THE SPECIES AND SUBSPECIES IN THE DRYOPTERIS AFFINIS GROUP

C.R. FRASER-JENKINS

Student Guest House, Thamel, P.O. Box no. 5555, Kathmandu, Nepal (chrisophilus@yahoo.co.uk)

Key words: Dryopteris affinis, Europe, taxonomy, specific rank, subspecies, hybrids

ABSTRACT
Following discussion of the different levels of variation and the ranking of the taxa, “morphotypes” have been replaced with formal names. The main taxa within the Dryopteris affinis aggregate in Europe, formerly treated as subspecies of D. affinis, are treated as six species, while the former geographical varieties are treated as nine subspecies belonging to three of the species. Seven new combinations are made at the subspecific rank and two new subspecies are described. A new species-name, D. iranica Fras.-Jenk. replaces D. wallichiana subsp. coriacea (Fras.-Jenk.) Fras.-Jenk. Four hybrids between the D. affinis agg. and D. filix-mas are treated at the nothospecific rank, two of them new and a third a new combination. Two of the hybrids are divided into six nothosubspecies, three of them new. A detailed key and comparative diagnostic descriptions are given, but it is not intended here to discuss the proposed different origins for the taxa and the evidence for those origins.

INTRODUCTION
The European, Macaronesian and W. Asian Dryopteris affinis (R.Lowe) Fras.-Jenk. (“D. paleacea” auct., D. borreri Newm., D. pseudomas (Wollast.) Holub & Pouz.) has long been known as the third member of the Dryopteris filix-mas (L.) Schott or Male Fern group, along with two other species, D. filix-mas, D. oreades (Fomin) Fras.-Jenk. & Corley. Dryopteris affinis is an apomictic complex, several of its members presumably derived by hybridisation of various taxa, but in all cases thought to contain a genome in common with or related to the pan-subtropical species, D. wallichiana (Spreng.) Hyl. They belong together with the other species with parallel-sided, ± truncate segments in Sect. Fibrillosae Ching, rather than in Sect. Dryopteris, where the rest of the Male Ferns belong.

As is well known, apomixis in D. affinis means that hybridisation with a sexual species can give rise to a new fertile, apomictic taxon of a different cytotype. Such hybridogenous taxa almost certainly correspond with and are the origin of most of the species within the group (Fraser-Jenkins 1982, as subspecies), though further longer-term study remains to be carried out to add to the known evidence for their proposed origins. However three of the species recognised here (from continental Europe and W. Asia) are insufficiently known as to their origin, but being well known taxa which appear to be of major distinction and having formerly been treated as subspecies, they are now raised to specific rank along with the others.

The other important result of apomixis in D. affinis is that any variants that arise within members of the group are preserved by the cloning type of reproduction through
spores. The more major variants have a discrete morphological difference and a partially distinct geographical range and are recognised here as subspecies, which may be of quite ancient origin. They are generally of a similar morphology to the species concerned, but are readily recognisable by their special morphological characteristics. In addition, more minor variants also occur frequently within and between populations, which differ only slightly from the general pattern of the subspecies and can be found here and there in various populations throughout the range of the subspecies. Although they may be partially distinguishable, they are connected by intermediates occurring in other localities and while they may be more-or-less recognised from place to place they merge into one another when all the intermediates from other populations are considered. These more minor variants are therefore understood to be merely part of the variation within the species and are not recognised here as being worthy of nomenclatural distinction. If some of them were needed to be recognised they could be more appropriately treated at the lower ranks of variety or forma, which would not have to be included in general floristic works, including County recording etc.

Detailed study of _D. affinis_ throughout its range in Macaronesia, Europe and W. Asia resulted in the present author (Fraser-Jenkins 1980, 1982, 1983, 1987, 1996a and b, Widén _et al._ 1996, Fraser-Jenkins & Trewren in prep.) separating a number of entities within it. These were initially treated as infraspecific taxa at the rank of subspecies (corresponding to the present species), with varieties (corresponding to the present subspecies) placed within them. This ranking of the group was then considered appropriate because _D. affinis sens. lat._ was widely considered to be of taxonomic equivalence to the other species recognised within the genus and some reluctance to accept further critical taxa within it was brought to the attention of the author at the time. In the author’s previous and present treatments the taxa were placed hierarchically in order to reflect their morphological and cytological relationships to each other.

Although following the present author in the taxa recognised, Jermy in Jermy & Camus (1991), chose not to accept his hierarchical taxonomic scheme and placed all the taxa he recognised into the category of “morphotypes”. These were intended to be temporary unranked names as a convenient handle to use for any recognisable variant in the complex since the authors had not themselves decided at what rank they would place taxa and did not propose an alternative taxonomy. Morphotypes were thus invalid names outside the standard and universally used hierarchy and Articles of the International Code of Botanical Nomenclature (ICBN 2005) and the authors also took the term morphotype in a different sense from that originally defined by Danser (1950), or Davis & Heywood (1970). In addition the relationships of taxa as reflected in the present author’s taxonomic scheme were obscured and no longer recognised. Jermy was followed by Pigott (1997), who added three new morphotype names, two for more minor morphological variants, not recognised here, and the third (“morphotype arranensis”) being an additional name for a new taxon recognised by the present author and cited by Pigott. The new morphotypes were published as Latin names, but although without a type or type-concept, they have been placed here in the synonymy of the relevant species and subspecies from material kindly made available to the author by Pigott. Morphotypes were advocated again, as the accepted treatment, by Jermy, Pigott & Merryweather (1998) and by Merryweather (2002), though suggesting that up to 70% of specimens were of doubtful identity and that there might be up to 11 possible species in Britain.

Thus until now the group has remained in a state of confusion with the existence of
two alternative types of treatment and the suggestion that it is much more complex than hitherto published or than indicated in Nature and is thus almost intractable to botanists in general. However the relationships and relative placement of the known varieties and subspecies in a formal taxonomic framework have continued to be appraised carefully in the field by the present author and as the present taxonomy has been found to work well, this scheme is again recognised here, as by Fraser-Jenkins (1996a). While it is acknowledged that the taxa in this group, like many others, require further sophisticated study of their origin and that a few of the apparently more minor variants within *D. borreri* require study as to whether they could be of greater significance, it is hoped that recent confusion can now be laid to rest and the established taxa can be treated in a normal botanical framework.

Part of the reason for recourse to morphotypes was that the authors did not wish to comment on possible relationships and the relative taxonomic significance of the taxa and were studying locally without seeing the larger picture of the taxa throughout their range. Although the vast majority of species have long been described without detailed molecular evidence and continue to be so, the use of morphotypes was also felt appropriate by some authors who sought further genetic, cytological, chemical or molecular proof of the present taxonomic scheme. However no suggestion was made as to where it might be mistaken, or contradicting it, and most workers today have come to accept the main taxa recognised by the present author. Further problems have been caused by the presence of the many minor variants within the subspecies, as following recognition of such variant forms locally, some workers have found it difficult to accept their placement within the species or subspecies. This has also been compounded by prevailing cladistic concepts that a species has to be a single homogeneous entity. But where this has been adhered to with insufficient use of subsidiary and lower ranks to allow for different levels of variation, it has already created enormous practical problems. Thus several now much confused and notorious Angiosperm genera have suffered from excessive separation of unwarranted microspecies unbalanced by practical considerations and have reached a state where almost no one can put a name on a specimen any more. The present scheme has undergone continuing reappraisal for more than 25 years in both field and herbarium and has been successfully used by a number of workers both in Britain and abroad and it is therefore hoped that its clarification here and will help to avoid some of the above difficulties. In particular it is hoped that the temporary and rather unsatisfactory usage of non-standard morphotype names, which have inevitably become the equivalent of formal names, may now be superseded by reverting to standard botanical nomenclature. Doing so will not preclude the recognition of new taxa, should that occur, nor adjustment of rank for individual taxa, should it become necessary, but it is emphasised that the rank of the species and subspecies, particularly in Britain now appears to have reached some stability and general acceptance.

A relatively major and important change in the taxonomy is effected here in altering the rank of the main taxa from subspecies to species. Taxonomic understanding of the group has undoubtedly changed considerably from 25 years ago, when the existence and delimitation of its constituent taxa were little known. Given the fact that the important taxa, the former subspecies, recognised within *D. affinis* by the author are sufficiently distinct and are now generally and widely able to be recognised, they are treated here as species in their own right. The choice of species versus subspecies is always an arbitrary one, and originally the rank of subspecies was chosen as much the
better “middle ground”, with good grounds to support it at the time. But as time has
gone on, their distinctiveness and ranges of variation have become much better known
to botanists than they were a decade ago, as have their apparent relationships. In general
they can be considered to be of roughly the same degree of distinction as the other
species of the Male Fern group and, being readily recognisable from their gross
morphology alone, it is more appropriate to recognise them as species. This also reflects
the biology of the taxa since it is known that most of them have a different individual
biological (cytological and genomic) basis, though the mere fact of the existence of
such a difference, had it been in the absence of relatively major and readily recognisable
morphological separability would in the present author’s opinion be an inappropriate
and undesirable basis on its own for recognising species.

As there are few great practical difficulties in the D. affinis group, the previous
subspecies are recognised in the present paper as species, and in tandem with this the
previous varieties are treated in a standard way as geographical subspecies within them.
Variant forms below these ranks are not considered to be of sufficient taxonomic
significance to be recognised here, though many have already been named in the past
as varieties or forms. They are obviously morphologically close to the subspecies
concerned and it can readily be recognised as to where they belong; these include two
of the new morphotypes of Pigott, one of which has been found (Fraser-Jenkins &
Trewren in prep.) to have similar 16 spore-mother-celled chromosome-pairing
behaviour and to be chemically similar (Widén et al. 1996) to D. borreri, though further
study is required into variation within the latter.

TAXONOMIC TREATMENT

The three best known species occurring throughout most of the range of the group, and
the only three known so far from Britain, are D. affinis, D. cambrensis and D. borreri.
Fortunately all three names, now well known as subspecies and two of them also as
species names, appear to be usable at the specific rank, despite the involved and
complicated synonymy of the taxa within the group.

The currently accepted species and subspecies in the D. affinis group are as follows
(those with an asterisk inserted after the names are present in Britain and/or Ireland):

(1854) [nom. inval. for Lastrea filix-mas var. affinis Newm.]. Lectotype (Fras-Jenkins
1980): from Madeira (Ribeiro Frio), R.T. Lowe, 1 Nov. 1828 in K!, paratypes: in K!
BM! M! B! etc. Cytotype: Diploid apomict.

A. subsp. affinis*. Synonyms: D. affinis [subsp. affinis] var. affinis (in Fraser-
Jenkins 1980), Dryopteris borreri var. subintegra (Aschers & Graebn.) Tavel (1937)
[based on Aspidium filix-mas var. subintegrum Döll (1857), non Boreau (1840)], D.
pseudomas (Woll.) Holub & Pouzar (1967), D. mediterranea Fomin [= D. wallichiana]
t. disjuncta Fomin, D. affinis [subsp. affinis] var. disjuncta (Fomin) Fras.-Jenk. (1980),
Dryopteris resendeana Rezend.Pinto (1969), Dryopteris borreri subsp. resendeana
(Rezend.Pinto) Malagar. (1975), Dryopteris affinis [subsp. affinis] var. azorica Fras.-
Jenk. (1980). Cytotype: Diploid apomict, the rare 16-smc sporangia showing almost all
univalents (Manton 1950, Döpp 1955). Range: Can, Mad, Az, Mor, Lu, Hs, Andorra,
Ga, Co, Be, Lux, Ho, Br (Scot., Wales, Engl. [VC. S, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 13,
14, 16, 17, 20, 21, 22, ??23, 24, 27, 29, 30, 32, 33, 34, 35, 36, 37, 38, 40, 41, 42, 43,
44, 45, 46, 47, 48, 49, 50, 51, 52, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 66, 67, 69, 70,
71, 72, 74, 75, 77, 78, 79, 83, 85, 86, 87, 89, 90, 92, 95, 96, 97, 98, 99, 100, 101, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112. Hb [VC H1, H2, H3, H4, H5, H6, H7, H8, H9, H10, H11, H12, H13, H14, H16, H17, H20, H21, H22, H27, H28, H29, H31, H32, H35, H36, H38, H39, H40], No, Ge (W and E), He, Liecht, It, Elba, Si, Sa, Au, Ju (Slov., Hrvat.), Ro, An, Rs (S) (Caucasus (Karach.-Cherk.), W. Transcaucasus (Gruz., Abkhaz., Adzhar.)). Specimens of this subspecies with more acute teeth and slightly convex pinnae were invalidly named by Pigott (1997) as his “morphotype Convexa”. This taxon is understood here to be one of the minor variant forms within subsp. affinis, occurring with intermediates from place to place and not requiring nomenclatural recognition. Some other specimens named as “Convexa” appear to be less lobed or convoluted specimens of subsp. paleaceolobata and some are flatter-pinnuled specimens of D. cambrensis. In its toothing it is slightly towards subsp. punctata and subsp. paleaceolobata, but is obviously not as distinct as they are.


NMW! H!; woods in from gate just south of Dunvegan Castle car-park, N.W. Skye, Inner Hebrides, Scotland. CRFJ 11130-11134, 11136-11141, 11143-11154, 16 Sept. 1984, in BM! NMW! Synonym: *D. affinis* [subsp. *cambrensis*] var. *pseudocomplexa* Fras.-Jenk., *nom. nud.* (1996b) ["form imitating *D. x complexa*” in Widén, Fraser-Jenkins, Reichstein, Gibby & Sarvela: 75 (1996)]. Cytotype unknown, but spores large and a fairly high percentage (up to c. 30%) of abortive spores, similar to those of the triploid apomict subsp. *cambrensis*. Range: Ga, Br (Scot. [VC. 100, 104], Hb [VC. H2, H6], No, ?Au. Also discovered independently by Dr. A. Church on the Isle of Arran, W. Scotland in 1992 and thence published as “morphotype Arranensis” by Pigott (1996), with the comment that it might be the same as the unattributed var. *pseudocomplexa* [from the author’s manuscript]. This is now placed within subsp. *pseudocomplexa*.


Many other varietal names also apply to this species. Cytotype: Triploid apomict, with the 16-smc sporangia showing c. 123 single chromosomes, or sometimes from 10-18 bivalents (Manton 1950, Schneller 1974, 1975a-b, Manton, Vida and Rasbach in Rube & Heise 1975, in Fraser-Jenkins 1980 and in Fraser-Jenkins & Trewren in prep.). Fraser-Jenkins' (1980) reports of some plants showing approximately equal numbers of bivalents and univalents was made prior to his reidentification of Manton's voucher-specimens, and referred to D. cambrensis. Range: Lu, Hs, Andorra, Ga, Co, Be, Lux, Ho, Br (Scot., Wales, Engl. [VC. S, 1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 19, 20, 22, 23, 24, 25, 26, 27, 29, 30, 33, 34, 35, 36, 37, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 52, 53, 54, 55, 57, 58, 59, 60, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 108, 109, 110, 111, ??112]), Hb [VC. H1, H2, H3, H4, H5, H6, H7, H8, H9, H10, H13, H15, H16, H20, H21, H23, H25, ?H26, H27, H28, H29, H30, H31, H32, H33, H35, H36, H37, H38, H39, H40], Da, No, [S], Ge (W. and E.), He, It, Elba, Si, Au, Hu, Cz (Bohem., Morav., Slovak.), Po, Ju (Slov., Hrvat., Bosn.-Herc., Crna Gora, Srb., Makedon.), Ro, Bu, Tu, An, Rs (W) (Kalinin., Ukr.), ?Rs (K), Rs (S) (Caucasus (Krasnod., Sev.-Osset.), Transcauc. (Abkhaz., Georg., Dagest., Adzhaz., Azerbayd.), Ir.

D. borreri is morphologically very close indeed to the triploid apomict D. pseudofilixmas Rothm. (1945), from Mexico, which may be due to chance convergence following the combination of their ancestors; their chemistry and presumably their origin is different, but further study is required to investigate its relationship to D. borreri. There are numerous minor variants of D. borreri, which all appear to merge into each other and are probably merely due to less significant variation being preserved through apomictic cloning, as also occurs within the subspecies of the other species. Being obviously below the rank of subspecies these are not recognised here even though many of them have received varietal names, albeit uncritically, in the past. The botanical varietal names have been detailed in Fraser-Jenkins & Trewren (in prep.), but a great many more varietal names given to abnormal cultivars are also valid at varietal rank and apply to the basic more normal plant from which the monstrosities were derived. Any attempt to apply lower ranking names to the minor variants within D. borreri or within the subspecies of the other species would therefore be extremely difficult. Applying new names would be still less advisable unless they were for more fundamental entities at the subspecific rank, which the author has not recognised in
Nature so far. It would probably also be of dubious value because whereas individual minor variants can recur frequently in many populations and be more-or-less recognisable from place to place, intermediates occur in other populations and in different regions and it appears doubtful whether any of them represent discrete entities. They have therefore not been recognised nomenclaturally by the present author, even at the rank of forma, though it is evident that further research is required. One such form that occurs frequently with rather small, squarely truncate pinnules similar to the type of *D. borreri*, has been separated by Pigott (1997) as “morphotype Insolens”. It may be directly synonymous with *D. borreri* itself, or may turn out to be a distinct entity on further investigation. It occurs commonly throughout Britain and in parts of the western European-continental range of the species, whereas in N.E. Europe *D. borreri* usually has wider and often more lobed pinnules (these forms also occurring in Britain and W. Europe). The present author mistakenly validated one of von Tavel & Oberholzer’s many varietal names within this species as *D. affinis* subsp. *robusta*, which was taken up by Holub, Jermy and then Pigott in various slightly different senses, the two latter as “morphotype Robusta”. But this name simply referred to plants of *D. borreri* with slightly long, developed, but hardly lobed lowest basiscopic pinnules, with more rounded pinule-apices, which can occur in several of its minor variants and perhaps varies continuously in degree of development, though requiring further study. Subsp. *robusta* has already been sunk by Fraser-Jenkins (1987, 1996b) but the name is still being used in various senses by some authors.


HYBRIDS

The cytotypes of the *D. affinis* x *D. filix-mas* hybrids detailed here are tetraploid or pentaploid, whereas the species are diploid or triploid. They are normally distinguishable by their intermediate frond-morphology combined with mostly abortive spores and by not usually forming large populations, but occurring as a few isolated individuals in a population. However the author has seen some considerable
populations of *D. x complexa* nothosubsp. *complexa* in S.W. Ireland, which may have something to do with spore-germination being favoured by the luxuriant, mild and consistently moist climate there, as elsewhere in the west. So far no definite *D. affinis* agg. x *D. oreades* Fomin has been discovered, previous records all being of *D. cambrensis*, which almost certainly had such an origin. Some further candidates have recently been suggested, but are at present of uncertain identity. A further complication is that *D. oreades* x *D. affinis* would presumably be genomically identical and probably the same as *D. cambrensis*, while *D. oreades* x *D. borreri* would presumably be genomically identical to *D. x complexa* and the two origins for both would probably give indistinguishable results. Only *D. cambrensis* x *D. oreades* should be expected to be a distinctive hybrid worth looking out for, though like any other hypothetical taxa within the group which may or may not exist, it need not be mentioned further until actually discovered in Nature.

The nomenclature of several of the hybrids in the group requires revision now that the subspecies of the *D. affinis* group have been raised to the specific rank. Hybrids within the group known to the author are as follows:-


   **A. nothosubsp. *complexa***. *D. affinis* subsp. *affinis* x *D. filix-mas*. Cytotype: Tetraploid semi-sterile hybrid, with the 16-smc sporangia showing c. 41 bivalents and c. 82 univalents (Manton 1950 and in Fraser-Jenkins & Trewren in prep., Rasbach in Rasbach, Rasbach, Reichstein & Schneller 1983 and in Fraser-Jenkins & Trewren in prep.). Range: Lu, Hs, Ga, Be, Br (Scot., Wales, Engl. [VC. S, 1, 2, 3, 5, 11, 32, 35, 36, 41, 42, 44, 51, 55, 62, 63, 69, 70, 82, 85, 87, 99, 103, 105]), Hb [H1, H2, H3, H6, H8, H10, H20, H22, H28, H29, H32, H33, H39], Ge (W.), He, It, Au, Ro.


D. *pseudodisjuncta* x *D. filix-mas*. Cytotype: unknown. Reports of this hybrid by Gätzi (1961: 44) and Döpp, Gätzi & Oberholzer (1963) have been investigated by the author and were in error for *D. filix-mas* and *D. pseudodisjuncta* respectively.

**borreri x D. filix-mas.** Cytotype: Pentaploid partly sterile hybrid, with the 16-smc sporangia showing a range from nearly all univalents to c. 68-81 bivalents and the rest univalents (Manton 1950, Vida in Rasbach, Rasbach, Reichstein & Schneller 1983, Schneller 1974, 1975a-b, Rasbach in Jessen 1985). Range: ?Hs, Ga, Be, Lux, Br (Scot., Wales, Engl. [VC. 27, 35, 36, 40, 47, 48, 49, 52, 55, 57, 60, 62, 63, 64, 69, 88, 92, 97, 104, 105], Hb [VC. H4, H23, ?H39 and collected by R.L. Praeger], No, Ge (W. and E.), He, It, Au, Hu, Ju (Hrvat.), Cz (Moravia), Ro, Bu, Tu. Some plants of *D. x complexa* were erroneously distributed to various British gardens as being this hybrid from the collection of the late Prof. I. Manton, Leeds, by the late Dr. A. Sleep, the two having become transposed at Leeds University Botanical Garden.

**KEY TO THE D. AFFINIS GROUP.**

Comparative diagnostic descriptions of the various taxa have been provided by Fraser-Jenkins & Trewren (in prep.) and these and the key from that work are provided here. Unfortunately, as with many complex groups in pteridophytes, apparently “diagnostic” characteristics can on occasion vary sufficiently in some individuals so as to be misleading and may have to overridden in order to place a specimen in its species or subspecies correctly. The key allows for this to some degree concerning the main exceptions likely to be encountered, but it may still be necessary to balance and evaluate a combination of characteristics simultaneously when examining a specimen. Mature specimens are dealt with in this key and both immature ones and occasional extremes may have to be abandoned, at least as far as the key and diagnostic descriptions are concerned (though with experience they can usually be correctly recognised identified more intuitively). Garden-grown specimens can also be particularly difficult when, as often occurs, rather exposed, or not well developed. It is also pertinent to point out that specimens which have been pressed and mounted in such a way that the very important upper (adaxial) surface of the lower part of the frond is covered over or scrumpled up may also be very difficult to identify. The smaller spore-size of *D. affinis* has not been used here as a key-characteristic, partly because many people will not have easy access to a microscope. However it should be pointed out that it can be useful in cases of doubt, as long as the spores are not mostly shed and as long as they are fully mature. Youngish spores in the *D. affinis* group, even after they have become brown and developed their perispore, are normally smaller than mature ones. It takes a little experience to recognise their very slightly paler colour, less wrinkled perispore, greater irregularity in size and partial clumping as being typical of an immature spore-sample, and not of a hybrid, and thus not to rely on their small size in such cases. However it is not uncommon to find specimens of *D. borreri* (which usually has the smallest spores of any of the triploids) with small spores almost approaching those of *D. affinis*, though they are less regular. A chromosome-count is not considered here to be a necessary or normal part of the identification process.

1a. Spores (when ripe and not mostly shed) almost entirely and highly irregularly abortive, with a few very large good ones (c. 5% - 20%) present, including ± spherical ones. [This characteristic has to be observed in combination with the occurrence of intermediate-type frond-morphology, as on rare occasions spore-abortion alone is not always absolutely reliable in this group.] Plants of sporadic occurrence and not normally forming populations ..............................................................

........................................**D. x complexa**, **D. x convoluta**, **D. x complanata** and **D. x critica**.
1b. Spores (when ripe and not mostly shed) mostly good, or with a majority, or high proportion of good ones mixed with abortives, so that the good spores predominate in the sample .......................................................... 2.

2a. Rachis-scales markedly long and narrow, strongly exserted from the rachis. Laminar texture very stiffly coriaceous; pinnules or pinna-lobes deeply joined together at their bases (i.e. sinus between the pinnules not extending as deeply as in D. affinis) in the mid-upper parts of the lamina and pinnae ................................. D. wallichiana agg.

2b. Rachis-scales shorter and usually wider, clothing the rachis more tightly. Laminar texture often coriaceous, but hardly stiffly coriaceous; pinnules or pinna-lobes not so deeply joined together at their bases (i.e. sinus between the pinnules very nearly reaching the costa) in the mid-upper parts of the lamina and pinnae .......................................................................................... D. affinis* agg.

3a. Sori tall, indusium ± thick, only slightly lifting and usually splitting on ripening and not, or only slightly shrivelling. The lowest basiscopic pinnule of the lowest pinna usually ¼ - ½ adnate to the pinna-costa; lamina considerably glossy above ................ 4.

3b. Sori not tall, indusium ± thin, lifting on or after ripening and shrivelling, not splitting [except for D. affinis, included under 28a. for comparison]. The lowest basiscopic pinnule of the lowest pinna usually fully stalked, or sometimes ¼ adnate; lamina not, or only slightly glossy ............................................................................. 12.

4a. Pinnules markedly crowded, some with sloping apices .......................................................... D. affinis subsp. kerryensis*.

4b. Pinnules not markedly crowded, with symmetrical apices ............................................ 5.


5b. Scales pale, reddish, or brown (rarely with very dark bases), pinnule-apices rounded-truncate to rounded-pointed, or pointed ..........................................................

6a. Lamina with marked “punctate” indentations on the top surface above each sorus .......................................................................................... D. affinis subsp. punctata.

6b. Lamina without, or only with shallow and insignificant “punctate” indentations above ........................................................................................................ 7.

7a. Lamina with a wide base, the lowest basiscopic pinnules of the lowest pinna developed and longer than the rest, the lower pinnules on each pinnule markedly lobed with small, neat lobes; stipe and rachis scales all narrow (indusium shrivels more than in other D. affinis subspecies) ........................................ D. affinis subsp. paleaceolobata*.

7b. Lamina more-or-less tapering to the narrowed base, the lowest basiscopic pinnules of the lowest pinna not usually the longest, lower pinnules on each pinna unlobed, or ± shallowly lobed with somewhat coarse lobes; stipe and rachis scales narrow or wide...................................................................................................... 8.

8a. Lamina flat, thickly coriaceous, with veinlets markedly impressed above. Pinnae long; pinnules markedly regular in size, with parallel sides, seldom lobed at the sides apart from a rounded basal auricle on the lowest pair of pinnules on each pinna. Sori large, spores small mostly regular (i.e. nearly all good) .................................................. D. affinis subsp. affinis*.
8b. Lamina not flat as at least some pinnules are normally curved up at their tips, coriaceous, but not thickly so, veinlets not markedly impressed above. Pinnae short; pinnules often irregular in size as the first opposite-pair of pinnules on each pinna is frequently somewhat longer than the rest, not completely parallel at the sides as they are often slightly spathulate and wider at their apices (sometimes due to the down-rolling of the lower-mid sides), usually lobed at the sides, at least on the lowest pair of pinnules on each pinna. Sori relatively small, spores large with a considerable proportion of abortive spores (sometimes nearly equal to the number of good spores)

9a. Pinnule side-lobes wedge-shaped and pointed, pinnule-apices with prominent, ± markedly long, acute, markedly flabellate teeth; frond-axes highly glandular, scales markedly reddish-yellow or red in colour.................... *D. cambrensis* subsp. *insubrica*.  
9b. Pinnule side-lobes not wedge-shaped or pointed, but rounded, pinnule-apices with smallish, ± obtuse to slightly acute, weakly flabellate or non flabellate teeth (or teeth absent); frond-axes mostly eglandular, scales varying from pale or whiteish to red or dark brown in colour ................................................................................................... 10.

10a. Scales red coloured ................................................. *D. cambrensis* subsp. *distans*.  
10b. Scales white or brown .............................................. 11.

11a. Scales all pale, lamina pale-green, pinnae long with well separated pinnules and teeth often absent, or, when present, narrowly acute ................................................................. *D. cambrensis* subsp. *pseudocomplexa*.  
11b. Scales not all pale (apart from in some exceptional plants), but brown or slightly yellowish-russet brown, lamina mid- to dark-green, pinnae short, teeth often absent, or, when present, somewhat obtuse, though often with a pointed apex ............ ................................................................. 12.

12b. Pinnule-teeth ± absent ............................................................................... 28b.

13b. Pinnule-apices ± rounded, or pointed ......................................................... 16.

14a. Scales black, lamina glossy and thick, pinnule-teeth long, but wide and irregular in length on each pinnule-apex ................................................. *D. affinis* subsp. *jessenii*.  
14b. Scales pale or brown, lamina ± matt and thin, pinnule-teeth long or short, with a ± narrowly acute apex, ± regular in length on each pinnule-apex ................................................................. 15.

15a. Lower pinnules with a wedge-shaped base, pinnules usually not markedly lobed, laminar upper surface ± glossy; indusia with well curved-down sides and a deep, darkish centre ................................................................................................. *D. pseudodisjuncta*.  
15b. Lower pinnules with a rectangular base, pinnules usually not markedly lobed, laminar upper surface matt; indusia with less markedly curved down sides and a shallow, concolorous centre ............................................................................. *D. borreri*.

16a. Pinnule-teeth ± narrowly acute at the tips of the pinnules ................................. 17.
16b. Pinnule-teeth ± obtuse at the tips of the pinnules ................................. 23.

17a. Lamina with marked “punctate” indentations on the top surface above each sorus ................................................................. *D. affinis* subsp. *punctata.*
17b. Lamina without, or only with very shallow and insignificant “punctate” indentations .................................................................................. 18.

18a. Lower pinnules with markedly rectangular side-lobes with pointed corners ........................................................................................................... *D. borreri*.*
18b. Lower pinnules ± without rectangular side-lobes (though often with rounded, or pointed ones) ............................................................................................................ 19.

19a. The lower pinnules on each pinna lobed with numerous small, neat lobes; stipe and rachis scales all narrow .......................................... *D. affinis* subsp. *paleaceolobata*.*
19b. The lower pinnules on each pinna unlobed or lobed with few, often somewhat coarse lobes; stipe and rachis scales include many wide ones ...................................................................................... 20.

20a. Pinnules long and narrow, widely separated .................................................... *D. cambrensis* subsp. *pseudocomplexa*.*
20b. Pinnules not noticeably long and narrow, crowded, or ± narrowly separated ......................................................................................................................... 21.

21a. Lamina pale-green and matt above, pinnule-teeth wide-based, narrowing ± abruptly to a long, acute apex; only a weak dark spot present at pinna-axils, or absent altogether; indusium rapidly lifting and shrivelling on sporangial ripening ................................................................. *D. schorapanensis.*
21b. Lamina ± darker green and ± glossy above, pinnule-teeth not abruptly narrowed from a wide base, long- or shortly acute; an obvious dark spot present at the pinna-axils; indusium remaining inflected at the sides until shrivelling soon after sporangial ripening ................................................................. 22.

22a. Scales paler- or brighter reddish in colour, pinnae short, lamina well tapered so that the lowest pinnae are usually the shortest, frond-axes highly glandular; pinnule-apices rounded to somewhat acutely pointed ............................................. *D. cambrensis* subsp. *insubrica.*
22b. Scales pale, or slightly smokey-yellow in colour, pinnae long, the lowest pinna ± as long as those above, frond-axes ± eglandular; pinnule-apices varying from narrowly truncate to narrowly pointed, but frequently lop-sided so that one apical corner is taller than the other ................................................................. *D. pseudodisjuncta.*

23a. Lamina with marked “punctate” indentations on the top surface above each sorus ................................................................................................. *D. affinis* subsp. *punctata.*
23b. Lamina without, or only with very shallow and insignificant “punctate” indentations .......................................................................................... 24.

24a. The lower pinnules on each pinna lobed with numerous small, neat lobes; stipe and rachis scales all narrow ............................................. *D. affinis* subsp. *paleaceolobata*.*
24b. The lower pinnules on each pinna unlobed, or lobed with few, somewhat coarse lobes; stipe and rachis scales include many wide ones ...................................................................................... 25.
25a. Lower pinnule-apices narrowly rounded-pointed; scales pale- to mid-brown ..........

26a. Scales brown .................................................. D. cambrensis subsp. cambrensis*.
26b. Scales reddish or red ........................................... 27.

27a. Pinnule side-lobes wedge-shaped and pointed, pinnule-teeth markedly long, frond-axes highly glandular .................................................. D. cambrensis subsp. insubrica.
27b. Pinnule side-lobes rounded or rounded-truncate, pinnule-teeth short, frond-axes hardly or not glandular .................................. D. cambrensis subsp. distans.

28a. Indusia large, markedly tall, thick, persistent, splitting, scales mostly to almost all narrow, lamina very glossy .................................. D. affinis* (included here for comparison).
28b. Indusia small, not markedly tall, relatively thin, not splitting, shrivelling later, scales include many wide ones, lamina matt or somewhat glossy ............... 29.

29a. Pinnule-apices squarely truncate, though often with rounded corners, so becoming truncately rounded ................................................................. 30.
29b. Pinnule-apices rounded to rounded-pointed .................................................. 32.

30a. Indusia ± flat to shallowly curved, but begin slightly inflected at their edges, then shrivel rapidly; pinnule side-lobes (usually present on lower pinnules) square or rectangular with pointed corners .......................................................... 31.
30b. Indusia markedly curved and begin well inflected at their edges with a central depression before shrivelling later; pinnule side-lobes absent, or wedge-shaped and pointed .................................. D. pseudodisjuncta.

31a. Stipe-base scales varying from ± concolorous to having vaguely defined darker bases and centres, or if well defined, the dark colour not extending upwards in narrow streaks .................................................. D. borreri*.
31b. Stipe-base scales bicolorous, pale, with glossy blackish streaks extending upwards from a clearly contrasting dark base .................................................. D. pontica.

32a. Pinnules well separated, pinnae long; scales very pale or whiteish ..................
32b. Pinnules crowded, pinnae short; scales reddish or bown .................................. 33.

33a. Scales reddish or red .............................................. D. cambrensis subsp. distans.
33b. Scales yellowish brown to brown ................................ D. cambrensis subsp. cambrensis*.

COMPARATIVE DIAGNOSTIC DESCRIPTIONS

1. D. affinis*.
1A. subsp. affinis*. The “purest” D. affinis morphology after D. wallichiana and the most reminiscent of D. wallichiana in its flat frond, “plasticy” (like a moulded plastic) upper surface, smooth laminar texture and regular, rounded-truncate pinnules.
Frond usually ± wide (except when exposed on screes etc.), with a relatively short stipe, except in large, luxuriant plants in woods; lamina generally tapering somewhat towards the base. Stipe and rachis densely clothed with somewhat narrow scales which stick out from the rachis, but not as much as in *D. wallichiana*; scales variable in colour, most commonly mid- to deep golden-brown, with darker centres and bases, but in some localised clones deep-brown to blackish, in others pale. Lamina thicker, more highly coriaceous and markedly more glossy above than in the other taxa, of a noticeably plastic-like texture above, with the veinlets impressed in the upper surface, somewhat glaucous below with the veinlets darkened. Variable in colour above, but usually dark-green except when exposed, when becoming yellower. Pinnae not, or hardly tapering throughout most of their length, but extending to a long caudate apex, flat; pinnules more regular in size and shape than in the other taxa, sometimes becoming ± crowded when growing in open places, though not overlapping, but usually ± separated, or well separated by a U-shaped gap (or “disjunction”), especially when growing in woods, though when not markedly “disjunct” the pinnules may be slightly more widely attached to each other at their bases than in the other taxa; usually ± unlobed except for a ± rounded basal auricle on the lowest-opposite pair of pinnules on each pinna (though occasional plants may have prominently lobed and/or even sharply toothed pinnules), the lowest opposite-pair of pinnules on each pinna usually ± the same length as the rest, basiscopic pinnules at the bases of the lowest pinnae not usually becoming developed or longer, with the lowest basiscopic pinnule of the lowest pinna either the same size as, or often somewhat smaller than the rest and usually between ¼ and ½ attached (or adnate) to the pinna-costa, usually nearly all along the acroscopic side of its stalk with most of the base on the other side free; pinnule-apices rounded to rounded-truncate (rarely more pointed further up the frond in large plants), bearing rather few, obtuse pinnule-teeth. Fronds eglandular. Sori the largest in the group, indusia thick, large, ± tall, somewhat pale until older, eglandular, markedly curved down and inwardly inflected at the margins until the spores ripen, when the indusia lift slightly at the edges and usually split open radially in one or more places as the sporangia turn black (the splits being difficult to see once the sporangia have dehisced), but hardly shrink and do not normally shrivel up or lift completely (except in a few exceptional specimens), persisting until the fronds begin to die. Spores relatively small and regular, ripening later than in the other taxa. Fronds ± persistent throughout most of winter.

1B. subsp. *paleaceolobata*. Can be confused with *D. cambrensis* subsp. *cambrensis* because of its lobed pinnules, but the pinnae are longer and more parallel-sided than in *D. cambrensis* and the lamina is more widely lanceolate with a somewhat wide base base or just above it, tapering from there to the apex, more glossy and with more twisted pinnules including their side-lobes, and the stipe-scales are consistently darker and narrower; the pinnule-lobes are also smaller, narrower and neater and the spores are smaller. Appears to be the nearest Atlantic equivalent to subsp. *punctata* but is more lobed and without the “punctate” indentations (apart from very small ones) above the sori. Also similar to subsp. *affinis* but differs somewhat markedly in its pinnules all being lobed at the sides and usually slightly irregularly twisted or tilted up from side-to-side (seldom curved up at the apices as in *D. cambrensis*). The lowest basiscopic pinnule is developed and becomes the longest and most lobed in the frond, and is fully stipitate. However it retains the dense, dark and narrow stipe- and rachis-scales and markedly glossy lamina of *D. affinis*, as well as the eglandular frond and tall
though not as thick, eglandular indusium, which splits, but then, unlike in subsp. *affinis*, shrivels somewhat on ripening. It also has similarly small spores and usually more obtuse teeth, though these often become somewhat acutely deltate (acuminate) and flabellately spread out around the pinnule-apex. The pinnule side-lobes are rounded and not as rectangular as in *D. borreri*.

1C. *subsp. punctata*. Differs from subsp. *affinis* in having larger, more crowded, often somewhat crinkled pinnules, bearing more side-lobes, including a pair of auricles at their bases, and with less regularly parallel margins and more rounded pinnule-apices; they also bear characteristic longer, more prominent and narrower, but obtuse-tipped teeth splayed out around the pinnule-apices in a fan-like arrangement. The upper surfaces of the pinnules have a marked circular, “punctate” indentation above each sorus, which is highly characteristic, and deeper than the small ones that sometimes occur in subsp. *affinis* etc. The lowest basiscopic pinnule on the lowest pinna is more narrowly attached to the costa than is usual in subsp. *affinis*, normally being fully stipitate, and the lower pinnules are usually markedly more lobed. Fronds eglandular. The indusium is eglandular and usually (but not always) splits on sporangial ripening, but is thinner than in subsp. *affinis* and lifts up and normally completely shrivels, except in plants from exposed places, which have thicker and less shrivelling indusia. In its scales, glossy, thick, usually dark-green, flat, regular lamina and large sori, it obviously belongs to *D. affinis*.

1D. *subsp. kerryensis*. Similar to *D. cambrensis* subsp. *cambrensis*, but with a smaller, somewhat diminutive frond, and markedly flatter and dark-green, glossy lamina. Stipe- and rachis-scales narrow, dark-brown to blackish; pinnae flat, or slightly convex from above, with the pinnules often slightly curved down at their edges and apical halves. Pinnules markedly crowded, ± rectangular, the lowest opposite-pair on each pinna often bearing a few distinctive ± wedge-shaped, pointed side-lobes and a similar basal auricle. Pinnule-apices varying from rounded to more usually rounded- to square-truncate, often slightly sloping obliquely from one side to the other, bearing somewhat long, acute teeth, but which are slightly wider up to their apices than in *D. borreri*.

1E. *subsp. jessenii*. Perhaps distantly related to subsp. *punctata*, and like it, has lobed pinnules and usually a fully stalked lowest basiscopic pinnule on the lowest pinna (but sometimes when ± unlobed, becomes half adnate to the costa in exposed plants, or in dry situations), it also has smaller punctate depressions above the sorit and somewhat small and thin, but inflected indusia, some of which split before shrivelling; but it differs in its usually markedly darker (usually almost black, at least at their bases) stipe- and rachis-scales, its smaller, more disjunct, and irregularly margined pinnules, and especially in at least the lower pinnule-apices being markedly squarely truncate, while the upper ones in the frond may become pointed, but are not as rounded as in subsp. *punctata*. The pinnule-teeth are characteristically longer and narrower than in the other varieties of *D. affinis*, becoming somewhat finger-like, but not acuminate, with slightly obtuse, if narrow apices, and are curiously irregular in length, slightly reminiscent of a monstrosity or abnormality. Axes, lamina and indusia eglandular.

2. *D. cambrensis*.

2A. *subsp. cambrensis*. Intermediate between *D. affinis* and *D. oreades*, and the nearest triploid to *D. affinis* in morphology. The British plants are usually the least toothed, with the brownest (or occasionally pale) scales, though in places in north Wales and the Cairngorm Highlands of Scotland they may become slightly more toothed, and
with more russet-brown scales, slightly approaching subsp. distans. The scales range from pale, to, more usually, mid- to dark-brown, usually with darker bases, and are glossy and usually slightly twisted; the larger ones are wider than in D. affinis and sometimes more glossy. Stipe usually relatively short, except when growing in woods, or between boulders. Lamina slightly thinner than in D. affinis, smooth, with the veinlets hardly impressed above, glossy above when compared with D. boreri, though not as glossy as in D. affinis, usually darker-green (darker than in subsp. insubrica) though paler or yellowish when in the open, characteristically narrow, ± tapering towards the base. Pinnae short compared to D. affinis, tapering throughout from their wider bases, seldom flat as at least some of the ± rounded or narrowly-rounded pinnule-apices, especially the lowest basiscopic ones and lowest opposite-pair on each pinna, are usually curved upwards out of the plane of the frond, and the pinnules sometimes twist irregularly laterally, resulting in a slightly crisped appearance to the frond (but not as markedly as in D. affinis subsp. paleaceolobata). Lowest opposite-pair of pinnules of each pinna (i.e. the lowest acroscopic (upper) and basiscopic (lower) pinnule of a pinna) the longest, and usually overlapping the rachis, the lowest one often deflexed basiscopically (i.e. bent slightly towards the base of the pinna) so as to lie slightly over the rachis, the lowest basiscopic pinnule of the lowest pinna is usually fully stalked, or stipitate. The pinnules vary from well lobed with rounded lobes to almost unlobed, the pinnule-apices are rounded and vary from fairly prominently toothed to more frequently small-toothed or ± untoothed and in either case have shorter and more obtuse teeth than in subsp. insubrica. In some specimens there are a few (up to c. 30) glands on the edge of the indusium, or the frond-axes are sparsely glandular, but most plants are ± eglandular. Sori smaller, or nearly the same size as in D. affinis, the indusia are somewhat thick, thicker than in D. boreri, though with a thinner margin than in D. affinis, ± tall, somewhat pale, or greyish, until old, markedly curved down and inflected as in D. affinis, but when the spores ripen the indusia frequently split, then lift up, to lie over the top of the sorus, finally shrivelling considerably and after some time, dropping off, but not shrivelling as much as in D. boreri and persisting longer, becoming brown. Spores markedly larger than in D. affinis and containing a markedly higher proportion of abortive ones; also somewhat darker brown in colour. Fronds turning brown and dying down in mid Autumn.

2B. subsp. distans. Generally intermediate in morphology between subsp. cambrensis and subsp. insubrica, but closer to the former except in scale-colour. Fronds are often taller than in subsp. insubrica; pinnules with small, rather insignificant teeth, occasionally becoming longer and slightly flabellate; pinnule-lobes when present rounded, not cuneate. Axes and indusia eglandular or bearing only few, scattered, small glands. Stipe-scales markedly reddish or reddish-brown, thin, often rather twisted. Some British and Norwegian populations of subsp. cambrensis approach it, but the distinction between the two is less clear in parts of those areas.

2C. subsp. insubrica. Strongly reminiscent of the pale russet-scaled, glandular and somewhat narrowly toothed forms of D. oreades of Corsica, Sardinia, Elba and northern Italy. More acute-toothed, pointed-lobed and with more reddish-russet coloured scales than in subsp. cambrensis. The larger stipe- and rachis-scales are wider than in D. affinis, more glossy and slightly thicker, often ± concolorous, ranging from pale yellow (particularly in eastern Europe), to pale-russet, to a more common and characteristic reddish or russet-brown, often with darker, castaneous bases and some dark flecks or streaks in the scales; some of the narrower ones characteristically exserted and...
somewhat twisted spirally, particularly on the upper stipe and lower rachis. Stipe usually relatively short except in large, luxuriant plants in woods, or when growing between boulders. Lamina narrow, ± tapering towards the base, slightly thinner and less highly coriaceous than in D. affinis, but of a slightly crispaceous texture, ± matt above, veinlets usually slightly impressed in the upper surface. Variable in colour above, but often dark- to mid-green, except when exposed, when yellowish. Pinnae usually short, tapering from their wider bases, ± flat. Pinnules rather irregular in length, crowded and sometimes slightly overlapping, though they may become separated by a ± narrow, V-shaped gap; the lowest opposite-pair on each pinna usually longer than the rest, and usually close to the rachis or somewhat overlapping it, the lowest basiscopic one on each pinna may sometimes be slightly basiscopically deflexed so as to lie partly over the rachis, the lowest basiscopic pinnule of the lowest pinna is usually fully stalked, or stipitate. The lowest opposite-pair of pinnules on each pinna is usually well lobed, with characteristic wedge-shaped, pointed side-lobes. Pinnule-apices rounded to rounded truncate, as in D. affinis, but often becoming square-truncate above, bearing prominent, long, ± narrow, but wide-based, usually somewhat acute-tipped teeth, which are flabellate, i.e. splayed out around the apex in the manner of D. oreades. Many small, fairly scattered, or dense, white glands on the frond-axes and on the indusia as well. Sorus usually smaller than in D. affinis, usually also slightly thinner, though thicker than in D. borleri, ± tall, somewhat pale, or greyish, until old, usually glandular near their margins, markedly curved down and inflected as in D. affinis, but when the spores ripen the indusia frequently split, then lift up to lie over the top of the sorus, finally shrivelling considerably and after some time dropping off, but not shrivelling as much as in D. borleri and persisting longer, usually remaining paleish to pale-brown until considerably later, when becoming brown. Fronds turning brown and dying down early in Autumn.

2E. subsp. pseudocomplexa*. Somewhat similar to D. x complexa, but with a paler coloured lamina and smaller, narrower, less lobed pinnules, and with a high proportion of good spores. It also differs in forming extensive populations. Generally similar to subsp. cambrensis, but with pale to very pale russet, thin, but slightly glossy, ovate stipe-base scales; the lamina thin, pale- to mid-green, wider and more lax than in subsp. cambrensis; pinnules usually rather widely separate, or at least not as crowded, long and narrow, with the side-lobes smaller and neater when present. Pinnule-apices narrowly rounded, often becoming somewhat pointed or rounded-pointed in larger plants, varying from being ± toothless to bearing small, somewhat narrow, often acute teeth, more acute than in subsp. cambrensis. Indusia somewhat thin, inflected at first, not as tall as in subsp. cambrensis and not, or seldom splitting, soon lifting and shrivelling markedly.

Stipe- and rachis-scales ± pale, usually with darker-brown bases; somewhat abundant narrow, hair-like, pale scales present on the costae on the underside of the pinnae. Frond wider than in D. cambrensis; lamina slightly glossy; pinna-axils very occasionally without the dark spot (darkened area of the petiole at the junction beneath); pinnae long, markedly flat; pinnules ± regular in length, or the first pair slightly the longest in each pinna, usually separated from each other above their bases by a distinctive, quite wide, V-shaped gap or notch, and in mid and upper pinnae somewhat widely attached to each other at their bases, often narrowed to their bases in the lowest pair of pinnules
in the lower pinnae which thus become ± wedge-shaped below, ± unlobed (including the lowest basiscopic pinnules of the lowest pinnae) apart from ± rounded (occasionally more rhombic) basal auricles in the basal pinnules of mid and upper pinnae in some plants, the lowest opposite-pair of pinnules of each pinna usually slightly longer than the rest and often somewhat deflexed towards the rachis (which rarely occurs also in D. borreri); the lowest basiscopic pinnule of the lowest pinna (i.e. the lowest one of the frond) sometimes becomes longer and developed, but is not usually the longest one, fully stalked or stipitate, pinnules usually sloping towards their narrow apices; pinnule-apices narrow or wedge-shaped, varying in the upper part of the frond from rounded to rounded-truncate (or often somewhat markedly truncate), but characteristically rounded-pointed in the lower pinnae. Fronds eglandular. Indusium tall, eglandular, small, ± thin, mid- to dark-brown, but greyish when younger, matt, markedly inflected at the margins, with a ± obvious depression in the centre that becomes noticeable when the indusium begins to lift slightly at the edges on ripening; often splitting before lifting slightly on ripening, though the edges remain downturned and enclosing much of the top of the sorus; only later, after the spores have been shed, do the edges lift up markedly before the indusium shrivels. Fronds turning brown and dying down in mid or late Autumn.

4. D. schorapanensis.
Close to D. filix-mas and often mistaken for it. Frond ± wide with a long stipe, tapering slightly to the lamina-base. Stipe and rachis not very densely clothed with scales; scales thin, ± wide, pale to pale-brown, concolorous, or with a dark base, or sometimes a few dark streaks in the centre. Lamina as thin as in D. borreri, or thinner, hardly coriaceous, ± matt above, slightly glaucescent below, lighter green than in D. borreri, veinlets slightly impressed above, not darkened. Pinna-axils usually without the dark spot normally present in the living state in all the other species and subspecies (but see under D. pseudodisjuncta); pinnae flat; pinnules ± regular in length, or the lowest opposite-pair of each pinna slightly the longest, seldom much separated, often somewhat narrowed towards their bases near the bottom of each pinna, ± unlobed, or with insignificant shallow, ± square lobes, the lowest basiscopic pinnule of the lowest pinna not usually becoming longer and developed, and not the longest one, fully stalked or stipitate; pinnule-apices truncate to rounded-truncate in the lower part of the frond, often becoming more pointed and wedge-shaped in the upper part of the frond, bearing characteristic subulate, wide-based teeth, somewhat abruptly narrowed to ± and often rather irregularly long-acute points and spread out around the apex in a flabellate, or fan-like arrangement. Fronds eglandular. Sori similar to D. borreri, the indusium eglandular, pale, starting only slightly curved down and not much inflected at the margins (less so than in D. borreri), until lifting, when it shrinks but does not split, either sitting ± flat over the top of the ripe sporangia until dropping off, or shrivelling considerably, though more persistent than in D. borreri. Spores large and long, with much abortive material present. Fronds turning brown and dying down early in Autumn.

5. D. pontica.
Similar to D. schorapanensis, but with the truncate lobes and pinnule-apices of D. borreri. Stipe-base scales with dark bases and prominent, separating, dark, glossy streaks extending upwards into the pale area of the scale. Lamina not markedly glossy.
Pinnules becoming wider towards their bases and somewhat remote towards their apices, with obliquely sloping, truncate-tipped basal lobes on each side and often a few smaller lobes above; pinnule apices varying from obtuse to more usually narrowly truncate, with rather prominent teeth. Indusia thin, beginning well turned down, but lifting and partly shrivelling on ripening. Spores larger than in *D. borreri*, with a similar proportion of abortive spores to that in *D. cambrensis*. Fronds turning brown and dying down early in Autumn.

Usually nearer in morphology to *D. filix-mas* than are the other taxa (except *D. schorapanensis* and *D. cambrensis* subsp. *pseudocomplexa*). Frond usually ± wide and, except when exposed, with a relatively long stipe, the lamina not usually tapering much below, or not as much as in the other taxa (excluding *D. schorapanensis*), except in more exposed plants and rarely in some localised clones. Stipe and rachis sometimes less densely clothed in scales than in the other taxa (except *D. schorapanensis* and *D. cambrensis* subsp. *pseudocomplexa*) and the scales often paler (sometimes with dark bases) and wider, though very variable. Lamina relatively thinner (except in exposed plants) than the other taxa (except *D. schorapanensis* and *D. cambrensis* subsp. *pseudocomplexa*), less coriaceous, hardly glossy, but more matt above, and usually lighter green than in *D. affinis*, though the colour varies considerably, veinlets not impressed above or darkened beneath, lamina not glaucous beneath. Pinnules ± flat; pinnules not as regular in length as in *D. affinis*, adjacent, but not crowded, though seldom much separated (though occasionally so, by V- or rarely U-shaped gaps), the lower pinnules on lower pinnae, particularly the lowest basiscopic one of the frond, usually lobed with characteristic ± rectangular side-lobes, and a larger, rectangular basal auricle (though they can be absent), the lowest opposite-pair of pinnules of each pinna often curved slightly away from the rachis, usually ± the same length as the rest, except that the basiscopic one frequently becomes a little longer, at least in the lower pinnae, the lowest, or second lowest basiscopic pinna of the lowest pinna is usually the longest in the frond, is often markedly developed and lobed with rectangular side-lobes, and is fully stalked or stipitate; pinnule-apices characteristically markedly square truncate in the lower parts of the frond, but becoming rounded or pointed, particularly in the upper frond, in many larger specimens, but at least some of the lower- or mid-frond pinnule-apices usually remain truncate, rounded-truncate, or obovate, as opposed to their all being more rounded as in *D. affinis* and in most *D. cambrensis* subsp. *pseudocomplexa* etc.; in normal plants the pinnule-apices bear characteristically long, mostly acute teeth, similar to those in *D. filix-mas*, but some plants are occasionally almost toothless, when they can become difficult to separate from *D. cambrensis* subsp. *pseudocomplexa*; in the truncate-pinnuled plants the teeth may be longer above each corner of the pinnule than in the centre of the apex (the late H.V. Corley’s “cat’s head” outline - the corner teeth representing the cat’s ears). Fronds eglandular. Sori smaller than in *D. affinis* or *D. cambrensis*, and indusia noticeably relatively thin and less tall, whiteish or pale- to mid-brown, eglandular, beginning curved down at the sides (but not inflected, or turned in, as in *D. affinis* and *D. cambrensis*) until the spores ripen, when they lift right up, without splitting, shrivel and shrink markedly to become a very small, inverted, wrinkled cone, or funnel on top of the fully exposed sporangia, and soon drop off. Spores relatively larger and with more abortive material than in *D. affinis* and quite often with as many abortive spores as in *D. cambrensis*, but they are usually more
regular and often noticeably smaller than in the other triploid taxa, and can be considerably smaller than expected. Spores ripen from two weeks to up to nearly a month earlier than in \textit{D. affinis}. Fronds mostly turn brown and die down early in winter, though some persist longer.

