altitude forests in the centre of the island.

**58. *Polystichum anomalum* (Hook. & Arn.) J.Smith**

Conservation status : Vulnerable and protected by the FFPO.

Distribution : Badulla, Kandy and Nuwara Eliya districts.

Note : Sledge (1982) identified this species as a Sri Lankan endemic. Fraser-Jenkins (1991, 2008, 2012) has confirmed its occurrence in South India. Its almost unique morphology of often having the sori on the top surface is highly distinctive.

**59. *Polystichum walkerae* (Hook.) Sledge\***

(*P. walkerae* var. *bipinnatum* (Bedd.) Sledge).

Conservation status : Near threatened.

Distribution : Kandy, Nuwara Eliya, Ratnapura and Matara districts.

Notes : Sledge (1973a) discussed the remarkable range of variation of the endemic species, *P. walkerae*. Like him, Fraser-Jenkins (2001, 2006) included all the variable forms within *P. walkerae*.

**60. *Pteridrys zeylanica* Ching**

Conservation status : Critically endangered (possibly Extinct) and protected by the FFPO.

Distribution : Kandy district.

Notes : Sledge (1982) and Zink (2006b) identified this species as a Sri Lankan endemic, but it is also present in South India (Fraser-Jenkins, 2012).



**61. *Tectaria thwaitesii* (Bedd.) Ching\***

Conservation status : Vulnerable and protected by the FFPO.

Distribution : Galle and Nuwara Eliya districts.

Notes : This endemic species occurs scattered in lowland forests in the south of the island. One collection is labelled Ramboda Pass, *Chevalier s.n.*, but if really from there, must have been at lower altitude below the start of the pass, however its presence in Nuwara Eliya district is unlikely and requires confirmation as it may be a mislocalisation.

**LOMARIOPSIDACEAE**

Although included recently within Dryopteridaceae on molecular-cladonomic grounds, its very distinctive morphology indicates that it is more appropriately maintained as a family in the traditional way.

**62. *Bolbitis subcrenata* (Hook. & Grev.) Ching**

Conservation status : Vulnerable.

Distribution : Ratnapura and Galle districts.

Notes : This species is not present in S. India as previously thought, including as “var. *subcrenata*” by Zink (2006c), where it is replaced by the related *B. beddomei* Fraser-Jenk. & Gandhi (2015, in press) (misapplied name : *B. subcrenatoides* Fraser-Jenk., *nom. superfl.* (Fraser-Jenkins 2008)). *B. subcrenata* is therefore endemic to Sri Lanka, where it is relatively common in lowland rainforests.

**63. *Elaphoglossum ceylanicum* Krajina ex Sledge\***

Conservation status : Endangered.

Distribution : Kandy and Nuwara Eliya districts.

Notes : This endemic species was misreported by Chandra (2000) from Sikkim in error for *E. stelligerum* (Wall. ex Baker) T.Moore ex Salomon (Fraser-Jenkins 2008). It is recommended for protection by the FFPO.

**POLYPODIACEAE****64. *Leptochilus metallicus* (Bedd.) C.Chr.\***

Conservation status : Endangered.

Distribution : Galle, Matara and Ratnapura districts.

Notes : Unfortunately the accounts of Nootboom (1998) and Hovenkamp (2006) for this genus are unsatisfactory and uncritical and failed to understand or separate the different species in Sri Lanka and elsewhere, so are of little use, treating all the narrower-fronded collections as belonging to a single species of various forms. However Sledge (1956, 1960), modified in one case by Fraser-Jenkins (2008), treated the separate species. It is confined to the south and south-west parts of the island, especially the Sinharaja region (Sledge 1956). It is recommended for protection by the FFPO.

**65. *Leptochilus thwaitesianus* Fée**

Conservation status : Not evaluated.

Distribution : Kandy and Nuwara Eliya districts.

Notes : Sledge (1956) initially reported this species in a mixed concept from S. and C. India as well as Sri Lanka, but later (Sledge 1982) narrowed his concept to include only Sri Lanka, as an uncommon endemic species. However, as suggested by Fraser-Jenkins (2008) the distinction of *L. thwaitesianus* is doubtful, and it is concluded here that it is only a smaller rheophytic form of *L. lanceolatus* Fée, which latter Fraser-Jenkins (2008) separated from *L. decurrens* Blume subsp. *decurrens*, in contrast to Sledge's combining them. Specimens belonging to this form also occur in India, and it is evidently not endemic to Sri Lanka.