The most widespread and commonest member of the group, though absent from Macaronesia, north-west Africa and southernmost mainland Italy and less common in Portugal and Spain than subsp. \textit{affinis}.

7. \textit{D. affinis} agg. hybrids with \textit{D. filix-mas}.

The frond-morphology does not fit in with any of the other taxa in the \textit{D. affinis} agg. and is intermediate between the parents, \textit{i.e.} markedly towards \textit{D. filix-mas} when compared with that of any other members of the \textit{D. affinis} agg., though the lamina clearly has more of the glossiness and darker colour (especially in \textit{D. x complexa}) of \textit{D. affinis} than is normal in \textit{D. filix-mas}. Fronds and segments often very large (though this can also occur sometimes in the rest of the \textit{D. affinis} agg., especially in \textit{D. affinis} subsp. \textit{affinis} and in \textit{D. borreri} and occasionally also in \textit{D. cambrensis} subsp. \textit{cambrensis}), the lamina is sometimes rather narrow in the lower part of the frond (particularly in \textit{D. x complexa} and \textit{D. x convoluta}). The stipe bears denser, darker and narrower scales than in \textit{D. filix-mas} (but it should be noted that occasionally \textit{D. filix-mas} can also be very densely scaly), which often become more russet-coloured and slightly towards those of \textit{D. cambrensis} subsp. \textit{insubrica}; the pinnules of the lower pinnae have more parallel sides than in \textit{D. filix-mas} and sometimes slightly more rectangular side-lobes, if present, though not as parallel and rectangular as in \textit{D. borreri}, but they become much more like \textit{D. filix-mas} with more curved and sloping sides and more pointed lobes and pinnule-apices further up the frond. The pinnule-teeth are \pm acute, though less so in \textit{D. x complexa}. The sori (except in \textit{D. x complexa}) have less inflected indusia than in \textit{D. affinis} etc. The spores, which are most important \textit{[examined dry at c. 100-150 x magnification when ripe, yet not mostly shed and lost]}, are characteristically highly abortive, without which feature being examinable it is difficult to confirm \textit{D. x complexa} except in very obvious specimens. Apart from the mass of abortive spores there is also a small and variable percentage (c. 5-20%, occasionally up to c. 50%) of mostly very large, or exceptionally large, sometimes nearly spherical, apparently good spores present. The all-good, very small spores of \textit{D. filix-mas}, by contrast, are instantly separable (and much smaller than in any species or subspecies of the \textit{D. affinis} agg.), while those of the species and subspecies of the \textit{D. affinis} agg. are usually at least 50%, to mainly good, unless nearly all shed. The abortive spores of the hybrids may be many small fragments (possibly confusable with slightly immature spores, but smaller and with more developed and darker perispores), or misshapen spores with an irregular, often darker perispore (not to be confused with shapeless, dark pieces of earth), \textit{with occasional unseparated diads or tetrads amongst them and usually with some perisporial (sporangial) debris attached to their surfaces, also with dark debris remaining in the sporangia} (not to be confused with earth or dust). They are usually more irregular and often with wider wings of perispore than in the less numerous abortive spores of any other members of the \textit{D. affinis} agg. The hybrids occur sporadically, but fairly commonly, as occasional plants among populations of the parents, not forming populations of their own, except some scattered rather small local, probably mostly vegetative ones, and seldom more than 1-5 clumps per local wood, except in a few favoured habitats where the parents have long been together in quantity, or conditions...
are very luxuriant, damp and favourable for spore-germination, when the hybrid can become more numerous. Rarely large-sized populations of hybrids may occur, for example, in places in south-western Ireland, and are likely to be discovered occasionally elsewhere in Atlantic Britain etc. Hybrids can occur throughout the range of the *D. affinis* agg. as *D. filix-mas* occurs in all the range of the *D. affinis* agg. as well as in its own, wider range. Without being properly familiar with all the taxa of the *D. affinis* agg. it is difficult to recognise, or even accurately guess the presence of genuine hybrids. In the past *D. borreri* was widely misidentified as being such hybrids and was often reported under the name *D. x tavelii* Rothm.

8. *D. wallichiana subsp. wallichiana.*

Morphology like an extreme *D. affinis*. Frond persistent in winter, tall and usually tapering towards the base. Stipe short, except in occasional luxuriant wide-fronded specimens with large segments; stipe and rachis densely clothed with longer, narrower scales than in any of the *D. affinis* agg., which stick out markedly from the rachis. Lamina more highly coriaceous and stiff, more glossy above and glaucous below and more crispaceous than in any of the *D. affinis* agg. Pinnae flat and regular; pinnules ± crowded, usually markedly squarely truncate at their apices, those in the upper parts of the frond more widely joined together at their bases than in *D. affinis*; pinnule-teeth few, more obtuse and short, though usually with an acute tip at their apex. Fronds eglandular. Sori smaller than in *D. affinis*, with thick, inflected, eglandular indusia that split on ripening and persist for a long time. Spores relatively small and regular (diploid apomict).

A pan subtropical montane taxon. Not in the European (*sens. lat.*) flora, where it is replaced by the W. Asian *D. iranica* (usually with a longer stipe, wider lamina-base, larger segments; triploid apomict, and with larger and less regular spores).

ACKNOWLEDGEMENTS

The author wishes to thank the following for their various help and contributions to this study:

Prof. Mary Gibby, Edinburgh; the late Dr. Trevor Walker, Newcastle; Miss Alison Paul, London; Miss Josephine Camus, London; Mr. Peter Edwards, Kew; the late Prof. I. Manton, Leeds; Mr. Ken Trewren, Egton Bridge; Mr. Anthony Pigott, Mendlesham; Mr. Alfred Eschelmüller, Sulzberg; the late Mr. Hugh Corley, Faringdon; Prof. Gabor Vida, Budapest; the late Dr. Walter Gätzi, St. Gallen; M. Michel Boudrie, Clermont Ferrand; Mr. Mike Taylor, Isle of Skye; Mr. Martin Rickard, Kyre Park; Dr. Jacob Schneller, Zürich; Dr. Stefan Jessen, Chemnitz; Herr Jens Freigang, Germany; Herr Walter Bujnoch, Germany, and above all his colleague of 25 years, the late Prof. Tadeus Reichstein, Basel and Agarone.

The great many correspondents and the staff of nearly 200 herbaria who have assisted in his inquiries have been acknowledged in full in the forthcoming study by Fraser-Jenkins & Trewren (in prep.).

REFERENCES


SELAGINELLA AGASTYAMALAYANA (SELAGINELLACEAE: PTERIDOPHYTA), A NEW SPECIES FROM SOUTH INDIA

RAJU ANTONY, A.E. SHANAVAS KHAN & G. SREEKANDAN NAIR
Tropical Botanic Garden and Research Institute, Palode, Thiruvananthapuram – 695 562, Kerala, India

Key words: Fern ally, Selaginella agastyamalayana, India

ABSTRACT

Selaginella agastyamalayana, a new species (Selaginellaceae: Pteridophyta) is described from Kerala, South India.

INTRODUCTION

The genus Selaginella P. Beauv. comprises about 700 species distributed throughout the world, but mainly concentrated in tropical and subtropical areas. Dixit (1992) recorded 62 species in India. Later Madhusoodanan and Nampy (1994) added one more species from Kerala.

As part of our floristic survey and ex-situ conservation of pteridophytes in the Western Ghats, South India, we made repeated plant exploration trips to Agastyamala, one of the well-known ‘hot spots’ of South India, which resulted in the collection of interesting specimens of Selaginella growing in wet rock crevices (1,750 m alt.) in evergreen forests. On careful examination it proved to be a species new to science. The new species is described here and named after the type locality. Selaginella agastyamalayana is known so far only from the type locality. Selaginella agastyamalayana sp. nov.

Stems slender, 3.5-7 cm, prostrate, branched from the base, branches short. Rhizophores long, thin, wiry, present throughout the plant. Leaves heteromorphic throughout, pale green, membranous; lateral leaves distant on main stem and branches, 1-2 x 0.8-1.5 mm, suborbicular, obtuse at apex, cordate at base, margin denticulate; axillary leaves suborbicular, obtuse at apex, cordate at base, margin denticulate; median leaves distant on main stem but subcontiguous on branches, 0.7-1 x 0.2-0.3 mm, ovate,
acuminate to aristate at apex, cordate at base, margin denticulate. Strobili 2.5-4 x 1.8-2 mm, terminal, single to double at the branches and branchlets; sporophylls dimorphic; larger sporophylls in the same plane as the median leaves, 1-1.5 x 0.4-0.8 mm, ovate-oblong, subacute at apex, cordate at base, margin denticate; smaller sporophylls 1-1.2 x 0.6-0.7 mm broadly ovate, acuminate at apex, cordate at base, margin denticulate. Megaspores dull yellow, 173-313 µm in diameter, spinulose. Microspores deep orange, 23-33 µm in diameter, verrucoid.

Other specimens examined: Agastyamala, Thiruvananthapuram District, Kerala, 10 December 1998; Raju Antony 29880 (TBGT).

Note: This species is allied to Selaginella miniatospora (Dalz.) Bak. But can be easily distinguished from it by prostrate stems, rhizophores present throughout the plant, suborbicular lateral leaves with obtuse apices, median leaves acuminate to aristate at apex, cordate at base, margin denticulate.

Figure 1. Selaginella agastyamalayana
A - habit; B - lateral leaf; C - axillary leaf; D - median leaf; E - strobilus; F - larger sporophyll; G - smaller sporophyll.
apex, denticulate sporophylls, spinulose megaspores as against stems erect, rhizophores
restricted to basal one fourth, ovate-oblong lateral leaves, subacute at apex, median
leaves cuspidate at apex, dentate sporophylls and papillate megaspores.

ACKNOWLEDGEMENTS

The authors thank Dr V.B. Hosa Goudar, Tropical Botanic Garden and Research
Institute, Palode, for the latin diagnosis. We also thank E.S. Santhosh for his help and
S. Suresh Kumar for the illustration.

REFERENCES

Dun.

MADHUSOODANAN, P.V. & SANTHOSH NAMPY, 1994. Selaginella dixitii, a new
BOOK REVIEW


Superficial comparison of the distribution maps in the New Atlas of the British and Irish Flora (Preston et al 2002) with those recorded in the Atlas of the British Flora (Perring & Walters 1962) show many changes resulting from a variety of causes – increased urbanisation, changes in farming practices, spread of non-native invasive species, or climate change. A survey of species from 811 tetrads in a regular grid across Britain, carried out in 1987 by BSBI recorders, provided a firm basis for further research to resurvey these sites and measure distributional changes for individual species. This publication is the result of the excellent collaboration between the valuable network of BSBI recorders and staff of the Biological Records Centre (BRC).

The range of species covered include native and long-established introductions, and more recent introductions as well as some rare or very widespread species. In reporting the results, the species are grouped under broad habitats – coniferous woodland, calcareous grassland etc., to try to identify patterns of change within a habitat.

What is happening to ferns? Their inclusion is clear from the front cover, with an illustration of Hart’s Tongue Fern, Asplenium scolopendrium (referred to here as Phyllitis scolopendrium). This species is included in two broad habitats, ‘Broad-leaved, mixed and yew woodland’, and ‘Inland rock’ that includes cliffs, screees, quarries and limestone pavement. In both habitats it seems to be increasing its range, and in Scotland appears to be colonising walls and open woodland, perhaps in response to a reduction in frosts. Similarly, Polystichum setiferum, another woodland species, also shows significant increase and may also be benefitting from milder winters. In contrast Cystopteris fragilis, more commonly found in rock outcrops or walls in the north and west, shows decline, particularly in lowland sites that may no longer provide damp, shaded conditions. Large decline is also recorded for Dryopteris expansa and D. oreades, although the results of their analyses are based on small samples.

This book raises a lot of questions. It also highlights the importance of good and accurate recording and, I hope, stimulates further activity in BPS field meetings.

REFERENCES


M. Gibby
DYNAMICS OF LONG-DISTANCE DISPERSAL: THE SPREAD OF
ASPLENIUM ADIANTUM-NIGRUM AND ASPLENIUM TRICHOMANES
(ASPLENIACEAE: PTERIDOPHYTA) ON LONDON WALLS

J.A. EDGINGTON

19 Mecklenburgh Square, London WC1N 2AD

ABSTRACT
Asplenium adiantum-nigrum L. and A. trichomanes L. have spread widely across inner London since about 1995 but have not yet colonised the district uniformly. The spacing between sites, and evidence that at most a few founding populations are involved, suggests that a sequence of long-distance dispersal events is responsible. A simple model of dispersal is proposed which predicts an exponential distribution of nearest-neighbour distances. The combined data for both species yield a good fit to such a distribution and a value of approximately 0.75 km for the mean distance between a newly-established sporophyte and the nearest potential parent plant. This leptokurtic distribution accounts for some offspring growing 5 km or more from their parent while the populated zone expands at up to 1 km per year. Assumptions underlying these conclusions are examined.

INTRODUCTION
It is well-known that plants can colonise fresh sites, such as oceanic islands, at great distances from existing populations but there are few experimental studies of long-range dispersal – in the case of seed plants, virtually none (see Cain, Milligan and Strand, 2000, for a review). The likelihood of establishing spore-producing plants as a function of distance from the source sporophyte is likewise poorly understood. Though measurements have been reported of atmospheric concentrations of spores at varying distance from their apparent source, the complex relationship between spore dispersal and viability on the one hand, and subsequent germination and development on the other, means that these data cannot be taken to be representative of the likelihood of sporophyte establishment as a function of distance from the parent plant. Knowledge of this would provide both reference data for the phytogeography of spore plants and constraints on models of migration and expansion.

There are few instances in which the spread of bryophytes and pteridophytes into a virgin habitat has been followed closely in time and space. A recent example is a survey (Miller and McDaniel, 2004) of the bryophyte flora of a road driven 65 years ago through the Adirondack Mountains in New York State. By observing the presence, in an otherwise acidic natural terrain supporting only a calcifuge flora, of a large number of calcicole bryophytes on man-made mortared structures, Miller and McDaniel concluded that some bryophytes may be capable of routine dispersal over distances of at least 5 km, and that long-distance colonisation had occurred at the rate of at least one species per year.

The present paper describes an analogous case involving ferns observed in the process of occupying a habitat which has recently become able to support a flourishing pteridophyte flora. The ferns concerned are calcicole epiliths and the habitat is mortared brick walls in central London. Colonisation seems to have occurred within the last
Figure 1. Sites for *Asplenium adiantum-nigrum* in the Metropolitan district of Middlesex; the River Thames (shown grey) is its southern boundary.

Figure 2. Sites for *Asplenium trichomanes* subsp. *quadrivalens* in the Metropolitan district of Middlesex; the River Thames (shown grey) is its southern boundary.
fifteen years and the distribution of sites, dense near the first recorded occurrence, sparser further away, suggests that is not yet complete. A model is proposed for the spatial distribution of long-distance dispersal events, which when fitted to the data yields an estimate of the mean dispersal distance and the likelihood of colonisation as a function of distance.

COLONISATION OF LONDON BY SPECIES OF ASPLENIUM

Since 1998 the author and others have recorded ferns growing on walls in the built-up area of inner London, specifically the so-called Metropolitan district (Kent, 1975) whose boundaries are essentially those of the pre-1965 London County Council north of the River Thames. The area of this district is about 140 km². A recent paper (Edgington, 2003), comparing current and historic records, showed there had been a significant increase in the number and variety of mural ferns since about 1990, probably associated with a contemporaneous decline in SO2 levels. More than twenty different species have been recorded. Excluding casual aliens, and a few native ferns represented by only one or two records, they fall in one of three groups.

Four species (Asplenium scolopendrium L. and three woodland ferns - Dryopteris flix-mas (L.) Schott, Dryopteris dilatata (Hoffm.) A. Gray and Pteridium aquilinum (L.) Kuhn) have been recorded regularly since 1869 and are essentially ubiquitous, found on a great many walls in central London; the former is always highly fertile while the woodland ferns, though normally sterile when growing on walls, are abundant in surrounding countryside and are presumably recruited from fertile plants growing in nearby woodland. Another five (Adiantum capillus-veneris L., Asplenium ceterach L., A. ruta-muraria L., Polypodium vulgare L. and P. interjectum Shivas) were rarely recorded in the past and are still known from rather few places. The most abundant are P. vulgare (sensu lato) and A. ruta-muraria with over a dozen sites each; some have been known for centuries but others are transient and there is little evidence of recent rapid spread, simply of better recording. Colonisation is evidently a slow and erratic process, like the occasional escape of alien ferns from cultivation.

Two species, however, A. adiantum-nigrum L. and A. trichomanes L. subsp. quadrivalens, which were apparently absent from central London¹ until recently, are now frequent. The historical flora of Middlesex (Kent, 1975) has no modern records in the district for either fern but the Supplement (Kent, 2000) with records up to 1997 lists four sites for A. adiantum-nigrum (including the City of London where Mr JM Montgomery found one plant in 1980 – the others were in 1988, 1990 and 1995) and two for A. trichomanes (1995 and 1996, Bloomsbury). Both ferns are now widespread and appear to be still increasing, with 40 and 43 records respectively at the time of writing, compared with 27 and 37 records respectively in Edgington (2003). They behave as strict calcicoles, growing only on mortared walls (or in one case, on eroded limestone boulders used as design features in a small park), generally in shade and often, though not exclusively, towards the top of the wall. Old crumbling mortar is preferred but many sites are on apparently sound mortar of modern walls where there is some permanent dampness. Figures 1 and 2 show their distributions within the Metropolitan district. Each record includes the street and sometimes the house number but in the Figures and what follows 6-figure National Grid references are used; sites closer than 100 m are treated as a single colony.

¹There is a solitary record of A. trichomanes at Chelsea, by Robert Nicholls before 1746.
Evidence for a small number of founding events
Both ferns form compact colonies where they occur; sporelings mature rapidly and within a year or two all plants are shedding enormous numbers of sooty spores. Though present in many districts around London they were, and still are, “thinly scattered ... and often scarce where they occur” (Burton, 1983), unlike *A. ruta-muraria*, for example, which is much more abundant on suitable sites in the surrounding countryside. Their sudden appearance in the Metropolitan district and their rapid spread suggests in the case of each species one or at most very few founding events followed by spore dispersal and establishment in suitable places with the cycle then repeating. Their distributions (clustered near their earliest recorded sites in the City and in Bloomsbury, sparser further away) are highly non-random. Dividing the district into equal areas along north-south and east-west axes, counting the number of sites in each sector and evaluating 2 assuming random distributions yields significant (P<0.05) and highly significant (P<<0.01) departures from randomness from east to west and from north to south respectively, for both species. In contrast the distribution of sites for *A. ruta-muraria* (Figure 3) is essentially random (0.1<P<0.9) in both directions.

The number of new records of *A. adiantum-nigrum* and *A. trichomanes* each year is shown in Table 1. Coverage is necessarily incomplete – only sites accessible to the public have been surveyed – but if recording efficiency is assumed to be constant across the whole area, the model of dispersal described below is still applicable. The decline in new records after 2003 is consistent with early colonisation of the most suitable sites and slower spread subsequently. If this process were to continue these species would no
doubt eventually become as common as *A. scolopendrium*, a longer-established and equally freely-fertile fern found throughout inner London on almost all suitable mortared walls; its present distribution is essentially uniform and tells us nothing about spore dispersal.

**A MODEL FOR THE DISPERSAL PROCESS**

The following simple model is proposed. During periods of calm, ejected spores will fall close to the plant. In windier weather some, maybe most, will be carried away and are capable of travelling considerable distances. As long as the atmosphere is turbulent they are likely to remain suspended. One mechanism for bringing them to ground is capture by (or nucleation leading to formation of) raindrops, a process that will obviously deposit them in a wet environment and enhance the chances of germination. The combination of an (assumed constant) wind velocity with a random process of precipitation (probably, but not necessarily by rain) acting on an (extremely large) population of spores results in an equal probability, $\varepsilon$, of deposition per unit distance travelled. The number of spores deposited at distance $d$ from their source thus follows an exponential distribution, $N \sim e^{-\varepsilon d}$, as in radioactive decay where time is the variable, and just as the time of the first decay after a clock has been started follows the same law, so does the distance from the source at which the first spore is deposited. If each deposited spore is equally likely to produce a mature sporophyte, the same exponential law will hold for the distance of these from their parent plant. Dispersal will take place in the direction of the prevailing wind, which will be variable but is assumed not to change significantly during each episode of spore release and travel. The predominance of stations in Figures 1 and 2 to the north-east of the presumed initial sites is consistent with the prevalence of south-westerly winds.

*A priori* we do not know the source of spores arriving at a particular site. To continue the analogy with radioactivity, where the interval between consecutive decays also follows the exponential law, so too does the distance between adjacent spore

---

**Table 1.** Annual summary of new records in the Metropolitan district.

<table>
<thead>
<tr>
<th>Year</th>
<th><em>A. adiantum-nigrum</em></th>
<th><em>A. trichomanes</em></th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1998</td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>1999</td>
<td>2</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>2000</td>
<td>6</td>
<td>8</td>
<td>14</td>
</tr>
<tr>
<td>2001</td>
<td>6</td>
<td>10</td>
<td>16</td>
</tr>
<tr>
<td>2002</td>
<td>6</td>
<td>10</td>
<td>16</td>
</tr>
<tr>
<td>2003</td>
<td>8</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>2004</td>
<td>4</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>2005</td>
<td>5</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>2006</td>
<td>2</td>
<td>4</td>
<td>6</td>
</tr>
</tbody>
</table>
depositions; that is, by assumption, between sites of mature ferns. It is sufficient, therefore, to identify each station’s nearest neighbour, determine their separation $D$ and estimate $1/e$ as $D_m$, the mean value of $D$. This procedure relies on each nearest-neighbour pair being in a direct parent-offspring relationship. The sparse distribution of these two ferns makes this a plausible assumption. (Its breakdown is one reason why this model cannot be applied to dense distributions like that of $A$. *scolopendrium.*) It is immaterial which of the pair is the parent and which the offspring. If there is more than one founding colony the exponential law will hold for each lineage separately and the estimated value of $D_m$ (based on the combined populations) will be a lower bound to the true value.

**Results of nearest-neighbour analysis**

The data in Figures 1 and 2 have been analysed using this model. The distributions of $D$ for the two species turn out to be similar. The mean and standard deviations (which for a true exponential distribution would be equal) are $D_m = 0.875$ km, $= \pm 0.872$ km for *A. adiantum-nigrum* and $D_m = 0.721$ km, $= \pm 0.891$ km for *A. trichomanes*. This agreement between $D_m$ and , excellent in the first case and adequate though not so compelling in the second, gives some support for the simplest model of a single founding event in each case.

If it is assumed that both data sets have the same true value of $e$, they can be combined, yielding the estimate $D_{m,\text{joint}} = 0.795$ km with a standard error of $m = 0.097$ km. Since plants separated by less than 100 m are treated as a single colony this procedure overestimates the mean separation by approximately 50 m; the corrected value is thus $D_{m,\text{joint}} = 0.745$ km The combined data are plotted in Figure 4 as a cumulative distribution of ($N > D$) versus $D$. The solid curve represents $N = NO \left(1 - e^{-eD}\right)$ where $NO = 83$ is the total number of sites (hence, nearest-neighbours) and $1/e = 0.745$ km is the mean dispersal distance.

The exponential distribution is strongly leptokurtic (kurtosis $k = 9$; compare $k = 3$ for a Gaussian distribution) with a long tail of improbable but not impossible events. The two largest observed values of $D$ are 3.5 and 4.8 km, for *A. adiantum-nigrum* and *A. trichomanes* respectively. Values as large as this or larger would be expected in about 1 in 100, and 1 in 1500 cases respectively, for the given exponential distribution. A separation of 3.5 km is therefore entirely consistent with the size of the data set (83 values of $D$). A separation of 4.8 km is less likely but not implausibly so ($P = 0.05$).

**DISCUSSION**

Two assumptions underlying this analysis are, that long-distance dispersal is not an unusual event but a regular process undergone by large numbers of spores, and that the breeding system allows growth of sporophytes from a small number of spores, perhaps only one.

**Experimental data on spore production and dispersal**

In totally still air, even the most energetic process can scarcely propel spores more than a very short distance from a dehiscing sporangium. Measurements of the deposition rate around a single fertile fern do indeed show that it falls rapidly with distance, reaching (in the case of woodland ferns such as *Pteridium*) background levels beyond 5-10 m (Dyer, 2005, *in litt*). However, in experiments involving the mosses *Atrichum undulatum* (Hedw.) P. Beauv. and *Bryum argenteum* Hedw., Miles and Longton (1992)
estimated that 85-95% of spores were dispersed more than 2 m from the parent gametophyte, presumably for the same reasons that pollen grains drift long distances in air currents. Such an experiment has not been carried out for pteridophytes but it does not seem unreasonable to suppose that similar results would be obtained. The fact that wind speeds generally increase with height is an argument favouring long-distance dispersal for spores of ferns growing on vertical walls. Since the number of spores per frond of *A. trichomanes* has been estimated to be about 750,000 (Page, 1979), a colony of a few mature plants, with a hundred or so fronds, could release up to 108 spores each season. If, as with the mosses in Miles and Longton’s studies, the majority spread beyond the immediate vicinity, then hundreds of spores could travel 10 km or more, even with a mean dispersal distance as short as 0.75 km.

**Germination and development in Asplenium**

Sporophyte production from a single spore requires either self-fertilisation or apogamous development of the gametophyte. The apogamous life-cycle occurs widely among epilithic taxa but is apparently present in only about 3% of *Asplenium* species (Van den Heede, Viane and Chase, 2003); neither *A. adiantum-nigrum* nor *A. trichomanes* is known to be apogamous. In a study of germination and gametophyte development in three *Asplenium* species, Pangua, Lindsay and Dyer (1993) showed that gametophytes of *A. trichomanes* were protogynous with about equal numbers developing archegonia only, and both antheridia and archegonia; rather few developed antheridia only. Fully 90% of archegoniate gametophytes went on to develop sporelings. These findings were obtained with rather densely sown cultures (ca 250 spores cm⁻²) so the likelihood of inter-gametophytic fertilisation was *a priori* high; indeed the authors concluded that the populations of *A. trichomanes* they studied were predominantly outbreeding. More recently, experiments on five Swiss populations of *A. trichomanes* subsp. *quadrivalens* (Suter, Schneller and Vogel, 2000) showed that more
than half (mean 56.4%, maximum in one population 83.3%) of deliberately isolated prothalli succeeded in forming sporophytes. Suter, Schneller and Vogel concluded that, although there was some evidence for cross-fertilisation, the taxon is highly inbreeding “with the capability of single-spore colonisation and subsequent founding of new populations” (loc. cit.). It seems safe to conclude that intra-gametophyte selfing is common in *A. trichomanes* and, if the similar behaviour of the taxa in London is any guide, in *A. adiantum-nigrum* too.

CONCLUSIONS

The present distributions of *A. adiantum-nigrum* and *A. trichomanes* in central London are well described by an exponential model of dispersion. Both species appear to have migrated about ten km from their presumed initial sites, the former in 15-20 years, the latter in 10-15 years. Their mean distance of travel is about 0.75 km while there is evidence for dispersal distances of up to 5 km during this period. This value is similar to that inferred for bryophytes in a comparable situation.

In the absence of experimental proof that the various colonies of each fern form a single lineage these conclusions must be tentative; evidence for single founding events is mainly circumstantial. *A. trichomanes* in particular is a variable species. Although most examples from central London are clearly referable to the tetraploid subsp. *quadrivalens* others appear morphologically close to subsp. *hastatum* or even the diploid subsp. *inexpectans*. Lacking biological evidence of affinity between colonies, this account must be treated as a hypothesis requiring validation by genetic studies to confirm the lineages.

REFERENCES


INSTRUCTIONS FOR AUTHORS

PAPERS should not usually exceed 20 printed pages and are generally expected to be considerably shorter. Review articles, as well as reports of original research, are encouraged. Short notes are acceptable e.g. new records. The senior author should supply a fax and email address to facilitate correspondence.

MANUSCRIPTS should be submitted in English (British) in electronic format (preferably) or hard copy (two copies), in 10-point Times New Roman font and double spaced. Electronic versions of text and tables should be compatible with WORD, with figures as pdf or jpg files, and sent as email attachments or CDroms. All manuscripts will be refereed.

THE TITLE should reflect the content of the paper and be in BOLD CAPITALS (11-point) and centrally aligned. Generic and specific names should be in italics and any title containing a generic or specific name must be followed by the family and Pteridophyta in brackets e.g.

TRICHOMANES SPECIOSUM (HYMENOPHYLLACEAE: PTERIDOPHYTA) IN SOUTHERN SPAIN

AUTHOR ABBREVIATIONS should follow Pichi Sermolli’s (1996) Authors of scientific names in Pteridophyta, Royal Botanic Gardens, Kew.

MAIN HEADINGS: should be in BOLD CAPITALS (10-point) and centrally aligned.

SUBSIDIARY HEADINGS: should be in bold, the first letter of each word in capitals, the rest in lower case and left-aligned.

AUTHORS’ NAMES AND FULL ADDRESSES: follow the title and are centrally aligned.

KEY WORDS: up to ten.

ABSTRACT: should reflect the content of the paper.

FIGURES: there is no distinction between photographs and line drawings in numbering. All should be presented in a form ready for reproduction, ideally in JPG format (please contact editor with queries), with a scale bar where appropriate. Lettering or numbers (Arabic) should be in the bottom left using uppercase Times Roman and be sufficiently large to be legible if reduction is necessary during printing. The number of photographs allowed in any one issue is limited by cost. Figure captions should be on a separate sheet.

TABLES: can be printed in either portrait or landscape format. Authors should consider this when preparing tables. Authors should ensure that tables fit the printed page size in a legible form.

MEASUREMENTS: should follow the metric system.

CHECKLISTS: should follow the format of Baksh-Comeau, Fern Gaz. 16(1, 2): 11-122.

REFERENCES: should follow the style of a recent issue of The Fern Gazette, e.g.:


JOURNAL ABBREVIATIONS: should follow Botanico Periodicum Huntianum Supplements.

Alterations from the original text at proof stage will be charged for unless they are minor points of detail. Twenty-five offprints will be supplied free to the senior author.
TWO NEW SPECIES OF SELAGINELLA SUBGENUS HETEROSTACHYS (SELAGINELLACEAE) FROM THE GUIANAS

G. CREMERS¹ & M. BOUDRIE²

¹ I.R.D., Muséum national d’Histoire naturelle, Département Systématique et Évolution, USM 0602, case postale 39, 37 rue Cuvier, F-75231 Paris Cedex 05, France. (Email : gecremers@orange.fr)
² 16, rue des Arènes, 87000 Limoges, France. (Email : boudrie.michel@orange.fr)

Key words: Selaginella, Heterostachys, Guyana, Suriname, French Guiana, South America.

ABSTRACT

During our study of the biodiversity of the Guianas and the preparation of the flora of this region, we discovered that the I. Valdespino’s monograph of the genus Selaginella subgen. Heterostachys was never published. Two taxa, S. gynostachya and S. karowtipuensis, presented in this monograph and new to the Guianas, are published herein.

INTRODUCTION

In 1995 Ivan A. Valdespino Quintero completed a monographic study to obtain his Doctor of Philosophy degree in Botany from the Graduate School of The City University of New York. This work was supervised by J.T. Mickel as Chair of the Examining Committee. Certain elements of the dissertation, such as the lectotypifications of S. flagellata Spring and of S. minima Spring, are cited by Mickel & Smith (2004), but unfortunately Valdespino’s monograph was never entirely published.

During our study of the biodiversity of the flora of French Guiana and in relation to the international programme of the ‘Flora of the Guianas’, we had to consult this work. For instance, S. minima, of which the type is from French Guiana, is treated in this work. This species was known only from a few specimens collected before 1850 but has been recently found again in French Guiana (Cremers & Boudrie, 2006). We are also preparing a paper dealing with ‘Pteridophytes having at least a syntype collected in the Guianas’ and fascicle 9 of the Pteridophytes of the Flora of the Guianas, both works which enhance the interest of such a monograph in which two new species have not been officially published.

We present here the descriptions of these two new species to the Guianas, with type specimens from Guyana. What follows has been extracted verbatim from Valdespino’s
monograph. Valdespino, who is currently unavailable, deserves full credit for recognizing and distinguishing these two new species. Here we intend to validate and to pay tribute to his work.

**NEW SPECIES**

**Selaginella gynostachya** Valdespino ex Cremers & Boudrie, sp. nov. (Figure 1 a, b, c; Figure 2 a, b, c)

*A. hyalogramma* Valdespino et *S. karowtipuensis* Valdespino foliis intermediis basi subtruncatis vel rotundatis nec non foliis lateralibus supra idioblastis destitutis diversa; ulterius a prima foliis intermediis ellipticis, ovato-ellipticis vel ovatis, foliis lateralibus oblongis vel oblongo-ovatis necnon megasporis pallide luteis; ulterius a secunda foliis intermediis apice acutis vel breviter acuminatis.

Type: GUYANA. Upper Potaro River, vicinity of Kopinang village, 4°58'N, 59°50'W, 670 m, 29 Jul. 1989, *Boom & Samuels 8939* (holotype NY; isotype BRG).

Etymology –Gr., gynê, female or pertaining to female organs, and stachys, spike; referring to the mostly megasporangiate strobili found on specimens of this species.

Plants terrestrial. Stems creeping, stramineous, 5-14 cm long, 0.4-0.8 mm diam., not articulate, not flagelliform, not stoloniferous, 1- or 2-branched. Rhizophores axillary, restricted to basal ½ of the stem, stout, (0.28-) 0.34-0.56 mm diam. Leaves dimorphic throughout, membranaceous, the upper surface green, composed of elongate cells with sinuate walls. Lateral leaves distant, slightly ascending, oblong to oblong-ovate, 2.8-4 x 1-1.9 mm; base subtruncate to rounded, the acroscopic base strongly overlapping the stem; margins slightly hyaline, or pale green, the acroscopic margin serrate to ciliate-denticulate along basal 1/3, serrulate apically, the basiscopic margin entire to serrulate apically; apex obtuse to broadly acute, dentate at tip; both surfaces glabrous, the upper surface without idioblasts, the lower surface frequently with conspicuous or obscure idioblasts, the stomata present only on the lower surface. Median leaves distant, ascending, elliptic to ovate-elliptic, 1.7-2.3 x 0.7-1.4 mm; base asymmetric with the inner base truncate and the outer base with a slightly developed auricle; margins slightly hyaline, serrate to serrulate; apex acute to shortly acuminate, the acumen, when present, less than 1/3 the length of the lamina, 0.1-0.26 mm long, puberulent and dentate at tip; both surfaces glabrous, the upper surface frequently with conspicuous idioblasts and stomata, the lower surface with obscure to conspicuous idioblasts, and without stomata. Axillary leaves similar to lateral leaves or more broadly ovate, except the base frequently rounded. Strobili terminal on branch tips and main stem apex, lax, flattened, and dorsiventral, 5-15 mm long. Sporophylls dimorphic, basally attached to the axis; dorsal sporophylls green, spreading, basally attached to the axis, with an adaxial flap extending along ca. ½ to ⅔ the sporophyll length, asymmetric or lanceolate to lance-ovate, 1.6-2.36 x 0.6-0.98 mm, with a strongly developed and slightly denticulate keel along midrib, the base ± rounded, the margins slightly hyaline to hyaline greenish, serrate to shortly ciliate, the apex acute to shortly acuminate, the upper surface green, composed of ± rounded cells, except for the portion that folds to form the flap where the cells hyaline and elongate with sinuate walls, glabrous, frequently with conspicuous idioblasts and stomata, the
Figure 1a. Scanned photograph of *Selaginella gynostachya* Valdespino ex Cremers & Boudrie (*Cremers 5379, CAY*): Herbarium sheet.
Figure 1b. Scanned photograph of *Selaginella gynostachya*. Detail of the adaxial face.

Figure 1c. Scanned photograph of *Selaginella gynostachya*. Detail of the abaxial face.
Figure 2. Drawings of the leaves of *Selaginella gynostachya* Valdespino ex Cremers & Boudrie (*Cremers 5379*, CAY).

a = axillary leaf (abaxial face); b = lateral leaf (abaxial face); c = median leaf (adaxial face);

The small lines on the leaves represent the idioblasts (M. Boudrie’s drawings).
lower surface silvery to silvery green, composed of elongate cells with sinuate walls; ventral sporophylls almost colourless to pale green, ascending, with a slightly developed adaxial flap, ovate, 1.48-1.9 x 0.56-0.84 mm, with a well developed and slightly denticulate to entire keel along midrib, the base attenuate to rounded, the margins hyaline to pale green, serrate to very shortly ciliate, the apex acute to shortly acuminate; both surfaces made of elongate and hyaline cells with sinuate walls, glabrous, with or without conspicuous idioblasts, the stomata present only along midrib on the lower surface. Megasporangia in two ventral rows; megaspores marguerite yellow (light yellow), with a well developed equatorial flange, the proximal face striate-reticulate to reticulate, the distal face reticulate with open reticulum of high ridges, 300-320 µm diam. Microsporangia mostly absent from the two dorsal rows, or few mature near the apex on dorsal rows; microspores not studied.

HABITAT AND DISTRIBUTION: On stream or river banks; 30-1000 m; known from Venezuela, Guyana, and French Guiana.

PARATYPES: VENEZUELA. Bolivar: Gran Sabana, ca. 10 km SW of Karaurin Tepui at junction of Rio Karaurin Tepui and Rio Asadon (Rio Sanpa), 5°19’N, 61°03’W, 900-1000 m, Liesner 23798 (UC).

GUYANA. Upper Mazaruni: East bank of Waruma River, 20 km S of confluence with Kako River, 5°19’N, 60°46’W, 1000 m, Feb 1985, Renz 14188 (U); Essequibo River of Porto Bartica, Jenman s.n. (K); Macouria Riv., Nov 1886, Jenman 2324 (BM, K, US); Macouria Creek, Essequibo River, Jenman s.n. (NY); Upper Potaro River: vicinity of Kopinang village, 4°58’N, 59°50’W, 670 m, 29 Jul 1989, Boom & Samuels 8939 (BRG, NY).

FRENCH GUIANA. Rivière Sinnamary à Petit Saut, 30m, 12 Feb 1979, Cremers 5379 (CAY!, Z).

TAXONOMIC DISCUSSION: Selaginella gynostachya seems most closely related to S. hyalogramma and S. karowtipuensis but differs by median leaves with a subtruncate to rounded base (vs. rounded to semicordate as in S. hyalogramma or subcordate to rounded as in S. karowtipuensis) and by lacking (vs. having) idioblasts on the upper surface of the lateral leaves. Selaginella gynostachya differs further from S. hyalogramma by elliptic to ovate-elliptic or broadly ovate (vs. lanceolate) median leaves, by oblong to oblong-ovate (vs. broadly ovate to broadly ovate-lanceolate) lateral leaves, and by light yellow (vs lemon yellow) megaspores. S. gynostachya differs from S. karowtipuensis also by its acute to shortly acuminate (vs. long-acuminate to short aristate) apex.

On the paratype (Cremers 5379, CAY) illustrated here, we noticed that the median leaves do not have idioblasts on their upper surface. Therefore, this character is variable and should be used with caution in the key. In addition, the lateral leaves are evidently cilio-denticulate.

Selaginella karowtipuensis Valdespino ex Cremers & Boudrie, sp. nov. (Figure 3 a, b, c; Fig. 4 a, b, c).

Selaginella seemannii Baker affinis, sed foliis lateralis, intermedii et sporophyllis superne idioblastis provisis diversa. A S. stenophylla A. Braun foliis intermedii basi
Figure 3a. Scanned photograph of *Selaginella karowtipsensis* Valdespino ex Cremers & Boudrie (Boom & Gopaul 7415, NY): Herbarium sheet.
**Figure 3b.** Scanned photograph of *Selaginella karowtipuensis.* Detail of the adaxial face.

**Figure 3c.** Scanned photograph of *Selaginella karowtipuensis.* Detail of the abaxial face.
Figure 4. Drawings of the leaves of *Selaginella karowtipuensis* Valdespino ex Cremers & Boudrie (*Boom & Gopaul 7415*, NY).

a = axillary leaf (abaxial face); b = lateral leaf (abaxial face); c = median leaf (adaxial face);
the small lines on the leaves represent the idioblasts (M. Boudrie's drawings).
non nisi auriculo exteriori vel serrulato provisis diversa.

Type: **GUYANA.** Upper Mazaruni: Karowtipu Mountain, between camp and peak on western side of mountain, 5°45’N, 60°35’W, 920-1080 m, 24 Apr 1987, **Boom & Gopaul 7698** (holotype NY; isotypes BM, BRG, PMA, UC, US).

Etymology—Named after the type locality.

Plants terrestrial. **Stems** creeping, stramineous, 20-34 (or more) cm long, 0.9-1.6 mm diam., not articulate, not flagelliform, not stoloniferous, 2- or 3(-4)- branched. **Rhizophores** axillary or occasionally with both axillary and dorsal rhizophores, restricted to basal ½ of the stem, stout, (0.44)0.54-0.88 mm diam. **Leaves** dimorphic throughout, membranaceous, the upper surface green, composed of ± rounded cells with slightly sinuate walls. **Lateral leaves** distant, perpendicular to the stem, oblong-ovate to oblong, 3.5-5.3 x 1.5-2.6 mm; base subcordate to rounded, the acroscopic base strongly overlapping the stem, the basiscopic base not overlapping the stem; margins hyaline to pale green, the acroscopic margin serrate, the basiscopic margin entire to serrulate apically; apex rounded to obtuse, dentate at tip; both surfaces glabrous, the upper surface with conspicuous idioblasts and without stomata, the lower surface with obscure idioblasts and with stomata along midrib. **Median leaves** distant, ascending, ovate to broadly ovate, 2.3-3.1 x 1-1.7 mm; base subcordate, the inner base rounded and the outer base with a well developed auricle; margins hyaline, serrate; apex long-acuminate to short-aristate, the acumen or arista ¼ or less of the length of the lamina, 0.28-0.54 mm long, puberulent and dentate at tip; both surfaces glabrous, the upper surface with conspicuous idioblasts, without stomata. **Axillary leaves** similar to lateral leaves or more cordiform. **Sporophylls** terminal on branch tips and main stem apex, slightly lax and flattened, dorsiventral, 3-13 mm long. **Sporophylls** dimorphic, basally attached to the axis; dorsal sporophylls green, spreading, with an adaxial laminal flap extending along ca. ½ to 1/3 the sporophyll length, asymmetric or lanceolate to lance-ovate, 1.54-2.08 x 0.6-0.92 mm, with a strongly developed and denticulate keel along midrib, the base rounded, the margins slightly hyaline to hyaline-greenish, serrate, the apex acute to shortly acuminate, the upper surface green, composed of ± rounded cells, except for the portion that folds to form the flap where the cells hyaline and elongate with sinuate walls, glabrous, with conspicuous idioblasts, the stomata along midrib, the lower surface silvery to silvery green, composed of elongate cell with sinuate walls, and without idioblasts; ventral sporophylls pale green, ascending to spreading, without an adaxial flap, ovate, 1.32-1.76 x 0.6-0.9 mm, with a well developed and slightly denticulate keel along midrib, the base rounded, the margins hyaline to pale green, serrate, the apex acute to shortly acuminate, the surface made of elongate cells with sinuate walls, glabrous, with idioblasts present only on the lower surface, the stomata present only along midrib of the lower surface. **Megasporangia** in two ventral rows; megaspores maize yellow, with a prominent equatorial flange, the proximal face striate to reticulate with open reticulum of low ridges, the distal face reticulate with open reticulum of high ridges, 320-340 µm diam. **Microsporangia** mostly absent from the two dorsal rows, or few mature near the apex on dorsal rows; microspores not studied.

**HABITAT AND DISTRIBUTION:** On sandy or rocky soil; 920-1080 m; known only from
Karowtipu Mountain in Guyana.

**PARATYPES:** GUYANA. Upper Mazaruni: Karowtipu Mountain, 5°45'N, 60°35'W, 920 m, 18 Apr 1987, Boom & Gopaul 7415 (BRG, MO, NY!, PMA, U, UC, VEN); 920-1080 m, 24 Apr 1987, Boom & Gopaul 7698 (BM, BRG, NY, PMA, UC, US).

**TAXONOMIC DISCUSSION:** *Selaginella karowtipuensis* resembles *S. seemannii* in its median leaves with a well developed outer auricle and acuminate apex, and typically oblong to oblong-ovate lateral leaves with subcordate to rounded base. It differs from *S. seemannii* by conspicuous (vs. without) idioblasts on the upper surface of the lateral and median leaves and sporophylls. In addition, *S. karowtipuensis* is a more robust plant with stouter rhizophores (0.54-0.88 mm diam., compared with 0.25-0.65 mm diam. for *S. seemannii*).

**DISCUSSION – CONCLUSION**

Of the 31 species mentioned by Valdespino (1995) within this subgenus, eight occur in the Guianas. A key, extracted from his monograph, is given below.

Key to the species of *Selaginella* P. Beauv. subg. *Heterostachys* Baker in the Guianas.

1. Acroscopic margin of the lateral leaves ciliate to ciliate-denticulate at least along basal ¼ .......................................................... 2

1’. Acroscopic margin of the lateral leaves serrate to serrulate or entire near the base or throughout ............................................................... 6

2. Upper surface of the lateral leaves with idioblasts ....................................... *S. muscosa*

2’. Upper surface of the lateral leaves without idioblasts .................................. 3

3. Lateral leaves semicordiform to cordiform; median leaves cordiform to ovate-deltate .......................................................... *S. porelloides*

3’. Lateral leaves ovate, ovate-orbicular, ovate-lanceolate, lanceolate, ovate oblong, or ovate-elliptic; median leaves ovate, ovate-lanceolate, lanceolate, elliptic, elliptic-orbicular, or, if ovate-deltate, then the apex broadly acute and ciliate at tip ... 4

4. Median leaves elliptic or ovate-elliptic .................................................. 5

4’. Median leaves ovate, ovate-lanceolate, or lanceolate ............................... *S. minima*

5. Lateral leaves with an acuminate apex; upper surface of the median leaves without idioblasts; megaspores lemon yellow .................................................. *S. sobolifera*

5’. Lateral leaves with a broadly acute to obtuse apex; upper surface of the median leaves with conspicuous to obscure idioblasts; megaspores light to maize yellow, cream, pale yellow-orange, or pale orange-yellow .......................... *S. gynostachya*

6. Upper surface of lateral and median leaves with idioblasts, or idioblasts restricted to the upper surface of the lateral leaves only, or idioblasts present on the upper surface of the median leaves and/or on the lower surface of the lateral leaves ...................... 7

6’. Upper surface of the lateral and median leaves without idioblasts, or idioblasts present only on the upper surface of the median leaves ............................ 9

7. Median leaves with at least the outer base well developed into an auricle free from the stem; rhizophores 0.3-0.86 mm diam ..................................... *S. karowtipuensis*

7’. Median leaves with the outer base asymmetric, rounded, oblique, or subcordate, if with an outer auricle then this not distinctly free from the stem; rhizophores 0.08-0.56 mm diam. ......................................................... 8
8. Apex of the lateral leaves obtuse to broadly acute; apex of the median leaves acute to shortly acuminate, the acumen \(1/8\) or less the length of the lamina ................................................................. \(S.\) gynostachya
8’. Apex of the lateral leaves acute to shortly acuminate; apex of the median leaves long acuminate to long-aristate, the acumen or arista \(1/4\) or usually more the length of the lamina ........................................................................................................ \(S.\) muscosa

9. Median leaves with the outer base well developed into an auricle ...... \(S.\) seemannii
9’. Median leaves with the outer base asymmetric, oblique or semicordate, without a well developed auricle ........................................................................................................ 10

10. Median leaves with the apex acute, acuminate, or short-aristate, the acumen or arista \(1/3\) or less the length of the lamina ...................................................... \(S.\) gynostachya
10’. Median leaves with the apex long-aristate, the arista more than \(1/3\) the length of the lamina ............................................................................................... \(S.\) flagellata

**DISTRIBUTION**
When comparing the distribution of the 35 species of subgenus *Heterostachys* from Central and South America, it is noticed that Venezuela has the highest diversity with 17 species. The Guianas have fewer: four for Guyana, two for Suriname and five for French Guiana. This is unusual because French Guiana typically has fewer species than Guyana. In terms of distribution, a few species occur over widespread areas (such as *S. flagellata*), whereas others are limited to the Plateau of the Guianas (*S. gynostachya*), or simply known only from Guyana (*S. karowtipuensis*).

**ACKNOWLEDGEMENTS**

We would like to express our gratitude and thanks to Drs. T. Lobova, J.T. Mickel, R.C. Moran and S.A. Mori (NYBG) who have kindly provided access to the specimens and a scan, to the technical staff of the National Museum of Natural History in Paris (P) who carried out one scan, and to Dr. J.J. de Granville (CAY Herbarium, French Guiana) who has made the detailed photographs of the specimens.

**REFERENCES**


SYSTEMATICS OF TRICHOMANES (HYMENOPHYLLACEAE: PTERIDOPHYTA), PROGRESS AND FUTURE INTERESTS

A. EBIHARA1, J.-Y. DUBUISSON2, K. IWATSUKI3 & M. ITO1

1Department of System Sciences, Graduate School of Arts and Sciences, the University of Tokyo, 3-8-1 Komaba, Tokyo 153-8902, Japan,
2Université Pierre et Marie Curie, 12 rue Cuvier, F-75005 Paris, France,
3The Museum of Nature and Human Activities, Hyogo, Yayoigaoka 6-chome, Sanda 669-1546, Japan

(Email: ebihara@kahaku.go.jp; present address: Department of Botany, 4-1-1 Amakubo, Tsukuba 305-0005, Japan)

Key words: filmy ferns, rbcL, Trichomanes

ABSTRACT

Trichomanes L. sensu lato (s.l.), is a large group of Hymenophyllaceae to which ca. 250 species are attributed, distributed from the tropics to temperate regions around the world. Their life forms and morphology are more diversified than those of the other large filmy-fern genus Hymenophyllum. Phylogenetic analyses were performed based on the rbcL sequences of 81 Trichomanes taxa, covering most of the major groups within the genus, in addition to morphological, anatomical and cytological investigations, that offer a number of insights concerning evolution of the genus. Eight robustly supported clades are recognized within Trichomanes, while some traditional trichomanoid taxa (e.g., Pleuromanes) are transferred to the Hymenophyllum clade.

INTRODUCTION

Because of their simplified morphology among pteridophytes, filmy ferns (Hymenophyllaceae) have attracted the attention of many researchers, especially those interested in evolution and phylogeny. The family’s basal placement among leptosporangiate ferns was already suggested by morphological evidence (oblique annuli of sporangia; Bower, 1926) and supported by recent molecular phylogenetic work (Pryer et al., 2004). In contrast, it is difficult to reconstruct its infrafamilial lineages from its morphological characters, probably as a result of numerous parallel evolutions (Dubuisson, 1997a). Several different classification systems (e.g., Copeland, 1938; Morton, 1968; Iwatsuki, 1984) are currently in use for this family.

Dubuisson (1997b) first adopted molecular phylogeny to infer infrafamilial relationships among the Hymenophyllaceae, specifically targeting one of the two largest groups, Trichomanes sensu lato (s.l.), to explore the reliability of the chloroplast rbcL marker at the infrageneric level. The result showed better resolution than for the other group, Hymenophyllum s.l., in which less genetic variation was found for rbcL (Pryer et al., 2001; Ebihara et al., 2002; Hennequin et al., 2003). Trichomanes, however, is a large genus comprising around 250 species (Iwatsuki, 1990) occurring nearly throughout the tropics and extending into the temperate zone, especially the southern latitudes. Despite the study by Dubuisson et al. (2003a) focusing on Neotropical Trichomanes, many distinctive Palaeotropical taxa remained unsampled. Recently, Ebihara et al. have added considerable new rbcL data, making a global revision of the genus possible.
COVERED SAMPLING

In total, 81 species of *Trichomanes*, approximately a third of the estimated number of extant species, were included in this study, though some traditional trichomanoid taxa (*Microtrichomanes* Copel. pro parte and *Caridiomanes reniforme* (G.Forst.) C.Presl) whose affiliations to the *Hymenophyllum* lineage have already been suggested (Pryer et al., 2001; Ebihara et al., 2004) were not counted as *Trichomanes*. This sampling covered all of Copeland’s trichomanoid genera (*Abrodictyum* C.Presl, *Callistopteris* Copel., *Cephalomanes* C.Presl, *Crepidomanes* (C.Presl) C.Presl, *Crepidopteris* Copel. [= *Reediella* Pic.Serm.], *Davalliopsis* Bosch, *Didymoglossum* Desv., *Feea* Bory, *Gonocormus* Bosch, *Lecanium* C.Presl, *Macroglena* (C.Presl) Copel., *Nesopteris* Copel., *Pleuromanes* (C.Presl) C.Presl, *Polyplebium* Copel., *Selenodesmium* (Prantl) Copel., *Trichomanes* sensu stricto (s.s.) and *Vandenboschia* Copel.) and most of Morton’s (1968) sections under *Trichomanes*, except for four small sections of the subgenus *Achomanes* C.Presl (sections *Odontomanes* (C.Presl) C.Chr., *Trigonophyllum* (Prantl) C.Chr., *Homoeotes* (C.Presl) C.Chr. and *Ragatelus* (C.Presl) C.Chr.).

A data matrix consisting of 1206 bp fragments of the *rbcL* sequences from 81 *Trichomanes* species as well as 12 other Hymenophyllaceae and 4 non-Hymenophyllaceae (*Polypodium glycyrrhiza* D.C.Eaton, *Matonia pectinata* R.Br., *Osmunda cinnamomea* L. and *Angiopteris evecta* Hoffm.; the last taxon was treated as an outgroup) was analyzed using the maximum-parsimony (MP) method with PAUP*4.0 software (detailed in Ebihara et al.).

EVOLUTIONARY RELATIONSHIP

In the resulting consensus MP tree (Ebihara et al., in prep.; Figure 1), both the *Trichomanes* and *Hymenophyllum* clades are strongly supported, as in Pryer et al. (2001) and Ebihara et al. (2004). *Pleuromanes*, a group which has always been considered a member of *Trichomanes*, is indeed embedded in the *Hymenophyllum* clade and eight robustly-supported subclades (BS > 90) are recognizable in the *Trichomanes* lineage. These groupings do not match any of the existing classifications, but seem to be closely related to the plants’ morphological characters, chromosome base numbers and geographical distributions.

The phylogenetic framework suggests three evolutionary scenarios for the genus: (1) Cytological data reveals that the chromosome base numbers are constant within each “clade,” so the observed diversity in number may originate from aneuploid reduction from the ancestral $x = 36$. (2) Life form data indicate that four monophyletic clades (Cr, Di, Pa and Va in Fig. 1), consisting mostly of epiphytic and epipetric taxa displaying evolutionary traits that tend towards morphological and anatomical reductions, are supported with fairly high reliability (Ebihara et al.). Assuming that the common ancestor of *Trichomanes* was terrestrial, the occurrence of epiphytism related to evolutionary regression was apparently quite a significant event in the genus, and at least four independent evolutionary transitions led to the epiphytic habit. (3) Geographical distribution data show that four of the eight clades are subcosmopolitan; the NT clade is nearly confined to the Neotropics, while the Ca, Ce and Cr clades are confined to the Palaeotropics. Peculiar monotypic trichomanoid “genera” distributed in the southern hemisphere, which formed the basis of the Antarctic origin theory of Hymenophyllaceae (Copeland, 1938, 1939), are all placed in derivative positions in the present phylogeny.
EBIHARA et al.: SYSTEMATICS OF TRICHOMANES

Figure 1. Evolutionary relationship of Trichomanes: a strict consensus of seven most parsimonious trees retrieved from an unequally weighted rbcL data matrix (3717.96 steps, CI=0.32 and RI=0.74). Bootstrap values ≥50% are shown. Taxon names generally follow the Morton’s (1968) system, and the trichomanoid genera defined by Copeland (1938) are indicated in parentheses.
FUTURE CHALLENGES

Usefulness of rbcL

In the case of *Trichomanes*, *rbcL* phylogeny is a useful tool for inferring the “macroevolution” or global relationships among sublineages of the genus. Indeed, eight principal clades have recently been defined as eight distinct genera (Ebihara et al.). Although our results show that there is some useful genetic variation for discussing relationships among species with closely-related *rbcL* sequences, further consideration is necessary before adopting chloroplast-coding markers for this purpose. If hybridization or reticulate evolution (e.g., Wagner 1954; van den Heede et al., 2003; Ebihara et al., 2005) occurred in a clade, the relationship between the members as reconstructed from chloroplast DNA, which is maternally inherited in ferns (Gastony & Yatskievych, 1992), would not be accurate.

For example, Copeland’s genus *Gonocormus*, ranging from Africa to the Pacific region, consists of several taxa segregated by leaf shape and proliferation (e.g., *Trichomanes saxifragoides* C.Presl, *T. minutum* Blume and *T. proliferum* Blume); however, Yoroi and Iwatsuki (1977) argued that it should be difficult to recognize such taxa morphologically and tentatively clustered them into a single species, *T. minutum* (Iwatsuki, 1984). Although much genetic variation is also found in *rbcL* sequences taken from several specimens of the *Gonocormus* species collected from various localities, there does not seem to be a clear relationship between their morphological and genetic variation (Ebihara, unpublished data). Considering the fact that diploid, triploid and tetraploid series are reported for *Gonocormus* (Braithwaite, 1969, 1975; Yoroi & Iwatsuki, 1977), reticulate evolution has probably occurred in this complex.

Another example is the *Trichomanes (Vandenboschia) radicans* complex (the Va clade), which includes the American *T. radicans* Sw., the European *T. speciosum* Willd., the African *T. giganteum* Willd., the Japanese *T. orientale* C.Chr. and the Asian *T. birmanicum* Bedd. Our study, utilizing the biparently-inherited nuclear *GapCp* marker, suggests that hybridization involving at least three biological units occurred in Japan, despite an observed difference in *rbcL* of up to 1.66% (20/1206 bp; Ebihara et al., 2005) among them. In addition, it is likely that both *T. speciosum* and *T. giganteum* are of hybrid origin (Ebihara, unpublished data). Considering the high incidence of allopolyploid hybridization in ferns (Soltis & Soltis, 1999), such examples may be ubiquitous rather than exceptional. These results strongly indicate the importance of biparently-inherited markers in species-level analyses. Analyses using sequences from multiple gene regions are also necessary to clarify relationships among the clades that are unresolved in the present *rbcL* phylogeny.

Importance of field observations

The evolution of life forms is one of the most interesting topics concerning Hymenophyllaceae. Their habits are usually divided into several types, such as terrestrial, epiphytic, epipetric, semi-epiphytic and true lianas (Dubuisson et al., 2003b), but in fact their ecological classification is routinely complex and requires careful and precise *in situ* observations. For example, we have never seen herbarium specimens of *T. auriculatum* with underground parts (roots). Rather, most herbarium specimens consist only of epiphytic parts, i.e., leaves with climbing rhizomes. Our field observations, however, reveal that the plant germinates on the ground and the rhizomes climb up tree trunks. Field investigations are therefore essential for evolutionary studies.
Diversification history and conservation

Extant filmy ferns exclusively prefer moist and shady environments, but the habitat where their common ancestor acquired its unique one-cell thick lamina in the Triassic or earlier (AxSmith et al., 2001; Pryer et al., 2004) remains unknown for certain. The fact that roughly half of the Hymenophyllaceae species are attributed to the hymenophylloids, which are mostly epiphytic on tree trunks and diversified relatively recently compared to trichomanoids (Hennequin et al., 2003; Schuettpeltz & Pryer, 2006), is consistent with the trend of extant fern diversification in angiosperm forests (Schneider et al., 2004). Our phylogeny also suggests that a few species in Trichomanes with an epiphytic habitat on trees may have recently acquired this habit.

Filmy ferns are one of the fern groups most sensitive to environmental changes, particularly decreased humidity caused by deforestation. Habitat conservation and conservation biology studies of already-endangered species (e.g., Rumsey et al., 1998) are crucial for the future study of this family and to maintain its present diversity.

ACKNOWLEDGEMENTS

The authors are grateful to Dr. H. Schneider for valuable comments on the manuscript.

REFERENCES


BOWER, F.O. 1926. The Ferns (Filicales). Vol. II The Eusporangiatae and Other Relatively Primitive Ferns. Cambridge, the University Press.


EBIHARA, A., HENNEQUIN, S., IWATSUKI, K., BOSTOCK, P.D., MATSUMOTO, S., JAMAN, R., DUBUISSON, J.-Y., & ITO, M. Polyphyletic origin of Microtrichomanes (Prantl) Copel. (Hymenophyllaceae), with a revision of the


SPATIAL PATTERN OF INDIVIDUAL GENETIC SIMILARITIES IN POPULATION OF ASPLENIUM CETERACH (ASPLENIACEAE: PTERIDOPHYTA)

VIRÁG KRÍZSIK,1 ISTVÁN PINTÉR², ÁGNES MAJOR3 & GÁBOR VIDA1,2

1 Department of Genetics, Eötvös Loránd University, Budapest, Hungary
2 HAS – ELTE Research Group for Evolutionary Genetics Budapest, Hungary
3 The Hungarian Natural History Museum

Keywords: intrapopulational structure, Aspleniaceae, RAPD, UPGMA

ABSTRACT

The genetic relatedness of individuals can give a population finer scale spatial pedigree structure. The relation of genetic similarity and spatial distance refers to the dispersal characters and reproductive relations existing among individuals. Our main purpose here was to obtain information on the genetic spatial pattern before a more profound spatial autocorrelation analysis of Asplenium ceterach individuals. Three physically isolated subpopulation patches of the tetraploid A. ceterach subs. ceterach were identified on the southern rocky faces of the St. György Hill in Hungary. The genetic properties were scored and cluster analysis, UPGMA, was carried out in three steps using progressively larger samples: 42, 85 and 320 individuals were chosen. Cluster analysis revealed a minimum of 70% genetic similarities among individuals indicating intensive gene flow between subpopulations, but there was also detectable correspondence between individual genetic similarities and spatial position.

INTRODUCTION

The homosporous, autotetraploid, xerophytic rock fern, Asplenium ceterach L. subsp. ceterach is one of three cytotypes of the species Asplenium ceterach (Reichstein 1981, Vida 1965, 1973). Asplenium ceterach and related taxa are circumscribed by special morphological characters within Asplenium. The taxonomic treatment of these ferns has been the subject of debate; some authors have recognised Ceterach as a separate genus within Aspleniaceae (Reichsten, 1981), but others consider it as a clade or subgenus within the genus Asplenium (Pintér et al. 2002, Viane et al. 1993).

The study of geographical distribution and patterns of genetic diversity within Asplenium ceterach has revealed its postglacial colonisation (Trewick et al. 2002). The European pteridophyte flora has an ancient origin with the Mediterranean areas having a major role as refugia during the glaciation periods (Vogel et al. 1999). Several experimental studies demonstrate that autoployploids are derived from diploids (Manton, 1950; Reichstein, 1981; Vida, 1973). Although the ancestral (diploid) and derived (polyploid) taxa have the same substrate preference, they have distinct geographical distributions. During the glaciation periods the Balkans and Italy acted as refugia for Asplenium ceterach. The diploids are mostly restricted to the Mediterranean basin (Pintér et al. 2002.), whereas the tetraploids occupy areas further north in Europe. The wide occurrence of the tetraploid Asplenium ceterach subsp. ceterach across
Europe can be explained by its better dispersal capacity owing to single spore colonisation in this taxon (Vogel et al. 1999). Analysing the haplotype patterns of European Asplenium ceterach has elucidated recurrent polyploid formation and colonisation from different population sources throughout Europe (Trewick et al. 2002). The tetraploid subspecies, Asplenium ceterach subsp. ceterach, is common and widespread in Europe bit in Hungary, diploid Asplenium ceterach subsp. bivalens predominates in natural habitats and the occurrence of tetraploid populations has been reported only from the St. György Hill and the Buda Hills parts of the Transdanubian Mountains (Vida 1973, Vida 1965). On the bases of chloroplast DNA analyses two different haplotype sequences were identified in Hungary (‘red’ and ‘green’ according to Trewick et al. 2002.). The haplotype sequence ‘red’ is found both in diploids and tetraploids, whereas the ‘green’ haplotype is found only in tetraploids. Diploid populations with the ‘red’ haplotype are described mainly from the Balkans, while tetraploid populations of ‘red’ and ‘green’ haplotypes are rather frequent in South-Western Europe (Trewick et al. 2002). The tetraploid Asplenium ceterach populations on the St. György Hill studied by us have the ‘green’ haplotype (Morgan-Richards, Vogel unpublished). While the volcanic soil of the hill has been utilized for vine-growing, the steep rocky slopes are natural habitats. These dry rocks may have colonized after the last glaciation. Here, six physically isolated subpopulation patches of A. ceterach subsp. ceterach were identified on the southern rocky faces of the hill (Figure 1).

The genetic relatedness of individuals can reveal a fine-scale spatial pedigree structure in a population (Vekemans & Hardy 2004). The relationship of genetic similarity and spatial distance reflects the dispersal characters and reproductive relationships among individuals (Hardy 2003). The aim of this study was to examine the genetic constitution of this particular tetraploid population in the context of the past colonisation events before a more profound spatial autocorrelation analysis. The analysis of the population’s genetic constitution and its spatial structure as revealed by molecular markers can provide information about microevolutionary processes occurring when the individuals are linked by bonds of mating and parenthood (Hardy & Vekemans 2002).

Genetic data derived from allozyme studies indicate that tetraploid Asplenium ceterach shows high genetic variation between populations and low within population variation, unlike diploids (Vogel et al. 1999). Genetic differences between diploid and tetraploid populations result from differences in their breeding systems. The high degree of population differentiation in the tetraploid taxon is caused by low level of outcrossing. (Vogel, pers. com.). There was no evidence of vegetative propagation among our cultivated individuals, nor are there any reported cases in the literature.

**MATERIAL AND METHODS**

In this study we present detailed information about the genetic relatedness of individuals in a tetraploid population. For measuring spatial distances the exact position of individuals was mapped (see below). This provides a 3D coordinate system for the finer scale spatial analysis that follows. Use of a large number of RAPD products gives a powerful tool for documenting offspring-parent relationships and dispersal distances (Levitan and Grosberg 1993, Hadrys 1992) especially at lower taxonomic levels (Rodrigues et al. 2002.).
Sampling strategy
Individuals of *Asplenium ceterach* were collected from the southern rocky faces of St. György Hill near Lake Balaton in Hungary. Here, six physically isolated subpopulation patches were identified from where we collected 440 leaf samples (1 leaf per individual). To obtain information on the genetic spatial pattern we surveyed three out of six patches with progressively larger samples. The sample size was increased by adding new individuals to the previously selected ones. These samples included 42, 85 and 320 individuals.

Constructing the spatial position map of the individuals
The task was to score the genetic properties of individuals and to give their exact position in space in order to construct the 3-dimensional population genetic structure before embarking on the fine scale analysis. For describing individual plants’ location on the hill, GPS localized reference points were used. The WGS84 GPS-based coordinates were converted to the Hungarian National Grid (EOV) (Timár et al. 2002, Molnár & Timár 2002, Timár & Molnár 2002) (Figure 2). Reference coordinates were the starting points of a grid, and before calculating the coordinates of each individual in 3D space. This coordinate system can be matched to a geographical map. The positional data formed the basis for the future analysis of the genealogical connections.

![Figure 1. St. György Hill and the subpopulation patches of *A. ceterach subsp. ceterach* (1a, 1b, 2) on the southern rocky faces of the hill.](image-url)
Genetic studies

Genetic studies on the reliability of RAPD markers prove that this method is as suitable for determining genetic identity as the AFLP techniques (Albert et al. 2003). Bias of polymorphic band selection is the weak point of this method. Many polymorphic bands can be generated by only a few RAPD primers (Stewart & Porter 1995), but a few are reliable. The applied bands have to be selected carefully. In our case, the decreased amount of primers might influence precise indication. However, polymorphic bands obtained from several primers give a more reliable result.

For total plant DNA isolation we used DNeasy Plant Mini Kit (Qiagen). The extraction protocol was slightly modified for pteridophyte material. A dry mass of leaves, 100mg of tissue was ground in liquid nitrogen the presence of Polyclar AT. A volume of 600µl extraction buffer and 6-8µl Rnase (100mg/ml), and 16-17µl β-mercaptoethanol were added. This suspension was homogenized and incubated at 65ºC for more than 1 hour with frequent and careful mixing. After adding 195-200µl precipitation buffer, the mixing was repeated. This was followed by 10 minutes incubation on ice and centrifugation at 12,000 rpm for 5-8 mins. The supernatant was removed and applied to the QIAshredder column, combined in a 2ml eppendorf and was centrifuged at 8000 rpm for 2 mins. Taking 1.5:1 proportion of the AP3/E and the liquid that came down the column and it was mixed carefully again. This suspension was centrifuged through the DNeasy mini column at 8000rpm for 1 min. Next a washing buffer was added, followed by centrifugation at 8000rpm for 1min. This process was repeated and an additional centrifugation step was applied for 3 mins.

![The converted EOV coordinates of the subpopulational patches](image)

Figure 2. To describe the location of individual plants on the hill, GPS localized reference points were used. The WGS84 GPS-based coordinates were converted to the Hungarian National Grid (EOV) (Timár et al. 2002, Molnár & Timár 2002, Timár & Molnár 2002).
Finally the DNS was eluted twice in 100µl and 50µl. The DNA samples were then either stored at +4ºC for immediate use or stored at -20ºC.

For the DNA concentration quantification a self-made DNA standard was used. Its concentration was measured by lambda 35 spectrophotometer and UV winlab program. The DNA samples were diluted to 1ng/µl.

RAPD procedure

For genetic identification the multilocus genotype (phenotype) of RAPD polymorphic loci was used. The RAPD method uses a large set of oligonucleotide primers annealing with various parts of the genome. RAPD markers produce good Mendelian characters, typically, but not always dominant (Hillis et al. 1996). For the generation of genetic data 60 oligonucleotid primers 10 basepairs long were screened. The best 8 were: OPA-7, OPA-19, OPB-18, OPK-9, OPK-19, OPP-4, OPP-5, OPP-14. These primers generated strong, clear and repeatable polymorphic bands.

For PCR reaction we applied 5µl (1ng/µl) DNA template. The PCR reactions were carried out in a PerkinElmer thermocycler. The amplification cycles ran: 60 sec at 94°C, two cycle of 30 sec at 94°C, 30 sec at 41°C, 120 sec at 72°C, 20 cycles of 30 sec at 94°C, 15 sec at 39°C, 15 sec at 45°C, 90 sec at 72°C, 18 cycles of 30 sec at 94°C, 15 sec at 39°C, 15 sec at 45°C, 120 sec at 72°C and the final cycle 72°C 5min (Schneller 1998.).

A 4-5 hour long electrophoresis at 180-200V was used for the separation of the fragments.

Data Analysis

The polymorphic bands of RAPD markers were scored 1 for presence and 0 for absence. We applied simple matching coefficient for the dissimilarity matrix (Sokal & Michener 1958). \[ SM = \frac{a+d}{a+b+c+d}; \] (a, d: the numbers of the binaric variable coincide, b, c: the numbers of the binaric variable do not coincide.)

For cluster analysis the UPGMA (unweighted pair group method with arithmetic mean) method was used. The complete multivariate analysis and its presentation were managed with the NTSYS-pc program Version 2. (Rohlf 2000, Podani 1997). The results were illustrated with dendrograms reflecting the genotypic (phenotypic) similarity between the objects.

The programmes SAHN module offers two options to deal with ties. The FIND option constructed each alternative clustering. As there were several ties in the dissimilarity matrix we had maximum 50 output trees. It was possible to compute their cophenetic correlation to check how well the different tied trees represent the original distance matrix (Rodrigues et al. 2002.). First the COPH module computed a cophenetic (ultrametric) value matrix from each dendrogram. These matrices are used to test the goodness of fit of clustering analysis by using MXCOMP module (Rohlf and Sokal 1981). The module evaluates the cophenetic correlation (product moment correlation: r) between the cophenetic value and the original distance matrices. We selected trees with the highest evaluated correlation coefficient from among the tied trees. The normalized Mantel test was also performed. The Mantel test statistic Z is frequently used to measure the correspondence between matrices (Mantel 1967, Podani 1997).
RESULTS

Our main purpose was to obtain information on the genetic spatial pattern before a more profound spatial autocorrelation analysis of 440 positioned *Asplenium ceterach* individuals. Based on the scored genetic properties and their spatial position the individuals were clustered in three steps using progressively larger samples: 42, 85 and 320 individuals were chosen. The progressive increase of the size of the samples may indicate the sensitivity of the spatial pattern analysis to the sample size.

The multivariate analysis of RAPD data revealed a high level of genetic relatedness among either individuals or subpopulations. In all samples the assessment of the minimum genetic similarity between individuals was approximately 70%, and at least half of the plants showed 80-90% genetic similarity. The high level of genetic relatedness between individuals either from the same or different subpopulations suggested a high level of gene flow between the different subpopulations. Since individuals show close genetic relatedness the UPGMA produced several alternative clusters. The cophenetic correlations did not detect important difference in goodness of fit among the dendrograms. Similar moderate correlation coefficient values were computed for each alternative dendrogram. The matrix correlations (= normalized Mantel stat Z) for different dendrograms were between $r=0.62$–$0.65$ for 42 individuals, $r=0.71$–$0.73$ for 85 individuals and $r=0.618$–$0.625$ for 320 individuals. The Mantel test gave $p$ (probability random $Z<\text{observed } Z$) = 1 for 1000 permutations for each tested dendrogram. We selected one tree with the highest evaluated cophenetic correlation coefficient (product moment correlation: $r$) (Rohlf and Sokal 1981) (Figures 3 & 4).

The first two sample sets (42, 85) showed a similar range of SM values for the clusters (Figures 3, 4). The SM index varied from 70% up to 100%. In half of the sampled individuals a similarity of more than 90% was detected. The genetic similarity of the common individuals in the first two sample set was practically the same. Among the first 42 individuals two homogenous subclusters were recognizable with 80-83% similarity level (‘subpopulations 1a2’ and ‘2’). In the sample of 85 individuals another homogenous ‘subpopulation 2’ cluster appeared with approximately 80% similarity. The individuals of these two ‘subpopulation 1a2’ and ‘2’ also displayed their cohesiveness (Figure 5). The rest of the dendrogram did not show any distinguishable cluster.

The first two samples with 42 and 85 individuals were relatively small compared with the total number of individuals. The doubling of the sample size did not alter the intrapopulational spatial genetic pattern. The next step was the analysis of 320 individuals. The dendrogram constructed with 320 individuals showed not only qualitative but also qualitative change in the picture of the spatial pattern. Increasing the sample size gave a more detailed spatial pedigree structure along the dendrogram. Subpopulations appeared as slightly separated subclusters of the tree. The minimum similarity value for these characterized subclusters was around 77-80% (The minimum genetic similarity between any two individuals is 70%). These distinguishable substructures may demonstrate a significant number of non-random events in the reproductive processes and propagation. This tree represents pedigree structure of these ferns, and it differs from random. Large number of individuals appear to be outside their characteristic subpopulational clusters scattered along the dendrogram.

The cluster analysis revealed minimum 70% genetic similarities among individuals. The spatial genetic pattern indicates intensive gene flow between subpopulations, but
also there was detectable correspondence between genetic similarities and spatial position. This dual spatial pattern can be derived from the two step process of pteridophyte reproductive biology and haploid-diploid life cycle, as the spores and gametes have different dispersal capacities.

**DISCUSSION**

*Asplenium ceterach* is a homosporous fern with hermaphroditic gametophytes. The spatial pattern of the genetically related individuals within the population is influenced by both reproductive biology and dispersal characteristics. According to Klekowski’s terminology two different kinds of mating types might produce different levels of heterozygosity: intragametophytic selfing, yielding completely homozygotic sporophytes (with the theoretical possibility of homeologous heterozygosity), and intergametophytic mating between two sib or non-sib gametophytes resulting in varying degree of heterozygosity (Klekowksi 1979). The tetraploid *Asplenium ceterach* is reported as a highly successful in-breeder inferred from allozyme data (Trewick *et al.* 2002).

The alternating haploid-diploid life-cycle is an important characteristic of ferns (Page 2002). Spores and gametes have different dispersal capacity. The distance between two gametophytes accomplishing mating is very much limited in space (Suter 2000). However, the distance over which spores travel is in comparatively unlimited. This kind of haplotype transport can reorganize the population structure. Yet some authors propose that 95% of the spore dispersal is within 1-10m from the parent plant (Vogel *et al.* 1999.) The question is how the mating system and spore dispersal affect

![Figure 3. Cluster analysis of 42 fern individuals. The individuals in the dendrogram are labelled according to their subpopulational (1a, 1b, 2) and intra-subpopulational (1a1, 1a2, 1b1, 1b2, 1b3, 1b4, 1b5, 21, 22, 23, 24, 25) positions: Subpopulations and their symbols: 1a1: 1a2: 1b1: 1b2: 1b3: 1b4: 1b5: 21: 22: 23: 24: 25:](image)
intrapopulation genetic pattern. The genetic similarity of neighbouring individuals may help elucidate the nature of breeding system. Cluster analysis of the RAPD multilocus phenotype suggests high levels of gene flow between these distant subpopulations and, likewise, a correspondence between individual genetic similarities and spatial position. Since the subpopulations are further than 10 m apart, this suggests that spore dispersal should exceed 10 m. But cluster analysis is not reliably informative to dissect the influence of spore travel from the influence of mating type in the determination of individuals genetic relatedness. This can be carried out by further, more profound spatial autocorrelation analysis.

**Figure. 4.** Cluster analysis of 85 fern individuals. The individuals in the dendrogram are labelled according to their subpopulational (1a, 1b, 2) and intra-subpopulational (1a1, 1a2, 1b1, 1b2, 1b3, 1b4, 1b5, 21, 22, 23, 24, 25) positions:

Subpopulations and their symbols:
Figure 5a. Cluster analysis of 320 fern individuals. The individuals in the dendrogram are labelled according to their subpopulational (1a, 1b, 2) and intra-subpopulational (1a1, 1a2, 1b1, 1b2, 1b3, 1b4, 1b5, 21, 22, 23, 24, 25) positions:

Subpopulations and their symbols:

G C ▲ ▼ ◀ ▶ △ ▽ ▼ ▲
Figure 5b. Cluster analysis of 320 fern individuals. The individuals in the dendrogram are labelled according to their subpopulational (1a, 1b, 2) and intra-subpopulational (1a1, 1a2, 1b1, 1b2, 1b3, 1b4, 1b5, 21, 22, 23, 24, 25) positions:

Subpopulations and their symbols:

ACKNOWLEDGEMENTS

I would like to express my thanks to Maria Takács and Maria Tuschek for their kind help, and many thanks for Gábor Timár and Bálint Halpern for their help in the GPS work.

REFERENCES


VIDA, G. 1965. A magyarországi páfrányok (Filicidae) cytontaxonómáiája (Cytotaxonomy of ferns (Filicidae) in Hungary) – Dissertation for candidate of sciences degree. Budapest


ASSESSING THE CONSERVATION STATUS OF PTERIDOPHYTES, A CHALLENGE FOR THE GLOBAL STRATEGY FOR PLANT CONSERVATION

S. BLACKMORE & K. WALTER

Royal Botanic Garden Edinburgh, 20a Inverleith Row, Edinburgh, EH3 5LR, Scotland, UK

Key words: conservation status, Global Strategy for Plant Conservation, Pteridophytes, Red Data Lists.

ABSTRACT

The Global Strategy for Plant Conservation (GSPC) sets out a series of activities with targets intended to halt the decline in plant biodiversity by 2010. This article examines the current state of knowledge concerning the conservation status of ferns in relation to Target 2 of the GSPC. The change in criteria used by the World Conservation Union (IUCN) for assessing conservation status has led to data generated prior to 1997 being marginalised. The latest information, using the revised criteria and published in 2003, refers to a smaller number of pteridophyte species, with only ten species being common to both the 1997 and 2003 assessments. There is an urgent need to capture the knowledge that pteridologists and other specialists undoubtedly have, relating to the conservation status of ferns and fern allies, and to incorporate this into Red Data Lists to provide firmer foundations for the GSPC.

INTRODUCTION

The global status and conservation of pteridophytes has been the focus of a recent conference, the proceedings of which provide an excellent overview (Dyer et al., 2002) and there are many published case studies for particular taxa. The purpose of this contribution is to review the current state of knowledge about pteridophytes in relation to selected targets of the GSPC. The point we wish to emphasise is that whilst the extant pteridophytes are less species rich than angiosperms and might therefore seem an easier group to conserve, much of the basic information needed to do this effectively is lacking. In particular we highlight the paucity of information concerning the conservation status of pteridophytes.
CONSERVATION STATUS OF PTERIDOPHYTES

The first three targets of the GSPC are all concerned with understanding and documenting plant diversity and concern the underpinning knowledge needed for conservation efforts to be demonstrably effective. Whilst most plant taxonomists are aware of the extent to which the initial exploration and documentation of biodiversity is incomplete, it continues to surprise many people, including policy makers, that many new species are discovered each year and how incomplete the documentation of life on earth is. Perhaps the most widely authoritative estimate, derived from the global biodiversity assessment (Heywood & Watson, 1995), is that 1.7 million species have so far been described out of an estimated total of 13 million. However, current estimates are approximate at best and the question of how many flowering plant species there are, for example, has seen much recent discussion. For pteridophytes, Roos (1996) estimated that between 10,500 and 11,300 species have been described from a total of between 12,000 and 15,000. In other words somewhere between 6% to as many as 30% of pteridophytes species have not yet been discovered. This has an important bearing on Target 1 of the GSPC: the preparation of “a widely accessible list of all plants, as a step towards a complete world flora.” The importance of the target derives from the widely acknowledge fact that one cannot be certain of conserving species without even knowing that they exist, although one important aspect of protected areas, especially in biodiversity hotspots is that, hopefully, they will harbour a good proportion of the unknown taxa. The technical rationale accompanying Target 1 makes it clear that a working list rather than a definitive list of species is the objective for 2010. Any such list can, by definition, only be a list of the known species and thus for pteridophytes our current state of knowledge would permit a list that contains somewhere between 70% and 94% of the estimated world total. It is encouraging to note that good progress has already been made towards the achievement of Target 1. The international plant names index (www.ipni.org) provides a highly accessible database of names and associated bibliographic information and now incorporates the data from the published volumes of Index Filicum (Johns, 1996) on the names of ferns and fern-allies. Web-based resources are not only the most accessible means of delivering such information but, in many ways, also the most appropriate, given that they can be updated much more readily than printed literature. The world of ferns website (http://homepages.caverock.net.nz/~bj/fern/) is another highly accessible source of information on names and synonymy in pteridophytes.

A much less favourable situation applies to Target 2: “a preliminary assessment of the conservation status of all known plant species, at national, regional and international levels”. As the technical rationale for Target 2 makes clear, the conservation status has so far been assessed for over 60,000 plant species, of which 34,000 are classified as globally threatened with extinction (Anon, 2003) and, given the vast amount of working still to be done, the intention is to undertake a preliminary assessment for the “data-deficient” species by 2010. The scale of this challenge emphasises just how little information we have to hand on the conservation status of plants in general. The situation for pteridophytes will be explored in more detail.

Information derived from the IUCN website (www.iucnredlist.org) in June 2004 indicated that there are 13,025 known species of pteridophytes. Of these, conservation status has only been determined for 180 of these species and as a result 111 species were
considered to be threatened in 2003. Although, on this information, only 1% of the total number of species of ferns and fern allies are known to be threatened, with two species being extinct, 62% of those that have actually been evaluated are considered to be threatened. More complete information on the status of 186 species of pteridophytes in 2003 from the IUCN web site is summarised in Table 1. Clearly we are in a state of relative ignorance about the true scale of the threats to pteridophytes species. If 62% of all pteridophytes were threatened, this would constitute some 8,075 species. There is, of course, no sound scientific basis for making such a projection.

It is interesting to compare this most recent summary of knowledge with earlier information available on the web. The web site of the World Conservation Monitoring Centre (www.unep-wcmc.org) presents information from the earlier assessment contained in Walter & Gillett (1997). According to this source, a more comprehensive survey of the conservation status of pteridophytes had already been previously undertaken (Table 2). In 1997, using the IUCN’s earlier system for evaluating threats, 768 species of pteridophytes had been assessed (compared to just 111 under the criteria in use in 2003), of which nine were extinct in the wild and a further 13 were suspected of being extinct. The 1997 Red Data List (Walter & Gillett, 1997) did not list species that were of indeterminate status or were not threatened.

Although good reasons were advanced for changing the criteria and categories for threatened plants between the 1997 and the 2003 assessments, the fact remains that hard-earned information recorded prior to 1997 was marginalised as a result. We estimate that preparation of the 1997 Red List required the equivalent of about 250 person years of work. Furthermore, very little re-assessment of previously studied species, to bring the pre-1997 data into the new system, has been undertaken. Only ten species out of the 768 species assessed as threatened in 1997 have been reassessed in the 2003 list (Table 3). In general it is easy to see, from the list of those species that occur in both the 1997 and the 2003 list, that reassessment is either not taking place is or is restricted to assessments of particular groups of endemic species, such as the

Table 1. Data on pteridophytes from the 2003 Red Data List. EX = extinct, EW = extinct in the wild, CR = critically endangered, EN = endangered, VU = vulnerable, NT = near threatened, LC = least concern, DD = data deficient. Species listed as NT, LC or DD are not considered to be threatened and therefore the total number of threatened pteridophytes detailed in Table 1 is 111, comprising those listed as CR, EN, or VU.

<table>
<thead>
<tr>
<th></th>
<th>EX</th>
<th>EW</th>
<th>CR</th>
<th>EN</th>
<th>VU</th>
<th>NT</th>
<th>LC</th>
<th>DD</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>LYCOPSIDA</td>
<td></td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>8</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>SELAGINELLOSIDA</td>
<td></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>ISOETOPSIDA</td>
<td></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>POLYPODIOPSIDA</td>
<td>2</td>
<td>0</td>
<td>26</td>
<td>22</td>
<td>50</td>
<td>12</td>
<td>7</td>
<td>45</td>
<td>164</td>
</tr>
<tr>
<td>Totals</td>
<td>2</td>
<td>0</td>
<td>27</td>
<td>24</td>
<td>60</td>
<td>14</td>
<td>14</td>
<td>45</td>
<td>186</td>
</tr>
</tbody>
</table>
pteridophytes of Ascension Island.

As a consequence of the extremely low rate of re-assessment and because of the change in criteria it is almost impossible to extract evidence of trends in the conservation status of pteridophytes, or other plants. We consider that this poses one of the greatest challenges to the GSPC. Although we strongly support efforts to move ahead with data gathering under the new system we are concerned that this is not happening rapidly enough. The reasons for this are difficult to determine but we suspect that for many species, especially for endemics, more information is known, informally by specialists on particular taxa or localities, than has been recorded. We therefore urge pteridologists, and other botanists, to enter such information as they do have into the IUCN system.

The importance of a better state of knowledge on the conservation status of ferns impacts on other targets within the GSPC. For example, Target 8 aims to have 60% of the world’s threatened species conserved in situ and 10% of them to be included in species recovery programmes. On the basis of the Red List data 2003, this would require only 66 threatened species of fern to be conserved in situ, with 6 being the subject of recovery programmes. That has probably already been achieved but this is hardly a satisfying observation in that it reflects ignorance rather than progress.

**CONCLUSIONS**

Current syntheses of the documented taxonomic diversity of pteridophytes provide a sound basis for the achievement of a preliminary checklist of the world’s ferns and fern allies in the context of Target 1 of the GSPC. This is not to deny the need for significant further revisionary work to define taxonomic concepts, particularly for large and complex genera. Syntheses of information on the conservation status of known pteridophytes are, in contrast, woefully inadequate. This results in part from changes of

**Table 2.** Summary of the status of pteridophytes recorded in the 1997 Red List (Walter & Gillett, 1997). Abbreviations: Ex = extinct, Ex/E = possibly extinct, E = endangered, R = rare, V = vulnerable, I = indeterminate. Total threatened species is the number of species assessed as Ex/E, E, V, R or I (in other words, it excludes extinct species). % threatened is the total threatened species as a percentage of the number of known species.

<table>
<thead>
<tr>
<th></th>
<th>Ex</th>
<th>Ex/E</th>
<th>E</th>
<th>V</th>
<th>R</th>
<th>I</th>
<th>Total Threatened Species</th>
<th>Number of known species</th>
<th>% Threatened</th>
</tr>
</thead>
<tbody>
<tr>
<td>LYCOPODIOPSIDA</td>
<td>1</td>
<td>0</td>
<td>3</td>
<td>6</td>
<td>11</td>
<td>3</td>
<td>23</td>
<td>519</td>
<td>4.4</td>
</tr>
<tr>
<td>SELAGINELLOPSIDA</td>
<td>1</td>
<td>0</td>
<td>3</td>
<td>5</td>
<td>9</td>
<td>6</td>
<td>23</td>
<td>713</td>
<td>3.2</td>
</tr>
<tr>
<td>ISOETOPSIDA</td>
<td>2</td>
<td>11</td>
<td>4</td>
<td>22</td>
<td>2</td>
<td>39</td>
<td>79</td>
<td>979</td>
<td>49.7</td>
</tr>
<tr>
<td>POLYPODIOPSIDA</td>
<td>5</td>
<td>13</td>
<td>85</td>
<td>97</td>
<td>133</td>
<td>683</td>
<td>9053</td>
<td>768</td>
<td>7.5</td>
</tr>
<tr>
<td>Totals</td>
<td>9</td>
<td>13</td>
<td>102</td>
<td>112</td>
<td>398</td>
<td>144</td>
<td>768</td>
<td>10,364</td>
<td>7.4</td>
</tr>
</tbody>
</table>
criteria used for evaluating conservation status but even more fundamentally from the low proportion of known species for which assessments of status have been recorded. There is now an urgent need to harness the expertise of people who know about pteridophytes and their status and to complete the recording of conservation status if we are to understand the conservation needs of ferns and fern allies properly. This case study focuses on pteridophytes but it is likely that a similar situation applies to plants in general. We end by urging pteridologists and others to familiarise themselves with the procedures for assessing conservation status (see: www.iucn.org/themes/ssc/redlists/RLcats2001booklet.html).

Table 3. Summary information on the ten species of pteridophytes that feature in both the 1997 and the 2003 Red Lists with an assessment of whether their status in the wild appears to have improved or worsened and their geographical distribution.

<table>
<thead>
<tr>
<th>Species</th>
<th>1997 Red List</th>
<th>2003 Red List</th>
<th>Change in Status</th>
<th>Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anogramma ascensionis</td>
<td>Ex/E</td>
<td>Ex</td>
<td>Unchanged</td>
<td>Ascension</td>
</tr>
<tr>
<td>Asplenium ascensionis</td>
<td>R</td>
<td>NT</td>
<td>Improved</td>
<td>Ascension</td>
</tr>
<tr>
<td>Ctenitis squamigera</td>
<td>E</td>
<td>CR</td>
<td>Unchanged</td>
<td>Hawaii</td>
</tr>
<tr>
<td>Cyathea bipinnata</td>
<td>R</td>
<td>VU</td>
<td>Worse</td>
<td>Ecuador</td>
</tr>
<tr>
<td>Cyathea heliophila</td>
<td>R</td>
<td>EN</td>
<td>Worse</td>
<td>Ecuador</td>
</tr>
<tr>
<td>Dryopteris ascensionis</td>
<td>Ex/E</td>
<td>Ex</td>
<td>Unchanged</td>
<td>Ascension</td>
</tr>
<tr>
<td>Elaphoglossum pellucidum</td>
<td>R</td>
<td>CR</td>
<td>Worse</td>
<td>Hawaii</td>
</tr>
<tr>
<td>Marattia purpurascens</td>
<td>R</td>
<td>NT</td>
<td>Improved</td>
<td>Ascension</td>
</tr>
<tr>
<td>Pteris adscensionis</td>
<td>E</td>
<td>CR</td>
<td>Unchanged</td>
<td>Ascension</td>
</tr>
<tr>
<td>Xiphopteris ascensionense</td>
<td>R</td>
<td>NT</td>
<td>Improved</td>
<td>Ascension</td>
</tr>
</tbody>
</table>
REFERENCES


HOUSE OF LORDS. 2002. What on Earth? The threat to the science underpinning conservation. HL Papers 118(i) and 118 (ii).


BOOK REVIEW


This is a highly informative and enjoyable book that most fern enthusiasts will wish to own. It is intended primarily for fern collectors and growers, amateur and commercial (see the review in Pteridologist, 2007), but there is much to interest fern biologists. Its considerable size and weight, and large number of colour photos, suggest a ‘coffee table book’ but these usually receive superficial attention and Sue Olsen’s book will be regularly consulted for detailed information on identification, cultivation and, in many cases, natural habitats of nearly 1000 species. Despite its all embracing title, there is a strong North American emphasis and the book is similar in scope to John Mickel’s Ferns for American Gardens (second edition 2003, first edition 1994, reviewed American Fern Journal 84 (3), p.104), but contains almost twice as many species. There is an overlap also with Rickard’s book The Plantfinder’s Guide to Garden Ferns (2000, published in UK by David & Charles, Newton Abbot, reviewed Fern Gazette 16(3), pp. 146, 167) but Rickard writes from a British perspective and gives more attention to the horticultural cultivars popular during the British fern craze. A strong case can be made for acquiring all three books because of their complementary strengths.

Olsen’s Encyclopedia contains 5 chapters, 8 Appendices, a Glossary, a Reference List and an Index. The ‘ferns’ of the title are taken to include not only horsetails, as we are now required to do, but also Psilotum and the lycophytes Diphasiastrum, Huperzia, Lycopodiella, Lycopodium and Selaginella. Isoetes and Tmesipteris are not, however, discussed. An initial preamble includes acknowledgement of the owners of gardens where she has taken photographs. Amongst these are several past and present BPS members including ex-Presidents Martin Rickard and Alastair Wardlaw. Then four short chapters deal with, in turn, “Ferns through the ages”, “Cultivating ferns”, with guidance on topics from garden habitats to companion planting, “Propagating ferns”, with descriptions of propagation techniques together with an outline of the typical life cycle, and “Fern structure and basic diagnostics” with a brief introduction to the main characters, including frond morphology, used in fern recognition.

Chapter 5, “Ferns from around the world”, is the heart of the book and, with 320 pages, the major part of it. Nearly 1000 fern species are arranged in alphabetical order of genera; about 700 are accompanied by colour photographs. For most species the entry begins with the Latin name, the common name, the translation of the Latin specific epithet, the height, whether it is “evergreen” or “deciduous”, and the plant hardiness zone(s) to which it is adapted. Then follows a concise but informative description of diagnostic features, an indication of its natural geographic range and habitat, and guidance on cultivation, together with additional helpful comments when appropriate. Some less frequently cultivated species are represented by a brief entry under “Shorter Notes”.

In the Appendices are a Plant Hardiness Zone map for the USA, a comparable map for Europe (unfortunately with a different colour coding), a list of ferns that have been awarded an RHS Garden Merit Award, and a list of ferns designated “Great Plants” by the Elisabeth C. Miller Botanical Garden, Seattle. Appendix 4 consists of “Top twenty ferns” lists provided by 19 enthusiasts from USA, UK and Germany and representing
hardiness zones from 4 to 11. Appendices 5 to 8 provide recommendations for ferns for special situations, a brief introduction to fern societies (are the BPS, AFS and the Hardy Fern Foundation really the only fern societies?), a list of gardens noted for ferns, and a list of commercial growers. The book finishes with a glossary of about 120 essential terms including “discombobulated: the feeling an uninitiated fern amateur might have when encountering technical terms”, a somewhat idiosyncratic list of books and papers referred to in the text, and an index of Latin and common plant names.

The list of featured species is impressive but nevertheless represents less than 10% of the world flora. The criteria for selecting the chosen species are not explicitly stated but most of the ferns mentioned are temperate species hardy at temperatures below freezing during winter (Hardiness Zone 9 or below), thereby eliminating most ferns, which are tropical. Many of those chosen are familiar garden subjects but I cannot believe that all of them were listed because they are commercially available. Ferns from all over the world are represented, but not every fern in cultivation is included. Even for Britain, the list is not quite complete. For example, Cystopteris dickieana is recognised in the text as a distinct species and shown in a photograph (p.168) but there is no descriptive entry for it even though this attractive dwarf fern is easy to grow, and plants propagated from spores collected at the type locality in a Scottish seaside cave have been widely distributed, at least among British fern enthusiasts. I suspect that the list simply represents those species which can be grown somewhere in the USA or are otherwise known to the author. Nevertheless, it will be possible to identify most garden ferns using the descriptions and illustrations provided.

With such an eclectic list of ferns, it is important to provide guidance to the readers about which ferns will grow in their area. Guidance on suitable climatic conditions is given by means of Plant Hardiness Zones, based on the “average annual minimum temperature” and thus a guide to how cold it can get in winter. This guidance is widely used in the USA but it is less familiar in the British Isles, perhaps because it is not sufficiently discriminatory. Most of Britain away from the coast, from Wick to Winchester, is in Zone 8. In continental Europe, Zone 8 extends from Stavanger to Salamanca. In eastern USA, Zone 8 extends from southern North Carolina to northern Florida. Clearly, few if any ferns will grow equally well throughout Zone 8 because of other environmental factors. Hardiness Zones are, at best, broad indicators of which ferns are worth trying.

In the introductory chapter on propagation (p.74), there is a brief account of hybrid formation, but the treatment of fertile allopolyploids is inconsistent and potentially confusing to the uninitiated. For example, there is no indication that research has revealed that Polystichum aculeatum is the allotetraploid hybrid of two ancestral species, P. setiferum and P. lonchitis, formed by ancient cross-fertilisation followed by chromosome doubling. However, tetraploid Dryopteris filix-mas, with a similar type of history thought to involve D. caucasica (or something similar) and D. oreades, is stated to be “Dryopteris caucasica x D. oreades” within the description and is mention of the fact that it is a fertile hybrid. Woodsia alpina, another allotetraploid species, is defined as Woodsia glabella x W. ilvensis” and this time, its status as “a fertile hybrid” is emphasised in the first sentence of the description. Some readers may not realise that all three species have arisen in a similar way, and that indeed many fern species are fertile polyploids derived from two or more diploid ancestors. In the absence of any mention of ploidy or chromosome number in the species entries, they might also find it difficult to distinguish these fertile polyploids of ancient hybrid origin from recent,
sterile, hybrids with no chromosome doubling. There is also an inconsistent treatment of these recent hybrids. For example, *Dryopteris x australis* (p.214) and *D. x bootii* (p.216) are correctly presented as recent sterile natural hybrids but a similar hybrid, *D. x complexa*, is described as fertile without explaining that the apparent fertility is due to inherited apomixis (apogamy plus diplospory) rather than to the compatibility of the parental genomes. To compound the confusion, *Dryopteris x remota*, a recent rare hybrid of *D. affinis* and *D. expansa*, is listed as “*D. remota*”, implying a species, but then described as a “fertile hybrid”, spore production being again due to inherited apomixis. A consistent treatment of hybrids, and some explanation of the role of hybridisation and polyploidy in species formation and evolution in ferns, perhaps in Chapter 1 “Ferns through the Ages”, would have been helpful.

Whilst acknowledging that fern gardening is all about the decorative sporophytes, in a book called an Encyclopedia I would like to have seen a little more about the vital gametophyte generation. There is a very brief mention in the outline of the fern life cycle (p.69) and in the account of propagation (p.72), and on p.151 the author comments that *Blechnum spicant* is “the only species where I have seen prothalli in nature”. The ecology of gametophytes in natural habitats is largely unknown and cannot therefore inform the choice of conditions for propagation from spores. However an indication of the diversity of form of gametophytes, with photographs, would have been welcome. I would also expect a mention of the perennial gametophytes that can be cultivated, but *Anogramma* is not included, even as a sporophyte, and under *Trichomanes* (p.389) the statement that filmy ferns are “sometimes only seen in a permanent state without sporophytes” will not be easily understood by readers who are not familiar with examples of independent gametophytes.

There are commendably few mistakes or typographical errors, though on p.69, “one pound [2kg] of spores” leaves the reader wondering whether *Cyathea medularis* produces 454gm or 2000gm of spores each year.

To the grower, I would suggest that you use the horticultural information in this book as a useful guide but don’t be inhibited by indications that a species might not be successful in your conditions; you might be pleasantly surprised. Not knowing that *Ceterach officinarum* is “wretchedly difficult” (p.49), I wedged my only plant between small rocks at the foot of a south-east facing slope and, some ten years later and with no further assistance other than some lime chippings, it is still growing, slowly but steadily. Less than 2m away I have three plants of the calcifuge *Cryptogramma crispa* of similar age and also slowly increasing even though this species is said by Olsen to be “almost impossible to cultivate” (p.180). Although these successes are more due to a lucky combination of garden conditions than to horticultural prowess, it does demonstrate that whatever the advice, it is always worth trying a fern you wish to grow, preferably with some attempt to imitate its natural habitat, and in several different conditions of aspect, shade and moisture.

To the fern biologist, I would say don’t dismiss this book as solely for gardeners. It is a goldmine of interesting information on the ecology and growth requirements of a wide selection of species.

A.F. Dyer
INSTRUCTIONS FOR AUTHORS

PAPERS should not usually exceed 20 printed pages and are generally expected to be considerably shorter. Review articles, as well as reports of original research, are encouraged. Short notes are acceptable e.g. new records. The senior author should supply a fax and email address to facilitate correspondence.

MANUSCRIPTS should be submitted in English (British) in electronic format (preferably) or hard copy (two copies), in 10-point Times New Roman font and double spaced. Electronic versions of text and tables should be compatible with WORD, with figures as pdf or jpg files, and sent as email attachments or CDroms. All manuscripts will be refereed.

THE TITLE should reflect the content of the paper and be in BOLD CAPITALS (11-point) and centrally aligned. Generic and specific names should be in italics and any title containing a generic or specific name must be followed by the family and Pteridophyta in brackets e.g.

TRICHOMANES SPECIOSUM (HYMENOPHYLLACEAE: PTERIDOPHYTA) IN SOUTHERN SPAIN


MAIN HEADINGS: should be in BOLD CAPITALS (10-point) and centrally aligned.

SUBSIDIARY HEADINGS: should be in bold, the first letter of each word in capitals, the rest in lower case and left-aligned.

AUTHORS' NAMES AND FULL ADDRESSES: follow the title and are centrally aligned.

KEY WORDS: up to ten.

ABSTRACT: should reflect the content of the paper.

FIGURES: there is no distinction between photographs and line drawings in numbering. All should be presented in a form ready for reproduction, ideally in JPG format (please contact editor with queries), with a scale bar where appropriate. Lettering or numbers (Arabic) should be in the bottom left using uppercase Times Roman and be sufficiently large to be legible if reduction is necessary during printing. The number of photographs allowed in any one issue is limited by cost. Figure captions should be on a separate sheet.

TABLES: can be printed in either portrait or landscape format. Authors should consider this when preparing tables. Authors should ensure that tables fit the printed page size in a legible form.

MEASUREMENTS: should follow the metric system.

CHECKLISTS: should follow the format of Baksh-Comeau, Fern Gaz. 16(1, 2): 11-122.

REFERENCES: should follow the style of a recent issue of The Fern Gazette, e.g.:


JOURNAL ABBREVIATIONS: should follow Botanico Periodicum Huntianum & Supplements.

Alterations from the original text at proof stage will be charged for unless they are minor points of detail. Twenty-five offprints will be supplied free to the senior author.
THE CYTOTAXONOMY OF THE ASPLENIUM STUHLMANNII COMPLEX (ASPLENIACEAE, PTERIDOPHYTA) IN AFRICA

A. F. BRAITHWAITE

4 Kendal Drive, Beeston, Nottingham, NG9 3AW
(Email: afbraithwaite@btinternet.com)

Key words: Asplenium mantoniae, Asplenium jaundeense, new species, chromosome numbers.

ABSTRACT

A new octoploid species, Asplenium mantoniae, intermediate between two tetraploids species, A. stuhlmannii and A. jaundeense, is described from West Africa. The morphology and distribution of members of the complex are consistent with the view that the octoploid has probably arisen by hybridization of the two tetraploids and chromosome duplication.

INTRODUCTION

Asplenium stuhlmannii Hieron. was first described from tropical East Africa and is widely distributed from northern Tanzania to the southern Sudan. Similar, though not identical, material occurs in West Africa and was placed in A. stuhlmannii by Tardieu-Blot (1953) and Alston (1959) and reported by Manton (1959) to be octoploid with \( n = 144 \) chromosomes, based on meiotic analysis. Subsequent cytological examination of East African material has shown the genuine A. stuhlmannii to be tetraploid with \( n = 72 \) chromosomes (Appendix in Braithwaite 1964; Fig. 1). Further studies of the two cytotypes suggest that they are sufficiently distinct morphologically and geographically to merit recognition as two separate species and the octoploid material from West Africa is described here as a new species, A. mantoniae. The new species also bears some resemblance to A. jaundeense Hieron., a tetraploid species (Fig. 1) from West Africa, and its possible relationships to the two tetraploids is discussed.

Figure 1. Acetocarmine meiotic squash preparations. A, Asplenium stuhlmannii \( n = 72 \), Somalia (British Somaliland; B, A. jaundeense \( n = 72 \), arrow points to an out of focus bivalent, Yaunde, Cameroon. Scales = 10µm
<table>
<thead>
<tr>
<th>Species</th>
<th>Locality and origin</th>
<th>Chromosome number</th>
<th>Spore size*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Length</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Breadth</td>
</tr>
<tr>
<td><em>A. stuhlmannii</em> Hieron</td>
<td>Somalia, collected by Mr Desmond Kelsall (O. S Dept, St Andrews) on a hill walking</td>
<td>n = 72</td>
<td>40·9 ± 2·49</td>
</tr>
<tr>
<td></td>
<td>expedition in 1949, ex University Botanic Gardens, St Andrews.</td>
<td></td>
<td>30·3 ± 2·06</td>
</tr>
<tr>
<td></td>
<td>Kenya, living plant sent to Kew with a consignment of orchids</td>
<td>n = 72</td>
<td>39·7 ± 2·0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>26·4 ± 1·0</td>
</tr>
<tr>
<td><em>A. mantoniae</em> sp. nov.</td>
<td>Nigeria, plant raised in Leeds from spores taken from Hambler 513 (BM)</td>
<td>n = 144</td>
<td>47·1 ± 3·57</td>
</tr>
<tr>
<td></td>
<td>Ghana, locality not known, collected by Adams (see Manton 1959), plant in this study</td>
<td>n = 144</td>
<td>31·7 ± 2·36</td>
</tr>
<tr>
<td></td>
<td>raised from spores taken from herb. specimen of Manton’s plant</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>A. jaundeense</em> Hieron.</td>
<td>Cameroon, Yaunde, collected for the author as a living plant and first established</td>
<td>n = 72</td>
<td>34·1 ± 2·85</td>
</tr>
<tr>
<td></td>
<td>at Kirstenbosch in 1961 then sent to Kew and subsequently transferred to Leeds</td>
<td></td>
<td>23·4 ± 1·69</td>
</tr>
</tbody>
</table>

* means ± SD (n = 100)

Table 1. Locality, source, chromosome numbers and spore sizes of living plants of the *Asplenium stuhlmannii* complex.
MATERIAL AND METHODS
Live plants for cytological investigation were accumulated from a variety of sources (see Table 1) and finally established in the Botanic Garden, University of Leeds. In addition, all the relevant herbarium material at BM and K was examined. Voucher specimens will be deposited in BM.

Chromosome counts were made on acetocarmine squash preparations of meiosis using the standard method for ferns (Manton 1950).

Spore samples for measurement were mounted in either gum chloral or Depex and measured using a calibrated eyepiece and ×40 objective.

THE SPECIES
Asplenium stuhlmannii Hieron.