**66. *Leptochilus wallii* (Baker) C.Chr.\***

Conservation status : Extinct.

Distribution : Matara district.

Notes : Extremely rare possible endemic species known only from one locality, since destroyed (Sledge 1956) and now presumed to be extinct. Its distinction from *L. minor* Fée is rather doubtful and requires further study, but many species have been included together in an uncritical account by Hovenkamp (2006).

**67. *Pyrrosia gardneri* (Mett.) Sledge\***

Conservation status : Least Concern.

Distribution : Anuradhapura, Galle, Kalutara, Kandy, Kurunegala, Matara, Nuwara Eliya and Ratnapura districts.

Notes : Although Sledge (1982) listed *P. gardneri* from both Sri Lanka and South India. Its S. Indian distribution must have referred to Beddome's unsubstantiated and perhaps erroneous report from the Anamalai Hills. Hovenkamp (1986, 2006) only listed it from Sri Lanka and was not aware of any possible occurrence in S. India. Fraser-Jenkins (2008) noted that its presence in South India is doubtful and requires confirmation and *P. gardneri* is accepted as most probably an endemic Sri Lankan species here. It is a common species in Sri Lanka and has a wide range of distribution at lower-mid altitude in the dry, intermediate and wet zones.

**68. *Pyrrosia pannosa* (Mett. ex Kuhn) Ching\***

Conservation status : Near Threatened.

Distribution : Ampara, Badulla, Kandy, Monaragala, Polonnaruwa and Ratnapura districts.

Notes : The present species occurs in the transition zone between the wet and dry zones (Sledge 1960) and is endemic to Sri Lanka. It was reported from Uttarakhand in the West Himalaya by Dhir (1980) in error for *P. flocculosa*, from Sikkim and peninsular India by Satija and Bir (1985) in error for *P. heteractis* (Fraser-Jenkins 2008, sub "*P. lingua*") and from Myanmar by Dickason (1946) in error for *P. heteractis* (Hovenkamp 1986).

## GRAMMITIDACEAE

The adjacent relationship between Grammitidaceae and Polypodiaceae has long been known taxonomically. But Schneider *et al.* (2004) and Smith *et al.* (2006) included Grammitidaceae within Polypodiaceae, calling them “polygramoids” merely in order to avoid paraphyly, which is not an important consideration taxonomically. Their combination of the two on molecular-cladonomic grounds alone was both unnecessary and less than useful, and is not followed here as Grammitidaceae is a morphologically distinct major group, best maintained traditionally as a separate family, as is being done by Smith in UC herbarium.

The generic concept used here follows the morphologically-based treatments in Parris (2006, 2007).

**69. Calymmodon glabrescens** Copel.\*

(“*C. cucullatus*” *sensu* Sledge (1960) *et al.*, *non* (Nees & Blume) C.Presl).

Conservation status : Least Concern.

Distribution : Kandy, Nuwara Eliya, Ratnapura, Matale and Matara districts.

Notes : This species is rather common and widely distributed in montane, submontane and lowland rain forests.

**70. Ctenopterella cornigera** (Baker) Parris\*

(*Xiphopteris cornigera* (Baker) Copel.).

Conservation status : Critically Endangered and protected by the FFPO.

Distribution : Nuwara Eliya district.

Notes : This species is endemic to Sri Lanka and very rare, only four specimens being known from a single known locality. Only one collection was made last Century and it has not been collected since 1950.

**71. Ctenopteris thwaitesii** (Bedd.) Sledge\*

Conservation status : Vulnerable and protected by the FFPO.

Distribution : Kandy, Kegalle and Nuwara Eliya districts.

Notes : This is a rare endemic species known from a handful of localities at mid-altitude in Central Sri Lanka. The last known record was from Kegalle district in 1954.

**72. Oreogrammitis medialis** (Baker) Parris\*

(*Grammitis medialis* (Baker) Ching).

Conservation status : Vulnerable.

Distribution : Kandy, Nuwara Eliya and Ratnapura districts.

Notes : This species is distributed in montane, submontane and lowland rainforests. It is more common in lowland evergreen forests, on wet rocks beside streams, than in montane forests.