Rhizome creeping with rather stiff loosely tufted fronds. Rhizome scales 3–5mm long, 0·5–0·75mm wide at the base, linear subulate with a rounded base and ending in a short hair point, clathrate with smooth cell walls; median cells dark thick-walled and compressed with narrow, sometimes obscured, lumens, becoming thinner walled and pellucid towards the margins. Fronds up to 24–45cm long, pinnate to deeply bipinnatifid; stipes black becoming green near apex, sparsely scaly. Lamina bright green, linear lanceolate, 15–37 × 2·5–9·5cm with 10–17 pairs of opposite or subopposite spreading pinnae. Pinnae 1·8–5·0 × 1·0–2·3cm, coriaceous, broadly trullate to trullate, base broadly cuneate; basal pinnae deeply divided, upper pinnae less so, into 3–5 lobes; largest lobes (pinnules) cuneate-obovate and further cut into 3 or 4 segments with truncate lacerate apices, smaller lobes rectangular with truncate lacerate-crenate apices. Veins and sori subflabelliform. Spores plano-convex, (32–) 36–44 (–50) × (20–) 24–30 (–35) µm perispore costate with loosely anastomosing low ridges or folds. Reproduction sexual, chromosome number n = 72 (2n = 144).

Ecology and distribution. Asplenium stuhlmannii is a fern of rocky outcrops often in grassland at altitudes from 850 – 2188m. It grows in sheltered rock crevices or in shade around the base of rocks or on top of rocks in the shade or less often in full sun. It is widely distributed in East Africa: Tanzania, Rwanda, Uganda, Kenya, E Zaire, Sudan and E Central African Republic (Figure 1).

Notes. The name A. stuhlmannii is here restricted to the East African material with creeping rhizomes bearing scales made up of smooth walled cells, pinnate to deeply bipinnatifid fronds with broadly trullate to trullate pinnae and spores with costate-alate spores with rather low smooth folds or wings (Figure 3). All the material is tetraploid in so far as can be judged from comparisons of spore measurements from specimens in
the herbaria with those from the cytologically authenticated material.

*Asplenium stuhlmannii* var *laciniata* with larger pinnae, more deeply dissected into laciniate lobes probably represents a larger luxuriant shade form. The rhizome scales and spore ornamentation and size match those of typical *A. stuhlmannii*.


---

**Figure 2.** Distributions of *Asplenium stuhlmannii* (●), *A. jaundeense* (■) and *A. mantoniae* (▲). The locality of *A. jaundeense* in Gabon not placed.

Asplenium mantoniae A. Braithw. sp. nov.

Asplenium stuhlmannii et A. jaundeense similis sed differt chromosomatique numero (n = 144) et sporis majoribus; a A. stuhlmannii pinnis trapezio-trullatis, basaleis acutis et lobis paucioribus; a A. jaundeense lobatis profunde trapezioid-trullatis pinnis.

Holotypus: Nigeria, Ondo Province, inselberg nr Ado Iyie, 7° 54’ N, 3° 30’ E, with creeping rhizome growing under overhanging boulders, Hambler 513 (BM).


Figure 3. Morphology of the Asplenium stuhlmannii complex, spores. A, A. stuhlmannii, Somalia; B, A. mantoniae, Hambler 513; C, A. jaundeense, Yaunde, Cameroon. Scales: A – C = 10 µm.
Rhizome creeping with stiff tufted fronds; rhizome scales dark brown, up to 6mm long, 1mm wide, linear-subulate, clathrate, cell walls thick and opaque in the middle, becoming thinner and pellucid towards the margin, walls facing lumens often irregularly minutely denticulate (Figure 3). Fronds 15–44cm long, pinnate to deeply pinnatifid; stipe dark purplish brown 4·5–20cm long with small scales similar to those of the rhizome at the base; rachis dark purplish brown, for the most part becoming green towards the apex, sparsely scaly. Lamina 10–24cm long, 3·5–7·5cm wide, narrowly ovate with 8–13 pairs of subopposite spreading pinnae merging into a lobed apex. Pinnae 2·0–6·5 × 0·75–2·5cm, narrowly parallelogram-shaped to trapezoid-trullate, base narrowly cuneate then divided into 3–4 lobes merging into lacerate-serrate, sometimes attenuate, acute apex (Figure 2); largest basal acroscopic lobe obtriangular to rectangular and further cut into 3 lobes with irregularly crenate apices, remaining lobes rectangular with irregularly crenate apices, becoming progressively smaller towards apex of pinna. Veins and sori subflabellate. Spores plano-convex, (40–) 46 – 48 (–55) µm × (28–) 31–32 (–37) µm, costate-alate with much anastomosing high wavy (undulating) ridges or wings. Reproduction sexual, chromosome number n = 144 (2n = 288).

Ecology and distribution. This new species is generally associated with rocky outcrops, usually but not exclusively granite, e.g. the inselbergs of Nigeria, where it is found in the shade on rock faces, in damp rock crevices or growing under overhanging boulders from 100 – 400m. It has a predominantly West Africa distribution (Guinea, Sierra Leone, Ivory Coast, Ghana, Nigeria, Cameroon) with outliers in the Central African Republic (Figure 2).

Notes. The new species resembles *A. stuhlmannii* in its general growth habit, frond architecture, colour and texture, but is distinguished by its slightly larger rhizome scales made up of cells with thicker and often dentate cell walls, generally larger but less divided and more trapezoid or parallelogram-shaped pinnae with narrower cuneate bases and by its larger costate-alate spores with broader more frequently anastomosing wavy (undulating) perispore folds or wings. In these respects it resembles the following species, *A. jaundeense*, despite being traditionally confused with *A. stuhlmannii*. (see Figures 2 & 3).

Etymology. Dedicated to the late Professor Irene Manton F. R. S. in recognition of her contribution to knowledge of the cytology of the fern flora of West Tropical Africa. specimens examined. GUINEA: Haut Niger (Fouta Djallon): Mt Bambaya, vers 100m, 1945, P. Jaeger 2113 (K); Macenta, Adams 5513 (P); Gueckedou, Adams 5581 (P). SIERRA LEONE: Northern Prov., Bumba (?Bumban), 1200ft, 1932, R. Glanville 436 (BM). IVORY COAST: Séguéla, rocher granitique a 15km E. sur la route de Beoul, sous un surplombe humide, 1948, *H. des Abbayes* 619 (BM); entre Seguela et Maukono, fissure rocheuse, 1954, R. Schell (K); Rocher d’Issia, en grove on granitic rock, 250m, 1962, A. J. M. Leuwenwerg 4140 (K); Pays des Ayoles, sommet du Mont Kouan près Aannmé (manelog granitique), 400m, 1909, A. Chevalier 21269 (K,P); Mt Dou, Man, *Porteres* s.n. (P); Mt Semelebou, A. Chevalier 22095 (P). GHANA: Bhongo-Ahfo Prov.: Ebaw Rock near Mim, growing in moist crevices on granitic outcrop near thicket margin, 1973, *Hall & Abbis* 44559 (K). NIGERIA: Oyo Prov.: hill 3 km N of Iseyin, 7° 58´ N, 3° 34´ E, 350m, rather shady crevice in granitic rocks, 1967, *J. B. Gillett* 15399 (K); Okeho, group of low hills about 3 miles from Iseyin road, in savannah country, 1959, R. W. J. Keay FHI 37748 (K); Ibadan, Oje Rock, sheltered rock crevices near summit, 1967, D. P. M. Guile 3018 (K). Ondo Prov.: Erionear Aramoko-
Figure 3. Morphology of the Asplenium stuhlmannii complex showing silhouettes of fresh juvenile fronds (top, scale = 5 cm), pinnae from lower part of mature dried fronds (middle, scale = 2 cm) and sections (middle to margin, scale = 0.1 mm) of the rhizome scales (bottom). A, *A. stuhlmannii*, Somalia; B, *A. mantoniae*, Hambler 513; C, *A. jaundeense*, Yaunde, Cameroon.
Ekiti, base of *Hildegardia* on steep rock faces, 1968, *J. B. Hall* 67 (K); *ibid.*, shade of rock on inselberg, 1968, *J. B. Hall* 71 (K); Idanre, *Jones* s.n. (FIH 14846) (BM); among granite boulders on the lower more or less forested slopes of granite hills, 1946, *A. P. D. Jones* 14844 (BM); Idanre, behind Rest House, in rock fractures, texture coriaceous, dark green, 1968, *D. Gledhill* 957 (K); amongst rubble under overhanging ledge – small quantity only growing with *Pellia doniana*, 1958, *D. J. Hambler* 419 (BM); inselberg NE of Ado Rock, 7° 51´ N, 3° 30´ E, under overhanging boulders growing with *Pellia doniana* and *Sanseviera* sp., 1958, *D. J. Hambler* 526 (BM).


*A. jaundeense* Hieron.


*Asplenium dimidiatum* var. *zenkeri* Hieron., in Engler *Veg. der Erde* 9: 28, fig. 24, 1908.

Rhizome creeping giving rise to fronds a few millimetres apart; rhizome scales dark brown, up to 6 × 1mm, subulate, clathrate with median cells dark thick-walled and compressed, often with narrow occluded lumens, marginal cells thin-walled and pellucid, walls facing lumens distinctly minutely dentate. Fronds up to 66 cm long; stipes up to 26cm, matt black with scales at the base similar to those of the rhizome. Lamina up to 41 × 8cm, oblong to linear-oblong with 10 – 20 opposite-subopposite pairs of spreading pinnae merging progressively into a lobed apex; rachises similar to stipe but glabrous and becoming green towards the apex. Pinnae up to 6 × 3cm, trapezoid-rhomboid to cuneiform hastate, base narrowly cuneate, inaequilateral, acrosopic side up to 1:5cm long, basiscopic side up to 3cm long; largest pinnae subtrilobed to trilobed, lateral lobes truncate irregularly inciso-dentate, terminal lobe long, elongate-deltoid, sparsely alternately inciso-dentate, ending in an acute point; trilobing tending to disappear and pinnae becoming trapezoid-rhomboid towards apex and in juvenile fronds. Costae not evident, veins and sori sublabellate. Spores plano-convex, (28–) 33–36 (–40) × (19–) 22–24 (–27) μm, perispore costate-aleate with anastomosing high wavy ridges or folds (wings). Reproduction sexual, chromosome
number \( n = 72 \) \((2n = 144)\).

Ecology and distribution. The limited ecological information available suggests that this species is associated with rocky outcrops or boulders at altitudes ranging from 300 – 1000m. It is known only from West Africa: Gabon (locality not placed), Cameroon and eastern Nigeria (Figure 2).

Notes. Distinguished from *Asplenium mantoniae* by its trapezioid- rhomboid three lobed pinnae with often long attenuate apical lobe and smaller spores, \((28–) 33 – 36\) \((-40) \mu m \times (19–) 22 – 24 \((-27) \mu m)\).

The morphologically similar *A. megalura* Hieron. differs by its erect rhizome, rather brittle wiry fronds with fewer and often long-attenuate pinnae, a large 3-lobed apical pinna and spores with sparsely anastomosing shallow ridges or wings. It also differs ecologically being usually epiphytic in forest and is widely distributed in tropical and subtropical Africa.


**DISCUSSION**

The three species of the *Asplenium stuhlmannii* complex are united by the presence of a creeping rhizome clothed in clathrate scales with dark median band and translucent margins, and bearing rather stiff once- pinnate narrowly lanceolate or narrowly ovate fronds. The rhizome scales, pinnae and spores of the three species are shown in Figures 2 & 3.

The clathrate rhizome scales of all three species are made up of dark thick-walled cells with compressed lumens in the middle parts becoming thinner-walled and translucent towards the margins. Apart from differences in the size of the cells related to ploidy, there are subtle differences in the inner surface of the cell walls bordering the lumens. Those of *A. stuhlmannii* are smooth while those of *A. jaundeense* are minutely denticulate. Those of *A. mantoniae* are often, but not always, sparsely denticulate (Figure 2), and thus somewhat intermediate.

The pinnae and spore ornamentation of *A. mantoniae* are also intermediate between those of the two tetraploids. The pinnae possess a narrower acute base and are more trapezoid-rhomboid and less dissected than the broadly trullate pinnae of *A. stuhlmannii* and possess a broader cuneate base and are more trullate with deeper lobes than the trapezio-rhomboid almost entire pinnae of *A. jaundeense*. The spores of *A. mantoniae* are larger than those of the two tetraploids on account of their higher level of polyploidy. Their higher more anastomosing wavy perispore folds or wings contrast with the rather low sparingly anastomosing straight perispore wings of *A. stuhlmannii*. In this respect they resemble the spores of *A. jaundeense*.

The morphological analysis suggests a close relationship between the three members of the complex and is consistent with the view that *A. mantoniae* has most likely arisen by hybridisation between the two tetraploids and subsequent doubling of the chromosome number of the hybrid to produce the octoploid. The present
distributions of A. jaundeense and A. stuhlmannii are widely separated in West and East Africa respectively so that such a hypothesis would imply that in the past their distributions must have either been sympatric or in close contact. The distribution of A. mantoniae partly falls between those of the two tetraploids, but has also extended the distribution of the complex particularly in West Africa where it may now be found as far west as Sierra Leone and Guinea.

REFERENCES
**ASPLENIUM DELAVAYI (PTERIDOPHYTA, ASPLENIACEAE)**

**A FERN SPECIES NEW TO NEPAL**

ARUN RIJAL

P.O. Box 4326, Kathmandu, Nepal

(E-mail: arunrijal@yahoo.com)

Key words: *Asplenium delavayi*, Pteridophyta, west Nepal, disjunct

**ABSTRACT**

*Asplenium delavayi* (Franch.) Copel., a Sino-Himalayan species, described from S.W. China and previously known only as far west as Sikkim, has been discovered in the Baitadi District of west Nepal. This is much further west than might be expected and emphasises the possibility of more species being discovered in Nepal with increased collection and study.

**INTRODUCTION**

Although Nepal is only c. 885 km from west to east and 145 to 241 km from north to south, it contains extreme differences in climatic and geographic situation, as a result of the great range of altitude, from c. 60 m. in the southern terai zone to more than 8000 m. in the high Himalaya. Plant diversity ranges from stunted alpines surviving in harsh environments in the frozen mountains, to mighty trees of the steamy lowland jungles. This diverse environment provides habitats for a surprisingly large number of plant species and more than 6000 species of flowering plants have been recorded so far from Nepal. It has been estimated that over 6600 species will be listed from the country when the poorly known remote regions are fully explored (RBGE 2007).

Nepal also has a rich fern-flora with 532 species of pteridophytes reported so far (Thapa 2002; Fraser-Jenkins & Thapa in prep.). Nepalese pteridophytes belong to two main phytogeographical elements, with a smaller third element. The dominant group of species are Sino-Himalayan species, with their centre of diversity in S.W. China, which have spread westwards along the Himalayan chain and are typically plants of the main and inner ranges, occurring from mid to higher altitudes, though some may occur in the lower, outer ranges nearer the plains. Such species usually occur more-or-less throughout Nepal, though the number of species is higher in the higher rainfall areas of the east. The second group of species are the S.E. Asian elements, which require more tropical conditions and high rainfall. They occur predominantly in E. Nepal from lower-mid to mid altitudes, and although they also extend westwards through Nepal, their numbers decrease rapidly further westward, particularly towards far-west Nepal. There is a small second enclave of S.E. Asian species in the locally high-rainfall area around Pokhara in W.C. Nepal. The third element is a small group of either European or W. Himalayan species, the latter a special part of the Sino-Himalayan group. These extend eastwards from the W. Indo-Himalaya into the far-west part of Nepal, with several occurring mainly behind the Himalayan line in C. Nepal.

*Asplenium* is one of the larger genera in the flora and contains 32-34 species and an additional subspecies in Nepal (Thapa 2002, Fraser-Jenkins & Thapa in prep.) of which 19-21 species may be considered Sino-Himalayan elements, eight S.E. Asian elements and five European elements (Fraser-Jenkins pers. comm., Dec. 2007). Most new
records for Nepal concern what is presumably the richest part of the flora in eastern Nepal. But the central region is by far the best collected due to its greater accessibility and, as currently known, more species are recorded from central Nepal than further east. This is likely to be an artificial anomaly resulting from the greater attentions of collectors there. The least known area is western Nepal, especially the far west. There is a higher proportion of semi-arid and European and W. Himalayan elements here, but it is clear that fewer species occur in W. Nepal due to the lower rainfall. However because the area is so under-collected some surprises occasionally turn up there, with some species extending further west than might be expected.

In 1997, the author came across an unusual species in far W. Nepal which was not familiar to him. It had the long, indusiate sori of an Asplenium, but a uniquely rounded, entire and simple lamina of small size, and a black stipe. This was subsequently identified in Dec. 2007 by C.R. Fraser-Jenkins as the very rare and little known species, Asplenium delavayi (Franch.) Copel., which was not previously known from Nepal, even in the east.

TAXONOMIC TREATMENT

Asplenium delavayi (Franch.) Copel., Genera Filicum: 165 (1947).

Basionym: Scolopendrium delavayi Franch., Bull. Soc. Bot. France, sér. 2, 32: 28 (1885); synonyms: Phyllitis delavayi (Franch.) C.Chr., Index Fil. 2: 492 (1906); Schaffneria delavayi (Franch.) Tardieu, Naturaliste Malgache 9(1): 30 (1957); Sinephropteris delavayi (Franch.) Mickel, Brittonia 28(3): 327 (1976).


Distribution: W. Nepal, Sikkim, Bhutan, N.E. India (Manipur), N. Myanmar, S.W. and S.C. China (Yunnan, Sichuan, Guizhou and Guangxi).

Asplenium delavayi was illustrated by Clarke (1888), who first reported it from India, Ching (1930), Mickel (1976) and Wu (1999) and is probably related to the similar, but larger, Chinese and Japanese species, A. cardiophyllum (Hance) Baker (syn.: Boniellia cardiophylla (Baker) Tagawa). Although several splinter-genera, including Sinephropteris, were raised at various times, these are now generally sunk.

Figure 1: Map of Nepal showing the location of A. delavayi in Baitadi District.
Asplenium delavayi was collected by the author in Nepal at Nwaghargad, Baitadi District, Far-West Development Region (Mahakali Zone); in crevices of damp rock in open places, 1258 m. alt. (4125 ft.). A. Rijal 3251, 15 January 1997 (KATH). The distribution of A. delavayi is that of a Sino-Himalayan species, though occurring at lower altitude.

Description: Rhizome short, unbranched, up to c. 1cm. long, erect, bearing a tuft of branched, dark-brown roots below, scales on the apex similar to those on the stipes but slightly smaller, and a tuft of semi-erect, radiating stipes. Stipes cylindrical with an adaxial groove, blackish-brown to black, glossy, 2.5-5cm. long, erect, bearing a tuft of small, greyish, narrowly lanceolate, acuminate, slightly toothed scales towards their bases, c. 2-3mm. long, 0.4-0.7mm. wide towards their bases. Lamina persistent in Winter, simple, 2-2.6 x 2.1-2.6 cm., glabrous above, bearing a few scattered small scales beneath, bright green, paler below, entire to slightly wavy at the margin, markedly rounded-ovate with a shallow cordate base and sometimes a slightly rounded-pointed apex, a vague darkish midrib present towards the base of the lamina, veins immersed, inconspicuous, radiating from the midrib, several times dichotomously forked, with the smallest forks towards the margin, but not reaching it, with occasional anastomoses near to the margin. Sori c. 20-28 per frond, elongated, straight to slightly curved, placed along the veins, not forked, obliquely radiating, starting near the midrib and ending below the margin, larger main sori c. 1cm. long, occasional smaller sori borne between the larger sori from about half way along their length, indusiate; indusium pale, very thin, becoming brown, lifting and shrivelling somewhat on soral ripening, opening towards the adaxial (midrib) side, Spores good, regular, bilateral, with short wings of perispore, c. 28 x 20 µm.

The general habit of the fern is similar to a small, more delicate Adiantum reniforme L. (from Macaronesia and S.W.China), but with the lamina not horizontal as in that species and the sori elongated and radiating on the lower surface of the frond, not short and around the edge. It is also similar to a very small Asplenium scolopendrium L. (from N. America, Europe, Macaronesia, W. Asia, China and Japan), but with round, not elongated ovate fronds and thin, black stipes.

CONCLUSION
The discovery of this rare species in far-west Nepal where it has been overlooked so far is probably connected with that area being under-collected. The considerable disjunction of this population from those further east is not likely to be an actual botanical reality. It is also likely that further unrecorded species may be found if more intensive collecting were made, particularly if carried out by specialists familiar with all the Nepalese pteridophytes who could easily pick out any unfamiliar taxa. Some other species also show similar disjunctions which may be expected to be only temporary until further study has been made. At one time there was a considerable gap in recording between Darjeeling/Sikkim and the W. Himalaya in Kumaon (Uttarakhand) for the majority of species extending that far west. But since the pteridophyte-flora of Nepal has become largely known over the latter half of the 20th Century, to date, the “central Himalayan gap” has largely been filled and can be seen as an artificial one. A few large disjunctions still remain, these are:

Acrophorus paleolulatus Pic.Serm. - gap from C. Nepal to Kumaon (Chamoli).
Figure 2: Sketch of the general habit, a stipe-base scale and the abaxial surface of the frond with sori.
Actinopteris radiata (Sw.) Link - gap from E. Nepal to Lumaon (Garhwal).
Acystopteris tenuisecta (Blume) Tagawa - gap from E. Nepal to Kumaon (Nainital).
Anogramma reichsteinii Fras.-Jenk. - gap from C. Nepal (Chapagaon, Kathmandu; locality perhaps doubtful) to Kumaon (Nainital).
Asplenium delavayi (Franch.) Copel. - gap from Sikkim to far-west Nepal (Baitadi).
Athyrium otophorum (Miq.) Koidz. - gap from N.E. India (Meghalaya) to Kumaon (Pithoragarh).
Athyrium roseum Christ - China; Darjeeling (Fraser-Jenkins) and gap to W.C. Nepal (below Annapurna Base-Camp. Fraser-Jenkins).
Cornopteris quadripinnatifida M.Kato - gap from C. Nepal to Kumaon (Chamoli).
Deparia lancea (Thunb.) Fras.-Jenk. - gap from C. Nepal (Sankhu) to ?Kumaon (Pithoragarh. Punetha & Kholia).

Plate 1 & 2: Asplenium delavayi from Baitadi, general view.
Dryopteris pulvinulifera (Bedd.) Kuntze - gap from E. Nepal to Kumaon (Nainital).
Lepisorus sublinearis (Baker ex Takeda) Ching - gap from W.C. Nepal (Pokhara) to Kumaon (Nainital).
Lindsaea commixta Tagawa - gap from N.E. India (Assam) to W.C. Nepal (Andheri Khola, N. of Tansen; locality sometimes given on label as Mussoorie in error).
Matteuccia intermedia C.Chr. - gap from W.C. Nepal (Annapurna Base Camp. Fraser-Jenkins) to Kumaon (Pithoragarh).
Microlepia hallbergii (d’Almeida) C.Chr. - gap from C. Nepal (Sankhu) to Kumaon (Garhwal).
Microsorum zippelii (Blume) Ching - gap from far E. Nepal to Kumaon (Chamoli).
Pteris kathmanduensis Fras.-Jenk., in prep. - gap from C. Nepal (Kathmandu) to Kumaon (Pithoragarh).
Pteris vittata L. subsp. vermae Fras.-Jenk. - gap from China, Tibet and ?Bhutan (Thimphu. Fraser-Jenkins) to Kumaon (Nainital).
Theleyptis (Christella) lebeufii (Baker) Panigrahi - gap from N.E. India (Assam State) to Kumaon (Tanakpur. Fraser-Jenkins).
Trichomanes parvifolium (Baker) Copel. - gap from Myanmar to W.C. Nepal (Gorkha).
Trichomanes saxifragoides C.Presl - gap from Bhutan to W.C. Nepal (Pokhara).

It is to be hoped that future work, concentrating on Nepal, may continue to make the full distribution patterns of Himalayan pteridophytes clear and other new records may be discovered.

Plate 3: Single frond (abaxial surface) showing the arrangement of the sori.
ACKNOWLEDGEMENTS
The author wishes to thank Mr. C.R. Fraser-Jenkins, of Naya Bazaar, Kathmandu, Research Associate of the Royal Botanic Garden Edinburgh, for helping in identification of the collection, revision of this paper and providing information on disjunct species.

REFERENCES
SHORT NOTE

CORRECTION TO A REVISED HANDBOOK TO THE FLORA OF CEYLON, VOLUME XV, PARTS A & B, FERNS AND FERN-ALLIES, 2006. M.D. Dassanayake (General Editor), Monika Shaffer-Fehre (Editor). ISBN, SET 1-57808-411-3

Monika Shaffer-Fehre, The Herbarium, Royal Botanic Gardens, Kew, Richmond, Surrey
(m.shaffer-fehre@rbgkew.org)

These volumes devoted to ferns and fern allies contribute to the Flora of Ceylon. Unfortunately some errors have been identified.

The following corrections are required to the contents: the family Dryopteridaceae (Vol. A) is treated in two chapters rather than one only, and Polypodiaceae begins Volume B. Regarding the Woodsiaceae, the name of the senior author is missing in ‘Contents’; three of the four genera treated, viz.: Hypodematium, Deparia and Athyrium have been described by C.R. Fraser-Jenkins and one, Diplazium, has been contributed by Dr M. Zink. There is one further omission: Vol. B, page 356: PTERIDACEAE, B. Verdcourt. The following text is missing from Hemionitis tomentosa at the very end of the treatment:

Specimens Examined. KANDY DISTRICT: Above Kandy: Roseneath Valley, The Heremitage, Sledge 1139 (BM, K); Abatage on Gampola-Pusselawa road, Faden & Faden 76/246 (K); Peradeniya, Matthews s.n.; cultivated at Kew from Ceylon material in 1954 (K).

The editor apologises for these mishaps, and a correct list of contents is given on the next page. The editor would appreciate hearing from readers of any other mistakes. A list of additional corrections will then be published at a later date.
FOREWORD
ACKNOWLEDGEMENTS
INTRODUCTION AND SURVEY OF TAXA WITH REFERENCES AND GENERAL LITERATURE by M. Shaffer-Fehre and P.J. Edwards
KEY to the FERNS and FERN-ALLIES of SRI LANKA by P.J. Edwards

VOLUME 15 PART A

ASPLENIACEAE by D.Philcox 1—35
AZOLLACEAE by Jennifer M. Ide 36—39
BLECHNACEAE by P. Jayasekara 40—47
CYATHEACEAE by D. Philcox 48—55
DAVALLIACEAE by H. P. Nooteboom 56—66
DENNSTAEDTIACEAE by M. J. Zink 67—99
DRYOPTERIDACEAE 1 by C. R. Fraser-Jenkins 100-155
DRYOPTERIDACEAE 2 by M. J. Zink 156-170
EQUISETACEAE by B. Wadhwa 171-172
GLEICHENIACEAE by Monika Shaffer-Fehre 173-175
GRAMMITIDACEAE by B. S. Parris 176-213
HYMENOPHYLLACEAE by P. Jayasekara 214-235
ISOETACEAE by B. Wadhwa 236-237
LOMARIOPSIDACEAE by M. J. Zink 238-248
LOXOGRAMMACEAE by M. G. Price 249-253
LYCOPODIACEAE by D. Philcox 254-270
MARATTIACEAE by D.M.U.B. Dhanasekara 271-274
MARSILEACEAE by Jennifer M. Ide 275-283
OLEANDRACEAE by B. Verdcourt 284-294
OPHIOGLOSSACEAE by D. Philcox 295-304
OSMUNDACEAE by P. Jayasekara 305-307
PARKERIACAE by B. Wadhwa 308-310

VOLUME 15 PART B

POLYPODIACEAE by P. H. Hovenkamp 311-348
PSILOTACEAE by B. Wadhwa 349-351
PTERIDACEAE by C. R. Fraser-Jenkins, B. Verdcourt & T. G. Walker 352-427
SALVINIACEAE by Jennifer M. Ide 428-432
SCHIZAEACEAE by D. Philcox 433-439
SELAGINELLACEAE by D. Philcox 440-454
THELYPTERIDACEAE by Monika Shaffer-Fehre 455-520
VITTARIACEAE by Monika Shaffer-Fehre 521-531
WOODSIACEAE by C.R. Fraser-Jenkins and M. J. Zink 532-576

New Names published in this Volume 577
List of endemic species 578-579
Selective Glossary of Terms 580-590
Index to Scientific Names 591-616
SHORT NOTE

TWO NEW SPECIES OF SELAGINELLA SUBGENUS HETEROCHYS (SELAGINELLACEAE) FROM THE GUIANAS - A CORRECTION

In the recent paper by Cremers & Boudrie (2007), the two names are ascribed to Valdespino ex Cremers & Boudrie. However, in referring to the descriptions, Cremers & Boudrie state that “what follows” was extracted verbatim from Valdespino’s monograph. As both the names and the descriptions are therefore ascribed to Valdespino, under Art. 46.2 the correct attribution of the names should be:

Selaginella gynostachya Valdespino in Fern Gaz. 18: 42[-46]. 2007

I thank Professor John McNeill for advice.


Mary Gibby
MORPHOTYPE AND CONFLICTING TAXONOMIES IN PTERIDIUM
(DENNSTAEDTIACEAE: PTERIDOPHYTA)

JOHN A. THOMSON

National Herbarium of NSW, Botanic Gardens Trust, Mrs Macquaries Road, Sydney,
NSW 2000, Australia.
(Email: johnt@accsoft.com.au)

Key words: Dennstaedtiaceae, bracken, genetics, morphology, morphotype,
polymorphism, Pteridium, subspecies, taxonomy.

ABSTRACT

Conflicting taxonomic treatments of the diploid bracken ferns of the Laurasian
lineage within Pteridium are briefly reviewed. The infraspecific entities
recognised in this section of the genus can be separated on morphological,
phenological and physiological criteria into two main groups referred to
respectively as ‘aquilinum’ and ‘latiusculum’ morphotypes. Evidence of gene
flow between morphotypes is discussed, including the finding from DNA studies
that taxa of the ‘aquilinum’ and ‘latiusculum’ morphotypes in each major
geographic region are more closely related to the contrasting morphotype from
the same region than to the corresponding morphotype from another region. It is
proposed here that the ‘aquilinum’ and ‘latiusculum’ morphotypes may be
regarded as mediated by a simple genetic polymorphism involving alternative
pleiotropic alleles at a single major morphogenetic locus comparable to those
previously described in Athyrium and postulated in Asplenium and Pteridium,
but other possible models are discussed.

It is concluded that P. aquilinum is best treated as a single species containing at
present 11 subspecies.

INTRODUCTION

A vigorous ongoing polemic continues to cloud taxonomic treatment of the diploid (2n
= 104; Wolf et al., 1987,1988) bracken ferns [Pteridium aquilinum (L.) Kuhn]
comprising a Laurasian lineage within the genus. Thomson and colleagues (Thomson,
2004; Thomson et al., 2005; Thomson et al., 2008; contra Thomson, 2000) regard
P. aquilinum as a grouping of 11 subspecies (Table 1) that in general correspond to
varieties within Tryon’s (1941) P. aquilinum subsp. aquilinum. In contrast, certain other
contemporary classifications are based on separation of these taxa into two phenotypic
groups designated here as the ‘aquilinum’ and ‘latiusculum’ morphotypes (Table 1).

Page (1997) and coauthors (Page & Mill, 1995; Gureyeva & Page 2005) regard these
‘aquilinum’ and ‘latiusculum’ morphotypic groups as multi-species complexes
represented in Europe by P. aquilinum and by P. pinetorum C.N. Page & R.R. Mill
respectively, each with several subspecies. Fraser-Jenkins (1997), on the other hand,
recognises P. latiusculum (Desv.) Hieron. ex R.E.Fr. at species level and accords
subspecific rank to P. latiusculum subsp. pinetorum (C.N. Page & R.R. Mill)
phenotypes as P. aquilinum subsp. aquilinum and those of ‘latiusculum’ as P. aquilinum
subsp. latiusculum (Desv.) Hultén. Shorina & Perestoronina (2000) distinguish the
European ‘latiusculum’ morphotype as P. aquilinum var. pinetorum (C.N. Page & R.R.
<table>
<thead>
<tr>
<th>Geographic region/morphotype</th>
<th>P. aquilinum subspecies</th>
<th>P. aquilinum variety</th>
</tr>
</thead>
<tbody>
<tr>
<td>Europe</td>
<td></td>
<td></td>
</tr>
<tr>
<td>‘aquilinum’</td>
<td>aquilinum</td>
<td>aquilinum</td>
</tr>
<tr>
<td>‘latusculum’</td>
<td>pinetorum (C.N. Page &amp; R.R. Mill) J.A. Thomson(^1,2)</td>
<td>latiusculum (Desv.) Underw. ex Heller</td>
</tr>
<tr>
<td>Asia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>‘aquilinum’</td>
<td>wightianum (Wall. ex J. Agardh) Shieh(^3)</td>
<td>wightianum (J. Agardh) R. Tryon</td>
</tr>
<tr>
<td>‘latusculum’</td>
<td>japonicum (Nakai) A. Löve &amp; D. Löve(^1)</td>
<td>latiusculum (Desv.) Underw. ex Heller</td>
</tr>
<tr>
<td>Africa</td>
<td></td>
<td></td>
</tr>
<tr>
<td>‘aquilinum’</td>
<td>capense (Thunb.) C. Chr.(^4)</td>
<td>aquilinum</td>
</tr>
<tr>
<td>‘latusculum’</td>
<td>centrali-africanum Hieron. ex R.E. Fr.(^4)</td>
<td>africanum Bonap.</td>
</tr>
<tr>
<td>North America</td>
<td></td>
<td></td>
</tr>
<tr>
<td>‘latusculum’</td>
<td>feei (W. Schaffn. ex Fée) J.A. Thomson, Mickel &amp; K. Mehltreter(^5)</td>
<td>feei (W. Schaffn. ex Fée) Maxon ex Yuncker</td>
</tr>
<tr>
<td></td>
<td>latiusculum (Desv.) Hultén auct. Thomson (2004)(^1)</td>
<td>latiusculum (Desv.) Underw. ex Heller</td>
</tr>
<tr>
<td></td>
<td>pseudocaudatum (Clute) Hultén(^5)</td>
<td>pseudocaudatum (Clute) Heller</td>
</tr>
<tr>
<td></td>
<td>pubescens (Underw.) J.A. Thomson, Mickel &amp; K. Mehltreter(^5)</td>
<td>pubescens Underw.</td>
</tr>
<tr>
<td>Hawaiian Islands</td>
<td></td>
<td></td>
</tr>
<tr>
<td>‘intermediate’</td>
<td>decompositum (Gaudich.) Lamoureux ex J.A. Thomson(^1)</td>
<td>decompositum (Gaudich.) R. Tryon</td>
</tr>
</tbody>
</table>

\(^1\) Thomson, 2004  
\(^3\) Also referred to as *P. revolutum* (Blume) Nakai  
\(^4\) Thomson *et al.*, 2005  
\(^5\) Thomson *et al.*, 2008
A dearth of useful discriminatory characters often leads to difficulties in pteridophyte taxonomy, especially in the case of low order taxa that may be separated on as few as one single character (Perrie & Brownsey, 2005). In many fern species the segmental units represented at successive levels by frond, pinna, pinnule, and even pinnulet, form a repetitive hierarchical series for which a feature expressed at one level may not be independent of a corresponding feature scored at another segmental level. In general, such attributes should be treated as relating to a single character, and may well share a common genetic basis. Examples are evident in the morphometric documentation of the relative number, size, shape and spacing of pinnae, pinnules and pinnulets in subspecies of *Pteridium aquilinum* (L.) Kuhn (Thomson et al., 2005; Thomson et al., 2008). Further, many commonly used features of indumentum, false indusium and laminal segmentation are extremely labile, being affected by age, shading, water-logging and other environmental conditions (Ashcroft & Sheffield, 1999; Karlsson, 2000; Thomson et al., 2005; Thomson et al., 2008) and must be employed quantitatively and with caution.

Three recent re-evaluations of disputed taxonomic treatments in ferns highlight the contribution that genetic evidence, either directly from breeding experiments or indirectly from molecular data, may make to more consistent and objective assignment of taxonomic rank. In *Athyrium distentifolium* Tausch ex Opiz (Woodsiaceae), morphotype ‘flexile’ is endemic to Scotland and is found only at localities where ‘distentifolium’ is also present (McHaffie et al., 2001). Sporophytes of the ‘flexile’ phenotype are distinguished from ‘distentifolium’ by frond morphology, position of sori and response to nutrients. The two phenotypes are controlled by alleles of a single major gene with pleiotropic effects expressed in both gametophyte and sporophyte, the ‘flexile’ morphotype being recessive to ‘distentifolium’. In one natural population the frequency of the recessive allele was about 0.4. The two morphotypes were originally described as separate species but McHaffie and colleagues recommend a taxonomic status not higher than variety.

In *Asplenium hookerianum* Colenso (Aspleniaceae), morphotype ‘hookerianum’ occurs in Australia and New Zealand and is distinguished from the endemic New Zealand morphotype ‘colensoi’ which has consistently narrower pinnules. Stands in New Zealand commonly comprise morphotype ‘hookerianum’ alone or co-occurring with ‘colensoi’; ‘colensoi’ by itself is rare (Perrie & Brownsey, 2005). The two forms were originally described as separate species. Neither nuclear genomic fingerprinting by AFLP nor the chloroplast sequence results separated the specimens according to morphotype. Geographic source accounts for much more of the total DNA-sequence variation than pinnule morphology in both the AFLP data (29% of genetic variation versus 0%) and the chloroplast haplotype data (58% of genetic variation versus 3%; Perrie & Brownsey, 2005). Plants of contrasting morphotype originating from close sites are more similar to each other genetically than to plants of the their own morphotype from distant sites. The phenotypic stability of plants of the two morphotypes even when growing intertwined in the field argues against a major role for environmental variables, and ‘colensoi’ is purported to breed true from spores (Perrie & Brownsey, 2005). It appears probable that morphotypic variation in *Asplenium*, like that in *Athyrium*, results from a simple genetic polymorphism based on allelic variation at a single locus. Perrie & Brownsey (2005) conclude that there is no significant genetic discontinuity between the two morphotypes, and no justification for separating them at
higher than varietal or form rank.

Within *P. aquilinum* in North America, the status of the two eastern taxa now designated subsp. *latiusculum* and subsp. *pseudocaudatum* (Table 1) proved contentious until detailed analyses of morphology and isozyme complements were made by Speer & Hilu (1999) and Speer *et al.* (1999). These taxa are clearly distinct on morphological and distributional grounds (Speer & Hilu, 1999; Thomson *et al.*, 2008). Over their main east-coast range, ‘*latiusculum*’ is more abundant in the northern states, ‘*pseudocaudatum*’ in the south (Speer & Hilu, 1999), with only very few narrow zones of overlap where intermediates suggesting introgression are seen. Detailed isozyme analyses showed unrestricted gene flow between the two morphotypes at one such zone of co-occurrence (Speer *et al.*, 1999). Speer and colleagues postulate that the ‘*latiusculum*’ and ‘*pseudocaudatum*’ phenotypes may be controlled by alternative alleles at a single genetic locus with pleiotropic effects. If the ‘*latiusculum*’ phenotype is dominant and determined by an allele with high frequency in the north of its range, while the recessive allele for the ‘*pseudocaudatum*’ phenotype is at high frequency or fixed in the south, the roughly equal frequencies of the two forms observed in the North Carolina piedmont would correspond to a frequency of about 0.7 for the recessive allele (Speer *et al.*, 1999). Strong selective pressure in relation to environmental features and habitat preference are indicated, with a taxonomic ranking of subspecies for the two morphotypes (Thomson *et al.*, 2008).

**CHARACTERISATION OF GENERALISED ‘AQUILINUM’ AND ‘LATIUSCULUM’ MORPHOTYPES IN *PTERIDUM***

Characters that reflect the relative number, relative size, spacing and shape of laminal segments at blade, pinna, pinnule and pinnulet levels (Thomson, 2000; Thomson *et al.*, 2005; Thomson *et al.*, 2008), are particularly effective in discriminating a ‘*latiusculum*-like group of taxa from an ‘*aquilinum*-like phenotypic group.

**The ‘*aquilinum*’ morphotype:** Blade long, ovate to linear, typically 2-3 times the length of the longest pinna which is generally one of the third to the fifth pair from the lamina base towards the tip. Pinnae, pinnules (and less markedly pinnulets), relatively long and narrow; typically 13-18 pinnules in the basal half of the longest pinna. Pinnae and pinnules commonly inserted on rachis and costa at 70-90°. Frond expansion gradual, progressing from base to apex. Basal 1-2 pinna pairs often marcescent before expansion of the distal pinnae is complete. Frond axes relatively thick and fibrous; dense stands leave heavy, often partially upright, litter in winter that is slow to collapse next season.

**The ‘*latiusculum*’ morphotype:** Blade short, broadly triangular, typically 1-1.5 times the length of the longest pinna which is generally one of the first or second pair from the base towards the tip. Pinnae, pinnules (and less markedly pinnulets) relatively short and broad; typically 6-9 pinnules in the basal half of the longest pinna. Basal segment(s) of each order sometimes much reduced, even vestigial. Pinnae and pinnules commonly inserted on rachis and costa at 45-70°. Frond expansion rapid, often almost synchronous, although progressive from base to apex. Basal pinna pairs not marcescent before frond expansion is complete. Frond axes relatively thin, not heavily fibrous; dense stands leave thin litter in winter that collapses readily next season.

The ovate to linear form of the expanded blade and pinna in ‘*aquilinum*’ morphotypes results from both the shorter length of the lowest pinna and pinnule pair(s) compared with those placed more centrally and the relatively higher number of these
segments on the frond axis and costa respectively. The broadly triangular frond blade and pinna of the ‘latiusculum’ morphotype could be envisaged as derived from the ‘aquilinum’ type by loss of pinna and pinnule pairs from the base of blade and pinna upwards, a process which would at the same time increase the apparent length, relative to more distal segments, of the pinnae/pinnules which thus become the basal or near basal components. Overall the ‘latiusculum’ morphotype appears to reflect adaptation to conditions providing a short growing season.

Where zones of contact or parapatry occur locally, as in Europe (Rumsey et al., 1991; Karlsson, 2000), NE Asia (Tryon, 1941), and Africa (Verdcourt, 2000), recurrent field observations of morphological intermediates provide evidence of recent, probably ongoing, interbreeding between ‘aquilinum’ and ‘latiusculum’ morphotypes. Multi-locus isozyme marker studies also reveal gene flow between multiple genets (Bridges et al., 1998) of subsp. pinetorum in Scotland and local populations of subsp. aquilinum (Rumsey et al., 1991).

DNA fingerprinting using the Arbitrarily Primed Polymerase Chain Reaction (AP-PCR) and Inter Simple Sequence Repeat (ISSR) procedures show that genomic similarity is higher between ‘aquilinum’ and ‘latiusculum’ morphotypes from the same geographic region than either is with morphotypes of its own group from other regions (Thomson et al., 2005; Thomson et al., 2008). Thus subsp. capense and centrali-africanum from sub-Saharan Africa are more similar genomically than capense is to aquilinum of Europe or centrali-africanum is to the N American latiusculum (Thomson et al., 2005; Thomson et al., 2008). Similarly, subsp. pinetorum and aquilinum of Europe share more genomic markers than pinetorum shares with latiusculum of North America (Thomson, 2000; Thomson et al., 2005). Chloroplast genome haplotype for the rps4-trnS region based on presence or absence of one or both of two 5-base direct repeats is not concordant with the ‘aquilinum’ or ‘latiusculum’ morphotypic groupings (Thomson et al., 2005; Thomson et al., 2008). For example, the haplotypes (Type A or B, Thomson et al., 2005) of three geographically contiguous ‘latiusculum’ and ‘aquilinum’ morphotype pairs are: subsp. pinetorum/aquilinum (Europe) respectively Types A and B, subsp. centrali-africanum/capense (Africa) both Type B, and subsp. japonicum/wightianum (NE Asia) both Type A.

These findings provide strong evidence against a taxonomy based on separation of ‘latiusculum’ and ‘aquilinum’ clades (Thomson et al., 2008), and in particular argue against recognition of ‘latiusculum’ or ‘aquilinum’ as reproductively-separated groupings that individually merit full species status. Within Pteridium aquilinum as recognised here (Table 1), reticulate phylogenetic relationships overlie evolutionary trends presumably based on diversification and local adaptation.

**IS THE ‘AQUILINUM’ VERSUS ‘LATIUSCULUM’ DISTINCTON A SIMPLE GENETIC POLYMORPHISM?**

Descriptively, the morphological polymorphisms analysed in Athyrium (McHaffie et al., 2001) and postulated in both Asplenium (Perrie & Brownsey, 2005) and Pteridium (Speer et al., 1999) behave as if based on variant alleles of major genes, with allele frequencies being maintained by balancing selection pressures in particular environments and/or differentially in the gametophyte or sporophyte stage. The contention that the ‘aquilinum’ versus ‘latiusculum’ contrast also represents a genetic polymorphism is supported by distributional data (Table 1), the genetic relationships of the contrasting morphotypes in areas of overlap, and evidence that laminal segment
morphology at frond, pinna, pinnule and even pinnulet levels is hierarchically repetitive and likely to be under control of a common gene or genes with alternative, apparently pleiotropic, alleles. Definitive characterisation of the genetic basis of morphotype in bracken must await integrated breeding and molecular analyses. The loci involved are, however, clearly distinct from those responsible for the small-scale morphological variants often collected and cultivated by growers (see, for example, Andersson, 1927) that are rare in natural populations, with very low allele frequencies maintained by recurrent mutation opposing negative selection (McHaffie et al., 2001).

While for descriptive purposes morphotypic variation in the ferns discussed here may be adequately treated in terms of single locus polymorphisms with pleiotropy, functional and structural molecular analyses of the loci responsible are now required to reveal how the underlying developmental process are controlled. In general, the more numerous and diverse the multiple phenotypic effects involving disparate morphological and physiological characteristics that appear to be under single gene control, the more an explanation invoking pleiotropy becomes questionable. In the present cases we therefore need to consider other possible models of gene structure such as that exemplified by the complex S locus responsible for self-incompatibility (SI)/compatibility (SC) in a number of families of flowering plants such as Brassicaceae. This super-locus provides co-ordinated unitary genetic control over multiple aspects of SI mediated by tightly linked co-adapted sequence segments collectively forming an S haplotype (Charlesworth et al., 2005). Multiple developmental, cellular, physiological and biochemical processes in different S phenotypes are mediated by the alternative S haplotypes represented in polymorphic populations or in different taxa (Bechsgaard et al., 2006; Sherman-Broyles et al., 2007). The several features characterising each S phenotype are controlled by distinct sequence elements and do not involve pleiotropy. Where aspects of phenotype are controlled by a complex super-locus or through a stepwise multigene pathway, multiple mutations may appear as a single event if a mutation acting at an early step blocks expression of accumulated changes effective later in the pathway. If features distinguishing allopatric morphotypes are subject to selection, the allelic variants responsible will be expected to change in frequency more rapidly than ‘neutral’ genomic elements. Phenotypic features under positive selection are likely to become fixed faster than other genomic segments so that the probability of finding DNA sequence markers correlating with morphotype is expected to be low, increasing with the time of separation of the contrasting forms. In Asplenium, Perrie & Brownsey (2005) found that neither AFLP fingerprinting of the nuclear genome nor chloroplast sequence data grouped the plants analysed according to their morphotype. In Pteridium, Thomson (2000) identified markers detected by AP-PCR that are specific to subsp. wightianum (as P. revolutum) and other markers that are specific to subsp. capense [misnamed by Thomson (2000) as P. aquilinum var. africanum; see Thomson et al., 2005]. These major markers are in both cases restricted in occurrence to geographically localised taxa here regarded as of subspecific status, and neither is shared by other ‘aquilinum’ morphotypes. Distinctive alleles, supergene haplotypes and/or modified dominance relations may account for the ‘intermediate’ morphotype of subsp decompositum (Table 1) in which genomic elements of both subsp. japonicum (‘latiusculum’) and subsp. wightianum (‘aquilinum’) are present (Thomson, 2000).
CONCLUSIONS

In most taxonomic investigations of ferns, especially where multiple taxa must be considered, controlled breeding experiments of the kind so admirably applied in *Athyrium* (McHaffie et al., 2001) are not practicable. More widely feasible are genomic comparisons based on methodologies such as AP-PCR (RAPD), AFLP, ISSR, or microsatellite analyses. If plants of taxon A from locality 1 are more closely related genetically to plants of taxon B from locality 1 than to taxon A plants from localities 2...n, and/or a comparable situation holds for the relationships of taxon B, there is *prima facie* evidence of recent and/or ongoing gene flow between the taxa that is likely to be inconsistent with the degree of reproductive isolation normally associated with full specific status. Rather, such a situation strongly suggests that the taxa concerned should be accorded infraspecific rank, for example as subspecies, varieties, or forms (Perrie & Brownsey, 2005; Thomson et al., 2008).

The work of McHaffie and colleagues on the ‘distentifolium’/‘flexile’ polymorphism in *Athyrium* represents an extraordinary contribution to our understanding of fern morphogenetics by showing how morphological and physiological studies of the gametophyte as well as the sporophyte may reveal at these two life stages ‘antagonistic pleiotropy’ (Shaw, 2001) that determines allele frequencies in natural populations through otherwise unsuspected opposing positive and negative selective pressures. However, as pointed out above, questions remain open regarding the structure of the genetic loci involved in the control of fern morphotype, and thus on the strict applicability of the term pleiotropy in these cases.

*P. aquilinum* appears at present to be best treated as a single species containing 11 subspecies as listed in Table 1. Further morphometric and genetic studies are needed to clarify the status of a number of named taxa described from many parts of Eurasia which on present evidence should, if named, be ascribed varietal, form or ecotype rankings (Stace, 1997).

ACKNOWLEDGEMENTS

I thank Elizabeth Brown (NSW) and Barbara Parris (Fern Research Foundation, Kerikeri) for helpful discussion and comments. Miguel Garcia (NSW) provided generous library assistance. I am indebted to Paul Wolf (Utah State University) for a constructive critical review leading to substantial improvement of the final manuscript.

REFERENCES


FRASER-JENKINS, C. R. 1997. New species syndrome in Indian pteridology and the


BOOK REVIEW


Wide ranging titles such as this usually mean a book will be a ‘Jack of all subjects’ and master of none, so you can imagine the pleasant surprise I had on dipping into it. Ferns are indeed a relatively minor part filling fewer than 100 pages but the coverage is more comprehensive than given in many field handbooks.

Apart from a couple of prefaces there are no introductory chapters. The books start straight away with the dichotomous keys. At the end there is a glossary and bibliography.

None but the most well read specialist will be familiar with all the taxa described here. Recently discovered species and subspecies are included. There are no lengthy field notes, details are precise and to the point. Most species are covered with fewer than four lines of text. Distribution is given by country or island within Europe and more briefly outside of Europe. As with the rest of the book the entire fern section is a generously annotated dichotomous key. The key is supported by many line drawings which work well for the well defined species but by the time you get down to the really critical taxa they are not so helpful. I looked long and hard at one sketch of the base of the lowermost pinna of Gymnocarpium robertianum but I still cannot work it out!

The fern tourist venturing anywhere in Europe, be it the Azores, Crete, Cape Verde, Madeira, Russia or closer to home will find all the local fern species covered. A few hybrids are also mentioned although the criteria for their inclusion is obscure to me. For example the very rare Aspelnium x heufleri is in the key but many others, such as A. x sarniense, are not.

I can think of no other up to date book covering all the ferns of Europe. Remy Prelli’s Les fougeres et plantes allies de France et d’Europe occidentale has a more restricted range. Where the two overlap I suggest the Prelli book will be the more user friendly even though it is in French. For full coverage of Europe in one go, however, this guide is a useful volume.

Martin Rickard
BOOK REVIEW


The editors of this new book have taken up the challenge of presenting the reader with the major research developments that have taken place over the last 10 years that contribute to the current understanding of the biology of ferns and lycophytes. To achieve this goal they have brought together the work of some 28 contributors all active in research, mainly from USA but also from Canada, Europe and Japan.

The subject areas are diverse. The first section on development and morphogenesis starts with the gametophyte and alternation of generations, before exploring the structure of meristems and subsequent diversification into the various organs – root, stems and leaves. The next section deals with genetics and reproduction, including chapters on the role of antheridogens, breeding systems, and the chloroplast and nuclear genomes. Ecology is a complex discipline in itself, and the focus here is on phenology and habitat specificity in tropical ferns, the ecology of gametophytes and a review of conservation biology. The final section, systematics and evolutionary biology, includes a review of the evolution of ferns and fern-like plants from the fossil record, a chapter on species and speciation, exploration of diversity, biogeography and floristics, and ending with phylogeny and classification.

Each chapter presents a personal review of the subject by its author(s), with summaries of discoveries and developments, explanations of concepts and ending with a section on prospects for the future - all supported by an extensive list of references.

This is a scholarly work, clearly aimed at the undergraduate student market, and I can see it being added to the essential reading list for many courses in plant evolutionary biology. But it is more than being a standard undergraduate textbook and with such a wide variety of topics covered, there will be sections to interest a variety of general readers and particularly for those with a fascination for fern biology. It is good to see that it available as a more modestly priced paperback as well in hardback format.

Mary Gibby
INSTRUCTIONS FOR AUTHORS

PAPERS should not usually exceed 20 printed pages and are generally expected to be considerably shorter. Review articles, as well as reports of original research, are encouraged. Short notes are acceptable e.g. new records. The senior author should supply a fax and email address to facilitate correspondence.

MANUSCRIPTS should be submitted in English (British) in electronic format (preferably) or hard copy (two copies), in 10-point Times New Roman font and double spaced. Electronic versions of text and tables should be compatible with WORD, with figures as pdf or jpg files, and sent as email attachments or CDroms. All manuscripts will be refereed.

THE TITLE should reflect the content of the paper and be in BOLD CAPITALS (11-point) and centrally aligned. Generic and specific names should be in italics and any title containing a generic or specific name must be followed by the family and Pteridophyta in brackets e.g.

TRICHOMANES SPECIOSUM (HYMENOPHYLLACEAE: PTERIDOPHYTA) IN SOUTHERN SPAIN


MAIN HEADINGS: should be in BOLD CAPITALS (10-point) and centrally aligned.

SUBSIDIARY HEADINGS: should be in bold, the first letter of each word in capitals, the rest in lower case and left-aligned.

AUTHORS' NAMES AND FULL ADDRESSES: follow the title and are centrally aligned.

KEY WORDS: up to ten.

ABSTRACT: should reflect the content of the paper.

FIGURES: there is no distinction between photographs and line drawings in numbering. All should be presented in a form ready for reproduction, ideally in JPG format (please contact editor with queries), with a scale bar where appropriate. Lettering or numbers (Arabic) should be in the bottom left using uppercase Times Roman and be sufficiently large to be legible if reduction is necessary during printing. The number of photographs allowed in any one issue is limited by cost. Figure captions should be on a separate sheet.

TABLES: can be printed in either portrait or landscape format. Authors should consider this when preparing tables. Authors should ensure that tables fit the printed page size in a legible form.

MEASUREMENTS: should follow the metric system.

CHECKLISTS: should follow the format of Baksh-Comeau, Fern Gaz. 16(1, 2): 11-122.

REFERENCES: should follow the style of a recent issue of The Fern Gazette, e.g.:-


JOURNAL ABBREVIATIONS: should follow Botanico Periodicum Huntianum & Supplements.

Alterations from the original text at proof stage will be charged for unless they are minor points of detail. Twenty-five offprints will be supplied free to the senior author.
This page is intentionally blank
This page is intentionally blank
This page is intentionally blank
This page is intentionally blank
AN ANNOTATED CHECKLIST OF THE MONILOPHYTES (FERNS)
AND LYCOPHYTES OF EL SALVADOR

J. MONTERROSA1 & A. K. MONRO2

1Herbario LAGU, Asociación Jardín Botánico La Laguna, Urbanización Industrial
Plan de La Laguna, Antiguo Cuscatlán, apartado postal 1197CG
Email: jorgemonterrosa@jardinbotanico.org.sv

2Botany Department, The Natural History Museum, London SW7 5BD, U.K.
Email: a.monro@nhm.ac.uk

Key words: checklist, El Salvador, pteridophytes, monilophytes, lycophytes, ferns,
Central America

ABSTRACT
We report a total of 397 species, 89 genera and 28 monilophyte and lycophyte
families for El Salvador. 29 of these are new records for the country and we have
excluded 28 previous records. We summarise the extent of collecting within El
Salvador and list the major collectors for the country. For each record, the local
name, herbarium collections (verifiable biodiversity data), distribution within El
Salvador and conservation status (where assessed) are given. This study is the
result of a literature review and a review of 6397 herbarium specimens at BM,
F, ITIC, LAGU, MHES and NY.

RESUMEN
Se reportan un total de 397 especies, 89 generos y 28 familias de monilophyte y
lycophyte para El Salvador. 29 de estas son nuevos registros para el país
y hemos excluido 28 registros anteriores. Se explican como el alcance de las
colectas en El Salvador y se listan los principales colectores para el país. Para
cada registro, nombre común, muestras de herbario (datos de biodiversidad
verificable), Distribución dentro de El Salvador y estado de conservación (dónde
se evalúa) son dados. Este estudio es el resultado de una revisión de la literatura
y 6397 muestras de herbario de BM, F, ITIC, LAGU, MHES and NY.

INTRODUCTION
El Salvador is located on the Pacific coast of Central America and covers 21,000 km².
It has a population of 6.9 million (The World Bank Group, 2007), making it the most
densely populated country in Latin America. It is also, by far, the most deforested
country in continental Central and South America. Holdridge (1975) estimated that
99.5% of El Salvador would have been forested prior to human occupation. The vast
majority of the country’s biodiversity including ferns, would have been associated with
that forest cover. In 2001 a forest survey of the country based on sattelite data estimated
undisturbed natural forest cover to be 7% (Ventura & Villacorta, 2001). The loss of so
much natural forest suggests that a huge proportion of El Salvador’s fern diversity is at
risk. Conservation tools such as checklists and identification guides are therefore of
critical importance since they enable the accurate identification and monitoring of
diversity. A fact recognised by El Salvador in the Estrategia Nacional de Biodiversidad
Past studies of the Salvadoran Pteridophyte flora

Ferns represent one of the most studied groups of organisms in El Salvador. The first study of Salvadoran ferns was undertaken in 1930 by Maxon & Standley, *Ferns of the Republic of Salvador*. This was based on the collections of Standley and listed 87 species for the country. In 1941 Calderón & Standley published the *Lista Preliminar de Plantas de El Salvador* (Preliminary list of the plants of El Salvador) which included 97 species. Thirteen years later Löetschert (1954), based at the ITIC herbarium of the University of El Salvador, published *Nuevas Pteridofitas para El Salvador* (New pteridophytes for El Salvador) in which 75 new records were included, bringing the total number of species to 172. In 1982, Ralph Seiler, a US Peace Corp worker based at the Museo de Historia Natural de El Salvador (MHES) from 1980 to 1982, published *Contribuciones a la Pteridología Centroamericana* (Contributions to Central American Pteridology) in which he recognised 316 species for El Salvador. This was based on a combination of his own collections (denoted by a ‘*’ in Seiler, 1982) and those that he studied at ITIC. Towards the end of the 1980’s Pfeiffer-Berendsohn, published *Listado Básico de la Flora Salvadorensis. Pteridophyta. Cuscatlania 1(1)*. This was based on the PLANTAS collections database of the research section of the Jardín Botánico La Laguna and listed 346 species for the country. This number was reduced with the publication of *Flora Mesoamericana* (Volume 1: Psilotaceae to Salviniaceae, Davidse et al.) in 1995. *Flora Mesoamericana* recorded 304 species for El Salvador although the collections at LAGU and ITIC were not consulted.

**MATERIALS AND METHODS**

The checklist is based on an inventory of the fern collections at BM, F, ITIC, LAGU, MHES and NY. All material was critically studied using the following reference works: *Listado Básico de la Flora Salvadorensis. Pteridophyta. Cuscatlania 1(1)* (Berendsohn, W. G., 1989); ‘The Pteridophytes of Mexico’ (Mickel & Smith, 2004); and *Flora Mesoamericana Volume 1* (Davidse et al., 1995). In additions colleagues in Costa Rica and Mexico (Alexander Rojas Alvarado, Jardín Botánico de Lankaster, Costa Rica y Daniel Tejero-Diez, Universidad Nacional Autónoma de Mexico, Iztacala, Mexico) were contacted where there were doubts over the identification of a species. In total 6397 collections were examined: 1329 at BM, 931 at F, 523 at ITIC, 1523 at LAGU, 992 at MHES and 1099 at NY.

Species were considered as being part of the Salvadoran flora where a herbarium collection of known Salvadoran origin was seen by the authors, or where a species was cited in one of the publications listed in Table 1 and referenced to a herbarium collection. Species records published elsewhere, or where cited in a publication in Table 1 but not referenced to a herbarium collection (or where the identification resulting in a citation was incorrect) were excluded. Of the species that met the above criteria for inclusion in the checklist some were excluded where a herbarium collection was based on cultivated material. Examples of other species that were excluded from the checklist are: *Athyrium dombei* Desv., a species described from Peru and whose citation for El Salvador is known only from Seiler (1982) but was not based on any herbarium material from El Salvador; and *Asplenium castanum* Schlecht. & Cham. (C.D. Adams, 1995)
whose citation was based on the misidentification of a Salvadoran collection (Seiler 160, F) of *Asplenium polyphyllum* Bertol.

Where species were cited in one of the publications but no specimens were seen by these authors, this is indicated in the checklist by the symbol: ‘▸’. Species were considered new records where that species, or its basionym / synonym had not been cited as occurring in El Salvador in a previous floristic publication encompassing the country (see Table 1). Such species are indicated in the checklist by the symbol ‘♦♦’.

The classification of ferns used in this study follows Smith et al. (2006).

**RESULTS**

A total of 397 species, 89 genera and 28 pteridophyte families are reported for El Salvador (summarized in Table 3). This compares with previous estimates ranging from 87 to 346 (Maxon & Standley, 1930; Calderón & Standley, 1940; Löetschert, 1954; Seiler, 1982; Berendsohn, 1989; Davidse et al., 1995). The records are listed below. 25 of these are new records for the country and we have excluded 28 previous records. Only two species are endemic to El Salvador: *Elaphoglossum microproductum* A. Rojas (known only from the type collection) and *Anemia salvadorensis* Mickel.

**New records for El Salvador**

29 new records were encountered during the course of this work. They are indicated by the symbol ‘♦♦’ preceding the taxon name in Appendix 1.

- *Asplenium cristatum* Lam.
- *Asplenium monodon* Liebm.
- *Asplenium theciferum* (Kunth) Mett.
- *Bolbitis bernoullii* (Kuhn ex Christ) Ching
- *Ctenitis equestris var. erosa* Stolze
- *Dennstaedtia globulifera* (Poir.) Hieron.
- *Dennstaedtia spinosa* Mickel
- *Diplazium drepanolobium* A.R. Sm.
- *Elaphoglossum lonchophyllum* (Fée) T. Moore
- *Elaphoglossum minutum* (Pohl ex Fée) T. Moore
- *Hymenophyllum crispum* Kunth
- *Lastreopsis effusa* subsp. *divergens* (Willd.) Tindale
- *Megalastrum pulverulentum* (Poir.) A. R. Sm. & R. C. Moran
- *Ofersia cervina* (L.) Kunze
- *Pityrogramma ochracea* (C. Presl) Domin
- *Polypodium diplotrichum* Mickel & Beitel
- *Polypodium thyssanolepis* A. Braun ex Klotzsch
- *Polystichum muenchi* (Christ) C. Chr.
- *Psilotum nudum* (L.) P. Beauv.
- *Pteris erosa* Mickel & Beitel
- *Terpsichore delicatula* (M. Martens & Galeotti) A. R. Sm.
- *Thelypteris angustifolia* (Willd.) Proctor
- *Thelypteris linkiana* (C. Presl) R.M. Tryon
- *Thelypteris oblirata* (Sw.) Proctor
- *Thelypteris serrata* (Cav.) Alston
Thelypteris standleyi (Maxon & C. V. Morton) R. M. Tryon
Trichomanes hymenophylloides Bosch
Vittaria bradeorum Rosenst.

Species excluded from the checklist

Asplenium auritum Sw. var. auritum
The only record of this species (Seiler, 1982) is an incorrectly identified collection of Asplenium monodon Liebm. (Seiler 466, MUHNES).

Asplenium castaneum Schlecht. & Cham.
The only record of this species (Adams, 1995), is an incorrectly identified collection of Asplenium polyphyllum Bertol. (Seiler 160, F).

Asplenium hastatum Klotsch ex Kunze
Seiler (1982) referred to the presence of this species in El Salvador, but referred to its presence as dubious because he had not seen a collection from the country. No collections of this species were located by Monterrosa & Monro.

Asplenium otites Link
Seiler (1982) reported this species for El Salvador. No specimens or additional citations associating this species to El Salvador were encountered and reports of this species from Mesoamerica as a whole are uncertain (Adams, 1995; Mickel & Smith, 2004).

Asplenium radicans L.
Seiler (1982) reported Asplenium radicans var. partitum for El Salvador. This variety has since been placed in synonymy with A. flabellulatum. (Adams, 1995).

Asplenium rigidum Sw.
This species was reported from El Salvador (Adams, 1995) based on misidentified material (see Mickel & Smith 2004: 90, under discussion for Asplenium cuspidatum Lam.). No collections of this species from El Salvador have been located.

Athyrium dombei Desv.
This species was reported from El Salvador (Adams, 1995) based on misidentified material (see Mickel & Smith 2004: 137 under discussion for Athyrium bourgeaui E. Fourn.). No collections of this species from El Salvador have been located.

Dennstaedtia dissecta (Sw.) T. Moore
This species is restricted to the Greater Antilles, Costa Rica, Panama and the Andes (Navarrete & Øllgaard, 2000). It is likely that Seiler (1982) mistakenly identified material of Dennstaedtia cornuta (Kaulf.) Mett., which was previously treated as conspecific to D. dissecta (see discussion of D. cornuta in Mickel & Smith, 2004).

Elaphoglossum firmum (Mett.) Urb.
Seiler (1982) referred to the presence of this species in El Salvador as dubious because he had not seen a collection from the country. No collections of this species were located by Monterrosa & Monro.

Elaphoglossum formosum (M. Martens & Galeotti) Urb.
Seiler (1982) referred to the presence of this species in El Salvador as dubious because he had not seen a collection from the country. No collections of this species were located by Monterrosa & Monro.

Elaphoglossum longifolium (Jacq.) J. Sm.
Seiler (1982) referred to the presence of this species in El Salvador as dubious because he had not seen a collection from the country. No collections of this species were located by Monterrosa & Monro.

Elaphoglossum pilosum (Humb. & Bonpl. ex Willd) T. Moore
Seiler (1982) referred to the presence of this species in El Salvador as dubious because he had not seen a collection from the country. No collections of this species were located by Monterrosa & Monro.

**Elaphoglossum revolvens** (Kunze) C. Chr.
Seiler (1982) referred to the presence of this species in El Salvador as dubious because he had not seen a collection from the country. No collections of this species were located by Monterrosa & Monro.

**Elaphoglossum rigidum** (Aubl.) Urban
Although Stolze (1981) reported this species (as a synonym of *E. flaccidum*) from El Salvador, Guatemala and Mexico, Mickel & Smith 2004 do not recognize this species from Mexico and Mickel in Davidse et al. (1995) treats *E. flaccidum* as native to South America.

**Grammitis heteromorpha** (Hook. & Grev.) C. V. Morton
Seiler (1982) referred to the presence of this species in El Salvador as dubious because he did not see a collection from the country. No collections of this species were located by Monterrosa & Monro. In addition, Mickel & Smith (2004) state that *G. heteromorpha* is restricted to the Andes.

**Grammitis meridensis** (Klotzsch) F. Seym.
Seiler (1982) referred to the presence of this species in El Salvador, but referred to its presence as dubious because he had not seen a collection from the country. No collections of this species were located by Monterrosa & Monro.

**Huperzia mexicana** (Herter) Holub
Seiler (1982) referred to the presence of this species in El Salvador, but referred to its presence as dubious because he had not seen a collection from the country. No collections of this species were located by Monterrosa & Monro.

**Huperzia verticillata** (L.f) Trevis.
Seiler (1982) referred to the presence of this species in El Salvador, but referred to its presence as dubious because he had not seen a collection from the country. No collections of this species were located by Monterrosa & Monro.

**Lellingeria delitescens** (Maxon) A. R. Sm. & R. C. Moran
Seiler (1982) referred to the presence of this species in El Salvador, but referred to its presence as dubious because he had not seen a collection from the country. No collections of this species were located by Monterrosa & Monro.

**Notholaena affinis** (Mett.) Hook. ex T. Moore
The only record of this species (**Seiler 88**, MHES, NY; Seiler, 1982) is an incorrectly identified collection of *Notholaena meridionalis* Mickel.

**Polypodium arcanum** Maxon
Seiler (1982) referred to the presence of this species in El Salvador, but referred to its presence as dubious because he had not seen a collection from the country. No collections of this species were located by Monterrosa & Monro.

**Polypodium montigenum** Maxon
Seiler (1982) referred to the presence of this species in El Salvador but did not cite a collection. No collections of this species were located by Monterrosa & Monro and it is possible that Seiler incorrectly identified a collection of *Polypodium alansmithii* R. C. Moran as *P. montigenum*.

**Polypodium ptllorrhizon** Christ
This species was reported in El Salvador by Seiler (1982) and Berendsohn (1989) and is based on a misidentification by Seiler (1982).
Polystichum ordinatum (Kunze) Liebm.
Maxon & Standley (1930) and later Calderón & Standley (1941) reported this species from El Salvador. Seiler (1982) referred to the presence of this species in El Salvador as dubious because he did not see a collection from the country. No collections of this species were located by Monterrosa & Monro.

Pteris pulchra Schltdl. & Cham.
Maxon & Standley (1930) reported this species as present in El Salvador. Seiler (1982) referred to the presence of this species in El Salvador as dubious because he did not see a collection from the country. No collections of this species were located by Monterrosa & Monro.

Pteris polita Link.
Seiler (1982) cites Pteris polita as present in El Salvador based on the misidentification of material of Pteris orizaba.

Thelypteris opposita (Vahl) Ching
Seiler (1982) cites Thelypteris opposita as present in El Salvador on the misidentification of material of Thelypteris balbisii (Spreng.) Ching and T. resinifera (Desv.) Proctor.

Vittaria lineata (L.) J. Sm.
Calderón & Standley (1941) reported this species as present in El Salvador. Seiler (1982) referred to the presence of this species in El Salvador as dubious because he did not see a collection from the country. No collections of this species were located by Monterrosa & Monro.

Uses
Marattia and Equisetum have documented (Pers. Obs.) medicinal uses: Marattia excavate as a contraceptive; Equisetum giganteum and E. myriochaetum as diuretics and hypoglycaemics and Equisetum species “cola de caballo” are commonly sold in local markets for these properties (Pers. Obs.). Polypodium pleurosorum “calaguala” is also sold as a medicinal plant, however the purported properties are unknown. Cyathea divergens, Nephrolepis spp. “cola de ardilla” and Polypodium pleurosorum are used as ornamentals in gardens and landscaping and the stems of Cyathea species are sold as a growing medium for the cultivation of orchids. No other uses are known for Salvadoran ferns.

Table 1. State-wise distribution of fern species records based on collections at LAGU.

<table>
<thead>
<tr>
<th>State</th>
<th># State records</th>
<th>State</th>
<th># State records</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ahuachapán</td>
<td>141</td>
<td>San Miguel</td>
<td>34</td>
</tr>
<tr>
<td>Cabañas</td>
<td>24</td>
<td>San Salvador</td>
<td>107</td>
</tr>
<tr>
<td>Chalatenango</td>
<td>142</td>
<td>San Vicente</td>
<td>46</td>
</tr>
<tr>
<td>Cuscatlán</td>
<td>10</td>
<td>Santa Ana</td>
<td>236</td>
</tr>
<tr>
<td>La Libertad</td>
<td>71</td>
<td>Sonsonate</td>
<td>87</td>
</tr>
<tr>
<td>La Paz</td>
<td>12</td>
<td>Usulután</td>
<td>47</td>
</tr>
<tr>
<td>Morazán</td>
<td>122</td>
<td>Total</td>
<td>952</td>
</tr>
</tbody>
</table>
Also of economic significance is the invasive species *Pteridium aquilinum* var. *feei* (bracken) that has been responsible for the poisoning of cattle throughout the country (Ministerio de Agricultura y Ganaderia, Pers. Comm., 2005).

**Locality distribution data within El Salvador**

Species records for a locality are the product of species distribution and sampling effort, with differences in the number of species records from one state to the next not necessarily reflecting differences in fern diversity or sampling effort. Combined with knowledge of the geography and vegetation of a country and collecting effort as indicated by herbarium records, however, they can be used to give an indication of both variation in sampling effort and diversity.

Analysis of the 1523 collections held at LAGU indicates that sampling effort has been very uneven in El Salvador - Santa Ana, Ahuachapán, Chalatenango and Morazán accounting for ca 75% of species-records whilst Cuscatlan and La Paz account for just 1.7% of records. In part this correlates with the expected distribution of fern diversity based on altitudinal gradients in these states. The unevenness of the records is, however, much greater than would be expected from altitudinal gradients and it appears that there has been collecting bias. Most likely collection effort has been focused on protected areas: the cloud forest of reserve of Montecristo (Santa Ana), the lowland tropical moist forest reserve of El Imposible (Ahuachapán), El Pital (Chalatenango) and the Río Sapo oak and pine forest reserve (Morazán). This also corresponds with the authors’ own knowledge of collecting effort. A future collection program focussing on the states with the fewest species records (Cuscatlan, La Paz, Cabañas, San Vicente and San Miguel) and agricultural (e.g. shade coffee farms) and private land would be expected to provide valuable baseline data essential for the conservation of ferns in El Salvador.

**Principal collectors and collections**

The principle collectors of ferns in El Salvador have been William Lötscher (also known as Loetschert, first set of collections at ITIC), William Maxon (first set of collections at US), Paul Standley (main sets of collections at US and F), Calderón (main sets of collections at US), John Tucker (first set of collections at DAV), Antonio Molina R. (first set of collections at EAP), Norman Fasset (first set of collections at WIS), Louis Williams (first set of collections at F) and Margery Carlson (first set of collections at MIES and F).

**DISCUSSION**

*El Salvador’s fern diversity in a national context*

Ferns are one the best studied groups of organisms in El Salvador, alongside birds and reptiles. The first checklist to the ferns of the country dates to the 1920s and several have followed (see introduction). This comparatively strong knowledge of the fern flora of El Salvador makes ferns a good candidate for developing national inventory protocols and conservation strategies that will contribute to El Salvador’s commitment to the Global Strategy for Plant Conservation (2002). A Darwin Initiative project initiated in 2006 with the Ministerio de Medio Ambiente y Recursos Naturales (Ministry of the Environment and Natural Resources), ‘Tools and training for fern conservation and monitoring (El Salvador)’, seeks to do exactly this and use ferns to develop a country-wide monitoring strategy that can subsequently be applied to other groups of organisms.
Fern species-records for Salvadoran ferns are very unevenly distributed between states, indicating an apparent sampling bias towards the country’s national parks and against private land and ‘disturbed’ vegetation (secondary forest, agroforest, small forest fragments). The relatively poorly sampled disturbed vegetation represents the greater part of the El Salvador’s forest cover (19% versus 7%) and further sampling in this areas should generate many new species-records at the state and possibly national level. As an example of this potential, an inventory of the ferns growing within 27 shade coffee farms enumerated 38 fern species (Monro et al., 2002) and accounts for a significant proportion of the fern records for the state of Cabañas. It should therefore be seen as a priority to sample such areas.

The economic importance of ferns to El Salvador although yet to be evaluated, is likely to be minimal and restricted to medicinal and ornamental uses and the toxicity of the invasive *Pteridium aquilinum*.

**El Salvador’s fern diversity in a regional context**

El Salvador has relatively high species diversity per km$^2$ compared with the neighbouring countries of Central America. This is possibly a sampling artifact, El Salvador having been more intensively collected for ferns than other countries in Central America. Although the most active collectors of ferns in El Salvador expended greater collecting effort in Guatemala, Guatemala has a greater area - over five times the size of El Salvador. El Salvador’s high fern diversity could also be ascribed to its large altitudinal variation (2418 m) and variation in rainfall across the country (1100-1700 mm pa), for its size. The transition from the dry coastal lowlands to the wetter highlands inland, combined with the presence of a number of isolated volcanic peaks that reach altitudes greater than 1700 m (Santa Ana, Coatepeque, Apaneca, Izalco, San Salvador, Ilopango, San Miguel, San Vicente, Tecapa and Conchagua) has resulted in a great diversity of forest and non-forest habitat types (Ventura et al., 2001) at altitudes associated with high fern diversity elsewhere (Kluge et al., 2006), many of which are isolated from each other. Kluge et al. (2006), studying fern diversity along an altitudinal gradient in Costa Rica found that fern diversity peaked at mid-elevations (ca 1700 m) and that the mid-domain position together with humidity and temperature were the most powerful explanatory variables species diversity. It may be that a combination of the relative frequency of mid-domain positions in volcano-dominated landscapes is high and that this, combined with a relatively steep rainfall gradient across the landscapes contributes to the relatively high diversity of ferns in El Savador.

As is the case for Neotropical ferns in general the level of endemism is very low at ca 0.5% of the species.

**Table 2.** Current estimates of fern diversity for Central America.

<table>
<thead>
<tr>
<th>Country</th>
<th>Fern diversity (source)</th>
<th>Surface area km$^2$</th>
<th>Altitudinal range (m)</th>
<th>Spp. per 1000 km$^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belize</td>
<td>234 (Balick et al. 2000)</td>
<td>22,960</td>
<td>1124</td>
<td>11.9</td>
</tr>
<tr>
<td>El Salvador</td>
<td>397 (this article)</td>
<td>21,000</td>
<td>2418</td>
<td>18.9</td>
</tr>
<tr>
<td>Costa Rica</td>
<td>1112 (Hammel et al., 2004)</td>
<td>51,100</td>
<td>3810</td>
<td>21.7</td>
</tr>
<tr>
<td>Panama</td>
<td>938 (Correa et al., 2004)</td>
<td>75,520</td>
<td>3475</td>
<td>12.4</td>
</tr>
</tbody>
</table>
BIBLIOGRAPHY


**ACKNOWLEDGEMENTS**

We would like to thanks the curators at BM, F, ITIC, LAGU, MHES and NY for providing access to the collections. In particular we would like to thank Alison Paul (BM) for help with the identification of some of the material at BM, Robbin Moran and John Mickel (NY) for their hospitality and kind help in the identification of material whilst at NY, José Daniel Tejero-Díez of the Faculty of Iztacala (UNAM) for the revision of the checklist and help with the nomenclature of a number of *Polypodium*
names, Alan Smith (UC) for his kind help in the identification of material of *Thelypteris*, David Barrington (VT) for his kind help in the identification of material of *Polystichum* and Alexander Rojas Alvarado (Lankester Botanic Garden) for his help with the identification of *Cyathea* and *Elaphoglossum* collections. We would also like to thank the Association La Laguna Botanic Garden for permission to undertake this research and access to the PLANTAS database and Gerrit Davidse and Jim Solomon at MO for providing a dump of Salvadoran fern records in TROPICOS. Jorge Monterrosa benefited from a Darwin Scholar Programme Award (No. EIDPS7), was able to visit F as part of Darwin Initiative project 640/15/015 and was able to visit NY as part of the Norwegian Agency for Development Cooperation project “Desarrollando Capacidades y Compartiendo Tecnología para la Gestión de la Biodiversidad en Centroamérica” through The Natural History Museum of El Salvador (MHES). We would also like to thank Harald Schneider and Bob Press (BM) for their comments on earlier drafts of this manuscript.

APPENDIX 1. CHECKLIST OF THE MONILOPHYTES (FERNS) AND LYCOPHYTES OF EL SALVADOR
Ferns or monilophytes are arranged by family in alphabetical order following Smith et al. (2006) assignment of genera to family. Lycophytes are arranged by family in alphabetical order following the assignment of genera to family of *Flora Mesoamericana* (Davidse et al., 1995).

Conspicuus of the monilophytes and lycophytes of El Salvador (see pages 131-132)

New records for El Salvador are indicated by “♦”. Endemic species are indicated by “z”. Species for which no collections have been seen but where we are confident of their inclusion by previous authors (see Table 1) are indicated by “X”.

DIVISION LYPHYTA
LYCOPODIACEAE

*Global distribution*: Mexico, Guatemala.

*Lycopodium dichotomum* Jacq., *Urostachys dichotomus* (Jacq.) Herter . Local name: candelillo.
*Global distribution*: USA, Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, French Guyana, Peru, Brazil, Bolivia, Paraguay.
*Salvadoran distribution*: Ahuachapán: Arana s.n. (JBL04315) (LAGU); R. Villacorta et al. 908 (B, LAGU, MO); W. Berendsohn & M. Sandoval 1634 (LAGU). Chalatenango: H. Sipman et al. s.n. (JBL02486) (LAGU).
TABLE 3. Conspectus of the monilophytes and lycophytes of El Salvador.

<table>
<thead>
<tr>
<th>Division</th>
<th>Class</th>
<th>Order</th>
<th>Family</th>
<th>Genus</th>
<th>Spec.</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIVISION</td>
<td>LYCOPSIDA</td>
<td>Lycopodiaceae</td>
<td>Huperzia</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>Lycopodiales</td>
<td>Lycopodiaceae</td>
<td>Lycopodiella</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lycopodiaceae</td>
<td>Lycopodium</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Selaginellales</td>
<td>Selaginellaceae</td>
<td>Selaginella</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>DIVISION</td>
<td>Lycopodiaceae</td>
<td>Huperzia</td>
<td>Botrychium</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>EUPHYLLOPHYTA</td>
<td>Ophioglossales</td>
<td>Ophioglossaceae</td>
<td>Ophioglossum</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Ophioglosales</td>
<td>Ophioglossaceae</td>
<td>Psilotum</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Psilotales</td>
<td>Psilotaceae</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SELAGINELLACEAE</td>
<td>Selaginellales</td>
<td>Selaginellaceae</td>
<td>Selaginella</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>EQUISETOPSIDA</td>
<td>Equisetales</td>
<td>Equisetaceae</td>
<td>Equisetum</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>EQUISETOPSIDA</td>
<td>Equisetales</td>
<td>Equisetaceae</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equisetales</td>
<td>Equisetaceae</td>
<td>Equisetum</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MARATTIOPSIDA</td>
<td>Marattiales</td>
<td>Marattiaceae</td>
<td>Marattia</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Marattiales</td>
<td>Marattiaceae</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hymenophyllales</td>
<td>Hymenophyllaceae</td>
<td>Hymenophyllum</td>
<td>Hymenophyllum</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Hymenophyllales</td>
<td>Hymenophyllaceae</td>
<td>Trichomanes</td>
<td>9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Osmundales</td>
<td>Osmundaceae</td>
<td>Osmunda</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Osmundales</td>
<td>Osmundaceae</td>
<td>Osmunda</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PSILOTOPSIDA</td>
<td>Ophioglossae</td>
<td>Ophioglossaceae</td>
<td>Ophioglossum</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>GLEICHENIALES</td>
<td>Ophioglossaceae</td>
<td>Psilotum</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GLEICHENIALES</td>
<td>Ophioglossaceae</td>
<td>Psilotum</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GLEICHENIALES</td>
<td>Ophioglossaceae</td>
<td>Psilotum</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DIACRONOTERIS</td>
<td>Diacronotera</td>
<td>Diacronotera</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DIPLOPETYRIUM</td>
<td>Diplopterygium</td>
<td>Diplopterygium</td>
<td>Diplopterygium</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>GLEICHENELLA</td>
<td>Gleichenella</td>
<td>Gleichenella</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STICHERUS</td>
<td>Sticherus</td>
<td>Sticherus</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HYPOMORPHIS</td>
<td>Hypomorpha</td>
<td>Hypomorpha</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LYMNOPTERIS</td>
<td>Lymnoptera</td>
<td>Lymnoptera</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DIPLOPTERIS</td>
<td>Diplopterus</td>
<td>Diplopterus</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>POLYPODIOPSIDA</td>
<td>Marattiales</td>
<td>Marattiaceae</td>
<td>Marattia</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Schizaeas</td>
<td>Lygodiaceae</td>
<td>Lygodium</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schizaeas</td>
<td>Lygodiaceae</td>
<td>Lygodium</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anemiaceae</td>
<td>Anemia</td>
<td>Anemia</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salviniales</td>
<td>Marsileace</td>
<td>Marsilea</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salviniales</td>
<td>Marsileace</td>
<td>Marsilea</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SALVINIACEAE</td>
<td>Azolla</td>
<td>Azolla</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salviniales</td>
<td>Salvinia</td>
<td>Salvinia</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>POLYPODIOPSIDA</td>
<td>Cibotiaceae</td>
<td>Cibotium</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CIBOTIACEAE</td>
<td>Cibotium</td>
<td>Cibotium</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cyatheales</td>
<td>Alsophila</td>
<td>Alsophila</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cyatheales</td>
<td>Alsophila</td>
<td>Alsophila</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sphaeropterus</td>
<td>Sphaeropterus</td>
<td>Sphaeropterus</td>
<td>Sphaeropterus</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>DICKSONIAE</td>
<td>Dicksonia</td>
<td>Dicksonia</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dicksonia</td>
<td>Dicksonia</td>
<td>Dicksonia</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOPHOSORIA</td>
<td>Lophosoria</td>
<td>Lophosoria</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polypodiales</td>
<td>Lindsaeaceae</td>
<td>Lindsaea</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LINDSAEACEAE</td>
<td>Lindsaea</td>
<td>Lindsaea</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lonchitis</td>
<td>Lonchitis</td>
<td>Lonchitis</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dennstaedtiaceae</td>
<td>Dennstaedtia</td>
<td>Dennstaedtia</td>
<td>Dennstaedtia</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Histopteris</td>
<td>Histopteris</td>
<td>Histopteris</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hypolepis</td>
<td>Hypolepis</td>
<td>Hypolepis</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PTERIDUM</td>
<td>Pteridium</td>
<td>Pteridium</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polypodiales</td>
<td>Acrostichum</td>
<td>Acrostichum</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acrostichum</td>
<td>Acrostichum</td>
<td>Acrostichum</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adiantum</td>
<td>Adiantum</td>
<td>Adiantum</td>
<td>18</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ananthacorpus</td>
<td>Ananthacorpus</td>
<td>Ananthacorpus</td>
<td>Ananthacorpus</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Acrogonna</td>
<td>Acrogonna</td>
<td>Acrogonna</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bommeria</td>
<td>Bommeria</td>
<td>Bommeria</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ceratopterus</td>
<td>Ceratopterus</td>
<td>Ceratopterus</td>
<td>Ceratopterus</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Cheiloclades</td>
<td>Cheiloclades</td>
<td>Cheiloclades</td>
<td>Cheiloclades</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>Cheiloplecton</td>
<td>Cheiloplecton</td>
<td>Cheiloplecton</td>
<td>Cheiloplecton</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Doryopteris</td>
<td>Doryopteris</td>
<td>Doryopteris</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eriosorus</td>
<td>Eriosorus</td>
<td>Eriosorus</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eriosorus</td>
<td>Eriosorus</td>
<td>Eriosorus</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HEMIONITIS</td>
<td>Hemiais</td>
<td>Hemiais</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hemiotes</td>
<td>Hemiotes</td>
<td>Hemiotes</td>
<td>3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**TABLE 3. (continued from previous page)**

<table>
<thead>
<tr>
<th>Division</th>
<th>Class</th>
<th>Order</th>
<th>Family</th>
<th>Genus</th>
<th>Sp p.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pteridaceae</td>
<td></td>
<td></td>
<td></td>
<td>Mildella</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Notholaena</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Pellaea</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Pityrogramma</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Polytienium</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Pteris</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Scoliosorus</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Vittaria</td>
<td>2</td>
</tr>
<tr>
<td>Aspleniaceae</td>
<td></td>
<td></td>
<td></td>
<td>Asplenium</td>
<td>29</td>
</tr>
<tr>
<td>Thelypteridaceae</td>
<td></td>
<td></td>
<td></td>
<td>Macrothelypteris</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Thelypteris</td>
<td>29</td>
</tr>
<tr>
<td>Woodsiaceae</td>
<td></td>
<td></td>
<td></td>
<td>Athyrium</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Cyatopteris</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Diplazium</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Woodsia</td>
<td>1</td>
</tr>
<tr>
<td>Blechnaceae</td>
<td></td>
<td></td>
<td></td>
<td>Blechnum</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Woodwardia</td>
<td>2</td>
</tr>
<tr>
<td>Dryopteridaceae</td>
<td></td>
<td></td>
<td></td>
<td>Arachniodes</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Bolbitis</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ctenitis</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Dryopteris</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Elaphoglossum</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Lastreopsis</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Megalastrum</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ofiersia</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Phanerophlebia</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Polystichium</td>
<td>8</td>
</tr>
<tr>
<td>Lomariopsidaceae</td>
<td></td>
<td></td>
<td></td>
<td>Cyclopeltis</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Neprolepis</td>
<td>4</td>
</tr>
<tr>
<td>Tectariaceae</td>
<td></td>
<td></td>
<td></td>
<td>Tectaria</td>
<td>5</td>
</tr>
<tr>
<td>Polypodiaceae</td>
<td></td>
<td></td>
<td></td>
<td>Ceradenia</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Cochlidium</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Lellingeria</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Melpomene</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Micropolypondium</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Terpsichore</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Campyloleuralum</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Loxogramme</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Niphidium</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Pecluma</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Phlebdium</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Pleopeltis</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Polypodium</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Serpocaution</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>Total</strong></td>
<td>397</td>
</tr>
</tbody>
</table>
*Lycopodium hippurideum* Christ in Pittier, *Urostachys hippurideus* (Christ) Herter ex Nessel  
*Global distribution*: Mexico, Guatemala, Honduras, Costa Rica, Panama, Antilles, Colombia, Venezuela, Guayana, Ecuador, Peru, Bolivia.  
*Salvadoran distribution*: **Santa Ana**: R. Villacorta *et al*. 1284 (B, LAGU, MO).  
**Chalatenango**: R. Villacorta *et al*. 2052 (B, LAGU, MO); R. Seiler 158 (F, MHES).

*Lycopodium linifolium* L., *Urostachys linifolius* (L.) Herter  
*Global distribution*: Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Suriname, Ecuador, Brazil, Bolivia.  
*Salvadoran distribution*: **Santa Ana**: H. Weber 277 (ITIC); R. Seiler 247 (MHES); S. Winkler 8b (ITIC).

*Lycopodium myrsinites* Lam., *L. skutchii* Maxon, *Plananthus myrsinites* (Lam.) P. Beauv., *Urostachys myrsinites* (Lam.) Herter  
*Global distribution*: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Antilles, Colombia, Venezuela, Trinidad and Tobago, Guayana, Ecuador, Peru.  
*Salvadoran distribution*: **Santa Ana**: R. Seiler 235 (F, ITIC, MHES); 288 (MHES); R. Villacorta *et al*. 1278, 1280 (B, LAGU, MO).  
**Chalatenango**: R. Villacorta *et al*. 2057 (B, LAGU, MO); R. Seiler 401 (JBL00110) (F, LAGU, MHES); 747 (F); S. Winkler 1a (ITIC).  
**Morazán**: R. Seiler 1021 (F, MHES).

*Global distribution*: Mexico, Guatemala, Honduras.  
**Santa Ana**: R. Seiler 764 (MHES).

*Global distribution*: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Antilles, Colombia, Venezuela.  
*Salvadoran distribution*: **Santa Ana**: R.A. Carballo *et al*. 90 (B, LAGU); R. Seiler 310 (MHES); S. Winkler 6b (ITIC).  
**Chalatenango**: R. Seiler 420 (JBL00111) (LAGU); R. Seiler 746 (MHES).  
**Morazán**: R. Seiler 982 (F, ITIC, MHES).

Global distribution: Mexico, Guatemala, Honduras.
Salvadoran distribution: Santa Ana: H. Weber 294 (ITIC); J. Lagos 12 (ITIC); R. Seiler 180, 767 (MHES); R. Villacorta & H. Sipman 1275 (B, LAGU, MO); S. Winkler 3 (ITIC). Chalatenango: R. Seiler 159 (ITIC, MHES); 743 (MHES). Morazán: E.A. Montalvo s.n. (ITIC); R. Seiler 1001 (F, MHES); 1022 (MHES).

Lycopodium reflexum Lam., Urostachys reflexus (Lam.) Herter
Global distribution: Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Ecuador, Peru, Brazil, Bolivia, Paraguay.
Salvadoran distribution: Sonsonate: R. Villacorta & M.L. Reyna de Aguilar 716 (B, ITIC, LAGU, MO). Santa Ana: A. Molina et al. 21712 (F, ITIC); M.C. Carlson 979 (F); R. Seiler 267 (F, MHES); 883 (F, ITIC, MHES); S. Winkler 7a (ITIC). La Libertad: M.C. Carlson 249 (F); R. Villacorta & E.A. Montalvo 2314 (B, LAGU, MO). San Salvador: A. Molina et al. 21862 (F). San Vicente: E.A. Montalvo s.n. (ITIC). Morazán: R. Seiler 1013, 1085 (F, MHES); 1052 (MHES); 1077 (F, ITIC, MHES).

Lycopodium taxifolium Sw., Urostachys taxifolius (Sw.) Herter
Global distribution: Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Ecuador, Peru, Bolivia.

Lycopodium watsonianum Maxon
Global distribution: Costa Rica, Panama.
Salvadoran distribution: Molina et al. 16823, F (Øllgaard in Davidse et al. 1995).

Lycopodium alopecurooides L.
Global distribution: USA, Mexico, Guatemala, Antilles, Colombia, Venezuela, Ecuador, Peru, Brazil, Bolivia, Paraguay, Uruguay.
Salvadoran distribution: Morazán: R. Seiler 1078 (F, ITIC, MHES).

Global distribution: USA, Mexico, Guatemala, Belize, Honduras, Nicaragua, Panama,
Antilles, Colombia, Venezuela, Guayana, Suriname, French Guiana, Ecuador, Peru.  
**Salvadoran distribution:** **Morazán:** R. Seiler 1014 (F, MHES).  

**Global distribution:** USA, Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Guayana, Suriname, French Guiana, Ecuador, Peru, Brazil, Bolivia, Paraguay, Trópicos y Subtrópicos del Viejo Mundo.  
**Salvadoran distribution:** **Santa Ana:** B. Bechyné 3908 (ITIC); E. Peñate s.n. (ITIC); R. Seiler 39 (F, MHES); 1204 (F); Thomson 55 (ITIC).  
**San Salvador:** N.C. Fassett 28310 (F, ITIC); W. Eggler 682 (F).  
**Chalatenango:** A. Díaz s.n. (ITIC); M.C. Carlson 592 (F); R. Villacorta & A. Araniva 980 (LAGU, MO, B, ITIC).  
**Usulután:** J. Lagos 2 (ITIC).  
**Morazán:** R.A. Carballo *et al.* 1032 (LAGU, MO); R. Seiler 978 (F, ITIC, MHES); 1012, 1043 (F, MHES).  

Local name: guía de roble.  
**Global distribution:** USA, Mexico, Guatemala, Honduras, Costa Rica, Panama, Antilles, Colombia, Venezuela, Guayana, Suriname, French Guyana, Ecuador, Peru, Brazil, Bolivia, Paraguay, Europe.  
**Salvadoran distribution:** **Santa Ana:** A. Molina *et al.* 12538, 16715 (F; B). Pfeiffer-Berendsohn 21 (B, LAGU, MO); E.A. Montalvo s.n., 3128, 4136 (ITIC); J. Lagos, 8, 1480 (ITIC); M.L. Reyna de Aguilar 1029 (MHES); N.C. Fassett 28310 (F, ITIC); R. Seiler 115 (F, ITIC, MHES); 769 (F, MHES); R. Villacorta *et al.* 1046 (B, LAGU, MO); W. Berendsohn *et al.* 1567 (B, LAGU, MO).  
**Chalatenango:** J. Tucker 1051 (F); R. Villacorta *et al.* 2077 (B, LAGU, MO); W. Berendsohn *et al.* 1565 (B, LAGU, MO).  

**Global distribution:** Mexico, Guatemala, Honduras, Costa Rica, Panama, Colombia, Venezuela, Ecuador, Peru, Brazil, Bolivia, Argentina.  
**Salvadoran distribution:** Padilla 170 (US) (Ollgaard in Davidse *et al.* 1995).  
**Chalatenango:** W. Berendsohn *et al.* 1567 (B, LAGU, MO).
SELAGINELLACEAE


Selaginella bernoullii Hieron., Hedwigia 41: 192. 1902. Global distribution: Mexico, Guatemala, Honduras. Salvadoran distribution: Chalatenango: R. Seiler 733 (F, MHES). Note: M.E. Fraile in Davidse et al. (1995) cites this name as a synonym of S. porphyrospora A. Braun. We have chosen to maintain the species distinct following the criteria cited by Mickel & Smith (2004).


Selaginella hoffmannii Hieron., Hedwigia 41. 184. 1902. Local name: yayuco colorado. Global distribution: Mexico, Belize, Guatemala, Honduras, Nicaragua, Costa Rica. Salvadoran distribution: Ahuachapán: E. Sandoval & F. Chinchilla 666 (B, LAGU); J. Lagos 5 (ITIC); J.M. Rosales 1231, 1232 (B, BM, LAGU, MO); 1257 (AAU, B, BM, LAGU, MO); 1300 (B, BM, EAP, LAGU, MO); 1619 (B, LAGU); R. Villacorta et al. 905 (B, LAGU, MO). Santa Ana: A.K. Monro & R. Douglas 3462 (B, BM, ITIC, LAGU, MO); R. Seiler 705 (F, MHES); R. Villacorta 2179 (B, LAGU, MO). La Libertad: A.K. Monro et al. 3082 (B, BM, ITIC, LAGU, MO); R.A. Carballo et al. 40 (B, LAGU, MO). San Salvador: Grupo Ecológico Cantón El Zapote s.n. (JBL03316) (LAGU, MO); R. Seiler 634 (F, MHES); 1509 (F). Chalatenango: R. Seiler 143 (F, ITIC, MHES).

Selaginella solmsii Baker
Global distribution: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama.
Salvadoran distribution: Santa Ana: A. Molina et al. 12633, 16866, 16883 (F); E.A. Montalvo 4137 (ITIC); G. Davidse et al. 37242, 37304 (B, BM, ITIC, LAGU, MO); J. Lagos 14 (ITIC); J. Tablas s.n. (ITIC); J. Toledo s.n. (ITIC); M.C. Carlson 890 (F); R. Seiler 108 (F, ITIC); 184 (F, MHES); 472 (F, ITIC, MHES); R. Villacorta et al. 1279 (B, LAGU); 2679 (F, B, LAGU, MO). La Libertad: F. López s.n. (ITIC).

Lycopodium pallecens C. Presl, L. cuspidatum Link, Selaginella cuspidata (Link) Link, S. cuspidata (Link) Link var. elongata Spring
Local names: helecho tuya, resurrección.
Global distribution: Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panamá, Colombia, Venezuela, Suriname, Brazil.
Salvadoran distribution: Ahuachapán: E. Sandoval et al. 602 (B, LAGU); 1338 (K, LAGU); J.M. Rosales 1299 (B, BM, EAP, LAGU, MO); 1403, 1586 (AAU, B, BM, LAGU, MO); M. Sandoval & E. Sandoval 20 (B, F, LAGU); T. Croat 42064 (ITIC). Sonsonate: R. Seiler 8 (F, MHES); T. Croat 42239 (ITIC). Santa Ana: A. Molina et al. 21881 (F, ITIC); T. Croat 42300 (ITIC); V.M. Martínez s.n. (CMC00262) (B, LAGU).

Selaginella bulbifera Baker, S. binervis Liebm. ex Baker
Global distribution: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Colombia, Venezuela, Ecuador.

Selaginella nicaraguensis Baker
Global distribution: Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama.
Cabañas: R. Seiler 526 (MHES).

Global distribution: Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Colombia, Venezuela, Ecuador, Peru, Bolivia.
Salvadoran distribution: Tucker 1174 (UC) (Fraile in Davidse et al. 1995).

Selaginella stellata Spring, Flora 21: 194. 1838.

Global distribution: Mexico, Guatemala, Belize, Honduras, Costa Rica, Panama.

Diplostachium tenellum P. Beauv., Lycopodium tenellum (P. Beauv.) Desv. ex Poir., Selaginella cladorrhizans A. Braun, S. subcaulescens Baker
Local name: helecho tuya.
Global distribution: Mexico, Guatemala, Belize, Honduras, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Brazil.
Salvadoran distribution: Ahuachapán: E. Sandoval & O. Rivera D. 1376 (B, LAGU); J.M. Rosales 1298 (B, BM, EAP, LAGU, MO); 1340 (B, LAGU). La Libertad: R. Villacorta 316 (B, EAP, LAGU, MO).

DIVISION EUPHYLOPHYTA, SUB-DIVISION MONILOPHYTA
ANEMIACEAE

Anemia guatemalensis Maxon, N. Amer. Fl. 16: 46. 1909.
Local name: petatillo.
Global distribution: Guatemala, Honduras, Nicaragua.
Salvadoran distribution: Santa Ana: B. Pfeiffer-Berendsohn & W. Berendsohn 15 (F, LAGU, MO); R. Villacorta et al. 1264 (B, ITIC, LAGU, MO). Chalatenango: D. Sloot & A. Reina 109 (MAG00538) (B, LAGU, U); L. Lara 220 (MHES); R. Seiler 562 (F, MHES). Morazán: J. Monterrosa & C. Rivera 712 (B, BM, LAGU, MO); R. Seiler 1050 (F, MHES).

Anemia hirsuta (L.) Sw., Syn. Fil. 156. 1806.
Osmunda hirsuta L., Ornithopteris hirsuta (L.) Bernh., Anemia hirsuta (L.) Sw. var. achillaeifolia M. Martens & Galeotti, A. opaca Fée
Local name: helecho pluma de perico.
Global distribution: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Ecuador, Peru, Brazil, Bolivia.
Salvadoran distribution: Ahuachapán: E. Sandoval et al. 484, 1317 (B, LAGU); F. Chinchilla s.n. (ISB00522) (AAU, B, LAGU); s.n. (ISB00501) (AAU, B, F, LAGU); s.n. (ISB00763) (B, LAGU); J.M. Rosales 898, 972, 1404 (AAU, B, BM, LAGU, MO); M. Sandoval & E. Sandoval 10, 39 (B, LAGU); R. Villacorta et al. 406 (B, LAGU, MO); 952 (B, LAGU); W. Berendsohn & E. Sandoval 1481 (B, LAGU). Sonsonate: R. Seiler 35 (F, MHES); R. Villacorta 2402 (AAU, B, LAGU). Santa Ana: B. Pfeiffer-Berendsohn 57 (B, LAGU, MO); M.L. Reyna de Aguilar 765 (MHES); R. Villacorta & H. Sipman 1270 (B, LAGU, MO). La Libertad: N. Ventura 5013 (ITIC); O. Rohweder s.n. (JBL01254) (LAGU). San Salvador: J. Lagos 1076 (ITIC); R. Seiler 69 (F, MHES); 445 (MHES); R. Villacorta & M.A. Sanabria 402 (B, LAGU, MO). Chalatenango: R. Seiler 366 (F, MHES); 553, 569 (MHES); R. Villacorta 2362 (B,
Anemia oblongifolia (Cav.) Sw., Syn. Fil. 156. 1806.

Osmunda oblongifolia Cav., O. humilis (Cav.) Sw., Anemia oblongifolia (Cav.) Sw. β humilis (Cav.) Hook., A. pilosa M. Martens & Galeotti α brevistipes Liebm., A. cornea Prantl, A. seemannii Hook.

Local name: helecho rosquilla pacha.

Global distribution: Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Colombia, Venezuela, Guayana, Suriname, French Guyana, Ecuador, Peru, Brazil, Bolivia, Argentina.


Chalatenango: L. Lara s.n. (JBL02202) (B, LAGU); 77 (MHES); R. Seiler 558 (F, MHES); S. Calderón 2474 (F). Usulután: D. Williams 140 (B, LAGU, MO). Morazán: J. Monterrosa & M. Rivera 602 (BM, LAGU); K. Sidwell et al. 773 (B, BM, ITIC, LAGU, MO); M. Renderos et al. 629 (AAU, B, LAGU, MO); R. Villacorta et al. (B, BM, LAGU, MO).


Anemia pilosa M. Martens & Galeotti β longistipes Liebm., A. longistipes (Liebm.) C. Chr., A. helveola Fée

Local names: petatillo.

Global distribution: Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Guayana, Suriname, French Guyana, Ecuador, Peru, Brazil, Bolivia.


Anemia phyllitidis (L.) Sw., Syn. Fil. 155. 1806.

Osmunda phyllitidis L., Anemidictyon phyllitidis (L.) J. Sm.

Local names: helecho cola de ratón, helecho de montaña.

Global distribution: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Guayana, Suriname, Ecuador, Peru, Brazil, Bolivia, Paraguay, Argentina, Uruguay.

Salvadoran distribution: Ahuachapán: B. Smalla & N. Kilian 81 (B, LAGU); E. Sandoval & H. Rivera 1319 (B, LAGU); J.M. Rosales 1005 (B, LAGU); M. Sandoval & E. Sandoval 53 (B, LAGU); R. Villacorta et al. 876 (B, LAGU); 955 (B, ITIC, LAGU, MO). Santa Ana: J. Monterrosa et al. 260 (B, BM, LAGU, MO); 674 (B, BM, LAGU); 921 (LAGU); 1027 (B, LAGU, NY); R. Villacorta 2172 (LAGU). San Salvador: M.C. Carlson 332 (F); R. Seiler 65, 781 (F, MHES). Chalatenango: R. Seiler 566 (MHES); 570 (F, MHES). Usulután: A.K. Monro et al. 3004 (B, BM, ITIC,
LAGU, MO); D. Williams 127, 131 (LAGU); 302 (LAGU, MO). Morazán: J. Monterroso & C. Rivera 674 (B, BM, LAGU); R. Seiler 1087 (F); 1090 (F, MHES).

Local names: helecho de rosa, helecho plumerillo.
Global distribution: Endemic.
Salvadoran distribution: Ahuachapán: E. Sandoval & F. Chinchilla 556 (B, LAGU); F. Chinchilla s.n. (ISB00541) (B, LAGU); s.n. (ISB00542) (LAGU); W. Berendsohn et al. 1395 (B, LAGU, MO); R. Seiler 947 (MHES, NY).

ASPLENIACEAE

Asplenium polymorphum M. Martens & Galeotti. Local name: helecho quezalío.
Global distribution: USA, Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, French Guyana; Colombia, Venezuela, Trinidad and Tobago, Ecuador, Peru, Brazil, Bolivia, Uruguay, Paraguay.

Caenopteris achillefolia M. Martens & Galeotti, Athyrium conchatum Fée, Asplenium conchatum (Fée) T. Moore, A. grande Fée
Global distribution: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Peru.
Salvadoran distribution: Sonsonate: A. Molina et al. 21623 (F); R. Seiler 624 (F, MHES). Santa Ana: J. Tucher 1248 (F); M.B. Siu s.n. (ITIC); M.L. Reyna de Aguilar 762 (MHES); R. Seiler 468 (F, MHES); R. Seiler 469 (F, ITIC, MHES); R. Seiler 269 (ITIC (F, LAGU (photo), NY)); R. Seiler 872 (ITIC); S. Winkler 37 (ITIC). San Salvador: M.C. Carlson 417 (F); R. Seiler 346 (F, ITIC, MHES).

Global distribution: Mexico, Guatemala, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Ecuador, Peru, Brazil, Bolivia.

Asplenium salicifolium L. var. auriculatum (Sw.) Proctor, A. semicordatum Raddi, A. pinnellifolium Fée & Schaffner ex Fée
Global distribution: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Ecuador, Peru, Brazil, Bolivia, Paraguay.
Salvadoran distribution: Ahuachapán: D. Witsberger 686 (MHES); E. Sandoval & M. Sandoval 1423 (B, LAGU); R. Seiler 821, 823, 961 (F, MHES); 910 (F, ITIC, MHES); S. Winkler 6a (ITIC). Sonsonate: R. Seiler 615 (F, MHES). Santa Ana: A. Molina et

Athyrium macrocarpon Fée, Asplenium macrocarpon (Fée) T. Moore, A. myapteron Fée, A. commutatum Mett. ex Kuhn, A. onustum Christ, A. subvestitum Copel.

Global distribution: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Antilles.


Asplenium radicans L. var. cirratum (Rich.) Rosenst.

Global distribution: Mexico, Belize, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Antilles, French Guyana, Colombia, Venezuela, Ecuador, Peru, Brazil, Bolivia.

Salvadoran distribution: Santa Ana: M.L. Reyna de Aguilar 848 (LAGU, MHES).

♦ Asplenium cristatum Lam., Encycl. 2: 310.1786.

Asplenium cicutarium Sw.

Global distribution: USA, Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Guayanas y Galapagos, Colombia, Venezuela, Trinidad and Tobago, Ecuador, Peru, Brazil, Bolivia, Paraguay.