**73. Oreogrammitis sledgei** (Parris) Parris\*

(*Grammitis sledgei* Parris).

Conservation status : Vulnerable.

Distribution : Galle, Nuwara Eliya and Ratnapura districts.

Notes : *O. sledgei* is quite common on mossy rocks along rivers in lowland evergreen forests. It was previously included within *O. medialis* by Sledge (1960).

**74. Oreogrammitis wallii** (Bedd.) Parris\*

(*Grammitis wallii* (Bedd.) Copel.).

Conservation status : Critically Endangered and protected by the FFPO.

Distribution : Kegalle, Nuwara Eliya and Ratnapura districts.

Notes : There were several collections from two known localities before 1900, but only two collections from a further locality in the middle of last Century.

**75. Oreogrammitis zeylanica** (Fée) Parris\*

(*Grammitis zeylanica* Fée).

Conservation status : Least Concern.

Distribution : Kandy, Matale and Nuwara Eliya districts.

Notes : This is a common if scattered species of upper-mid level forests.

**76. Prosaptia ceylanica** Parris\*

Conservation status : Critically Endangered.

Distribution : Matara district.

Notes : *P. ceylanica* was collected in 1954 in Sinharaja Forest and is known only from the type specimen at Kew. It is recommended to be protected by the FFPO.

**77. Radiogrammitis beddomeana** (Alderw.) Parris

(*Grammitis beddomeana* (Alderw.) Ching).

Conservation status : Critically Endangered.

Distribution : Nuwara Eliya district.

Notes : There are very few collections from only two known localities, confined to upper-mid altitude forest areas in Nuwara Eliya district. It has not been collected since the mid 19<sup>th</sup> Century, leading to fears that it might be extinct, but it is probably more likely that it may have been overlooked due to its small size. It is recommended to be protected by the FFPO.

This species has recently been found in Vietnam (Parris et al. 2015), so is no longer endemic to Sri Lanka.

**78. Tomophyllum epaleatum** (Parris) Parris

(*Ctenopteris epaleatum* Parris).

Conservation status : Endangered.

Distribution : Kandy and Nuwara Eliya districts.

Note : Sledge (1982) identified it as a Sri Lankan endemic. But based on

information from Parris, Ebihara *et al.* (2012) listed its occurrence also in Java. It is recommended to the FFPO for protection.

#### DISCUSSION AND CONCLUSIONS

From the above list it can be seen that Sri Lanka has 47 endemic taxa of pteridophytes, which is shortly over 10% of the total number of 350 species of pteridophytes now known on the island. Its isolated island situation is undoubtedly one of the main reasons for this high level of endemism of pteridophytes. In addition the long-separate and isolated position of the Hindu-Lankan flora of S. India and Sri Lanka, particularly of the latter, has brought about the fact that the great bulk of endemic species of the Indian region (*sens. lat.*) are in the South, not in the Himalayan region, as had at one time been surmised by Indian botanists (see Fraser-Jenkins 2012). Prior to the present study, Sledge (1982) reported 57 species as endemic. Fernando (2002) compiled a checklist of Sri Lankan pteridophytes which also listed 57 species as endemics. Shaffer-Fehre (2006a) reported the occurrence of 348 pteridophyte species of which 48 were considered to be endemic.

Though the *Revised Handbook to the Flora of Ceylon* was compiled from 1993-1995, it was not published until 2006. Important taxonomic changes proposed after 1995 were therefore not included in it. Ranil *et al.* (2008) evaluated the status of the endemic pteridophytes of Sri Lanka which was based entirely on the list provided in the *Flora*. But during the last decade or two, the number of endemic pteridophytes has changed largely due to recently conducted pteridological study in South India and also due to reidentification of previously misidentified species. Thus 10 species that were reported as endemics by Shaffer-Fehre (2006a) are now known not to be endemic to Sri Lanka due to their presence in South India or other phytogeographically related areas in the region. We have now revised the status of 30 species and there remain only 2 species whose endemic status is uncertain. Further taxonomic research is required to clarify the possible endemic status of these 2 species.

Jaysekara & Wijesundara (1993) reported that 81% of pteridophyte specimens in the National Herbarium have been collected from the wet zone of Sri Lanka. Similarly all the endemic species are recorded from the wet zone with the exception of only two species, *Pyrrosia pannosa* and *P. gardneri*, which have been recorded from the dry zone of Sri Lanka. The central province of Sri Lanka (Kandy, Matale and Nuwara Eliya districts) provides the habitat for 32 endemic species. Eleven endemic species are confined to the Southern lowland rainforests.