Asplenium cuspidatum Lam., Encycl. 2: 310.1786.

Asplenium lacerum Schltdl. & Cham., A. mexicanum M. Martens & Galeotti, A. fragrans Sw. var. mexicanum (M. Martens & Galeotti) Christ, A. auritum Sw. var. bipinnatifidum Kunze, A. pyramidatum Liebm., A. auritum Sw. var. bipinnatisectum Mett.

Local name: helecho trensillo de altura.

Global distribution: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Ecuador, Peru, Bolivia. Brazil and Paraguay.

Salvadoran distribution: Ahuachapán: A.K. Monro et al. 2008 (B, BM, ITIC, LAGU, MO); D. Witsberger 687 (LAGU); E.A. Montalvo 60 (ITIC); E. Sandoval & M. Sandoval 1633 (LAGU); W. Berendsohn & M. Sandoval 1633 (LAGU); W. Berendsohn et al. 1519 (B, LAGU). Sonsonate: R. Seiler 183 (F); 617 (MHES). Santa Ana: A. del Cid 1618 (ITIC); J. Monterrosa & R. Martinez 949 (B, LAGU, MO, NY); L. González 1617 (ITIC); M.L. Reyna de Aguilar 816 (MHES); R. Seiler 83, 183 (MHES); S. Winkler 47 (F).
Asplenium feei Kunze ex Fée, Mém. Foug. 5: 194. 1852.

Asplenium sanguinolentum Kunze ex Mett., A. sarcodes Maxon

Global distribution: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Suriname, Brazil, Bolivia.

Salvadoran distribution: San Salvador: M. Carlson 428a (F).

Asplenium flabellulatum Kunze, Linnea 9: 71. 1834.

Asplenium flabellulatum Kunze var. dentatum Klotzsch, A. radicans L. var dentatum (Klotzsch) Bonap., A. flabellulatum Kunze var. partitum Klotzsch, A. partitum (Klotzsch) C. Chr., A. radicans L. var partitum (Klotzsch) Hieron

Global distribution: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Ecuador, Peru, Paraguay.

Salvadoran distribution: Santa Ana: M.L. Reyna de Aguilar 824 (MHES).

Chalatenango: R. Seiler 406 (JBL00086) (F, LAGU, MHES).


Asplenium formosum Willd. var. incultrum H. Christ, A. subalatum Hook. & Arn.

Global distribution: Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Guayana, French Guayana, Ecuador, Peru, Brazil, Bolivia, Paraguay, Argentina, Africa, S India, Sri Lanka.

Local names: helecho peine de niño, helecho peinetero, helecho de rosquilla.

Salvadoran distribution: Ahuachapán: E. Sandoval & F. Chinchilla 99, 541 (B, LAGU); E. Sandoval & F. Pérez 1264 (B, LAGU); R. Seiler 927 (F, MHES); R. Villacorta et al. 939 (B, LAGU); W. Berendsohn et al. 1401, 1432, 1611 (B, LAGU); W. Berendsohn et al. 1453 (LAGU). Sonsonate: R. Seiler 76 (F, MHES). Santa Ana: B. Pfeiffer-Berendsohn 18 (B, LAGU, MO); M. Magaña 28 (MP-00028) (LAGU); S. Winkler 14 (ITIC). La Libertad: E.A. Montalvo 6002 (ITIC); R. Seiler 713 (F, MHES).

San Salvador: R. Seiler 49 (MHES). Chalatenango: J. Lagos 1720 (ITIC); L. Lara 234 (MHES); R. Seiler 146 (F, MHES); 372 (F, ITIC, MHES). Usulután: A. del Cid 3014 (B, BM, ITIC, LAGU, MO); D. Williams & R.W. Herrera 315 (LAGU, MO); D. Williams & R.W. Herrera 503 (LAGU); L. González 1085 (ITIC).

Cabañas: A.K. Monro et al. 3748 (B, BM, ITIC, LAGU, MO). Morazán: J. Monterrosa & C. Rivera 676 (B, BM, LAGU, MO); R. Seiler 1089 (F, MHES); S. Winkler 5 (ITIC).

Asplenium fragrans Sw., Prodr. 130. 1788.

Asplenium auritum Sw. var. tripinnatum E. Fourn., A. cuspidatum Lam. var. tripinnatum (E. Fourn.) C.V Morton & Lellinger, A. foeniculaceum Kunth, A. cuspidatum Lam. var. foeniculaceum (Kunth) C.V Morton & Lellinger, A. coriifolium Liebm.

Global distribution: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Suriname, Brazil, Bolivia, Guayana, French Guayana, Ecuador, Peru, Paraguay, Argentina, Africa, S India, Sri Lanka.
Antilles, Colombia, Venezuela, Ecuador, Peru, Bolivia.

Salvadoran distribution: Chalatenango: R. Seiler 151 (F, MHES); 422 (JBL00087) (F, ITIC, LAGU, MHES).


Asplenium erectum Bory var. harpeodes (Kunze) Mett., A. donnell-smithii Christ. Local names: helecho llorón, quetzal silvestre.

Global distribution: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Guayana, French Guyana, Ecuador, Peru, Brazil, Bolivia.

Salvadoran distribution: Santa Ana: A. Molina et al. 16802 (F); E.A. Montalvo 15b, 19 (ITIC); J. Monterrosa et al. 221 (B, BM, LAGU, MO); M.L. Reyna de Aguilar 1458 (LAGU); R. Seiler 120 (F, ITIC, MHES); R. Villacorta et al. 1039, 1281 (B, LAGU, MO); S. Winkler 2 (ITIC). Chalatenango: J. Tucker 1105 (F). Morazán: J.L. Linares & A. Pool 2285 (JBL01930) (LAGU); J.L. Linares & C. Peña H. 2749 (JBL01928) (LAGU).

Asplenium hoffmannii Hieron., Hedwigia 60: 258. 1918.

Asplenium membraniifolium Maxon

Local names: helecho de roca.

Global distribution: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Colombia, Venezuela, Trinidad and Tobago.


Asplenium laetum Sw., Syn. Fil. 79, 271. 1806.

Asplenium lugubre Liebm.

Global distribution: Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, French Guyana, Ecuador, Peru, Brazil, Bolivia, Paraguay.

Salvadoran distribution: Ahuachapán: M. Sandoval & E. Sandoval 297 (B, F, LAGU).


Asplenium bradeorum Hieron., A. schlechtendahlianae Hieron., A. standleyi Maxon

Global distribution: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Colombia, y Brazil.


Asplenium monanthes L., Mant. Pl. 130.1767.

Asplenium monanthemum L., A. arcuatum Liebm., A. obtusissimum Fée, A. galeottii Fée, A. leptophyllum Fée, A. curvatum Fée

Global distribution: S USA, Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Ecuador, Peru, Brazil, Bolivia, Uruguay, Chile, Argentina, Africa, Hawaii.

Salvadoran distribution: Ahuachapán: F. Wunderling 1226 (ITIC); Santa Ana: B. Pfeiffer-Berendsohn 80 (LAGU, MO); G. Cerén & D. Rodríguez s.n. (JBL04646)
Asplenium auritum Sw. var. monodon (Liebm.) E. Fourn.
Global distribution: USA, Mexico, Guatemala, Honduras, Costa Rica, Panama, Antilles, Venezuela, Colombia, Trinidad and Tobago, Ecuador.
Salvadoran distribution: Santa Ana: R. Seiler 466 (MHES).

Asplenium polymeris T. Moore, A. bertolonii Donn. Sm., A. trichomanes L. var. viridissimum Christ, A. viridissimum J. Bommer ex Christ
Global distribution: Mexico, Guatemala, Honduras, Costa Rica, Panama, Colombia, Venezuela, Ecuador, Peru, Bolivia.
Salvadoran distribution: Santa Ana: B. Pfeiffer-Berendsohn 41 (LAGU, MO); J. Monterrosa & R. Carballo 252 (B, BM, LAGU, MO); J. Monterrosa & R. Carballo 837 (B, LAGU, MO); M.L. Reyna de Aguilar 764 (MHES); R. Seiler 464 (F, MHES); R. Villacorta & L. Lara 2663 (B, LAGU, MO); V.M. Martinez s.n. (CMC01046) (B, LAGU, MO); L. Lara 238 (MHES).

Asplenium potosinum Hieron., Hedwigia 60: 247.1918.
Asplenium regulare Sw. var. latior E. Fourn., A. lunulatum Sw. var. latius E. Fourn., A. hesperium Mickel & Beitel
Local names: helecho cola de pavo real.
Global distribution: Mexico, Guatemala.
Salvadoran distribution: Ahuachapán: E. Sandoval & F. Chinchilla 40 (LAGU, MO); R. Seiler 824 (JBL04817) (F, ITIC, LAGU, MHES); R. Seiler 903 (F, ITIC, MHES); 955 (F, MHES); W. Berendsohn & E. Sandoval 1513 (B, LAGU).
Usulután: A.K. Monro et al. 3008, 3015 (B, BM, ITIC, LAGU, MO); D. Williams 53 (LAGU, MO); D. Williams 413 (LAGU).

Asplenium praemorsum Sw., Prodr. 130. 1788.
Global distribution: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Ecuador, Peru, Brazil, Bolivia.
Salvadoran distribution: Ahuachapán: M. Magaña 33 (MP-00018) (LAGU); R. Seiler 819 (F, MHES). Morazán: R. Seiler 1035 (F); 1072 (F, MHES).

Asplenium pulchellum Raddi, Opusc. Sci. 3: 291.1819.
Asplenium pulchellum Raddi var. subhorizontale Rosenst.
Global distribution: Mexico, Honduras, Nicaragua, Costa Rica, Panama, Colombia, Venezuela, Ecuador, Peru, Brazil, Bolivia, Paraguay.
Asplenium pumilum Sw., Prodr. 129. 1788.
Asplenium anthriscifolium Jacq., A. leucothrix Maxon, Athyrium verapax Christ

Global distribution: USA, Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Ecuador, Peru, Brazil, Bolivia, Africa.


Global distribution: Mexico, Guatemala, Costa Rica.

Salvadoran distribution: Ahuachapán: A. Molina et al. 21797 (ITIC); G. Davidse et al. 37372 (B, BM, ITIC, LAGU, MO); R. Seiler 957, (F, MHES). Sonsonate: R. Villacorta 751 (LAGU).


Asplenium serra Langsd. & Fischer var. incurvatum H. Christ, A. insigne Liebm., A. progrediens Fée

Global distribution: Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Ecuador, Peru, Brazil, Bolivia, Paraguay, Uruguay.

Salvadoran distribution: Santa Ana: A. Molina et al. 16755 (F); J. Monterrosa & R. Carballo 860 (B, LAGU, MEXU, MO); R. Seiler 106, 191b (F, MHES); 114 (MHES); 192 (F); V.M. Martínez s.n. (CMC01095) (B, EAP, LAGU, MO). Chalatenango: J. Tucker 1045 (F); R. Seiler 424 (F, MHES); W. Berendsohn et al. 1574 (B, LAGU, MO).

Asplenium sessilifolium Desv. var. guatemalense Hieron.

Global distribution: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Ecuador, Peru, Bolivia.

Salvadoran distribution: Sonsonate: R. Seiler 625 (F, MHES). Santa Ana: A. Molina & E.A. Montalvo 21512 (JBL01516) (F, LAGU); B. Pfeiffer-Berendsohn 55 (LAGU, MO); J. Monterrosa & R. Martínez 936 (B, LAGU, MO, NY); R. Seiler 121 (JBL04803) (F, LAGU, MHES); R. Seiler 13 (ITIC, MHES); 84 (ITIC); 354 (F, ITIC, MHES). Chalatenango: L. Lara 233 (MHES); R. Seiler 378 (JBL00085) (F, LAGU, MHES).

Asplenium tenerreimum Mett. ex Kuhn, Linnea 36: 97. 1869.
Asplenium cuspidatum Lam. var. tenerreimum (Mett. ex Kuhn) C.V. Morton & Lellinger, A. fournieri Kuhn ex E. Fourn.

Global distribution: Mexico, Honduras, Nicaragua, Colombia, Venezuela, Ecuador.

Salvadoran distribution: Santa Ana: R. Seiler 545 (F).

Davallia thecifera Kunth, D. lindenii Hook., Dorea thecifera (Kunth) E. Fourn., Loxoscaphe lindenii (Hook.) T. Moore, L. thecifera (Kunth) T. Moore

Global distribution: Mexico, Honduras, Nicaragua, Costa Rica, Panama, Antilles,

Global distribution: Mexico, Guatemala, Honduras, Costa Rica, Panama, Colombia, Venezuela.


BLECHNACEAE


Blechnum glandulosum Kaulf. ex Link, B. meridionale C. Presl, B. occidentale L. var. minor Hook., B. occidentale L. var. pubirhachis Rosenst.

Local names: helecho esqueleto de pescado, petatillo.

Global distribution: USA, Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Ecuador, Peru, Brazil, Bolivia, Paraguay, Argentina.

Salvadoran distribution: Ahuachapán: A.K. Monro et al. 1994 (B, BM, ITIC, LAGU, MO); F. Pérez s.n. (ISB00003) (B, LAGU, MO); G. Davidse et al. 37417 (B, BM, ITIC, LAGU, MO); J.G. Sandoval et al. s.n. (ISB00027) (B, LAGU, MO), US; K. Sidwell et al. 814 (B, BM, ITIC, LAGU, MO); S. Castillo s.n. (ISF00594) (B, F, LAGU, MO).

Sonsonate: R. Villacorta & A. González 693 (B, LAGU, MO). Santa Ana: B. Pfeiffer-Berendsohn 65 (LAGU, MO); D. Rodríguez & G. Cerén s.n. (ISB00003) (B, LAGU, MO); M.L. Reyna de Aguilar 684 (MHES); R. Seiler 349, 477 (F, MHES); VM. Martinez s.n. (CMC01069) (B, EAP, LAGU, MO). La Libertad: A. Mangandi et al. s.n. (JBL04492) (LAGU); A.K. Monro et al. 2217, 2223 (B, BM, ITIC, LAGU, MO); J.C. González 415 (B, LAGU); M. Renderos et al. 412 (LAGU). San Salvador: A.K. Monro et al. 2217, 2223 (B, BM, ITIC, LAGU, MO, L), O. Williams et al. 15232 (F); M.C. Carlson 329 (F); R. Seiler 29 (F, MHES). Chalatenango: D. Sloat & A. Reina 216 (MAG00645), 433 (MAG00862) (LAGU, U); L. Lara 218, 225 (MHES); M. Renderos & R. Villacorta 141 (B, LAGU); R. Seiler 413 (JBL00091) (LAGU, MHES); W. Heed 26 (ITIC). San Vicente: E.A. Montalvo 4615, 4616 (ITIC). Usulután: L. González 1089, 1787 (ITIC). San Miguel: K. Sidwell et al. 885 (B, BM, ITIC, LAGU, MO); M. Renderos et al. 687 (LAGU, MO). Cuscatlán: S. Dar s.n. (JBL03666) (LAGU, MO). Morazán: J. Monterroso & M. Rivera 615 (B, BM, LAGU); J. Tucker 608 (F).

Blechnum appendiculatum Willd. x Blechnum gracile Kaulf

Global distribution: Mexico, Honduras, Nicaragua, Colombia, Venezuela.


Blechnum x caudatum Cav., Descr. Pl. 262. 1802.

Global distribution: Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Colombia, Venezuela, Suriname, Ecuador, Peru, Brazil.
Salvadoran distribution: **Santa Ana**: B. Pfeiffer-Berendsohn 59 (B, LAGU, MO); C. Salazar s.n. (ITIC). **Morazán**: A.K. Monro *et al.* 3804 (B, BM, ITIC, LAGU, MO); J. Monterroso & R. Carballo 794 (LAGU).

Note: *Blechnum x caudatum* is a hybrid between *Blechnum gracile* and *B. occidentale* (Mickel & Smith 2004: 146, Fig.: 55C).


**Global distribution**: Mexico, Guatemala, Honduras, Costa Rica, Panama, Antilles, Colombia, Venezuela, Ecuador, Peru, Brazil, Bolivia.

**Salvadoran distribution**: **Santa Ana**: R. Seiler 765, 892 (F, MHES); 1156, F (ITIC).

*Blechnum ensiforme* (Liebm.) C.Chr., *Index Filic.* 153: 1905.

*Lomaria ensiformis* Liebm., *Struthiopteris ensiformis* (Liebm.) Maxon

**Global distribution**: Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Colombia, Venezuela, Guayana, Ecuador, Peru, Bolivia.

**Salvadoran distribution**: **Santa Ana**: G. Cerén & D. Rodríguez s.n. (JBL04660) (LAGU); R. Seiler 299 (F, MHES). **Chalatenango**: R. Seiler 389 (JBL00092) (F, LAGU, MHES). **Morazán**: R. Seiler 1026 (F, ITIC, MHES).

*Blechnum falciforme* (Liebm.) C. Chr., *Index Filic.* 154: 1905.

*Lomaria falciformis* Liebm., *Struthiopteris falciformis* (Liebm.) Broadh.

**Global distribution**: Mexico, Guatemala, Honduras, Costa Rica, Panama, Colombia, Ecuador.

**Salvadoran distribution**: **Sonsonate**: R. Seiler 632 (F, MHES). **Santa Ana**: A. Hernández s.n. (ITIC); M.C. Carlson 725, 891, 952 (F); R. Seiler 348, 478 (MHES); 863 (F, ITIC, MHES). **Chalatenango**: N. Ventura 5026 (ITIC); R. Seiler 409 (MHES). **Morazán**: R. Seiler 990 (F, MHES).


**Global distribution**: Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Ecuador, Peru, Bolivia.

**Salvadoran distribution**: **Santa Ana**: R. Seiler 654 (F, MHES). **Morazán**: R. Seiler 1041 (F, ITIC, MHES).

*Blechnum gracile* Kaulf., *Enum. Filic.* 158. 1824.

*Blechnum intermedium* Link., *B. subdimorphum* Copel., *B. fraxineum* auct., *non* Willd.

**Global distribution**: Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Guayana, Suriname, French Guyana, Ecuador, Peru, Brazil, Bolivia, Paraguay, Argentina.

**Salvadoran distribution**: **Chalatenango**: M.B. Siu s.n. (ITIC); M.C. Carlson 594 (F); R. Seiler 572 (F, ITIC); (MHES). **Cabañas**: A.K. Monro *et al.* 3746 (B, BM, ITIC, LAGU, MO). **Morazán**: R. Seiler 1083 (F, ITIC, MHES).
**Blechnum l’herminieri** (Bory) C. Chr. subsp. lehmannii (Hieron) Lellinger, *Struthiopteris masonii* Broadh.  
**Global distribution:** Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Colombia, Venezuela, Ecuador, Peru, Brazil, Bolivia.  
**Salvadoran distribution:** **Sonsonate:** J.L. Linares & C.A. Martínez 3033 (JBL01933) (LAGU). **Santa Ana:** F. Wunderling 1245 (ITIC); G. Cerén & D. Rodríguez s.n. (JBL04650) (LAGU); R. Seiler 894 (F, ITIC, MHES). **Morazán:** R. Seiler 979, 1039, F (ITIC, MHES).  

**Local names:** helecho esqueleto de pescado.  
**Global distribution:** Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Guayana, Suriname, French Guyana, Ecuador, Peru, Brazil, Bolivia, Paraguay, Argentina.  
**Salvadoran distribution:** **Ahuachapán:** A.K. Monro et al. 1929, 2984 (B, BM, ITIC, LAGU, MO); A. Sermeño 98 (JBL00999) (B, LAGU, MEXU, MO); E. Sandoval & M. Sandoval 864 (B, LAGU); J.M. Rosales 1188 (B, LAGU, MO); 1715, 1723 (B, BM, LAGU, MO); M. Magaña 19 (MP-00032) (LAGU); M. Sandoval & E. Sandoval 136 (B, F, LAGU); R. Villacorta 622 (B, LAGU, MO); S. Castillo & B.A. Martínez s.n. (ISF00406) (AAU, F, LAGU); W. Berendsohn et al. 1316, 1368, 1393 (B, LAGU, MO). **Sonsonate:** D. Rodríguez & G. Trejo 203 (LAGU). **Santa Ana:** G. Davidse et al. 37226 (B, BM, ITIC, LAGU, MO); J. Monterrosa & R. Carballo 509 (LAGU); K. Prestegard 10 (MP-00031) (LAGU); M.L. Reyna de Aguilar et al. 1439 (B, ITIC, LAGU, MO). **La Libertad:** F. Wunderling 461 (ITIC); N. Ventura 5001, 5004 (ITIC); O. Tejada et al. s.n. (JBL04504) (LAGU); R. Guerra et al. s.n. (JBL04502) (LAGU); R. Menjivar & J. Sermeño s.n. (JBL04483) (LAGU). **San Salvador:** M.C. Carlson 4a (ITIC); R. Seiler 457 (F, MHES); 783 (F, ITIC, MHES). **Chalatenango:** E.A. Montalvo 30, 3202, 3778 (ITIC); L. Lara 498 (MHES); M.B. Siu s.n. (ITIC). **Usulután:** D. Williams 54 (LAGU, MO). **San Miguel:** A.K. Monro et al. 2944 (B, BM, ITIC, LAGU, MO); A. Salgado 66 (MHES). **Cuscatlán:** E.A. Montalvo 3312 (ITIC). **Cabañas:** A.K. Monro & K. Sidwell 2778 (B, BM, ITIC, LAGU, MO). **Morazán:** J. Monterrosa et al. 45 (B, LAGU, MO).  

**Blechnum polypodioides** Raddi, Opusc. Sci. 3: 294. 1819, non (Sw.) Kuhn, 1868.  
**Asplenium blechnoides** Lag. ex Sw., *Blechnum unilaterale* Sw., *B. blechnoides* (Lag. ex Sw.) C. Chr., *B. scabrum* Liebm., *B. angustifrons* Fée  
**Local names:** helecho peineeta amarilla.  
**Global distribution:** Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Guayana, Suriname, French Guyana, Ecuador, Peru, Brazil, Bolivia, Paraguay, Argentina.  
**Salvadoran distribution:** **Ahuachapán:** W. Berendsohn et al. 1469 (LAGU). **Chalatenango:** M.B. Siu s.n. (ITIC); L. Lara 230 (MHES); R. Seiler 564 (MHES); 571 (F, MHES). **Usulután:** D. Williams 55 (LAGU, MO). **Morazán:** J. Monterrosa & C. Rivera 690 (B, BM, LAGU); J. Tucker 643 (F).
Blechnum schiedeanum (Schltdl. ex C. Presl) Hieron., Hedwigia 47: 239. 1908.
Global distribution: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama.
Salvadoran distribution: Ahuachapán: B. Pfeiffer-Berendsohn 51 (B, LAGU, MO); 53 (B, LAGU); J. Monterrosa & R. Carballo 262 (B, LAGU, MO); R. Seiler 196, 681 (F, MHES). Santa Ana: A. Hernández s.n. (ITIC). Morazán: R. Seiler 1034 (F, ITIC, MHES); 1051 (F, MHES).

Global distribution: USA, Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Guayana, Suriname, French Guyana, Ecuador, Peru, Brazil, Bolivia, Paraguay, Argentina, Australia.

Blechnum stoloniferum (Mett. ex E. Fourn.) C. Chr., Index Filic. 154. 1905.
Lomaria stolonifera Mett. ex E. Fourn., L. ghiesbreghtii Baker, Struthiopteris stolonifera (Mett. ex E. Forun.) Broadh., Blechnum ghiesbreghtii (Baker) C. Chr.
Global distribution: Mexico, Guatemala, Honduras, Costa Rica.
Salvadoran distribution: Santa Ana: R. Seiler 678 (F); 780 (MHES). Chalatenango: R. Seiler 731 (F, MHES).

Global distribution: Mexico, Nicaragua, Costa Rica, Panama, Colombia, Ecuador.
Salvadoran distribution: Santa Ana: A. Molina et al. 16837 (F); E.A. Montalvo 17 (ITIC).

Global distribution: Mexico, Costa Rica.

Woodwardia spinulosa M. Martens & Galeotti, Mém. Foug. Mexique 64. 1842.
Global distribution: Mexico, Guatemala, Honduras, Nicaragua.
Salvadoran distribution: Santa Ana: G. Davidsen et al. 37216 (B, BM, ITIC, LAGU, MO); V.M. Martinez s.n. (CMC00979) (B, LAGU, MO); s.n. (CMC01024) (B, BM, EAP, LAGU, MO); R. Seiler 471 (F, MHES); W. Berendsohn et al. 1679 (LAGU).
Chalatenango: R. Seiler 727 (MHES). Morazán: R. Seiler 1002 (F); 1027 (F, MHES).

CIBOTIACEAE

Cibotium regale Verschaff. & Lem., Ill. Hort. 15: under pl. 548 (F). 1868.
Cibotium guatemalense Rchb. f. ex Kuhn, C. wendlandii Mett. ex Kuhn
Local names: cabeza de niño.

Global distribution: Mexico, Guatemala, Belize, Honduras.


Note: listed as ‘at risk’ by MARN, 2004.

**CULCITACEAE**


Dicksonia conifolia Hook.

Global distribution: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Ecuador, Peru, Brazil, Bolivia.

Salvadoran distribution: Molina R. 12682, GH (Pérez-García in Davidse et al. 1995). **Santa Ana**: A. Molina et al. 12682 (F); R. Seiler 485 (F, ITIC, Mhes); 1129 (F, ITIC); L. Lara 279 (Mhes).

Note: listed as ‘at risk’ by MARN, 2004.

**CYATHEACEAE**


Global distribution: Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Ecuador.

Local names: helecho de espina, helecho cuerpo espin

Salvadoran distribution: **Ahuachapán**: M. Sandoval & E. Sandoval 9 (B, LAGU); W. Berendsohn et al. 1455 (B, LAGU).

**Alsophila salvinii** Hook. in Hooker & Baker, Syn. Fil. 36. 1866. *Cyathea salvinii* (Hook.) Domin, *Alsophila muenchii* Christ

Global distribution: Mexico, Guatemala, Belize, Honduras, Nicaragua, Peru.

Salvadoran distribution: R. Seiler 899, MO (Riba in Davidse et al. 1995). **Santa Ana**: A. Molina et al. 16749 (F); R. Seiler 296 (F, ITIC, Mhes).

Note: Listed as ‘threatened’ by MARN, 2004.

**Alsophila tryoniana** (Gastony) D.S. Conant, J. Arnold Arbor. 64: 371. 1983. *Nephelea tryoniana* Gastony

Global distribution: Mexico, Guatemala, Honduras, Nicaragua.


Note: Listed as ‘threatened’ by MARN, 2004.

Global distribution: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama.
Salvadoran distribution: Santa Ana: R. Seiler 301 (F, ITIC, MHES).
Note: Listed as ‘at risk’ by MARN, 2004; listed as Appendix II by CITES.


Global distribution: Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama.

Note: Listed as ‘at risk’ MARN, 2004; listed as Appendix II by CITES.


Global distribution: Costa Rica, Panama, Colombia, Venezuela, Guayana, Suriname, Ecuador, Peru.
Salvadoran distribution: _Sonsonate_: J. Monterrosa & D. Rodríguez 1539 (LAGU); R. Seiler 276 (MHES). _Morazán_: R. Seiler 980 (F, MHES).

Note: This species is cultivated at Los Planes, Montecristo national park (Pers. Obs.).


_Cyathea tuerckheimii_ Maxon, *Cyathea juergensenii_ E. Fourn.

Global distribution: Mexico, Belice, Guatemala, Nicaragua.
Salvadoran distribution: _Santa Ana_: J. Monterrosa & D. Rodríguez 1539 (LAGU); R. Seiler 276 (MHES). _Morazán_: R. Seiler 980 (F, MHES).

Note: Listed as ‘at risk’ MARN, 2004; listed as Appendix II by CITES.


Global distribution: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Colombia, Venezuela, Ecuador.

Note: Listed as Appendix II by CITES.


Global distribution: Mexico, Guatemala, Honduras, Panama.
Salvadoran distribution: _Santa Ana_: R. Seiler 243 (F, ITIC, MHES).

Note: Listed as ‘threatened’ by MARN, 2004; listed as Appendix II by CITES.
Global distribution: Mexico, Belize, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Colombia.
Salvadoran distribution: Santa Ana: J. Monterrosa & R. Carballo 848 (LAGU); R. Seiler 172, 237 (F, MHES). Chalatenango: J. Tucker 1129 (F); R. Seiler 760 (F, MHES). Morazán: J. Tucker 788 (F); R. Seiler 1082 (F, ITIC, MHES).
Note: Listed as ‘threatened’ by MARN, 2004; listed as Apendix II by CITES.

Cibotium horridum Liebm., C. princeps Linden ex J. Smith, Cyathea princeps E. Mayer, C. bourgaeau E. Fourn., C. glauca E. Fourn., C. muenchii Christ
Global distribution: Mexico, Guatemala, Belize, Honduras, Nicaragua.
Note: Listed as ‘at risk’ by MARN, 2004.

DENNSTAEDTIACEAE

Dicksonia bipinnata Cav., D. adiantoides Humb. & Bonpl. ex Willd. Local name: helecho palma de paraiso.
Global distribution: USA, Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Colombia, Venezuela, Trinidad and Tobago, Ecuador, Peru, Bolivia.

Dicksonia cornuta Kaulf.
Global distribution: Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Ecuador, Peru, Brazil, Bolivia, Argentina.
Salvadoran distribution: Santa Ana: R. Seiler 165, 271, 693, 1192 (F, MHES).

Dennstaedtia distenta (Kunze) T. Moore, Index Fil. 306. 1861.
Dicksonia distenta Kunze
Global distribution: Mexico, Guatemala, Costa Rica, Panama, Antilles.

Polypodium globiferum Poir., Dicksonia globulifera (Poir.) Kunze, Dennstaedtia gracilit A. Rojas & Tejero
Global distribution: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Ecuador, Trinidad and Tobago, Ecuador, Peru, Brazil, Bolivia, Paraguay, Argentina, Uruguay.
Salvadoran distribution: **San Salvador**: S. Winkler 74 (ITIC).

*Global distribution*: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama.
*Salvadoran distribution*: **Ahuachapán**: W. Berendsohn et al. 1320 (B, LAGU, MO).

Note: This collection was cited as *Dennstaedtia cicutaria* (Moran in Davidse et al. 1995), however it possesses spines that are diagnostic for *D. spinosa*.

*Histiopteris incisa* (Thunb.) J. Sm., Hist. Fil. 295. 1875.

*Pteris incisa* Thunb., *Litobrochia incisa* (Thunb.) C. Presl
*Global distribution*: Mexico, Guatemala, Honduras, Costa Rica, Panama, Antilles, Colombia, Venezuela, Ecuador, Peru, Brazil, Bolivia, Africa, Asia.
*Salvadoran distribution*: R. Seiler 1195 (UC) (Moran in Davidse et al. 1995). **Santa Ana**: A. Molina et al. 12534 (F); R. Seiler 253 (F, MHES). **Chalatenango**: J. Tucker 1122 (F).

*Global distribution*: Mexico, Guatemala, Honduras, Costa Rica.
*Salvadoran distribution*: **Santa Ana**: A. Molina et al. 12528, 16775, 16885 (F); R. Seiler 249, 294 (F, MHES). **Chalatenango**: R. Seiler 427 (JBL00108) (LAGU, MHES).


*Dennstaedtia munchii* H. Christ, *Hypolepis flexuosa* Sodiro
*Global distribution*: Mexico, Honduras, Costa Rica, Panama, Antilles, Colombia, Venezuela, Ecuador, Peru, Bolivia.
*Salvadoran distribution*: **Chalatenango**: Tucker 1121 (F).

*Global distribution*: Mexico, Guatemala, Honduras, Costa Rica, Panama, Antilles, Colombia, Venezuela, Ecuador, Peru, Brazil, Bolivia.
*Salvadoran distribution*: **Santa Ana**: J.Monterrosa & D.Rodríguez 1532 (LAGU)

*Hypolepis repens* (L.) C. Presl, Suppl. Tent. Pterid. 162. 1836.

*Global distribution*: Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Guyana, Suriname, French Guyana, Ecuador, Peru, Brazil, Bolivia.
*Salvadoran distribution*: **Santa Ana**: Tucker 1303 (F, LAGU (photo), NY).


*Pteris feei* W. Schaff. ex Fée, *Pteridium feei* (W. Schaffn. ex Fée) Faull
*Global distribution*: Mexico, Guatemala, Honduras.
*Salvadoran distribution*: **Santa Ana**: R. Seiler 777 (F, MHES). **Chalatenango**: R. Seiler 417 (JBL00109) (F, LAGU, MHES). **Morazán**: J. Tucker 696 (F); R. Seiler 1058 (F, MHES).
Note: An invasive species that has been responsible for the poisoning of cattle throughout the country (Ministerio de Ganaderia, Pers. Comm., 2005).

**Pteridium arachnoideum** (Kaulf.) Maxon, J. Wash. Acad. Sci. 14: 89. 1924.
Pteris arachnoidea Kaulf., *P. aquilina* L. var. arachnoidea (Kaulf.) D. C. Eaton, *Pteridium aquilinum* (L.) Kuhn var. arachnoidea (Kaulf.) Brade, *P. caudatum* (L.) Maxon subsp. arachnoideum (Kaulf.) Lellinger.

Local name: helecho petatillo

**Global distribution:** Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Guayana, Suriname, French Guyana, Ecuador, Peru, Brazil, Bolivia, Paraguay, Argentina, Uruguay.

**Salvadoran distribution:** Ahuachapán: D. Witsberger 665 (MHES); E. Sandoval & F. Chinchilla 429 (B, LAGU); R. Seiler 665 (MHES). **Santa Ana:** R. Seiler 306 (F, MHES). **Chalatenango:** D. Sloop & A. Reina 310 (MAG00739) (LAGU, U); R. Seiler 266 (F, MHES). **San Vicente:** R. Seiler 333 (MHES). **Morazán:** R. Seiler 1093 (F); 1094 (F, MHES).


**Global distribution:** USA, Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Guayana, Suriname, French Guyana, Ecuador, Peru.

**Salvadoran distribution:** **Santa Ana:** J. Monterrosa & R. Carballo 251 (B, LAGU, MO); J. Tucker 1298 (F). **La Libertad:** J.C. González 372 (B, LAGU, MO); J. Lagos s.n. (ITIC). **San Salvador:** M.C. Carlson 404, 418 (F); S. Calderón 461 (F). **Chalatenango:** M.C. Carlson 611 (F); R. Villacorta & A. Araniva 981 (B, LAGU, MO). **Usulután:** D. Williams & R.W. Herrera 451 (LAGU). **Morazán:** J. Tucker 697 (F).

**DICKSONIACEAE**


**Global distribution:** Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Colombia, Venezuela, Ecuador, Peru, Brazil, Bolivia, Uruguay.

**Salvadoran distribution:** **Santa Ana:** A. Molina et al. 12523, 16757, 16915, 16917 (F); M.C. Carlson 964 (F); R. Seiler 240 (F, ITIC, MHES); S. Winkler 100 (ITIC). **Chalatenango:** J. Tucker 1127 (F, MO) (Pérez-García in Davidse et al. 1995); R. Seiler 416 (JBL00094), (JBL00095) (F, LAGU, MHES).

Note: Note: listed as ‘at risk’ by MARN, 2004; listed as Apendix II by CITES.


**Global distribution:** Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama,
Antilles, Colombia, Venezuela, Trinidad and Tobago, Ecuador, Peru, Bolivia, Chile, Argentina.

**Salvadoran distribution:** Santa Ana: A. Molina *et al.* 16773 (F); G. Cerén & D. Rodriguez s.n. (JBL04655) (B, LAGU); s.n. (JBL04656), s.n. (JBL04657) (LAGU); R. Seiler 292 (F, ITIC, MHES). **Chalatenango:** J. Tucker 1150 (F). Morazán: R. Seiler 1030 (F, MHES).

Note: Listed as ‘threatened’ by MARN.

**DRYOPTERIDACEAE**


**Global distribution:** Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Guayana, Ecuador, Peru, Brazil, Bolivia.

**Salvadoran distribution:** Sonsonate: R. Seiler 607 (F, MHES). **Santa Ana:** A. Molina *et al.* 12497 (F); F. Wunderlin 543 (ITIC); G. Cerén & D. Rodriguez s.n. (JBL04653) (B, LAGU, MO); J. Monterrosa *et al.* 204 (AAU, B, BM, INB, LAGU, MEXU, MO); M.C. Carlson 953 (F); R. Seiler 126 (F, ITIC, MHES); 179 (MHES); 239 (F, MHES); V.M. Martínez s.n. (CMC01027) (B, LAGU, MO). **Chalatenango:** J. Tucker 1060 (F); R. Seiler 154 (F); 410 (F, ITIC, MHES); 423 (JBL00082) (LAGU, MHES); W. Berendsohn *et al.* 1573 (B, LAGU, MO). Morazán: J.L. Linares & A. Pool 2291 (JBL01780) (LAGU); R. Seiler 1065 (F, MHES).

*Bolbitis aliena* (Sw.) Alston, Kew Bull. 1932: 310. 1932.

**Acrostichum alienum** Sw., *Gymnopteris aliena* (Sw.) C. Chr.

**Global distribution:** Mexico, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Ecuador, Peru, Bolivia.


*Bolbitis bernoullii* (Kuhn ex Christ) Ching in Christensen, Index Filic., Suppl. 3: 47. 1934.

**Acrostichum bernoullii** Kuhn ex Christ, *Gymnopteris bernoullii* (Kuhn ex Christ) Diels in Engler & Prantl, G. tuerckheimii Christ, G donnell-smithii Christ, Leptochilus bernoullii (Kuhn ex Christ) C. Chr., L. tuerckheimii (Christ) C. Chr., L. donnell-smithii (Christ) C. Chr., *Bolbitis donnell-smithii* (Christ) Ching in C. Chr.

Local names: helecho cola de león.

**Global distribution:** Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Colombia, Ecuador.

**Salvadoran distribution:** Ahuachapán: M. Sandoval & E. Sandoval s.n. (ISB00801) (AAU, B, F, LAGU); M. Sandoval & E. Sandoval 299 (B, F, LAGU). **La Libertad:** W. Berendsohn *et al.* 1454 (LAGU).
Acerostichum portoricensis Spreng., A. cladorrhizans Spreng., A. irregulare Liebm., Gymnopteris portoricensis (Spreng.) Fée, Leptochilus cladorrhizans (Spreng.) Maxon, Bolbitis cladorrhizans (Spreng.) Ching in Christensen.

Local names: helecho colchón de león, helecho salamandra, pescadillo.

Global distribution: Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Ecuador.

Salvadoran distribution: Ahuachapán: A.K. Monro et al. 1954, 2987 (B, BM, ITIC, LAGU, MO); A. Sermeño s.n. (JBL01118), 97 (JBL01000) (B, LAGU, MO); E. Sandoval 1149 (B, LAGU); F. Chinchilla s.n. (ISB00314) (LAGU); J.M. Rosales 6 (AAU, B, BM, EAP, LAGU, MEXU, MO); 2450 (B, BM, LAGU, MEXU, MO); M. Sandoval & E. Sandoval 269 (B, F, LAGU); P. Standley et al. 2604 (F); R. Seiler 923 (MHES); T. Croat 42096 (ITIC); W. Berendsohn 1317 (B, LAGU, MO); 1724 (B, LAGU).
Santa Ana: J. Monterrosa et al. 84 (B, LAGU, MO); M. Magaña 45 (MP-00023) (LAGU); R. Seiler 706 (MHES).
La Libertad: A.K. Monro et al. 3771 (B, BM, ITIC, LAGU, MO); B. Pfeiffer-Berendsohn et al. 67 (B, LAGU, MO); F. Wunderlin 460 (ITIC); K. Sidwell et al. 479 (B, BM, ITIC, LAGU, MO); M.A. Hernández s.n. (JCG00562) (B, LAGU, MO); W. Heed 27, 28, 29 (ITIC).
San Salvador: K. Sidwell et al. 569 (B, BM, ITIC, LAGU, MO); R. Seiler 314, 454, 458 (F, MHES).
Chalatenango: R. Seiler 144 (F, MHES).
Cabañas: A.K. Monro et al. 3750 (B, BM, ITIC, LAGU, MO); R.A. Carballo et al. 259 (LAGU).
La Unión: A.K. Monro et al. 3537 (B, BM, ITIC, LAGU, MO).

Ctenitis equestris (Kunze) Ching var. equestris, Sunyatsenia 5: 250. 1940.
Lasreia ciliata Liebm., Polypodium alsophiloides Liebm., Aspidium bourgeaui E. Fourn., A. scabrisculum Davenport, Dryopteris davenportii C. Chr., D. equestris (Kunze) C. Chr. var. mentiens C. Chr.

Global distribution: Mexico, Belize, Guatemala, Honduras, Nicaragua, Costa Rica, Panama.

Salvadoran distribution: Ahuachapán: A.K. Monro et al. 2013 (B, BM, ITIC, LAGU, MO); G. Davidsé et al. 37379 (B, BM, ITIC, LAGU, MO); R. Seiler 814, 906 (F, MHES); 954 (MHES); W. Berendsohn & E. Sandoval 1510 (B, LAGU).
Sonsonate: A. Molina et al. 21630, 21673, 21775 (F, ITIC); 21770, 21773 (F); R. Seiler 612 (F, MHES).
Santa Ana: A. Molina et al. 12654, 21496 (F); 21513 (F, ITIC); D. Rodriguez & G. Cerén s.n. (JBL04604) (LAGU); J. Tucker 1216 (F); K. Sidwell et al. 440 (B, BM, ITIC, LAGU, MO); I. Lara 227, 228 (MHES); M. Magaña 23 (MP-00010) (LAGU); R. Seiler 19 (MHES); 350 (F, MHES); S. Winkler 67 (ITIC); T. Croat 42232 (ITIC); V.M. Martínez s.n. (CMC00819) (B, LAGU, MO); s.n. (CMC01000) (B, EAP, LAGU, MO).
San Salvador: M.C. Carlson 427, 477 (F); R. Seiler 208 (MHES); 209 (F, MHES).
Chalatenango: R. Seiler 435b (JBL04943) (LAGU, MHES).
San Vicente: R. Seiler 332 (F, MHES).
Morazán: R. Seiler 1006 (F, MHES).


Global distribution: Mexico, Guatemala, Honduras.

Salvadoran distribution: Santa Ana: R. Seiler 484, 690 (F, MHES).


Global distribution: Mexico, Guatemala, Honduras.
**Salvadoran distribution:** R. Seiler 890 (UC) (Mickel & Smith, 2004); Croat 42398 (CAS, MEXU) (Mickel & Smith, 2004). **Santa Ana:** B. Pfeiffer-Berendsohn 52 (B, LAGU, MO); J. Monterroso & R. Carballo 287 (B, BM, LAGU); R. Seiler 136 (MHES); 312 (F); 479 (F, ITIC, MHES). **Chalatenango:** Tucker 1140 (LL, UC, US) (Mickel & Smith, 2004).

**Ctenitis excelsa** (Desv.) Proctor, Rhodora 63: 34. 1961. *Polypodium excelsum* Desv., *Dryopteris excelsa* (Desv.) C. Chr. Local name: helecho colchón de león. **Global distribution:** Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles. **Salvadoran distribution:** *Ahuachapán:* A.K. Monro et al. 1945, 3078 (B, BM, ITIC, LAGU, MO); E. Sandoval 1148 (LAGU, MO); E. Sandoval & F. Chinchilla 488 (B, LAGU); R. Seiler 922 (F, MHES). **Santa Ana:** R. Seiler 879 (F).

**Ctenitis hemsleyana** (Baker) Copel., Gen. Fil. 124. 1947. *Polypodium hemsleyanum* Baker ex Hemsl., *Dryopteris hemsleyana* (Baker ex Hemsl.) C. Chr., *Ctenitis costaricensis* R.C. Moran **Global distribution:** Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama. **Salvadoran distribution:** **Morazán:** R. Seiler 1024 (F, MHES).


**Ctenitis nigrovenia** (Christ) Copel., Gen. Fil. 124. 1947. *Nephrodium nigrovenium* Christ in Donnell Smith, *Dryopteris nigrovenia* (Christ) C. Chr. Local name: helecho trecillo. **Global distribution:** Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Colombia, Venezuela, Peru, Bolivia. **Salvadoran distribution:** *Ahuachapán:* D. Witsberger 692, 655 (MHES); E. Sandoval 1135 (B, LAGU, MO); R. Seiler 817 (F, ITIC, MHES, NY).

**Ctenitis sloanei** (Poepp. ex Spreng.) C.V. Morton, Amer. Fern J. 59: 66. 1969. *Polypodium sloanei* Poepp. ex Spreng. **Global distribution:** USA, Mexico, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Ecuador, Peru, Bolivia. **Salvadoran distribution:** *Ahuachapán:* N. Herrera s.n. (JBL03707) (LAGU, MO). **San Salvador:** A.K. Monro et al. 3453 (B, BM, ITIC, LAGU, MO).

**Dryopteris karwinskyana** (Mett.) Kuntze, Revis. Gen. Pl. 2: 813. 1891. *Aspidium karwinskyanum* Mett., *Nephrodium karwinskyanum* (Mett.) Baker in Hooker & Baker. Local name: helecho pata de paloma. **Global distribution:** Mexico, Guatemala, Honduras, Nicaragua, Costa Rica. **Salvadoran distribution:** *Ahuachapán:* J.M. Rosales 1063 (AAU, B, BM, LAGU, MO); M. Sandoval & E. Sandoval 69, 102 (B, F, LAGU); W. Berendsohn et al. 1642 (B, BM, LAGU, MO). **La Libertad:** N. Ventura 5010, 5024 (ITIC). **San Salvador:** K.

Dryopteris patula (Sw.) Underw. var. moreliae Christ in Lecomte

Global distribution: Mexico, Guatemala, Costa Rica.

Salvadoran distribution: R. Seiler 1485 (MO) (Moran in Davidse et al. 1995)


Local names: helecho petatillo de montaña.

Global distribution: Mexico, Guatemala, Honduras, Costa Rica, Panama.


Dryopteris patula (Sw.) Underw., Native Ferns, ed. 4, 117. 1893.

Aspidium patulum Sw., A. paupertinum Kunze, A. mexicanum C. Presl var. obtusilobum Kunze ex Mett., A. apertum Fée, Dryopteris aperta (Fée) C. Chr., D. simplicior Mickel & Beitel

Local names: helecho cola de pavo real, helecho pata de comadreja, helecho pata de paloma, helecho pluma de faisán.

Global distribution: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Ecuador, Peru, Brazil, Bolivia, Paraguay.

Salvadoran distribution: Ahuachapán: E. Sandoval & M. Sandoval 1371 (B, LAGU); F. Chinchilla s.n. (ISS00538) (AAU, B, LAGU); s.n. (ISS00659) (AAU, B, F, LAGU); M. Sandoval & E. Sandoval 19 (B, LAGU); M. Sandoval 66 (B, F, LAGU). Sonsonate: R. Seiler 34, 611 (F, MHES); T. Croat 42245 (ITIC). Santa Ana: K. Prestegard 1 (MP-00012) (LAGU); M.B. Siu s.n. (ITIC); R. Seiler 82 (MHES); 500 (F, ITIC, MHES); 660 (F, MHES). La Libertad: E.A. Montalvo & R. Villacorta 6268 (B, LAGU). San Salvador: R. Seiler 25, 52 (F, MHES); 437 (F, ITIC, MHES); 441 (MHES); S. Winkler 79 (ITIC). Chalatenango: R. Seiler 567 (JBL04812) (F, LAGU); R. Seiler 142, 568 (F, MHES). San Vicente: R. Seiler 318 (JBL04806) (F, LAGU, MHES). Morazán: J. Monterrosa & M. Rivera 643 (B, EAP, LAGU); J. Monterrosa & C. Rivera 648 (BM, LAGU); S. Winkler 84 (ITIC).


Aspidium paleaceum D. Don, A. wallichianum Spreng., A. donianum Spreng., A. paleaceum Sw., A. parallelogrammum Kunze, A. crinitum M. Martens & Galeotti, Dryopteris paleacea (Sw.) C. Chr., D. parallelogramma (Kunze) Alston

Global distribution: Mexico, Guatemala, Honduras, Costa Rica, Panama, Antilles, Colombia, Venezuela, Ecuador, Peru, Brazil, Bolivia, Paraguay, Africa, Asia, Hawaii.

Salvadoran distribution: Chalatenango: Hammer s.n. (12-274) (MHES); R. Seiler 163 (F, MHES). San Vicente: S. Winkler 77 (ITIC).

Elaphoglossum affine (M. Martens & Galeotti) T. Moore, Index Fil. 4. 1857.

Acrostichum affine M. Martens & Galeotti

Global distribution: Mexico, Guatemala, Costa Rica, Panama, Colombia, Venezuela.

Global distribution: Mexico, Guatemala.

Global distribution: Mexico, Guatemala, Honduras, Costa Rica, Panama.
Salvadoran distribution: Santa Ana: R. Seiler 290 (F, MHES); R. Seiler 688 (F, MHES, NY).

Global distribution: Mexico, Guatemala, Honduras.
Salvadoran distribution: Santa Ana: A. Molina et al. 16855 (F); T. Croat 42423, holotipo MO, isotipo NY; R. Seiler 170 (F, MHES). Chalatenango: R. Seiler 397 (JBL00100) (F, LAGU, MHES); R. Seiler 429 (JBL00098), F (LAGU). Morazán: R. Seiler 992 (F, MHES).

Elaphoglossum erinaceum (Fée) T. Moore var. erinaceum, Index Fil. 9. 1857.
Acrostichum erinaceum Fée,
Global distribution: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Ecuador, Peru, Brazil, Bolivia.
Salvadoran distribution: Santa Ana: M.L. Reyna de Aguilar 839, 872 (MHES).

Elaphoglossum eximium (Mett.) Christ, Monogr. Elaph. 107. 1899.
Acrostichum eximium Mett.
Global distribution: Mexico, Guatemala, Honduras, Costa Rica, Panama, Antilles, Colombia, Venezuela, Ecuador, Peru, Bolivia.
Salvadoran distribution: Santa Ana: A. Molina et al. 16824; B. Pfeiffer-Berendsohn 35 (LAGU); J. Lagos s.n. (ITIC); R. Seiler 174 (F, MHES); S. Winkler 617 (ITIC).
Usulután: L. González 1942 (ITIC).

Acrostichum glabellum (J. Sm.) Klotzsch
Global distribution: Mexico, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Guayana, Suriname, Ecuador, Peru, Bolivia.
Salvadoran distribution: Ahuachapán: P. Standley 20172 (US).

Elaphoglossum glaucum T. Moore, Index. Fil. 10. 1857.
Acrostichum glaucum Fée, Elaphoglossum eucraspedum Christ
Global distribution: Mexico, Guatemala, Honduras.
Elaphoglossum guatemalense (Klotzsch) T. Moore, Parker’s Cat. 1858.
Acrostichum guatemalense Klotzsch, A. salvinii Baker ex Hemsl.
Global distribution: Mexico, Guatemala, Belize, Honduras.

Global distribution: Mexico, Guatemala, Honduras, Costa Rica, Panama.
Salvadoran distribution: Morazán: R. Seiler 1080 (F, ITIC, MHES).

Global distribution: Mexico, Guatemala, Honduras, Costa Rica, Panama.
Salvadoran distribution: Santa Ana: R.A. Carballo 649 (B, LAGU, MO); R. Seiler 104, 173 (F, MHES); 684 (MHES). Chalatenango: R. Seiler 161, 739 (F, MHES).

Elaphoglossum latifolium (Sw.) J. Sm., J. Bot. 1: 197. 1842.
Acrostichum latifolium Liebm., A. sartori Liebm., A. scapellum Kunze ex Fée, Elaphoglossum latifolium (Sw.) J. Sm. var. lutescens Rosenst., E. sartori (Liebm.) Mickel, E. scapellum (Kunze ex Fée) T. Moore
Global distribution: Mexico, Belize, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Guayana, Ecuador, Peru, Bolivia, Brazil.
Salvadoran distribution: Santa Ana: G. Cerén & D. Rodríguez s.n. (JBL04645) (LAGU); G. Davidse et al. 37290 (B, BM, ITIC, LAGU, MO); J.L. Linares & C.A. Martinez 1520 (JBL01904) (LAGU); J. Monterrosa & R. Carballo 859 (LAGU); J. Monterrosa et al. 174, 179 (LAGU); R. Seiler 103, 175, 657 (MHES); R. Villacorta et al. 1286, 1018 (B, LAGU, MO). Chalatenango: W. Berendsohn et al. 1596 (B, LAGU); R. Seiler 150, 749; 753 (F, MHES).
Note: Rojas-Alvarado (2003) notes that Elaphoglossum latifolium is taxonomically difficult because of variation in rhizome habit and scales, frond scales, size, apex and base shape. Rojas-Alvarado (2003) and Mickel & Smith (2004) suggests that E. latifolium sensu stricto may be restricted to the Caribbean islands. It would seem probable that the collections cited here as E. latifolium include more than one species.

Elaphoglossum lonchophyllum (Fée) T. Moore, Index. Fil. 360. 1862.
Acrostichum lonchophyllum Fée, Elaphoglossum acutissimum Christ
Global distribution: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Antilles.

Global distribution: Mexico, Guatemala, Honduras, Costa Rica, Panama.

Global distribution: Mexico, Guatemala.
San Vicente: R. Seiler 322 (F, MHES).

Global distribution: Mexico, Guatemala, Honduras, Nicaragua.
Salvadoran distribution: Santa Ana: M. Carlson 753 (F). San Salvador: M. Carlson 593 (F). Chalatenango: R. Seiler 258 (F, MHES); S. Calderón 2448 (F).
Note: Mickel & Smith (2004) cite Seiler 578 as Elaphoglossum yourkeorum (see below), this specimen may be conspecific to E. mesoamericanum but the two species have been maintained distinct here pending further research.

Acrostichum mexicanum E. Fourn.
Global distribution: Mexico, Guatemala, Honduras.

Global distribution: Endemic.

Elaphoglossum minutum (Pohl ex Fée) T. Moore, Index Fil. 12. 1857.
Acrostichum minutum Pohl ex Fée, A. conforme Sw. var. alpinum J. Bommer ex H. Christ?, A. leptophyllum Fée, Elaphoglossum leptophyllum (Fée) T. Moore
Global distribution: Costa Rica, Panama, Antillas, Colombia, Venezuela, Ecuador, Peru, Brazil, Bolivia, Brazil.

Elaphoglossum muscosum (Sw.) T. Moore, Index Fil. 12. 1857.
Acrostichum muscosum Sw., Elaphoglossum hookeriun Underw. ex Maxon
Global distribution: Mexico, Guatemala, Honduras, Costa Rica, Panama, Antilles, Colombia, Venezuela, Ecuador, Peru.

Acrostichum paleaceum Hook. & Grev., A. squamosum Sw., Elaphoglossum squamosum J. Sm., E. hirtum sensu auct., non Acrostichum hirtum Sw.
Global distribution: Mexico, Guatemala, Honduras, Costa Rica, Panama, Antilles, Colombia, Venezuela, Ecuador, Peru, Brazil, Bolivia, Hawaii.
Elaphoglossum peltatum (Sw.) Urb., Symb. Antill. 4: 60. 1903.
Osmunda peltata Sw., Acrostichum peltatum (Sw.) Sw., Rhipidopteris peltata (Sw.) Schott ex Fée, Peltapteris peltata (Sw.) C.V. Morton.
Local names: sombrillita.
Global distribution: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Guayana, Suriname, French Guyana, Ecuador, Peru, Bolivia.
Salvadoran distribution: Sonsonate: R. Seiler 597 (F, MHES). Santa Ana: A. Molina et al. 16754, 16850 (F; B). Pfeiffer-Berendsohn & W. Berendsohn 27 (B, F, LAGU, MO); G. Davidsen et al. 37298 (B, BM, ITIC, LAGU, MO); K. Sidwell et al. 846 (B, BM, ITIC, LAGU, MO); M.C. Carlson 882 (F); O. Rohweder s.n. (JBL01258), 2649 (JBL01243) (LAGU); R. Seiler 97 (F, ITIC, MHES); 868 (MHES). Morazán: R. Seiler 993 (F, MHES).

Elaphoglossum petiolatum (Sw.) Urb., Symb. Antill. 4: 61. 1903.
Acrostichum petiolatum Sw., A. viscosum Sw., A. schiedei Kunze, A. schmitzii Mett. ex Kuhn, Elaphoglossum viscosum (Sw.) J. Sm.
Global distribution: Mexico, Guatemala, Honduras, Costa Rica, Panama, Antilles, Colombia, Venezuela, Ecuador, Peru, Brazil.

Acrostichum piloselloides C. Presl
Global distribution: Mexico, Guatemala, Honduras, Costa Rica, Panama, Antilles, Colombia, Venezuela, Guayana, Suriname, French Guyana, Ecuador, Peru, Brazil, Bolivia, Chile.

Global distribution: Mexico, Guatemala, Honduras, Costa Rica, Panama.
Salvadoran distribution: San Vicente: R. Seiler 327 (F, MHES).

Elaphoglossum setosum (Liebm.) T. Moore, Index Fil. 366. 1862.
Acrostichum setosum Liebm., A. recognitum Kunze ex E. Fourn., Elaphoglossum catharinae Underw. ex Maxon
Global distribution: Mexico, Guatemala, Nicaragua, Costa Rica.
Salvadoran distribution: Chalatenango: J. Monterrosa et al. 1619 (BM, LAGU, MHES, NY).

Elaphoglossum squamipes (Hook.) T. Moore, Index Fil. 15. 1857.
Acrostichum squamipes Hook., A. ovatum Liebm., Elaphoglossum subaequale T. Moore
Global distribution: Mexico, Guatemala, Costa Rica, Panama, Antilles, Colombia, Venezuela, Ecuador, Peru, Brazil, Bolivia.
**Salvadoran distribution:** **Chalatenango**: R. Seiler 425 (JBL00096) (LAGU); R. Seiler 149 (F, MHES); 745 (MHES).


**Global distribution:** Mexico, Guatemala, Honduras, Costa Rica, Colombia, Venezuela, Ecuador, Peru, Brazil, Bolivia.

**Salvadoran distribution:** **San Salvador**: R. Seiler 31, 54, 515 (MHES). **Chalatenango**: W. Heed 31 (ITIC).


**Global distribution:** Mexico, Guatemala, Honduras.

**Salvadoran distribution:** **Chalatenango**: R. Seiler 578 (F, MHES, NY).


*Polypodium divergens* Willd.

**Global distribution:** Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Guayana, Suriname, French Guyana, Ecuador, Peru, Brazil, Bolivia, Paraguay.

**Salvadoran distribution:** **Santa Ana**: J. Monterrosa, D. Rodríguez & E. Pérez 1553 (BM, LAGU).


**Global distribution:** Mexico, Guatemala, Honduras, Costa Rica, Panama, Antilles, Colombia, Venezuela, Ecuador, Peru, Bolivia.

**Salvadoran distribution:** **Santa Ana**: J. Monterrosa & R. Martínez 944 (LAGU); J. Monterrosa et al. 961 (LAGU, NY).

♦♦ **Olfersia cervina** (L.) Kunze, Flora 7: 312. 1824.

**Global distribution:** Mexico, Guatemala, Belice, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Guayana, Suriname, French Guyana, Ecuador, Peru, Brazil, Bolivia.

**Salvadoran distribution:** **Cabañas**: G. Cerén 1788 (LAGU, MEXU, MHES); J. Monterrosa & D. Rodríguez 1633 (BM, LAGU, MHES, MO).

**Phanerophlebia juglandifolia** (Humb. & Bonpl. ex Willd.) J. Sm., J. Bot. (Hooker) 4: 187. 1841.

*Polypodium juglandifolium* Humb. & Bonpl. ex Willd., *Cyrtomium juglandifolium* (Humb. & Bonpl. ex Willd.) T. Moore

**Global distribution:** Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama,


Global distribution: Mexico, Guatemala, Costa Rica, Panama.
Salvadoran distribution: Chalatenango: R. Seiler 418 (JBL00081) (F, LAGU, MHES).


Polystichum aculeatum (L.) Roth var. alfaroi Christ

Global distribution: Mexico, Guatemala, Costa Rica, Panama.


Ahuachapán: J. Monterroso & D. Rodríguez 1343 (B, BM, LAGU, MO, NY).


Polystichum pallidum E. Fourn.

Global distribution: Mexico, Guatemala, Honduras.


Polystichum muelleri ex E. Fourn.

Global distribution: Mexico, Guatemala, Honduras.


Chalatenango: R. Sidwell et al. 833 (B, LAGU, MO).

Usulután: A.K. Monro et al. 3007 (B, BM, ITIC, LAGU, MO).


Local name: helecho trenza de sansón.

Global distribution: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Colombia?, Venezuela, Ecuador, Bolivia.
Global distribution: Mexico, Guatemala, Honduras.
Salvadoran distribution: P. Standley 20135, GH (Barrington in Davidse et al., 1995: 222).

Polystichum muenchii (Christ) C. Chr., Index Fil. 585. 1906.
Aspidium muenchii Christ
Global distribution: Mexico, Guatemala.

Polystichum muricatum (L.) Fée, Mém. Foug. 5: 278. 1852.
Polypodium muricatum L.
Local names: helecho pata de león, helecho rosquilla de altura, helecho trenza de sansón.
Global distribution: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Venezuela.
Salvadoran distribution: Ahuachapán: E. Sandoval 1134 (B, LAGU); F. Chinchilla et al. s.n. (ISB00091) (B, LAGU, MO); M. Sandoval & E. Sandoval 92 (B, F, LAGU); R. Villacorta et al. 906 (B, LAGU, MO). Usulután: D. Williams 58 (LAGU, MO).

Polystichum smithii Mickel & Beitel
Local name: helecho trenza de sansón.

EQUISETACEAE

Local name: cola de caballo.
Global distribution: Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Ecuador, Peru, Brazil, Bolivia, Paraguay, Uruguay, Argentina, Chile.
Salvadoran distribution: Santa Ana: M.B. Siu s.n. (ITIC); R. Villacorta & H. Sipman 1260 (B, LAGU, MO); V.M. Martinez s.n. (CMC00048) (B, BM, LAGU, MEXU, MO); V.M. Rosales 10 (ITIC). Chalatenango: B. López s.n. (ITIC); E.A. Montalvo 5435 (ITIC); R. Seiler 255 (F, ITIC, MHES).

Local name: cola de caballo.
Equisetum robustum A. Braun ex Engelm., E. robustum A. Braun ex Engelm. γ affine Engelm., E. hyemale L. subsp. affine (Engelm.) Calder & Roy Taylor
Global distribution: Canada, USA, Mexico, Guatemala, Asia.
**Equisetum myriochaetum** Schltdl. & Cham., Linnea 5: 623. 1830.

**Equisetum mexicanum** Milde

*Global distribution*: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Colombia, Venezuela, Ecuador, Peru.

*Salvadoran distribution*: **Santa Ana**: R. Villacorta *et al*. 1049 (B, LAGU, MO). **Chalatenango**: E.A. Montalvo 5279 (ITIC). **Morazán**: M. Renderos *et al*. 628 (B, BM, LAGU, MO).


*Global distribution*: Mexico, Guatemala a Peru.

*Salvadoran distribution*: S. Calderón 1864 (F, ITIC, US).

Note: *Equisetum x schaffneri* is believed to be a hybrid between *E. giganteum* and *E. myriochaetum* (Hauke, 1995: 326).

**GLEICHENIACEAE**


**Mertensia flexuosa** Schrad., **Gleichenia flexuosa** (Schrad.) Mett.

*Global distribution*: USA, Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Guyana, Suriname, French Guyana, Ecuador, Peru, Brazil, Bolivia, Paraguay.

*Salvadoran distribution*: **La Libertad**: M.C. Carlson 251 (F). **Usulután**: D. Williams 141 (LAGU, MO); J. Lagos 1777 (ITIC). **Morazán**: K. Sidwell *et al*. 736 (B, BM, ITIC, LAGU, MO); R. Seiler 1049b (F, ITIC, MHES); R. Villacorta *et al*. (B, LAGU).


**Gleichenia bancroftii** (Hook.) Kunze, **Mertensia bancroftii** (Hook.) Kunze var. vitellina Kunze, **Dicranopteris bancroftii** (Hook.) Underw., **Hicriopteris bancroftii** (Hook.) Ching

*Global distribution*: Mexico, Guatemala, Honduras, Costa Rica, Antilles, Colombia, Venezuela, Ecuador, Peru, Bolivia.

*Salvadoran distribution*: **Santa Ana**: J. Tucker 1184, F, K; Puller s.n. (12-548) (MHES); R. Seiler 238 (F, ITIC, MHES); S. Winkler 68 (ITIC).

**Gleichenella pectinata** (Willd.) Ching, Sunyatsenia 5: 276. 1940.

**Mertensia pectinata** Willd., **M. glaucescens** Humb. & Bonpl. *ex* Willd. var. *mexicana* Fée, **Gleichenia pectinata** (Willd.) C. Presl, **G. nitida** C. Presl, **Dicranopteris pectinata** (Willd.) Underw.

*Global distribution*: Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Guyana, Suriname, French Guyana, Ecuador, Peru, Brazil, Bolivia.

*Salvadoran distribution*: **Santa Ana**: A. Molina *et al*. 12577 (F); R. Seiler 460 (F, MHES); 1199 (F). **Chalatenango**: E.A. Montalvo s.n. (ITIC); M.C. Carlson 590 (F); R. Villacorta & A. Araniva 968 (B, LAGU, MO). **Morazán**: R. Seiler 983 (F, MHES).

**Sticherus bifidus** (Willd.) Ching, Sunyatsenia 5: 282. 1940.

**Mertensia bifida** Willd., **M. fulva** Desv., **M. gleichenioides** Liebm., **Gleichenia bifida** (Willd.) Spreng., **G. liebmannii** T. Moore, **Dicranopteris bifida** (Willd.) Maxon, **D. fulva**
Local name: helecho cien pié.
Global distribution: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Guayana, Suriname, French Guyana, Ecuador, Peru, Brazil, Bolivia.

Salvadoran distribution: **ahuachapáñ**: E. Sandoval & M. Sandoval 1375 (B, LAGU); J.M. Rosales 1294 (B, LAGU, MO). **Santa Ana**: H. Weber 293 (ITIC); M.C. Carlson 997 (F). **La Libertad**: M.A. Hernández s.n. (JCG00590) (B, LAGU, MO). **Morazán**: J. Tucker 792 (F).

**Sticherus brevipubis** (Christ) A. R. Sm., Amer. Fern J. 70: 27. 1980.
**Gleichenia brevipubis** Christ

Global distribution: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Ecuador.

Salvadoran distribution: **ahuachapáñ**: J.L. Linares 482 (JBL01980) (LAGU). **Santa Ana**: A. Molina et al. 12520 (F); G. Cerén & D. Rodríguez s.n. (JBL04661) (LAGU); G. Davidse et al. 37309 (B, BM, ITIC, LAGU, MO); M.L. Reyna de Aguilar 682 (MHES); R. Villacorta et al. 1065 (B, ITIC, LAGU, MO). **Chalatenango**: J. Tucker 1183 (F); R. Seiler 725 (F, MHES). **Morazán**: R. Seiler 989 (F, MHES).

**Mertensia palmata** W. Schaffn. ex Fée, **M. palmata** W. Schaffn. ex E. Fourn., **Gleichenia palmata** T. Moore, **G. palmata** W. Schaffn. ex E. Fourn., **Dicranopteris palmata** J. H. Schaffn. ex Underw.

Global distribution: Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles.

Salvadoran distribution: **Santa Ana**: J. Monterrosa & R. Carballo 273 (B, BM, LAGU, MO); R. Seiler 233 (F, ITIC, MHES); 241 (ITIC).

**Dicranopteris underwoodiana** Maxon, **Gleichenia underwoodiana** (Maxon) C. Chr.

Local names: helecho de mano, helecho pié de gallina.

Global distribution: Mexico, Guatemala, Honduras.

Salvadoran distribution: **Santa Ana**: A. Molina et al. 16747 (F; B). Pfeiffer-Berendsohn 38 (B, LAGU, MO); B. López s.n. (ITIC); G. Davidse et al. 37269 (B, BM, ITIC, LAGU, MO); R. Seiler 195 (MHES); 230 (ITIC, MHES); 251 (F, ITIC, MHES); W. Berendsohn et al. 1547 (B, LAGU). **Chalatenango**: R. Seiler 726 (F, MHES).

**HYMENOPHYLLACEAE**


Global distribution: Mexico, Guatemala, Honduras.

Salvadoran distribution: **Santa Ana**: A. Molina et al. 12638, 16767, 16811 F; 12488, 12504 (F, ITIC); M.C. Carlson 894 (F); R. Seiler 102 (F, MHES); 687, 876 (MHES); R. Villacorta et al. 1023 (B, LAGU, MO); W. Berendsohn et al. 1698 (B, LAGU, MO). **Chalatenango**: J. Tucker 1062a. **Morazán**: J.L. Linares & A. Pool 2296 (JBL01929) (LAGU).
Sphaerocionium crispum (Kunth) Klotzsch, S. schiedeanum C. Presl, Hymenophyllum schiedeanum (C. Presl) Bosch
Global distribution: Mexico, Guatemala, Honduras, Costa Rica, Antilles, Colombia, Venezuela, Ecuador, Peru, Brazil, Bolivia.
Salvadoran distribution: Chalatenango: J. Monterrosa et al. 1618 (BM, LAGU, MHES).

Hymenophyllum fucoides (Sw.) Sw., J. Bot. (Schrader) 1800(2): 99. 1801.
Trichomanes fucoides Sw., Mergingium fucoides (Sw.) Copel.
Global distribution: Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Guayana, Suriname, Ecuador, Peru, Brazil, Bolivia.
Salvadoran distribution: Santa Ana: B. Pfeiffer-Berendsohn & W. Berendsohn 22 (LAGU, MO); 31 (B, LAGU, MO); M.L. Reyna de Aguilar 877 (MHES); R. Seiler 284a (ITIC, MHES); 295 (F, MHES); 297 (F, ITIC, MHES). Chalatenango: R. Seiler 433 (F). Morazán: R. Seiler 996 (F, ITIC, MHES).

Sphaerocionium microcarpum (Desv.) Copel., Hymenophyllum angustifrons Christ, H. microcarpum Desv. var. lanceolatum C. V. Morton
Global distribution: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Dominica, Colombia, Venezuela, Guayana, Ecuador, Peru, Brazil, Bolivia.

Mecodium myriocarpum (Hook.) Copel., M. nigricans (C. Presl ex Klotzsch) Copel., Hymenophyllum nigrescens Liebm., Sphaerocionium nigricans C. Presl ex Klotzsch
Global distribution: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Colombia, Venezuela, Guayana, Suriname, French Guyana, Ecuador, Peru, Bolivia.

Hymenophyllum polyanthos (Sw.) Sw., J. Bot. (Schrader) 1800(2): 102. 1801.
Trichomanes polyanthos Sw., Mecodium polyanthos (Sw.) Copel., Hymenophyllum jalapense Schltdl. & Cham., H. millefolium Schltdl. & Cham., H. botryoides Bosch
Global distribution: Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Guayana, Suriname, French Guyana, Ecuador, Peru, Brazil, Bolivia, Africa, Asia.
Salvadoran distribution: Sonsonate: A. Molina et al. 21767 (F, ITIC); R. Seiler 599 (F, MHES). Santa Ana: A. Molina et al. 12629, 12661 (F, ITIC); 12685 F; G. Davidse et al. 37215 (B, BM, ITIC, LAGU, MO); R. Seiler 282 (F, MHES). Morazán: R. Seiler 988 (F).
**Hymenophyllum pulchellum** Schltdl. & Cham., Linnea 5: 618. 1830.
*Sphaerocionium pulchellum* (Schltdl. & Cham.) C. Presl, Hymenophyllum pannosum Christ

*Global distribution:* Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Brazil.


**Hymenophyllum tegularis** (Desv.) Proctor & Lourteig, Bradea 5: 385. 1990.
*Davallia tegularis* Desv., *Hymenophyllum elegans* Bosch, *Sphaerocionium elegans* (Bosch) Copel.

*Global distribution:* Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Ecuador, Peru, Bolivia.

*Salvadoran distribution: Santa Ana:* A. Molina *et al.* 12505 (F, ITIC); 16813 (F); R. Seiler 231 (F, ITIC, MHES); 683 (MHES); S. Winkler 91 (ITIC). *Chalatenango:* R. Seiler 435a (JBL00106) (F, ITIC, LAGU, MHES).

*Trichomanes tunbrigense* L., *Hymenophyllum fucoides* (Sw.) Sw. var. frigidum Liebm.

*Global distribution:* USA, Mexico, Guatemala, Honduras, Costa Rica, Panama, Antilles, Venezuela, Ecuador, Bolivia, Chile, Argentina; Europe, Africa, Australia.

*Salvadoran distribution:* Santa Ana: R. Seiler 125 (F, ITIC, MHES); 284 (F, MHES). *Chalatenango:* R. Seiler 432 (F, MHES).


*Global distribution:* Mexico, Guatemala, Belize, Honduras, Costa Rica, Panama, Antilles, Colombia, Venezuela, Ecuador, Peru.

*Salvadoran distribution:* Santa Ana: R. Seiler 964 (F, MHES).

*Trichomanes bradei* Christ

*Global distribution:* Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Guayana, Ecuador, Peru, Brazil.

*Salvadoran distribution:* Ahuachapán: E. Sandoval & F. Chinchilla 731 (B, LAGU).

**Santa Ana:** A. Molina *et al.* 16804 (F); R. Seiler 250 (F, MHES); 303 (F, ITIC, MHES).

**Usulután:** D. Williams 247 (LAGU).

**Trichomanes hymenoides** Hedw., Fil. Gen. Sp., t. 3. 1799.
*Trichomanes muscoides* Sw., *T. apodum* Hook., *Didymoglossum hymenoides* (Hedwig) Copel., *Microgonium schaffneri* Bosch ex Fée

*Global distribution:* Mexico, Guatemala, Belize, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Ecuador, Peru, Brazil, Bolivia, Argentina, Uruguay.

302 (F, MHES); 357 (F, ITIC, MHES); S. Winkler 64 (ITIC).

*Trichomanes leptophyllum* Bosch, *Vandenboschia hymenophylloides* (Bosch) Copel.  
**Global distribution**: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Guyana, Suriname, French Guyana, Ecuador, Brazil.  
**Salvadoran distribution**: Santa Ana: J.Monterrosa & D.Rodriguez 1586 (BM, LAGU, MO).

*Trichomanes krausii* Hook. & Grev., Icon. Filic. t. 149. 1831.  
*Didymoglossum krausii* (Hook. & Grev.) C. Presl, *Hemiphlebium krausii* (Hook. & Grev.) Prantl  
**Global distribution**: USA, Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Venezuela, Trinidad and Tobago, Guayana, Suriname, French Guyana, Ecuador, Peru, Brazil, Bolivia, Paraguay, Argentina.  
**Local names**: helecho musgo de pimiento  
**Salvadoran distribution**: Ahuachapán: E. Sandoval & F. Chinchilla 685 (B, LAGU).  
Santa Ana: S. Winkler 94 (ITIC).  
Moraizán: R. Seiler 1020 (F, MHES).

*Microgonium petersii* (A. Gray) Bosch, *Hemiphlebium petersii* (A. Gray) Prantl,  
**Global distribution**: USA, Mexico, Guatemala, Honduras, Nicaragua, Costa Rica.  
**Salvadoran distribution**: Chalatenango: R. Seiler 390 (JBL00107) (F, ITIC, LAGU, MHES).

*Trichomanes radicans* Sw., J. Bot. (Schrader) 1800(2): 97. 1801.  
*Trichomanes scandens* Hedw., *T. kunzeanum* Hook., *T. Mexicanum* Bosch,  
*Vandenboschia radicans* (Sw.) Copel.  
**Local names**: helecho plumajillo, helecho pluma de quetzal.  
**Global distribution**: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Guayana, Suriname, French Guyana, Ecuador, Peru, Brazil, Bolivia, Paraguay, Europe, Asia, Africa.  
**Salvadoran distribution**: Ahuachapán: A.K. Monro et al. 1982, 1985 (B, BM, ITIC, LAGU, MO); E. Sandoval & F. Chinchilla 44, 518 (B, LAGU); J.G. Sandoval et al. s.n. (ISB00026) (B, LAGU, MO); M. Sandoval & E. Sandoval s.n. (ISB00799) (AAU, F, LAGU); R. Seiler 812 (F, ITIC, MHES); 958 (F, MHES); W. Berendsohn et al. 1363 (B, BG, LAGU, MO).  
Sonsonate: A. Molina et al. 21771 (F); J.L. Linares & C.A. Martinez 3035 (JBL01905) (LAGU); R. Seiler 618 (F, ITIC, MHES).  
Santa Ana: A. Molina et al. 12648, 16905 (F); J. Monterrosa et al. 172 (B, BM, LAGU, MO); N. Lopez et al. s.n. (JBL04627) (LAGU); R. Seiler 116, 364 (F, ITIC, MHES); R. Villacorta & M. Calderon 368 (B, LAGU, MO); S. Winkler 93 (ITIC); W. Berendsohn et al. 1542 (B, LAGU, MO).  
San Salvador: R. Seiler 341 (F, MHES).  
Chalatenango: J. Tucker 1217 (F).

*Trichomanes reptans* Sw., Prodr. 136. 1788.  
*Didymoglossum reptans* (Sw.) C. Presl, *Hemiphlebium reptans* (Sw.) Prantl.
Global distribution: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Guyana, Suriname, French Guyana, Ecuador, Peru, Brazil, Bolivia, Paraguay, Argentina.

Salvadoran distribution: **Ahuachapán**: E. Sandoval & F. Chinchilla 576 (B, LAGU); G. Davidse et al. 37423 (B, BM, ITIC, LAGU, MO). **Sonsonate**: R. Seiler 598 (F, MHES). **Santa Ana**: S. Winkler 95 (ITIC). **Chalatenango**: R. Seiler 391 (F, MHES). **Usulután**: A.K. Monro *et al.* 3005 (B, BM, ITIC, LAGU, MO).


Global distribution: Honduras.


**LINDSAEACEAE**


Global distribution: Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Guyana, Suriname, French Guyana, Ecuador, Peru, Brazil, Bolivia.

Salvadoran distribution: **Morazán**: A.K. Monro *et al.* 3856 (B, BM, ITIC, LAGU, MO); K. Sidwell *et al.* 733, 734 (B, BM, ITIC, LAGU, MO); M. Renderos *et al.* 605 (AAU, B, LAGU, MO); R. Seiler 1073 (F, MHES).

Note: Seiler (1982) and Berendsohn (1989) treat *L. stricta* and *L. portoricensis* as distinct species.

> **Lonchitis hirsutus** L., Sp. Pl. 2: 1078. 1753.


Global distribution: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Suriname, Ecuador, Peru, SE Brazil, Bolivia.


**LOMARIOPSISIDACEAE**

*Cyclopeltis semicordata* (Sw.) J. Sm., Bot. Mag. 72 (Compendium): 36. 1846.

*Polypodium semicordatum* Sw., *Aspidium semicordatum* (Sw.) Sw., *Dryopteris semicordata* (Sw.) Kuntze, *Polypodium semicordatum* (Sw.) T. Moore

Global distribution: Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Guyana, Suriname, French Guyana, Ecuador, Peru, Brazil, Bolivia.

Salvadoran distribution: **Ahuachapán**: J.M. Rosales 488 (AAU, B, BM, LAGU, MO); R. Seiler 925 (F, MHES). **Sonsonate**: D. Rodriguez & M. Trejo 99 (LAGU). **San Miguel**: A. Salgado 70 (F, MHES); J. Tucker 925 (F).

*Nephrolepis biserrata* (Sw.) Schott, Gen. Fil., t. 3. 1834.

*Aspidium biserratum* Sw., *Nephrolepis mollis* Rosenst.

Global distribution: USA, Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa...
Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Guayana, Suriname, French Guyana, Ecuador, Peru, Brazil, Bolivia, Africa, Asia, Polynesia.
Local names: helecho cola de pescado
**Salvadoran distribution:** Ahuachapán: M. Magaña 17 (MP-00030) (LAGU). **La Libertad:** R. Seiler 1046 (F, MHES). **Chalatenango:** L. Lara 211 (MHES).

*Nephrolepis cordifolia* (L.) C. Presl, Suppl. Tent. Pterid. 79. 1836.
*Polypodium cordifolium* L.
Local names: centavito, helecho cola de ardilla.
**Global distribution:** USA, Mexico, Guatemala, Honduras, Panama, Antilles, Peru, Brazil, Trópicos del Viejo Mundo.
**Salvadoran distribution:** **La Libertad:** K. Prestegard 47 (MP-00028) (LAGU); M. Magaña 46 (MP-00027) (LAGU). **San Salvador:** R. Seiler 509 (F, MHES); Vaquerano s.n. (12-923) (MHES).

*Nephrolepis hirsutula* (G. Forst.) C. Presl, Suppl. Tent. Pterid. 79. 1836.
*Polypodium hirsutulum* G. Forst., *Davallia multiflora* Roxb., *Nephrolepis multiflora* (Roxb.) Jarret ex C.V. Morton
Local name: helecho cola de quetzal.
**Global distribution:** USA, Mexico, Belize, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Guayana, Ecuador, Peru, Brazil, Bolivia, Asia, Polynesia.
**Salvadoran distribution:** **Ahuachapán:** E. Sandoval & F. Chinchilla 79 (LAGU, MO); E. Sandoval & E. Fuentes 1300 (B, LAGU); E. Sandoval & M. Sandoval 1016 (B, LAGU); R. Seiler 945 (F); S. Castillo s.n. (ISF00687) (B, F, LAGU, MO); T. Croat 42159 (ITIC). **La Libertad:** E.A. Montalvo 73a (ITIC); K. Prestegard 27 (MP-00034) (LAGU). **San Salvador:** R. Seiler 223, 373 (F, MHES). **Chalatenango:** L. Lara 141 (MHES). **La Paz:** R. Villacorta et al. 2855 (AAU, B, BM, LAGU, MO). **Usulután:** D. Williams 51 (B, EAP, LAGU, MO). **Morazán:** R. Seiler 1044 (F, ITIC); 1088a (F, ITIC, MHES).

*Aspidium undulatum* Afzel. ex Sw., *Nephrolepis occidentalis* Kunze, *N. intermedia* Fée
Local names: helecho cola de iguana, helecho cola de quezallio, helecho quetzal.
**Global distribution:** Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Ecuador, Peru, Brazil, Bolivia, Africa, Asia.
**Salvadoran distribution:** **Ahuachapán:** E. Sandoval et al. 773, 1070 (B, LAGU); M. Sandoval & E. Sandoval 70 (B, F, LAGU). **Santa Ana:** B. Pfeiffer-Berendsohn 58 (B, LAGU, MO). **San Salvador:** R. Seiler 1215 (F, MHES). **San Salvador:** R. Seiler 44 (F, MHES); 637 (MHES).

**LYGODIACEAE**

*Lygodium mexicanum* C. Presl
Local names: alambrillo, helecho bejuco de san pablo, helecho cresplillo.
**Global distribution:** Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica,
Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Guayana, Suriname, French Guyana, Ecuador, Peru, Brazil, Bolivia, Paraguay.

**Salvadoran distribution**: 

**Ahuachapán**: A. Sermeño 42 (JBL00946) (B, F, LAGU, MO); D. Witsberger s.n. (12-998) (MHES); E. Sandoval & M. Sandoval 1150 (B, LAGU); F. Chinchilla s.n. (ISB00307), s.n. (ISB00377) (LAGU); J.L. Linares & C.A. Martínez 3085 (JBL01902) (LAGU); J.M. Rosales 241, 477 (AAU, B, BM, LAGU, MO); 1128 (B, BM, LAGU, MO); 1858, 2403 (B, BM, LAGU, MEXU, MO); M. Sandoval & E. Sandoval 106 (B, LAGU); O. Guerrero s.n. (ISF00448) (AAU, B, F, LAGU); O. Rivera D. & E. Sandoval s.n. (ISB00695) (AAU, B, F, LAGU); S. Castillo s.n. (ISF00108) (B, LAGU); W. Berendsohn et al. 1412 (B, LAGU, MO).

**Santa Ana**: J.C. González & R. Villacorta 121 (B, LAGU, MO); J.L. Linares & C.A. Martínez 1169 (JBL04295) (LAGU); K. Prestegard 22 (MP-00045) (LAGU).

**La Libertad**: L.O. Williams et al. 15218 (F); N. Ventura 5008 (ITIC); O. González et al. s.n. (JBL04501) (LAGU); R. Villacorta 1187 (B, LAGU, MO).

**San Salvador**: M.C. Carlson s.n., 11 (F).

**Chalatenango**: M.L. Reyna de Aguilar 269 (MHES).

**La Paz**: R. Villacorta & S. Villacorta 1147 (B, ITIC, LAGU, MO); W. Berendsohn et al. 1194 (B, F, HBG, LAGU).

**San Vicente**: P. Standley et al. 3516a, 3669 (F).

**San Miguel**: A. Salgado 68 (MHES); J. Tucker 816 (F).

**Cabañas**: G. Davidse et al. 37095 (B, BM, ITIC, LAGU, MO); R.A. Carballo et al. 222 (B, LAGU, MO).

**Morazán**: J. Monterrosa & C. Rivera 670 (B, BM, LAGU, MO).

**La Unión**: A.K. Monro et al. 2762 (B, BM, ITIC, LAGU, MO); G.W. Barclay 2632 (F).

**MARATTIACEAE**

**Marattia excavata** Underw., N. Amer. Fl. 16: 22. 1909.

Local names: helecho casco de mula, helecho casco de burro.

**Global distribution**: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama.

**Salvadoran distribution**: 

**Sonsonate**: J.L. Linares & C.A. Martínez 3046 (JBL01932) (LAGU).

**Santa Ana**: A. Molina et al. 21493 (ITIC); G. Cerén & D. Rodríguez s.n. (JBL04652) (LAGU); J. Monterrosa & R. Carballo 854 (LAGU); J. Monterrosa & R. Martínez 947 (LAGU); L. González s.n. (ITIC); L. Lara 229 (MHES); R. Seiler 268 (MHES); R. Villacorta et al. 1054 (B, LAGU, MO).

**Chalatenango**: R. Seiler 436 (JBL00112) (LAGU, MHES).

**Morazán**: R. Seiler 1031a (ITIC, MHES).

Note: Used by local people in Montecristo National Park as a contraceptive.


**Global distribution**: Mexico, Guatemala, Honduras, Costa Rica, Panama.

**Salvadoran distribution**: 

**Santa Ana**: R. Seiler 234 (F, MHES).

**MARSILEACEAE**


**Zaluzianskia ancylopoda** (A. Braun) Kuntze, Z. mexicana (A. Braun) Kuntze, *Marsilea mexicana* A. Braun

**Global distribution**: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Ecuador, Peru, Brazil, Bolivia, Paraguay, Argentina, Uruguay.
Salvadoran distribution: La Unión: N.C. Fassett 28654 (ITIC); R. Villacorta et al. 2708 (LAGU); J. Monterrosa & R. Villacorta 1636 (BM, LAGU, MHES, MO).

**OPHIOGLOSACEAE**

Global distribution: Mexico, Guatemala, Honduras, Costa Rica, Colombia, Venezuela, Ecuador, Peru, Bolivia, Argentina.

- *Botrychium ternatum* Hook. & Baker var. *daedaleum* Christ
Global distribution: Guatemala, Honduras, Costa Rica, Panama, Antilles, Colombia, Venezuela, Brazil.
Salvadoran distribution: Santa Ana: B. Pfeiffer-Berendsohn 46 (B, LAGU, MO); 49 (LAGU, MO); M.L. Reyna de Aguilar 778 (MHES); S. Winkler 8a (ITIC).

- *Botrychium virginianum* (L.) Sw., J. Bot. (Schrader) 1800(2): III. 1801.
Global distribution: Canada, USA, Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Ecuador, Peru, Brazil, Bolivia, Europe, Asia.
Salvadoran distribution: Santa Ana: F. Wunderlin 1230 (ITIC); J. Monterrosa et al. 197 (LAGU); 1023 (B, LAGU, NY); M.L. Reyna de Aguilar 679 (MHES); R. Seiler 132 (F, MHES); 252 (F, ITIC); 1146 (F). Chalatenango: R. Seiler 382 (JBL00093) (LAGU, MHES).

Global distribution: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Guayana, Suriname, French Guyana, Ecuador, Peru, Brazil, Bolivia, Argentina, Africa, Asia.
Salvadoran distribution: Santa Ana: M.L. Reyna de Aguilar 777 (MHES).

**OSMUNDACEAE**

- *Osmundastrum cinnamomeum* (L.) C. Presl
Global distribution: Canada, USA, Mexico, Guatemala, Honduras, Costa Rica, Antilles, Colombia, Venezuela, Ecuador, Peru, Brazil, Bolivia, Paraguay, Asia.
Salvadoran distribution: Sonsonate: R. Villacorta 768 (B, LAGU, MO). Morazán: R. Seiler 1009, 1075 (F, MHES); S. Winkler 7b (ITIC).
**Osmunda spectabilis** Willd., *O. mexicana* Fée, *O. palmeri* A. E. Bobrov  
Local names: helecho real.  
**Global distribution**: Canada, USA, Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Antilles, Colombia, Venezuela, Ecuador, Peru, Brazil, Bolivia, Paraguay, Argentina, Uruguay.  
**Salvadoran distribution**: Ahuachapán: G. Davidse et al. 37401 (B, BM, ITIC, LAGU, MO); N.C. Fassett 28718a (ITIC); N. Herrera s.n. (JBL03779) (B, LAGU, MO). Sonsonate: R. Villacorta 771 (B, LAGU, MO). Santa Ana: R. Seiler 779 (F). Morazán: R. Seiler 977 (F, ITIC, MHES).  

**POLYPODIACEAE**  

**Campyloneurum amphostemon** (Kunze ex Klotzsch) Fée, Mém. Foug. 5: 258. 1852.  
**Global distribution**: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Ecuador, Peru, Bolivia.  
**Salvadoran distribution**: Santa Ana: A. Molina et al. 16764 (F, ITIC); J. Monterrosa et al. 193 (B, BM, LAGU, MO); R. Seiler 89, 113 (F, MHES); 187 (MHES); 656, 669 (F, MHES); S. Winkler 49, 58 (ITIC). Chalatenango: R. Seiler 385 (JBL00203) (LAGU, MHES); 395 (JBL04945) (F, LAGU, MHES); 392, 754, 755 (F, MHES); W. Berendsohn et al. 1592 (B, LAGU, MO).  

**Campyloneurum angustifolium** (Sw.) Fée, Mém. Foug. 5: 257. 1852.  
*Polypodium angustifolium* Sw.  
**Global distribution**: USA, Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Ecuador, Peru, Brazil, Bolivia.  

**Campyloneurum costatum** (Kunze) C. Presl, Suppl. Tent. Pterid. 190. 1836.  
*Polypodium costatum* Kunze  
**Global distribution**: USA, Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Guayana, Suriname, French Guyana, Ecuador, Brazil.  
Source: Seiler (1982): 385 (as *Polypodium costatum*); Berendsohn (1989) 1: 17 (as *Polypodium costatum*).  

**Campyloneurum ensifolium** (Willd.) J. Sm., Cat. Cult. Ferns 12. 1857.  
*Polypodium ensifolium* Willd., *P. angustifolium* Sw. var. *ensifolium* (Willd.) Hicken, *Campyloneurum angustifolium* (Sw.) Fée var. *ensifolium* (Willd.) Farw.  
Local names: ajillo, helecho barba de cacique, helecho barbiquejo.  
**Global distribution**: Mexico, Guatemala.  
**Salvadoran distribution**: Jaurequi 87 (UC) (Mickel & Smith 2004). Ahuachapán: A.K. Monro et al. 2971, 3425 (B, BM, ITIC, LAGU, MO); E. Sandoval 1258 (B, LAGU);
Note: This species name has been placed in synonymy, or as a variety of *C. angustifolium*. Lellinger (1988) and León (1992) clarify the diagnostic characters (scale cell shape). See discussion by Mickel & Smith (2004) under *C. ensifolium*.

**Campyloneurum phyllitidis** (L.) C. Presl, Suppl. Tent. Pterid. 190. 1836.

*Polypodium phyllitidis* L.

*Global distribution:* USA, Mexico, Guatemala, Belize, Honduras, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Guayana, Suriname, French Guiana, Ecuador, Peru, Brazil, Bolivia.

*Salvadoran distribution:* *San Salvador:* R. Seiler 971 (F, MHES).

**Campyloneurum xalapense** Feé, Mém. Foug. 5: 258. 1852.


*Global distribution:* Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica.

*Salvadoran distribution:* *Ahuachapán:* M.L. Reyna de Aguilar 651 (MHES); R. Seiler 907 (F, ITIC, MHES). *Sonsonate:* R. Seiler 595 (F, MHES); R. Villacorta et al. 329 (LAGU, MO). *Santa Ana:* A. Molina et al. 12658; B. Pfeiffer-Berendsohn 48 (B, LAGU, MO); 76 (LAGU, MO); J. Monterrosa et al. 274, 670 (F, MHES); S. Winkler 57 (ITIC). *San Salvador:* M.C. Carlson 505 (F); S. Winkler 59 (ITIC). *San Vicente:* E.A. Montalvo 4655 (ITIC); R. Seiler 324 (F); 325 (F, MHES). *San Miguel:* M. Renderos et al. 672 (LAGU).


*Polypodium jungermannioides* Klotzsch, *Grammitis jungermannioides* (Klotzsch) Ching

*Global distribution:* Mexico, Guatemala, Honduras, Costa Rica, Panama, Antilles, Colombia, Venezuela, Brazil, Azores.


*Grammitis marginata* A. R. Sm.

*Global distribution:* Mexico, Guatemala, Honduras.

*Salvadoran distribution:* Tucker 1075 (UC) (A.R. Smith in Davidse et al. 1995).
Cochlidium rostratum (Hook.) Maxon ex C. Chr., Dansk Bot. Ark. 6(3): 23. 1929.
Monogramma rostrata Hook., Grammitis rostrata (Hook.) R. M. Tryon & A. F. Tryon
Global distribution: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama,
Antilles, Colombia, Venezuela.
Salvadoran distribution: Sonsonate: R. Seiler 606 (F, MHES). Santa Ana: A. Molina et al. 12492, 16796 (F); J. Toledo s.n. (ITIC); R. Seiler 98 (F, MHES); 647 (MHES).
Morazán: R. Seiler 997 (F, MHES); S. Winkler 46 (ITIC).

Acrostichum serrulatum Sw., Grammitis serrulata (Sw.) Sw., Xiphopteris serrulata (Sw.) Kauff., Polypodium serrulatum (Sw.) Mett., P duaule Maxon
Global distribution: Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Guayana, Ecuador, Peru, Brazil, Bolivia, Africa.

Polypodium apiculatum Kunze ex Klotzsch, Cienopteris apiculata (Kunze ex Klotzsch) Copel., Grammitis apiculata (Kunze ex Klotzsch) F. Seym.
Global distribution: Mexico, Guatemala, Honduras, Costa Rica, Panama, Antilles, Colombia, Venezuela, Guayana, Ecuador, Peru, Bolivia, Brazil.
Source: Seiler (1982): 385 (as Grammitis apiculata); Berendsohn (1989) 1: 16 (as Grammitis apiculata).

Grammitis prionodes Mickel & Beitel
Global distribution: Mexico, Guatemala, Honduras, Nicaragua.

Loxogramme mexicana (Fée) C. Chr., Index Filic. Suppl. 3: 25. 1934.
Selliguea mexicana Fée, Gymnogramma mexicana (Fée) Baker in Hooker & Baker, G salvinii (Hook.) Hook., Grammitis salvinii Hook., Loxogramme salvinii (Hook.) Maxon
Global distribution: Mexico, Guatemala, Nicaragua, Costa Rica, Panama.
Salvadoran distribution: Ahuachapán: E.A. Montalvo 57 (ITIC); G. Davidse et al. 37411 (B, BM, ITIC, LAGU, MO); R. Seiler 822 (F, MHES). Santa Ana: R. Seiler 359, 503 (F, MHES). San Salvador: R. Seiler 342 (F, MHES).

Grammitis deltata Mickel & Beitel

Global distribution: Mexico, Honduras.


Global distribution: Mexico, Guatemala, Honduras, Costa Rica, Panama, Antilles, Colombia, Venezuela, Guayana, Ecuador, Peru, Bolivia.

Salvadoran distribution: **Sonsonate**: R. Seiler 603 (MHES). **Santa Ana**: J. Monterrosa et al. 182 (LAGU); R. Seiler 96 (F, ITIC, MHES). **Chalatenango**: R. Seiler 737 (MHES). **Morazán**: R. Seiler 998 (F, MHES).


Global distribution: Mexico, Guatemala.

Source: Stolze (1981): 258 (as *Grammitis leptostoma*); Berendsohn (1989) 1: 16 (as *Grammitis leptostoma*).


*Polypodium moniliforme* Lag. ex Sw., *P. moniliforme* Lag. ex Sw. var. major Liebm. *Ctenopteris moniliformis* (Lag. ex Sw.) J. Sm., *Grammitis moniliformis* (Lag. ex Sw.) Proctor

Global distribution: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Ecuador, Peru, Brazil, Bolivia.

Salvadoran distribution: **Santa Ana**: L. Lara 98 (MHES); M.C. Carlson 900a (F); W. Berendsohn et al. 1550 (B, LAGU). **Chalatenango**: R. Seiler 431 (JBL04944) (F, LAGU, MHES); R. Seiler 748 (F, MHES); 758 (MHES); R. Villacorta et al. 2074 (B, LAGU, MO); W. Berendsohn et al. 1568 (B, LAGU, MO).


*Polypodium pilosissimum* M. Martens & Galeotti, *Ctenopteris pilosissima* (M. Martens & Galeotti) Copel., *Grammitis pilosissima* (M. Martens & Galeotti) C. V. Morton

Global distribution: Mexico, Guatemala, Honduras, Costa Rica, Panama, Colombia, Venezuela, Suriname, Ecuador, Peru, Bolivia, Brazil.

Source: Seiler (1982): 386 (as *Grammitis pilosissima*); Berendsohn (1989) 1: 16 (as *Grammitis pilosissima*).


Global distribution: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Ecuador, Peru, Bolivia.

Salvadoran distribution: **Santa Ana**: R. Seiler 93 (F, MHES); 95 (ITIC, MHES).
Polypodium basiattenuatum Jenman, Xiphopteris basiattenuata (Jenman) Copel.,
Grammitis basiattenuata (Jenman) Proctor, G. basiattenuata (Jenman) Proctor var.
valens Mickel & Beittel
Global distribution: Mexico, Guatemala, Honduras, Antilles, Venezuela.

Polypodium crassifolium L., Pessopteris crassifolia (L.) Underw. & Maxon
Local name: cincho.
Global distribution: Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica,
Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Guayana, Suriname,
French Guyana, Ecuador, Peru, Brazil, Bolivia, Paraguay.

Polypodium cupreolepis A. M. Evans, Pecluma cupreolepis (A. M. Evans) M. G. Price
Global distribution: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica.
Salvadoran distribution: Ahuachapán: J.M. Rosales 410 (AAU, B, BM, LAGU, MO); R. Seiler 914 (F, ITIC); 968 (F, MHES). Santa Ana: B. Pfeiffer-Berendsohn 81 (LAGU, MO); G. Cerén & D. Rodríguez s.n. (JBL04647) (LAGU); J. Tucker 1249 (F); R. Seiler 129 (F, MHES); 287 (MHES). Chalatenango: R. Seiler 385 (F, MHES). San Vicente: E.A. Montalvo 73b (ITIC). San Miguel: W. Eggler 665 (ITIC). Morazán: R. Seiler 1023 (F, MHES).

Polypodium plumula Humb. & Bonpl. ex Willd., P. pulchrum M. Martens & Galeotti, P. pulchrum M. Martens & Galeotti var. minus E. Fourn., Ctenopteris plumula (Humb. & Bonpl. ex Willd.) J. Sm.
Global distribution: USA, Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Guayana, Suriname, French Guyana, Ecuador, Peru, Brazil, Bolivia.

Polypodium pseudoaureum Cav., Polypodium areolatum Humb. & Bonpl. ex Willd., P.

Local names: helecho calaguala, helecho cola de pavo real.

Global distribution: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Guayaquil, Ecuador, Peru, Brazil, Bolivia, Argentina, Paraguay.

Salvadoran distribution: Ahuachapán: D. Witsberger 696 (MHES); E. Sandoval & M. Sandoval 1299 (B, LAGU); W. Berendsohn et al. 1458 (LAGU). Santa Ana: G. Davidse et al. 37233 (B, BM, ITIC, LAGU, MO); J. Monterrosa & R. Carballo 284 (B, BM, EAP, F, LAGU, MO); R. Seiler 185 (MHES). San Salvador: J. Monterrosa 284 (B, BM, EAP, F, LAGU, MO); R. Seiler 913, 965 (F, MHES); W. Berendsohn et al. 1456, 1459 (LAGU). Sonsonate: R. Seiler 627 (F, MHES). La Libertad: W. Berendsohn et al. 1445 (LAGU); W. Eggler 681 (ITIC). San Miguel: A.K. Monro et al. 2253 (B, BM, ITIC, LAGU, MO); M.C. Carlson 429 (F); O. Rohweder s.n. (ITIC); R. Seiler 26 (F, ITIC, MHES). Usulután: A.K. Monro et al. 2999 (B, BM, ITIC, LAGU, MO); D. Williams 129 (B, LAGU, MO).


Polypodium angustum (Humb. & Bonpl. ex Willd.) Liebm.

Global distribution: Mexico, Guatemala, Honduras, Nicaragua.

Local names: helecho mano de mapache, helecho pie de mapache.

Salvadoran distribution: Ahuachapán: A.K. Monro et al. 2977, 3426 (B, BM, ITIC, LAGU, MO); D. Witsberger 688 (MHES); E. Sandoval & M. Sandoval 1298 (B, LAGU); F. Chinchilla s.n. (ISB00206) (B, LAGU, MO); M. Magaña 16 (MP-00040) (LAGU); R. Seiler 913, 967 (F, MHES); S. de Moore s.n. (12-927) (MHES); W. Berendsohn et al. 1456, 1459 (LAGU). Santa Ana: B. Pfeiffer-Berendsohn et al. 10 (B, F, LAGU, MO); G. Cerén & D. Rodriguez s.n. (JBL04668) (LAGU); J. Monterrosa et al. 175 (B, BM, LAGU, MO); 176 (B, LAGU, MO); J. Monterrosa et al. 920 (B, LAGU, NY); 973 (LAGU); K. Sidwell et al. 436 (B, BM, ITIC, LAGU, MO); M.B. Siu s.n. (ITIC); R. Seiler 168 (F, MHES). La Libertad: W. Berendsohn et al. 1445 (LAGU); W. Eggler 681 (ITIC). San Salvador: A.K. Monro et al. 2253 (B, BM, ITIC, LAGU, MO); M.C. Carlson 429 (F); O. Rohweder s.n. (ITIC); R. Seiler 26 (F, ITIC, MHES). Usulután: A.K. Monro et al. 2999 (B, BM, ITIC, LAGU, MO); D. Williams 129 (B, LAGU, MO).


Polypodium astrolepis Liebm., P. elongatum (Sw.) Mett., P. lanceolatum L. var. elongatum (Sw.) Krug, Phlebodium astrolepis (Liebm.) Conzantti, Grammitis laceolata Schkuhr, G. revoluta Spreng. ex Willd., Gymnogramma elongata (Sw.) Hook., Pleopeltis revoluta (Spreng. ex Willd.) A. R. Sm.

Local names: helecho barba amarilla, helecho barba negra, helecho barboquejo.

Global distribution: USA, Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Suriname, French Guyana, Ecuador, Peru, Brazil, Bolivia.

Salvadoran distribution: Ahuachapán: A.K. Monro & M.L. Fomtg 2973 (B, BM, ITIC, LAGU, MO); D. Witsberger 711 (MHES); E. Sandoval et al. 729, 1430 (B, LAGU); F. Chinchilla s.n. (AAU, B, LAGU); M. Sandoval & E. Sandoval 138 (F, LAGU); P. Standley et al. 2516 (F); R. Seiler 928, 965 (F, MHES); W. Berendsohn et al. 1430 (B, LAGU, MO); 1466 (LAGU). Sonsonate: R. Seiler 77 (F). Santa Ana: B.
Pfeiffer-Berendsohn 20 (LAGU, MO); V.M. Martínez s.n. (CMC00103) (LAGU).

La Libertad: J. Monterrosa et al. s.n. (JBL04485) (LAGU); N. Ventura 5020 (ITIC); O. Rohwedder 2634 (JBL01246), 2635 (JBL01245), 2636 (JBL01244) (LAGU); W. Zelaya et al. s.n. (LAGU).

San Salvador: R. Seiler 507 (F, MHES); 1515 (F).

San Vicente: E.A. Montalvo 5098 (ITIC).

Usulután: E.A. Montalvo 5047 (ITIC); J. Lagos 1783 (ITIC).

Cuscatlán: C. Salazar s.n. (ITIC).


Drymaria mexicana Fée, Polypodium lanceolatum L. var. trichophorum Weath., Pleopeltis macrocarpa (Bory ex Willd.) Kaulf. var. trichophora (Weath.) Pic. Serm.

Global distribution: Mexico, Guatemala, Honduras, Nicaragua.

Salvadoran distribution: Santa Ana: A. Molina et al. 12652 (F; B). Pfeiffer-Berendsohn 26, 78, 79 (B, LAGU, MO); 56 (LAGU, MO); G. Davidse et al. 37164, 37306 (B, BM, ITIC, LAGU, MO); J. Monterrosa et al. 171 (B, BM, LAGU, MO); R. Seiler 109 (F, MHES); S. Winkler 56 (ITIC). Chalatenango: R. Seiler 386 (JBL00201) (ITIC, LAGU); R. Seiler 152, 729 (F, MHES). Morazán: R. Seiler 1005 (F, ITIC, MHES); 1015 (F, MHES).


Polypodium peltatum Cav. var. interjectum Weath., Pleopeltis macrocarpa (Bory ex Willd.) Kaulf. var. interjectum (Weath.) A. R. Sm., P. interjecta (Weath.) Mickel & Beitel

Global distribution: Mexico, Guatemala.

Salvadoran distribution: Santa Ana: W. Berendsohn et al. 1714 (B, LAGU).


Global distribution: Mexico, Guatemala, Honduras, Nicaragua.

Salvadoran distribution: Sonsonate: R. Seiler 633 (MHES). Santa Ana: A. Molina et al. 12562 (F; B). Pfeiffer-Berendsohn 77 (B, LAGU, MO); E.A. Montalvo s.n., 3641 (ITIC); G. Cerén & D. Rodriguez s.n. (JBL04667) (LAGU); G. Davidse et al. 37301 (B, BM, ITIC, LAGU, MO); J. Monterrosa et al. 165 (B, BM, LAGU, MO); 951, 964 (B, LAGU, NY); 1007 (LAGU, NY); K. Sidwell et al. 847 (B, BM, ITIC, LAGU, MO); M.C. Carlson 726, 727, 970 (F); N.C. Fassett 28292 (ITIC); R. Seiler 87 (F); 91, 190 (F, MHES); R. Villacorta & Claus 2147 (B, LAGU, MO); W. Berendsohn 1303 (LAGU, MO). San Salvador: R. Seiler 214 (F, MHES). Chalatenango: R. Seiler 398 (JBL00198) (F, LAGU, MHES); W. Heed 36 (ITIC). San Vicente: R. Seiler 326 (MHES).


Global distribution: Guatemala.


Polypodium colpodes Kunze var. colpodes, Linnea 23: 276, 316. 1850.

Polypodium fuscopetiolatum A. R. Sm.

Local names: helecho calaguala rojo, helecho de árbol, helecho pluma de ganzo.

Global distribution: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Colombia.