Four endemic species have not been recorded during the last and present Centuries (*Thelypteris gardneri* (Holttum) Panigrahi, *Thelypteris thwaitesii* (Hook.) C.F.Reed, *Asplenium disjunctum* Sledge and *Leptochilus wallii* (Baker) C.Chr.). These species are considered likely to be extinct, as reflected in their IUCN category, with the possible



exception of *R. beddomeana*, which could easily have been overlooked due to its small size. However it is unfortunately the case that almost no modern exploration by specialists fully familiar with the Sri Lankan pteridophyte flora has been carried out since the important work of the Leeds University personnel (Prof. I. Manton, Dr. W.A. Sledge and Dr. T.G. Walker) in the 1950s and this especially applies to recent years due to rigid new restrictions on collection activity. No systematic investigation of the last known localities for very rare species has been carried out. It is therefore possible that continued occurrence of some of the above species may have been overlooked.

However these probable extinctions should probably be expected to have occurred, considering the marked climatic and environmental changes in the environment that have happened since last century, caused by extensive deforestation and habitat degradation. The island has lost approximately half of the area of forest it had just over half a century ago in the 1950s, and currently retains only about 23.5% of its area in forest cover (IUCN 2007). Habitat loss and fragmentation, spread of invasive species, soil erosion and environmental pollution are common even in the wet zone of Sri Lanka where almost all its indigenous and endemic pteridophytes occur and the most immediate threats to survival of biodiversity have arisen (MFE 1999; NSF 2000). The high pteridophytic diversity areas of tropical lowland and montane forest are highly fragmented, and in many montane forests, such as the Knuckles regions, the forest understory which is the main habitat for pteridophytes has been cleared for cardamom cultivation. These problems will undoubtedly be worsened by human pressure on resources in the future. The results of this study, which reveal how little we know of the present status of many of the rarest endemic species, provide strong support for the need to initiate an island-wide survey of the endemic pteridophytes and their recorded localities in Sri Lanka. Given the minimum of modern collection by Sri Lankan botanists over the last twenty years, the occurrence of many species has simply not been investigated, which is urgently needed. Such an assessment would result in a wealth of accurate information on the pteridophyte-flora of Sri Lanka and on the environmental health of the localities they occur in as well as providing a baseline measurement towards resolution of many of the taxonomic and conservation issues that we face today.

A summarized list of accepted, rejected and doubtful endemic species in Sri Lanka.

#### **(A) Accepted endemics**

##### **Selaginellaceae**

1. *Selaginella calostachya* (Hook. & Grev.) Alston
2. *Selaginella latifolia* (Hook. & Grev.) Spring
3. *Selaginella ornithopodioides* (L.) Spring
4. *Selaginella praetermissa* Alston

##### **Hymenophyllaceae**

5. *Hymenophyllum macroglossum* Bosch
6. *Trichomanes wallii* Thwaites ex Trimen

**Cyatheaceae**

7. *Cyathea hookeri* Thwaites
8. *Cyathea sinuata* Hook. & Grev.
9. *Cyathea sledgei* Ranil, Pushpakumara & Fraser-Jenk.
10. *Cyathea srilankensis* Ranil
11. *Cyathea walkeri* Hook.

**Lindsaeaceae**

12. *Lindsaea caudata* Hook.
13. *Lindsaea schizophylla* (Baker) Christ

**Thelypteridaceae**

14. *Thelypteris dassanayakei* Fraser-Jenk.
15. *Thelypteris gardneri* (Holtum) Panigrahi
16. *Thelypteris sledgei* Fraser-Jenk.
17. *Thelypteris thwaitesii* (Hook.) C.F.Reed
18. *Thelypteris zeylanica* Ching

**Aspleniaceae**

19. *Asplenium disjunctum* Sledge
20. *Asplenium longipes* Fée

**Woodsiaceae**

21. *Deparia polyrhiza* (Baker) Seriz.
22. *Deparia thwaitesii* (A.Braun ex Mett.) Fraser-Jenk.
23. *Deparia zeylanica* (Hook.) M.Kato
24. *Diplazium decurrens* Bedd.
25. *Diplazium paradoxum* Fée

**Dryopteridaceae**

26. *Dryopsis obtusiloba* (Baker) Holttum & P.J. Edwards
27. *Ctenitis thwaitesii* Holttum
28. *Dryopteris deparioides* (T.Moore) Kuntze subsp. *ambigua* (Sledge) Fraser-Jenk.
29. *Dryopteris deparioides* (T.Moore) Kuntze subsp. *deparioides*.
30. *Dryopteris macrochlamys* (Fée) Fraser-Jenk.
31. *Dryopteris undulata* (Bedd.) Kuntze
32. *Polystichum walkerae* (Hook.) Sledge
33. *Tectaria thwaitesii* (Bedd.) Ching

**Lomariopsidaceae**

34. *Bolbitis subcrenata* (Hook. & Grev.) Ching
35. *Elaphoglossum ceylanicum* Krajina ex Sledge

#### **Polypodiaceae**

36. *Leptochilus metallicus* (Bedd.) C.Chr.
37. *Leptochilus wallii* (Baker) C.Chr.
38. *Pyrrosia gardneri* (Mett.) Sledge
39. *Pyrrosia pannosa* (Mett. ex Kuhn) Ching

#### **Grammitidaceae**

40. *Calymmodon glabrescens* Copel.
41. *Ctenopterella cornigera* (Baker) Parris
42. *Ctenopteris thwaitesii* (Bedd.) Sledge
43. *Oreogrammitis medialis* (Baker) Parris
44. *Oreogrammitis sledgei* (Parris) Parris
45. *Oreogrammitis wallii* (Bedd.) Parris
46. *Oreogrammitis zeylanica* (Fée) Parris
47. *Prosaptia ceylanica* Parris

#### **(B) Rejected endemics**

#### **Lycopodiaceae**

1. *Huperzia ceylanica* (Spring) Trevis.

#### **Selaginellaceae**

2. *Selaginella cochleata* (Hook. & Grev.) Spring
3. *Selaginella crassipes* Spring

#### **Osmundaceae**

4. *Osmunda collina* Sledge

#### **Hymenophyllaceae**

5. *Hymenophyllum gardneri* Bosch

#### **Cyatheaceae**

6. *Cyathea walkeri* Hook. var. *tripinnata* Hook. & Baker

#### **Dennstaedtiaceae**

7. *Microlepia majuscula* (E.J.Lowe) T.Moore

#### **Pteridaceae**

8. *Coniogramme serrulata* (Blume) Fée.
9. *Pteris gongalensis* T.G.Walker
10. *Pteris praetermissa* T.G.Walker
11. *Pteris reptans* T.G.Walker

**Vittariaceae**

12. *Vittaria microlepis* Hieron.

**Thelypteridaceae**

13. *Thelypteris oppositifolia* (C.Chr.) Ching  
14. *Thelypteris obtusiloba* (Sledge) Fraser-Jenk.  
15. *Thelypteris ratnapurana* Fraser-Jenk.  
16. *Thelypteris srilankensis* Panigrahi  
17. *Thelypteris stipitata* Fraser-Jenk.  
18. *Thelypteris taprobanica* Panigrahi

**Aspleniaceae**

19. *Asplenium gardneri* Baker

**Woodsiaceae**

20. *Diplazium beddomei* C.Chr.  
21. *Diplazium cognatum* (Hieron.) Sledge

**Dryopteridaceae**

22. *Dryopteris deparioides* (T.Moore) Kuntze subsp. *concinna* C.Chr.  
23. *Dryopteris deparioides* (T.Moore) Kuntze subsp. *gracillima* (Ching) Fraser-Jenk.  
24. *Dryopteris srilankensis* Fraser-Jenk.  
25. *Polystichum anomalum* (Hook. & Arn.) J.Smith  
26. *Pteridrys zeylanica* Ching

**Polypodiaceae**

27. *Leptochilus thwaitesianus* Fée

**Grammitidaceae**

28. *Tomophyllum epaleatum* (Parris) Parris  
29. *Radiogrammitis beddomeana* (Alderw.) Parris

**(C) Doubtful endemics****Pteridaceae**

1. *Pteris quadriaurita* Retz.

**Thelypteridaceae**

2. *Thelypteris arthurii* Fraser-Jenk.

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