*Goniophlebium lepidotrichum* Fée

**Global distribution**: Mexico.

**Salvadoran distribution**: **Ahuachapán**: J. Monterrosa & D. Rodríguez 1446 (BM, IZTA, LAGU).


**Global distribution**: Mexico, Guatemala, Honduras.

**Local names**: helecho calaguala

**Salvadoran distribution**: **Chalatenango**: W. Berendsohn et al. 1571 (B, LAGU); R. Seiler 156, 164, 756 (F, MHES).

**Polypodium furfuraceum** Schltld. & Cham., Linnea 5: 607. 1830.

**Polypodium nivosum** Fée, *P. furfuraceum* Schltld. & Cham. var. *coronulatum* E. Fourn., *P. furfuraceum* Schltld. & Cham. var. *rufum* E. Fourn., *P. margallii* Rovirosa

**Local names**: cola de ardilla, helecho peine de indígena, helecho peinetero rojo, palmita de café.

**Global distribution**: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Peru, Bolivia.

**Salvadoran distribution**: **Ahuachapán**: A.K. Monro & M.L. Fomtg 2972 (B, BM, ITIC, LAGU, MO); E. Sandoval et al. 1190, 1403 (B, LAGU); F. Chinchilla & E. Sandoval s.n. (ISB00428) (LAGU); R. Seiler 829 (ITIC); 970 (F, MHES); S. de Moore s.n. (12-929) (MHES); W. Berendsohn et al. 1429 (LAGU). **Santa Ana**: B. Pfeiffer-Berendsohn 19 (LAGU); E.A. Montalvo 5350 (ITIC); L.O. Williams et al. 16746 (F); S. Flores 8 (ITIC). **San Vicente**: E.A. Montalvo 5091 (ITIC). **Cuscatlán**: C. Salazar s.n. (ITIC). **Usulután**: D. Williams & R.W. Herrera 300 (LAGU). **San Miguel**: A. Salgado 65b (F, MHES). **La Unión**: A.K. Monro et al. 2123 (B, BM, ITIC, LAGU, MO).

**Polypodium hartwegianum** Hook. in Bentham, Pl. Hartw. 54. 1840.

**Polypodium ellipsoideum** Fée, *P. pubescens* Fée

**Global distribution**: Mexico, Guatemala, Honduras.

**Salvadoran distribution**: **Santa Ana**: A. Molina et al. 12560 (F, ITIC); J. Monterrosa et al. 1031, B, IZTA (LAGU, NY); 1044, IZTA (LAGU); L. Lara s.n. (12-992) (MHES);
*Global distribution*: Mexico, Guatemala, Belize, Honduras, Nicaragua.  

Polypodium lindenianum Kunze, Farrnkräuter 2: 83. 1851.  
Polypodium cancellatum Fée, P. verapax Christ  
*Global distribution*: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica.  

Pleopeltis muenchii (Christ) A. R. Sm., Microgramma muenchii (Christ) Copel., Microphlebodium muenchii (Christ) L. D. Gómez  
*Global distribution*: Mexico, Guatemala, Honduras.  
*Salvadoran distribution*: Chalatenango: R. Villacorta *et al*. 2075 (B, LAGU); R. Seiler 400 (JBL00200) (LAGU); R. Seiler 153 (MHES); Tucker 1070 (EAP, F).

Polypodium plebeium Schltdl. & Cham., Linnea 5: 607. 1830.  
Polypodium cheilostictum Fée, P. karwinskyanum (C. Presl) A. Braun ex Kunze, Marginaria karwinskyana C. Presl  
*Global distribution*: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama.  

Polypodium plesiosorum Kunze var. plesiosorum, Linnea 18: 313. 1844.  
Local name: calaguala.  
*Global distribution*: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama.  
*Salvadoran distribution*: Ahuachapán: A. K. Monro *et al*. 3428 (B, BM, ITIC, LAGU, MO). **Sonsonate**: A. Molina *et al*. 21758 (F, ITIC); R. Seiler 594 (F, MHES). **Santa Ana**: G. Davidse *et al*. 37240, 37307 (B, BM, ITIC, LAGU, MO); J. Monterrosa *et al*. 932 (B, LAGU, NY); L. Lara 223 (MHES); R. Seiler 167 (F, ITIC, MHES); 344 (F, MHES). **Chalatenango**: R. Seiler 388 (JBL00197) (F, LAGU, MHES); R. Seiler 757 (F, MHES).

Local name: calaguala.
Global distribution: Mexico, Guatemala, Nicaragua.
Salvadoran distribution: **Santa Ana**: Linares s.n. (JBL01320) (B, LAGU, MO).
Note: var. rubicundum is found in Mexico, Honduras, Costa Rica and Panama.


Local name: helecho calaguala.

Global distribution: Mexico, Guatemala, Honduras, Costa Rica, Panama.

Salvadoran distribution: **Ahuachapán**: D. Witsberger 65b (MHES); E.A. Montalvo 3506 (ITIC); M. Sandoval & E. Sandoval 16 (LAGU); T. Croat 42145 (ITIC).
**Sonsonate**: M.B. Siu s.n. (ITIC); T. Croat 42207 (ITIC).
**Santa Ana**: D. Rodriguez et al. 5 (B, LAGU, NY); J. Monterrosa & R. Carballo 224, 285 (B, LAGU); J. Monterrosa et al. 965 (B, NY, LAGU); M.B. Siu s.n. (ITIC); N. López et al. s.n. (JBL04626) (LAGU); R. Seiler 191, 280 (MHES); R. Villacorta & M. Calderón 375 (LAGU, MO).
**San Salvador**: R. Seiler 27 (F, MHES); 512 (MHES).
**Chalatenango**: J. Tucker 1031, 1252 (F); R. Seiler 407 (JBL00195) (F, LAGU, MHES); 732 (MHES).

**Polypodium polypodioides** (L.) Watt. (B, LAGU, MHES); 512 (MHES).

Local name: helecho peinetero amarillo.

Global distribution: USA, Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Guayana, Suriname, French Guyana, Ecuador, Peru, Brazil, Bolivia, Paraguay, Uruguay, Argentina.

Salvadoran distribution: **Ahuachapán**: F. Chinchilla s.n. (ISB00568) (AAU, B, F, LAGU); J.M. Rosales 2537 (B, BM, LAGU, MO); 2673 (B, LAGU, MO).
**La Paz**: R. Villacorta & S. Villacorta 1173 (B, LAGU, MO).
**Usulután**: A. del Cid 1782 (ITIC); D. Williams 50 (B, LAGU, MO); R. Seiler 588 (MHES).
**Morazán**: J. Monterrosa & C. Rivera 705 (B, BM, LAGU).


**Pleopeltis polypodioides** (L.) Watt var. *aciculare* (Weath.) E. G. Andrews & Windham
Local name: helecho peinetero rojo.

Global distribution: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama.

Salvadoran distribution: **Ahuachapán**: E. Sandoval et al. 540, 1291 (B, LAGU); M. Sandoval & E. Sandoval 94 (LAGU); R. Seiler 828 (ITIC, MHES); 912 (F, ITIC, MHES); R. Villacorta et al. 880 (B, LAGU, MO).
**Sonsonate**: R. Seiler 78 (MHES).
**Santa Ana**: B. Pfeiffer-Berendsohn & W. Berendsohn 11 (LAGU, MO); J. Monterrosa et al. 225 (B, BM, LAGU, MO); R. Seiler 169 (ITIC, MHES).
**San Salvador**: R. Seiler 215 (MHES).
**San Miguel**: A. Salgado 65a (MHES).
**La Unión**: R. Seiler 216 (MHES).
Polypodium puberulum Schltdl. & Cham., Linnea 5: 607. 1830.

Polypodium ehrenbergianum Klotzsch, P. olivaceum Liebm. var. elatum Liebm., P. pubescens Fée, P. fournieri C. Chr., P. galeottii Mett. ex Kuhn, P. glaberulum Mickel & Beitel

Global distribution: Mexico.
Salvadoran distribution: Chalatenango: R. Seiler 752 (F, MHES).


Polypodium isomeron E. Fourn., P. lesourdianum E. Fourn.

Global distribution: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama.

Polypodium sanctae-rosae (Maxon) C. Chr., Index Filic., Suppl. I: 62. 1913.

Goniophlebium sanctae-rosae Maxon

Global distribution: Mexico, Guatemala, Honduras, Nicaragua.


Polypodium subpetiolatum Hook. in Bentham, Pl. Hartw. 54. 1840.

Polypodium biserratum M. Martens & Galeotti, P. schaffneri Fée, P. guilleminianum E. Fourn., P. hahnii E. Fourn., P. firmulum Maxon, P. maxonii C. Chr., P. adelphum Maxon, P. teresae Maxon

Global distribution: Mexico, Guatemala, Honduras.
Salvadoran distribution: San Vicente: R. Seiler 328 (F, MHES).

Polypodium thyssanolepis A. Braun ex Klotzsch, Linnaea 20: 392. 1847.

Goniophlebium thyssanolepis (A. Braun ex Klotzsch) T. Moore, G. rhagadiolepis (Fée) Fée, Marginaria thyssanolepis (A. Braun ex Klotzsch) Farw., Polypodium incanum Sw. var. fimbriatum M. Martens & Galeotti, P. rhagadiolepis Fée, P. purpusii Christ

Global distribution: USA, Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Ecuador, Peru, Bolivia.

Salvadoran distribution: Chalatenango: J.Monterrosa et al. 1612 (BM, LAGU, IZTA, MHES).

Polypodium ursipes Moritz ex C. Chr., Index Filic. 572. 1906.

Polypodium ambiguum Mett. ex Kuhn

Global distribution: Costa Rica, Panama.


Goniophlebium calaguala Fée, G. invertens Fée, Polypodium falcaria Kunze.

Global distribution: Mexico, Guatemala, Honduras.
Salvadoran distribution: Santa Ana: A. Molina et al. 16774 (F; B). Pfeiffer-Berendsohn 23, 37 (LAGU, MO); J. Monterrosa & R. Carballo 852 (B, LAGU, MO); M.C. Carlson 728 (F); R. Seiler 123, 176 (F, MHES); 651 (MHES); V.M. Martinez s.n.

Note: The name *Polypodium loriceum* has been applied by Löetschert (1954), Stolze (1981), Seiler (1982) and Moran in Davidse et al. (1995) to this species. See discussion as *P. falcaria* in Mickel & Smith (2004).


Global distribution: Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Guayana, Suriname, French Guyana, Ecuador, Peru, Brazil, Bolivia, Paraguay.

Local names: helecho calaguala, helecho yema de huevo.

Salvadoran distribution: *Ahuachapán*: F. Chinchilla & M.J. López s.n. (ISB00635) (AAU, B, F, LAGU); M. Sandoval & E. Sandoval s.n. (ISB00929) (B, F, LAGU, MO).
*San Salvador*: E.A. Montalvo 20 (ITIC).
*Chalatenango*: D. Sloot et al. 41 (MAG00470) (LAGU, U).
*Morazán*: J. Monterrosa & C. Rivera 695 (B, LAGU, MO).


Global distribution: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Guadalupe, Colombia, Venezuela, Guayana, Ecuador, Peru, Bolivia.


*Polypodium asplenifolium* L., *P. laxifrons* Liebm., *Ctenopteris asplenifolia* (L.) Copel., *Grammitis asplenifolia* (L.) Proctor

Global distribution: Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Guayana, Ecuador, Peru, Bolivia.


*Polypodium cultratum* Willd., *Ctenopteris cultrata* (Willd.) Copel., *Grammitis cultrata* (Willd.) Proctor

Global distribution: Mexico, Guatemala, Honduras, Costa Rica, Panama, Antilles, Colombia, Venezuela, Ecuador, Peru, Brazil, Bolivia.

Polypodium delicatulum M. Martens & Galeotti, Ctenopteris delicatula (M. Martens & Galeotti) J. Sm., Grammitis delicatula (M. Martens & Galeotti) Proctor
Global distribution: Mexico, Guatemala, Honduras, Jamaica.
Salvadoran distribution: Chalatenango: J. Monterrosa et al. 1624 (BM, LAGU, UC).

Polypodium lehmannianum Hieron., P. sublongipes Christ, Ctenopteris lehmanniana (Hieron.) Copel., Grammitis lehmanniana (Hieron.) C. V. Morton
Global distribution: Belize, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Colombia, Ecuador.

Polypodium semihirsutum Klotzsch, P. semihirsutum var. fuscocostosum Hieron., Ctenopteris semihirsuta (Klotzsch) Copel., Grammitis semihirsuta (Klotzsch) C. V. Morton, G. semihirsuta (Klotzsch) C. V. Morton var. fuscocostosa (Hieron.) Lellinger
Global distribution: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Ecuador, Peru, Brazil, Bolivia.

Polypodium taxifolium L., P. lherminieri Fée var. costaricense Rosenst., Ctenopteris taxifolia (L.) Copel., Grammitis taxifolia (L.) Proctor
Global distribution: Costa Rica, Panama, Antilles, Colombia, Venezuela, Suriname, Ecuador, Peru, Brazil, Bolivia.

**PSILOTACEAE**

*Psilotum complanatum* Sw., J. Bot. (Schrader) 1800(2): 110. 1801.
Local name: helecho palma de esquipulas.
Global distribution: Mexico, Guatemala, Honduras, Antilles, Colombia, Venezuela, Peru, Malasia, Oceania.
Salvadoran distribution: Ahuachapán: E. Sandoval s.n. (MS-00325) (B, LAGU, MO); E. Sandoval & F. Chinchilla 54 (B, LAGU); M. Sandoval & E. Sandoval 247 (B, LAGU, MO). San Vicente: Lötetschert 252 (EAP) (Palacios-Río in Davidse et al. 1995).

Lycopodium nudum L., Psilotum triquetrum Sw.
Global distribution: USA, Mexico, Guatemala, Belice, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Guyana, Suriname, French Guyana, Ecuador, Peru, Brazil, Bolivia, Paraguay, Argentina, Old World tropics, Australia, New
Zealand.

Salvadoran distribution: **La Unión**: R. Ibarra, R. Juárez, F. Franco, I. Vega & O. Jiménez s.n. (JBL05114) (BM, LAGU, MHES); J. Monterrosa & R. Ibarra 1608 (BM, LAGU, MHES, MO).

**PTERIDACEAE**

**Acrostichum aureum** L., Sp. Pl. 2: 1069. 1753.

*Global distribution*: USA, Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Guayana, Suriname, French Guyana, Ecuador, Brazil, Paraguay, Trópicos del Viejo Mundo.

*Salvadoran distribution*: **Ahuachapán**: R. Seiler 137 (MHES); R. Villacorta & E.A. Montalvo 826 (B, LAGU, MHES, MO). **La Unión**: K. Sidwell *et al*. 674 (B, BM, ITIC, LAGU, MO).


Local names: helecho de manglar, helecho de pantano.

*Global distribution*: USA, Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Guayana, Suriname, French Guyana, Ecuador, Peru, Brazil, Bolivia, Paraguay.

*Salvadoran distribution*: **Ahuachapán**: J.M. Rosales 2191 (B, LAGU). **La Libertad**: M. Magaña 48 (MP-00008) (LAGU). **San Miguel**: J. Tucker 908 (F); R. Villacorta 2889 (B, BM, LAGU).


**Adiantum princeps** T. Moore

Local names: helecho de arriero, centavito.

*Global distribution*: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Colombia, Venezuela.

*Salvadoran distribution*: **Ahuachapán**: A.K. Monro *et al*. 1925, 3642, 3700 (B, BM, ITIC, LAGU, MO); A. Sermeño 106 (JBL01020) (B, LAGU, MEXU, MO); J.M. Rosales 5 (AAU, B, BM, LAGU, MEXU, MO); M. Sandoval & E. Sandoval 304 (B, F, LAGU); R. Seiler 938 (F); T. Croat 42060, 42061, 42095, 42102 (ITIC); W. Berendsohn 1390, 1391 (B, LAGU, MO). **Santa Ana**: L. Lara 221 (MHES). **La Libertad**: A.K. Monro *et al*. 3770 (B, BM, ITIC, LAGU, MO); B. Pfeiffer-Berendsohn 68 (B, LAGU, MO); E.A. Montalvo s.n. (ITIC); J. Monterrosa *et al*. s.n. (JBL04488) (LAGU); K. Sidwell *et al*. 465 (B, BM, ITIC, LAGU, MO); N. Ventura 5012, 5015 (ITIC). **San Salvador**: K. Sidwell *et al*. 582 (B, BM, ITIC, LAGU, MO); R. Seiler s.n. (12-326) (MHES); 72 (F, MHES); 711 (F). **Cuscatlán**: S. Dar s.n. (JBL03659) (B, BM, LAGU, MO). **Morazán**: J. Monterrosa & C. Rivera 675 (BM, LAGU). **La Unión**: A.K. Monro *et al*. 2753 (B, BM, ITIC, LAGU, MO).


glaucophyllum Hook. Local name: helecho centavito.

Global distribution: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Colombia.

Salvadoran distribution: **Ahuachapán**: A.K. Monro et al. 2003 (B, BM, ITIC, LAGU, MO). **Sonsonate**: T. Croat 42212 (ITIC). **Santa Ana**: A. Molina et al. 16881 (F); D. Rodriguez & G. Cerén s.n. (JBL04597) (B, LAGU); G. Davidse et al. 37231 (B, BM, ITIC, LAGU, MO); J. Monterrosa et al. 917 (LAGU, NY); 1024 (LAGU); L. Lara 226 (MHES); R. Seiler 135, 277, 463 (F, MHES). **La Libertad**: M. Renderos et al. 413 (LAGU, MO). **San Salvador**: E.A. Montalvo 3155 (ITIC); M.C. Carlson 383, 472 (F); R. Seiler 211, 517 (F, MHES); S. Winkler 18 (ITIC). **Chalatenango**: R. Seiler 404 (JBL00080) (F, LAGU, MHES); 730 (F, MHES); W. Berendsohn & H. Sipman 1585 (B, LAGU). **San Vicente**: R. Seiler 320, 329 (F, MHES). **Usulután**: D. Williams 136 (B, LAGU, MO). **Morazán**: J. Tucker 607 (F).

*Adiantum braunii* Mett. ex Kuhn, Linnea 36: 75. 1869.


Local names: helecho nido de arriero, helecho nido de pijuyo.

Global distribution: Mexico, Guatemala, Nicaragua, Costa Rica, Colombia, Venezuela.


*Adiantum lutescens* Mougeot ex Fée

Local names: helecho cola de arriero, helecho nido de arriero, helecho palmita.

Global distribution: Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Ecuador, Peru, Brazil.

Salvadoran distribution: **Ahuachapán**: A.K. Monro et al. 1915 (B, BM, ITIC, LAGU, MO); E. Sandoval & F. Chinchilla 704 (B, LAGU); E. Sandoval & M. Sandoval 1402 (LAGU); 1521 (B, LAGU); F. Chinchilla s.n. (ISB00534), s.n. (ISB00736), s.n. (ISB00768) (AAU, B, F, LAGU); M. Magaña 7 (MP-00002) (LAGU); M. Sandoval & E. Sandoval 101 (B, F, LAGU); R. Villacorta et al. 942 (B, LAGU, MO); T. Croat 42115 (ITIC). **Sonsonate**: D. Rodríguez & M. Trejo 83 (LAGU). **Santa Ana**: L. Lara 222 (MHES); M.L. Reyna de Aguilar & R. Villacorta 1438 (B, LAGU, MO). **La Libertad**: A.K. Monro et al. 2335, 3084 (B, BM, ITIC, LAGU, MO); J. Reyes et al. (JBL04510) (LAGU); J. Williams s.n. (ITIC); K. Sidwell et al. 483, 698 (B, BM, ITIC, LAGU, MO); M.B. Siu s.n. (ITIC); N. Ventura 5007, 5011, 5025 (ITIC); R. Amador et al. s.n. (JBL04461) (LAGU); R. Menjivar & J. Sermeño s.n. (JBL04484) (LAGU); V. Salzman s.n. (JBL02066) (LAGU). **San Salvador**: A.K. Monro et al. 3437 (B, BM, ITIC, LAGU, MO); J. Williams 94 (ITIC); K. Sidwell et al. 577 (B, BM, ITIC, LAGU, MO); M.C. Carlson 2 (F); R. Seiler 511 (F, MHES); Tobar s.n. (12-10) (MHES); W. Heed 25 (ITIC). **Chalatenango**: L. Lara 207, 214, 217 (MHES); M.B. Siu s.n. (ITIC); R. Seiler 141 (MHES). **San Miguel**: J. Tucker 976 (F). **Cabañas**: A.K. Monro et al. 2775 (B, BM, ITIC, LAGU, MO); G. Davidse et al. 37111 (B, BM, ITIC, LAGU, MO); R. Seiler 527 (F, MHES). **Morazán**: J. Tucker 640 (F).
**Adiantum deflectens** Mart., Icon. Pl. Crypt. 94. 1834.  
**Global distribution:** Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Colombia, Venezuela, French Guyana, Ecuador, Peru, Brazil, Bolivia, Paraguay.  

**Adiantum latifolium** Lam., Encycl. I: 43. 1783.  
**Adiantum lucidum** Sw. var. *bipinnatum* Mett. ex E. Fourn.  
**Global distribution:** Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Africa, Asia.  
Local names: helecho rosquilla  
**Salvadoran distribution:** Ahuachapán: J.M. Rosales 1916 (AAU, B, BM, LAGU, MO). Usulután: J. Lagos 1084 (ITIC); R. Seiler 591 (F, MHES).  

**Adiantum lunulatum** Burm. f., Fl. Indica 235. 1768.  
Local names: helecho cola de arriero, helecho pie de zanate, helecho salamanquera.  
**Global distribution:** Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Africa, Asia.  

**Adiantum macrophyllum** Sw., Prod. 135. 1788.  
Local name: helecho palma de esquipulas, helecho palma de roca.  
**Global distribution:** Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Guayana, Suriname, French Guyana, Ecuador, Peru, Brazil, Bolivia.  
**Salvadoran distribution:** Ahuachapán: E. Sandoval et al. 106 (LAGU); s.n. (JBL01386), 1293 (B, LAGU); F. Chinchilla s.n. (ISB00660) (AAU, B, F, LAGU); M. Sandoval et al. s.n. (ISB00842) (AAU, B, F, LAGU); 273 (B, F, LAGU); P. Standley et al. 2673 (F); R. Seiler 932 (MHES). La Libertad: D. Matamoro s.n. (JBL01317) (LAGU); M.C. Carlson 143 (F); R. Seiler 717 (MHES). San Salvador: E.A. Montalvo 15a (ITIC); R. Seiler 449, 508, 530 (F, MHES).  

**Adiantum lobatum** C. Presl  
Local names: helecho nido de arriero, helecho pata de paloma, petatillo rojo.  
**Global distribution:** Mexico, Guatemala, Honduras, Costa Rica, Colombia, Venezuela, Ecuador, Peru, Bolivia, Africa.

*Adiantum lucidum* (Cav.) Sw. var. *pinnatum* E. Fourn.  
Global distribution: Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Guyana, Suriname, French Guyana, Ecuador, Peru, Brazil, Bolivia.  

*Adiantum thalictroides* Willd. ex Schltdl., *A. pellucidum* M. Martens & Galeotti, *A. gratum* Fée  
Global distribution: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Ecuador, Peru, Bolivia, Chile, Argentina, Viejo Mundo.  

Global distribution: Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Guyana, Suriname, French Guyana, Ecuador, Peru, Brazil, Bolivia.  

*Adiantum raddianum* C. Presl, Suppl. Tent. Pterid. 158. 1836.  
*Adiantum cuneatum* Langsd. & Fisch., *A. mexicanum* C. Presl, *A. werckleanum* Christ  
Local name: helecho colchón de guardabarranco.  
Global distribution: Mexico, Guatemala, Nicaragua, Costa Rica, Antilles, Colombia, Venezuela, Trinidad and Tobago, Ecuador, Peru, Brazil, Bolivia, Paraguay, Argentina, Uruguay.  
Note: A.K. Monro & D. Alexander 3084 is cited erroneously as *A. raddianum* in Monro et al. 2002, it is *A. concinnum* Humb. & Bonpl. ex Willd.

*Adiantum tenerum* Sw., Prodr. 135. 1788.  
*Adiantum trapezoides* Fée  
Global distribution: USA, Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Antilles, Venezuela, Trinidad and Tobago.  
Source: Maxon & Standley (1930): 172 (as *Adiantum trapezoides*). Calderón &
Adiantum fruticosum Poepp. ex Spreng., A. tetraphyllum Humb. & Bonpl. ex Willd. var. costaricense Christ

Local names: helecho ciempiés, helecho rosquilla pacha.

Global distribution: Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Ecuador, Peru, Bolivia, Paraguay.

Salvadoran distribution: Ahuachapán: E. Sandoval et al. 1119, 1207 (B, LAGU, MO); F. Chinchilla s.n. (ISB00315) (LAGU); s.n. (ISB00661) (AAU, B, F, LAGU); M. Sandoval et al. s.n. (ISB00815), AAU, B, F, AAU; 298 (B, F, LAGU); R. Morales et al. s.n. (JBL01274) (B, LAGU, MO); R. Seiler 924 (F, ITIC, MHES); R. Villacorta 623 (B, LAGU, MO); W. Berendsohn et al. 1355, 1369, 1398 (B, LAGU, MO); 1428 (B, LAGU). Santa Ana: R. Villacorta & J. María 2203 (B, LAGU, MO). San Salvador: R. Seiler 531 (F, MHES). Chalatenango: R. Seiler 265 (F, MHES). Cabañas: A.K. Monro et al. 3747 (B, BM, ITIC, LAGU, MO); J. Monterrosa & R. Carballo 230 (AAU, B, BM, LAGU, MO). Morazán: J. Monterrosa & C. Rivera 673 (B, BM, LAGU, MO).

Adiantum trapeziforme L. var. oblongatum T. Moore, A. trapeziforme L. var. plumieri T. Moore

Local names: cabello de ángel, helecho nido de arriero, lantrillo.

Global distribution: Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Antilles, Trinidad and Tobago, Bolivia, Paraguay; naturalised in Asia and the Pacific Islands.

Salvadoran distribution: Ahuachapán: E. Sandoval & F. Chinchilla 177, 266 (LAGU); F. Chinchilla & R.E. Sandoval s.n. (ISB00589) (AAU, B, F, LAGU); M. Sandoval & E. Sandoval s.n. (ISB00838) (AAU, B, LAGU); P. Standley et al. 3024 (F); R. Seiler 937 (F, MHES); T. Croat 42103 (ITIC); W. Berendsohn et al. 1434 (B, LAGU, MO). Santa Ana: A.K. Monro & R. Douglas 3464 (B, BM, ITIC, LAGU, MO). La Libertad: O. Pank s.n. (MP-00004) (LAGU). San Salvador: K. Sidwell et al. 580 (B, BM, ITIC, LAGU, MO); M.C. Carlson 20, 327 (F); R. Seiler 67 (F, ITIC, MHES); 785 (F, MHES). Chalatenango: R. Seiler 139 (F, MHES). Usulután: E.A. Montalvo 5101 (ITIC); S. Winkler 16 (ITIC). Cuscatlán: S. Dar s.n. (JBL03658) (LAGU, MO). La Unión: A.K. Monro et al. 3536 (B, BM, ITIC, LAGU, MO).


Global distribution: Mexico, Guatemala, Nicaragua, Costa Rica.


Local names: helecho ciempiés, helecho rosquilla pacha.

Global distribution: Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Ecuador, Peru, Brazil.

Salvadoran distribution: Ahuachapán: E. Sandoval & F. Chinchilla 486 (B, LAGU);
J.M. Rosales 1419 (LAGU); M. Sandoval et al. 29 (B, LAGU); T. Croat 42087 (ITIC); W. Berendssohn & R. Villacorta 1350 (LAGU, MO). **Santa Ana**: M.L. Reyna de Aguilar 663 (MHES). **La Libertad**: R. Seiler 716 (F, MHES). **Chalatenango**: R. Seiler 140 (F, MHES). **San Vicente**: M.C. Carlson 67 (MHES); J. Tucker 848 (F). **Cabañas**: R. Seiler 225 (JBL04805) (F, LAGU, MHES). **San Miguel**: A. Salgado 71 (MHES); J. Tucker 848 (F). **Cabañas**: R. Seiler 225 (JBL04805) (F, LAGU, MHES).

**Ananthacorus angustifolius** (Sw.) Underw. & Maxon in Maxon, Contr. U.S. Natl. Herb. 10: 487. 1908.
**Pteris angustifolia** Sw., **Taenitis angustifolia** (Sw.) Spreng., **Vittaria angustifolia** (Sw.) Baker in Martius, **Vittaria costata** Kunze
Local name: helecho barbiquejo. **Global distribution**: Mexico, Guatemala, Belize, Honduras, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Guayana, Suriname, French Guyana, Ecuador, Peru, Brazil, Bolivia. **Salvadoran distribution**: Ahuachapán: E. Sandoval et al. 439, 1303 (B, LAGU); J.M. Rosales 1466 (B, BM, LAGU, MO); 1513 (B, LAGU, MO); M.L. Reyna de Aguilar 652 (MHES); M. Sandoval & E. Sandoval s.n. (ISB00930) (LAGU). **San Salvador**: R. Seiler 459, 788 (F, MHES).

**Anogramma chaerophylla** (Desv.) Link, Fil. Spec. 138. 1841. **Gymnogramma chaerophylla** Desv. **Global distribution**: Mexico, Antilles, Brazil, Paraguay, Argentina, Uruguay. **Salvadoran distribution**: **San Salvador**: H. Weber 24 (ITIC); R. Seiler 20 (MHES).

**Anogramma leptophylla** (L.) Link, Fil. Spec. 137. 1841. **Polypodium leptophyllum** L., **Gymnogramma leptophylla** (L.) Desv. var. **mexicana** Kunze, **Pityrogramma guatemalensis** Domin, **Anogramma guatemalensis** (Domin) C. Chr. **Global distribution**: Mexico, Guatemala, Nicaragua, Costa Rica, Panama, Venezuela, Ecuador, Peru, Brazil, Eurasia, Africa. **Salvadoran distribution**: Sonsonate: R. Seiler 610, 616, 629 (F, MHES). **Santa Ana**: E.A. Montalvo 4895 (ITIC); J. Williams 31 (ITIC); R. Seiler 110 (F, ITIC, MHES); 658 (F, MHES). **San Salvador**: Castañeda s.n. (12-897) (MHES). **Usulután**: D. Williams & R.W. Herrera 424 (LAGU).

**Bommeria pedata** (Sw.) E. Fourn., Bull. Soc. Bot. France 27: 327. 1880. **Hemionitis pedata** Sw., **Gymnogramma pedata** (Sw.) Kaulf., **Gymnopteris pedata** (Sw.) C. Chr.
Local name: helecho mano de mapache. **Global distribution**: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica. **Salvadoran distribution**: Ahuachapán: M. Sandoval & E. Sandoval 40 (B, F, LAGU). **Santa Ana**: R. Seiler 498 (F, MHES). **San Salvador**: R. Seiler 46 (F, MHES); 640 (MHES); O. Pank s.n. (12-987) (MHES).

Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Guayana, Suriname, French Guyana, Ecuador, Peru, Brazil, Bolivia, Paraguay, Argentina. **Salvadoran distribution:** *Ahuachapán:* J.M. Rosales 2674 (B, LAGU, MO). **La Paz:** N.C. Fassett 28557 (EAP, F); 29180 (F). **San Miguel:** N.C. Fassett 29391 (F).

Local name: helecho de agua.  
**Global distribution:** USA, Mexico, Guatemala, Nicaragua, Costa Rica, Panama, Venezuela, Suriname, Ecuador, Brazil, Africa, Asia, Australia, Pacific Islands.  
**Salvadoran distribution:** *Ahuachapán:* J.M. Rosales 1921 (B, LAGU, MO); 2070 (LAGU). **San Vicente:** N.C. Fassett 29157 (F); 29162 (EAP, F). **Usulután:** R.A. Carballo & S. Santamaría 899 (B, LAGU, MO).

Local name: helecho tuya morada.  
**Global distribution:** Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama.  
**Salvadoran distribution:** *Ahuachapán:* E. Sandoval & F. Chinchilla 664 (B, LAGU); J.M. Rosales 1230 (B, LAGU, MO); R. Villacorta & Martínez 626 (B, LAGU, MO); W. Berendsohn & R. Villacorta 1384 (B, LAGU, MO). **Sonsonate:** R. Seiler 37 (F, MHES). **Santa Ana:** B. Pfeiffer-Berendsohn & W. Berendsohn 13 (F, LAGU, MO); S. Winkler 28 (ITIC). **La Libertad:** E.A. Montalvo s.n. (ITIC). **San Salvador:** H. Castañeda s.n. (12-899) (MHES); E.A. Montalvo s.n. (ITIC). **Chalatenango:** L. Lara 213, 231 (MHES); R. Seiler 559 (F, MHES); S. Calderón 2476 (F). **San Vicente:** E.A. Montalvo 5095 (ITIC). **Usulután:** D. Williams & R.W. Herrera 301 (LAGU, MO). **Morazán:** J. Monterrosa & C. Rivera 689 (B, BM, LAGU, MO); M. Renderos *et al.* 611 (LAGU, MO).

*Aleuritopteris aurea* (Baker) Ching  
**Global distribution:** Mexico, Guatemala.  
**Salvadoran distribution:** *Ahuachapán:* J.M. Rosales 1229 (B, LAGU); W. Berendsohn *et al.* 1644 (BM, LAGU, MO). **San Salvador:** R. Seiler 23, 579 (F, MHES).

**Global distribution:** Mexico.  
**Salvadoran distribution:** *San Salvador:* R. Seiler 45, 579 (F, LAGU, MHES, NY).

Local names: helecho de bulto, helecho dorado, helecho pluma de búho.  
**Global distribution:** Mexico, Guatemala, Honduras, Nicaragua, Costa Rica.  
**Salvadoran distribution:** *Ahuachapán:* A.K. Monro *et al.* 3644 (B, BM, ITIC, LAGU, MO); E. Sandoval & F. Chinchilla 468 (B, LAGU, MO); E. Sandoval & M. Sandoval
1404 (B, LAGU); J.M. Rosales 1289, 1587 (AAU, B, BM, LAGU, MO); M. Sandoval et al. 61 (B, F, LAGU); R. Seiler 926 (F, MHES); R. Villacorta & Martínez 404 (F, LAGU, MO); T. Croat 42155 (ITIC); W. Berendsohn et al. 1408 (B, LAGU, MO). Sonsonate: R. Seiler 7 (F, MHES). Santa Ana: K. Prestegard 30 (LAGU); T. Croat 42238 (ITIC). La Libertad: A.K. Monro et al. 2919 (B, BM, ITIC, LAGU, MO); E.A. Montalvo & R. Villacorta 6266 (B, LAGU, MO); J. Flores s.n. (JF-00106) (LAGU); R. Villacorta s.n. (JBL00543) (B, LAGU, MO). San Salvador: R. Seiler 444 (F, MHES). Chalatenango: L. Lara 212, 216 (MHES); R. Seiler 367, 551 (F, MHES). San Vicente: O. Rohweder 2643 (JBL01248), 2644 (JBL01247) (LAGU). San Miguel: A. Salgado 63 (MHES); R. Seiler 540 (F, MHES); R. Villacorta 2391 (LAGU, MO). Morazán: J. Monterrosa & C. Rivera 709 (B, BM, LAGU, MO). La Unión: A.K. Monro et al. 3540 (B, BM, ITIC, LAGU, MO).

*Allosorus chaerophyllus* M. Martens & Galeotti
*Global distribution*: Mexico, Guatemala, Honduras, Costa Rica.
*Salvadoran distribution*: Chalatenango: J. Monterrosa et al. 1611 (BM, LAGU, NY).

*Global distribution*: Mexico, Guatemala.

**Cheilanthes kaufussii** Kunze, Linnea 13: 145. 1839.
*Cheilanthes viscosa* Link, *C. glandulifera* Liebm.
*Global distribution*: USA, Mexico, Guatemala, Honduras, Costa Rica, Colombia, Venezuela.

*Global distribution*: Mexico, Guatemala, Honduras, Costa Rica, Panama, Colombia, Venezuela, Ecuador, Peru, Bolivia, Argentina.
*Salvadoran distribution*: Santa Ana: B. Pfeiffer-Berendsohn 47 (LAGU, MO); 54 (B, LAGU, MO); R. Seiler 298, 473 (F, MHES); 1208 (F); R. Villacorta & J.C. González 1160 (LAGU). Chalatenango: R. Seiler 383 (F, MHES); W. Berendsohn & H. Sipman 1582 (B, LAGU). Morazán: R. Seiler 986 (F, ITIC, MHES); 1069 (F, MHES); 1071 (F).

*Cheilanthes paleacea* M. Martens & Galeotti, *C. intermedia* Baker, *C. fournieri* C. Chr.,
Myriopteris intermedia E. Fourn.
*Global distribution*: Mexico, Guatemala, Honduras, Nicaragua, Antilles, Colombia, Venezuela, Ecuador, Peru, Brazil, Bolivia, Chile, Argentina.
*Salvadoran distribution*: R. Seiler 1471 (MO) (Yatskievych & Moran in Davidse et al. 1995).

Cheilanthes pyramidalis Fée, Mém. Foug. 7: 38. t. 25 (F). 3. 1857.
*Pellaea angustifolia* (Kunth) Baker var. *elongata* Rovira
*Global distribution*: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica.
*Salvadoran distribution*: R. Seiler 1471 (MO) (Yatskievych & Moran in Davidse et al. 1995).

*Pellaea skinneri* Hook., *Doryopteris fournieri* (Baker) C. Chr.
*Local names*: helecho cola de pavo real, helecho morado.
*Global distribution*: Mexico, Guatemala, Nicaragua, Costa Rica, Panama, Colombia.

Cheiloplecton rigidum (Sw.) Fée var. *rigidum*, Mém. Foug. 7: 34, t. 20 (F). 3. 1857.
*Pteris rigidida* Sw., *P. cartilaginea* C. Presl, *Pellaea rigidida* (Sw.) Hook.
*Global distribution*: Mexico, Guatemala.
*Salvadoran distribution*: Santa Ana: R. Seiler 1190 (F, MHES).

*Global distribution*: Mexico, Guatemala, Honduras, Antilles, Colombia, Venezuela, Ecuador, Peru, Brazil Bolivia, Paraguay, Argentina, Uruguay, Africa, Asia, Australia.

*Gymnogramma flexuosus* Desv., *Grammitis flexuosa* Kunth
*Global distribution*: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Guayana, Ecuador, Peru, Brazil, Bolivia.
*Salvadoran distribution*: Santa Ana: J. Lagos 13 (ITIC); R. Seiler 177 (JBL04804) (F, LAGU, MHES); R. Villacorta et al. 1048 (B, LAGU, MO); W. Berendsohn 1069 (B, BM, LAGU, MO). Chalatenango: J. Tucker 1120 (F).

*Hemionitis otonis* Maxon
*Global distribution*: Mexico, Nicaragua, Costa Rica.
Salvadoran distribution: S. Calderón 1710, MO (Ranker in Davidse et al. 1995).  
*Ahuachapán*: J.M. Rosales 1187 (B, LAGU).  
*San Miguel*: R. Villacorta 2392 (B, LAGU, MO).

**Global distribution**: Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Guayana, Suriname, French Guiana, Ecuador, Peru, Brazil, Bolivia.  
**Salvadoran distribution**: P. Standley 19894 (GH) (Ranker in Davidse et al. 1995).  

**Local names**: helecho ostra.  
**Global distribution**: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica.  
**Salvadoran distribution**: *Ahuachapán*: E. Sandoval & F. Chinchilla 469 (B, LAGU).  
*Sonsonate*: R. Seiler 493 (F, MHES).  
*Santa Ana*: R. Seiler 9 (F, MHES).  
*San Miguel*: R. Seiler 59 (F, MHES).  

**Pteris intramarginalis** Kaulf. ex Link, *Cheilanthes intramarginalis* (Kaulf. ex Link) Hook., *Pellaea intramarginalis* (Kaulf. ex Link) J. Sm.  
**Global distribution**: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Galápagos.  
**Salvadoran distribution**: *Sonsonate*: R. Seiler 9 (F, MHES).  
*Santa Ana*: B. Pfeiffer-Berendsohn & W. Berendsohn 14, 16 (LAGU); G. Davidse et al. 37247 (B, BM, ITIC, LAGU, MO); J. Lagos 1422 (ITIC); J. Monterrosa et al. 223 (B, BM, LAGU, MO); 994 (LAGU); M.B. Siu s.n. (ITIC); N. López et al. s.n. (JBL04635) (LAGU); R. Seiler 352 (F, MHES); 898 (F); R. Villacorta et al. 1159 (LAGU); 1052, 1257 (B, LAGU, MO).  
*San Salvador*: A.K. Monro et al. 2234 (B, BM, ITIC, LAGU, MO); M.C. Carlson 424 (F); R. Seiler 30 (JBL04799) (F, LAGU, MHES); 58 (F).  
*Chalatenango*: L. González 1711 (ITIC); L. Lara 215 (MHES); R. Seiler 577 (F, MHES).  
*San Vicente*: J. Lagos 66 (ITIC).  
*Usulután*: D. Williams 57, 60 (B, LAGU, MO).  
*Morazán*: R. Seiler 1088b (F, ITIC, MHES).

*Cheilanthes candida* M. Martens & Galeotti, *Aleuritopteris candida* (M. Martens & Galeotti) Fée, *Chrysochosma candida* (M. Martens & Galeotti) Kümmeler  
**Global distribution**: Mexico, Guatemala, Honduras, Nicaragua.  
**Salvadoran distribution**: *Sonsonate*: R. Seiler 497 (F, MHES).  
*San Miguel*: A. Salgado 62 (MHES).

*Global distribution*: Mexico, Guatemala, Nicaragua, Costa Rica.

*Salvadoran distribution*: **Ahuachapán**: A.K. Monro *et al*. 3645 (B, BM, ITIC, LAGU, MO).  
**Santa Ana**: R. Seiler 88 (F, MHES, NY).

**Pellaea ternifolia** (Cav.) Link. subsp. *ternifolia*, Fil. Spec. 59. 1841.

*Pteris ternifolia* Cav.

*Global distribution*: USA, Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Antilles, Colombia, Venezuela, Ecuador, Peru, Brazil, Bolivia, Chile, Paraguay, Argentina, Hawaii.

*Salvadoran distribution*: **Santa Ana**: R. Seiler 679 (MHES); 467 (F).


**Acrostichum calomelanos** L., *Gymnogramma calomelanos* (L.) Kaulf., *Ceropteris serrata* Fée

Local name: helecho pinta mano.

*Global distribution*: USA, Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Guayana, Suriname, French Guyana, Ecuador, Peru, Brazil, Bolivia, Paraguay, Argentina.

*Salvadoran distribution*: **Ahuachapán**: E. Sandoval *et al*. 279 (B, LAGU, MO); 1103, 1301 (B, LAGU); F. Chinchilla s.n. (ISB00093) (B, LAGU, MO); J.M. Rosales 117, 1228 (B, LAGU); 788 (B, LAGU, MO); M. Magaña 8 (MP-00006) (LAGU); M. Sandoval *et al*. 103, 312 (B, F, LAGU); W. Berendsohn *et al*. 1335 (B, LAGU, MO).

**Sonsonate**: M.B. Siu s.n. (ITIC); M.L. Reyna de Aguilar 586 (MHES); R. Seiler 631 (F, MHES).  
**Santa Ana**: M.C. Carlson 841 (F); M.L. Reyna de Aguilar & R. Villacorta 1440 (B, LAGU, MO); R. Seiler 228 (F, MHES).  
**La Libertad**: K. Sidwell *et al*. 468 (B, BM, ITIC, LAGU, MO); N. Ventura 5014 (ITIC); R. Guerra *et al*. s.n. (JBL04503) (LAGU); R. Menjivar & J. Sermeño s.n. (JBL04494) (LAGU).  
**San Salvador**: K. Sidwell *et al*. 563 (B, BM, ITIC, LAGU, MO); M.C. Carlson 3 (F); N.C. Fassett 28599 (ITIC); R. Seiler 57 (F, MHES); S. Winkler 680 (ITIC); W. Heed 33 (ITIC).  
**La Paz**: J.C. González 102 (B, LAGU, MO); R. Villacorta *et al*. 2854 (B, LAGU).  
**San Vicente**: P. Standley *et al*. 3689 (F).  
**Usulután**: A. del Cid 1941 (ITIC); D. Williams 14, 297 (LAGU).  
**San Miguel**: A. Salgado 75 (MHES); J. Tucker 977 (F).  
**Morazán**: R. Seiler 1047 (F).


*Global distribution*: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama.

*Salvadoran distribution*: **Ahuachapán**: N.C. Fassett 28718b (F); S. de Moore s.n. (12-916) (MHES).  
**Sonsonate**: J. Tucker 1340 (F).  
**Santa Ana**: A. Molina *et al*. 16844 (F); M.B. Siu s.n. (ITIC).  
**La Libertad**: N. Ventura 5019 (ITIC); V. Hellebyuck s.n. (12-92) (F, MHES).  
**San Salvador**: A. Molina *et al*. 21829 (F, ITIC); M.C. Carlson 464 (F); R. Seiler 66 (F, MHES).  
**Chalatenango**: L. Lara 208, 219 (MHES).  
**San Miguel**: A. Salgado s.n. (JBL04801) (LAGU).  
**Morazán**: A. Salgado 62 (MHES); J. Monterrosa *et al*. 43 (B, BM, LAGU, MO); 671 (BM, LAGU).
Acrostichum ebeneum L., A. tartareum Cav., Pityrogramma tartarea (Cav.) Maxon, P. tripinnata Domin

Global distribution: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Ecuador, Peru, Brazil, Bolivia.
Salvadoran distribution: Sonsonate: R. Seiler 630 (F, MHES). Santa Ana: J. Monterrosa et al. 1029 (LAGU, NY); M.L. Reyna de Aguilar 669 (MHES); R. Seiler 40 (F, MHES); 462 (F, ITIC, MHES). San Vicente: S. Winkler s.n. (ITIC).

Gymnogramma ferruginea Kunze, G. bommeri Christ

Global distribution: Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Peru.

Gymnogramma ochraceae C. Presl, Acrostichum caudatum Cav., Pityrogramma calomelanos (L.) Link var. ochracea (C. Presl) R. M. Tryon

Global distribution: Honduras, Colombia, Venezuela, Ecuador, Peru, Bolivia.
Salvadoran distribution: Usulután: D. Williams 139 (B, LAGU, MO); 427 (LAGU).

Acrostichum trifoliatum L., Trismeria trifoliata (L.) Diels in Engl. & Prantl

Local names: helecho vertical.
Global distribution: USA, Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Ecuador, Peru, Brazil, Bolivia, Chile, Paraguay, Argentina, Uruguay.
Salvadoran distribution: Ahuachapán: E. Sandoval & F. Chinchilla 431 (B, LAGU); K. Prestegard 49 (MP-00007) (LAGU). Santa Ana: M.C. Carlson 840 (F); P. Standley et al. 3254 (F); R. Seiler 1207 (F, MHES). La Libertad: L. Williams & A. Molina 15192 (JBL015499), LAGU (F). San Salvador: F. López s.n. (ITIC); R. Seiler 264 (MHES); R. Villacorta et al. 2086 (B, LAGU, MO).

Hemionitis cajenense Desv., Anthrophyum cajenense (Desv.) Spreng., A. lacantunense Rovirosa

Global distribution: Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles; Colombia, Venezuela, Trinidad and Tobago, Guayana, Suriname, French Guiana, Ecuador, Peru, Brazil, Bolivia.

Pteris altissima Poiret in Lamarck, Encycl. 5: 722. 1804.
Pteris kunzeana J. Agardh, P. protea Liebm., Litobrochia kunzeana (J. Agardh) Fée, L. grandis Fée
Local names: helecho cola de pavo real, helecho palma de cristo.

*Global distribution:* Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Guayana, Suriname, French Guyana, Ecuador, Peru, Brazil, Bolivia.

*Salvadoran distribution:* Ahuachapán: A.K. Monro *et al.* 1978 (B, BM, ITIC, LAGU, MO); E. Sandoval & R. Chinchilla 1167 (B, LAGU); F. Chinchilla s.n. (ISB00330) (LAGU); R. Seiler 944 (MHE5); W. Berendsohn *et al.* 1425 (B, LAGU, MO). **Santa Ana:** S. Winkler 31 (ITIC). **San Salvador:** R. Seiler 536 (MHE5).


Local names: helecho cola de ganso, helecho palma real.

*Global distribution:* Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Guayana, Suriname, French Guyana, Ecuador, Peru, Brazil, Bolivia, Old World Tropics.

*Salvadoran distribution:* Ahuachapán: J.M. Rosales 490 (AAU, B, BM, LAGU, MO); M. Sandoval & E. Sandoval s.n. (ISB00873) (AAU, B, F, LAGU); R. Seiler 921 (ITIC, MHE5); W. Berendsohn *et al.* 1399 (B, LAGU, MO); 1423 (LAGU); 1426 (B, LAGU). **Sonsonate:** D. Rodríguez 157 (LAGU). **La Libertad:** A.K. Monro *et al.* 2314 (B, BM, ITIC, LAGU, MO); J. Monterrosa *et al.* s.n. (JBL00206) (LAGU); K. Sidwell *et al.* 699 (B, BM, ITIC, LAGU, MO); N. Ventura 5009 (ITIC); O. Tejada *et al.* s.n. (JBL04489) (LAGU). **San Salvador:** B. López s.n. (ITIC). **Cabañas:** A.K. Monro *et al.* 3751 (B, BM, ITIC, LAGU, MO); G. Davidse *et al.* 37119 (B, BM, ITIC, LAGU, MO).


*Pteris triphylla* M. Martens & Galeotti, *P. trifoliata* Fée

Local name: helecho pié de zenzontle.

*Global distribution:* USA, Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Peru, Brazil, Argentina, Old World Tropics and Subtropics.

*Salvadoran distribution:* **La Libertad:** E.A. Montalvo 6227 (B, LAGU). **San Salvador:** R. Seiler 222 (MHE5). **Chalatenango:** R. Seiler 212 (F, MHE5).


*Global distribution:* Mexico, Guatemala.

*Salvadoran distribution:* **Sonsonate:** R. Seiler 622 (MHE5). **Santa Ana:** D. Rodríguez & G. Cerén s.n. (JBL04599) (LAGU); J. Monterrosa *et al.* 206 (B, LAGU, MO); R. Seiler 246 (MHE5); V.M. Martínez s.n. (CMC00844) (B, LAGU). **San Salvador:** R. Seiler 212 (F, MHE5). **San Vicente:** R. Seiler 316 (MHE5).

Note: Moran in Davidse *et al.* (1995) considered this name a synonym of *Pteris orizabae* M. Martens *et al.* Galeotti. Mickel & Smith (2004) consider *P. orizabae* and *Pteris erosa* distinct based on differences in indusium margin and other characters.


*Litobrochia grandifolia* (L.) J. Sm., *Heterophlebium grandifolium* (L.) Fée

*Global distribution:* Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Ecuador, Peru, Brazil.

*Salvadoran distribution:* P. Standley 21242, MO (Moran in Davidse *et al.* 1995). **San Vicente:** R. Seiler 974 (ITIC, MHE5).
**Pteris muricella** Fée, Mém. Foug. 8: 73. 1857.

Global distribution: Mexico, Guatemala, Nicaragua, Costa Rica, Panama, Venezuela.

**Salvadoran distribution**: Chuao: R. Seiler 904 (F, ITIC, MHES).

---

**Pteris mollis** Christ

Global distribution: Mexico, Guatemala, Nicaragua, Costa Rica, Panama, Venezuela.

**Salvadoran distribution**: Ahuachapán: R. Seiler 904 (F, ITIC, MHES).

---

**Pteris orizabae** M. Martens & Galeotti, Foug. Mexique 53, pl. 13. 1842.

**Pteris apicaulis** Liebm., **P. hemipteris** (Fée) Hook., **Litobrochia orizabae** (M. Martens & Galeotti) Fée, **L. setifera** Fée, **L. hemipteris** Fée

Global distribution: Mexico, Guatemala, Honduras, Nicaragua.

**Salvadoran distribution**: T. Croat 42417, MO (Moran in Davidse et al. 1995). **Santa Ana**: J. Monterrosa & R. Martinez 945 (B, LAGU, MO); R. Seiler 272, 692 (MHES). **Morazán**: R. Seiler 1032 (ITIC, MHES).

---

**Pteris paucinervata** Fée, Mém. Foug. 8: 73. 1857.

Global distribution: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama.

**Salvadoran distribution**: Chalatenango: R. Seiler 408 (JBL00205) (F, LAGU, MHES).

---

**Pteris podophylla** Sw., J. Bot. (Schrader) 1800(2): 67. 1801.

**Lonchitis pedata** L.

Global distribution: Mexico, Guatemala, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Suriname, Ecuador, Peru, Brazil, Bolivia.

**Salvadoran distribution**: **Santa Ana**: R. Seiler 675 (F, MHES).

---

**Pteris quadriaurita** Retz., Observ. Bot. 6: 38. 1791.

**Pteris plumula** Desv., **P. nemoralis** Willd. var. major M. Martens & Galeotti, **P. galeotti** (Fée) Hook., **Litobrochia galeotti** Fée

Global distribution: Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Guayana, Suriname, French Guyana, Ecuador, Peru, Bolivia, Argentina, Africa, Asia.

**Salvadoran distribution**: **Ahuachapán**: G. Davidse et al. 37435 (B, BM, ITIC, LAGU, MO); R. Seiler 813, 908, 951 (MHES); W. Berendsohn et al. 1347 (B, LAGU, MO). **Sonsonate**: R. Seiler 813 (MHES). **Santa Ana**: K. Prestegard 2 (MP-00035) (LAGU); M.B. Siu s.n. (ITIC); R. Seiler 1205 (MHES); S. Winkler 36 (ITIC); T. Croat 42306 (ITIC). **La Libertad**: W. Berendsohn et al. 1048 (B, LAGU). **San Salvador**: R. Seiler 217 (MHES). **Chalatenango**: J.C. González & M.A. Hernández 268 (B, LAGU, MO). **Cabañas**: A.K. Monro et al. 3743 (B, BM, ITIC, LAGU, MO); R.A. Carballe et al. 253 (LAGU, MO).

---

**Pteris vittata** L., Sp. Pl. 2: 1074. 1753.

Local name: helecho de banda.

Global distribution: Mexico, Honduras, Panama, Antilles, Venezuela, Peru, Brazil, Argentina; Viejo Mundo.

**Salvadoran distribution**: **Ahuachapán**: K. Prestegard 6 (MP-00036) (LAGU); R. Seiler 811 (F, ITIC, MHES). **La Libertad**: E.A. Montalvo 6340 (B, LAGU, MO).

---

**Scoliosorus ensiformis** (Hook.) T. Moore, Index Fil. xxix, 1857.

**Antrophyum ensiforme** Hook. in Bentham, **A. falcatum** M. Martens & Galeotti, **A. carnosum** Liebm., **A. galeotti** Fée, **Polytaenium ensiforme** (Hook.) Benedict
Global distribution: Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama.

Salvadoran distribution: **Ahuachapán**: M. Renderos et al. 430 (LAGU); R. Seiler 915 (ITIC, MHES); 966 (MHES). **Sonsonate**: E.A. Montalvo s.n. (ITIC); R. Seiler 614 (MHES); T. Croat 42216 (ITIC). **Santa Ana**: B. Pfeiffer-Berendsohn & W. Berendsohn 30 (B, LAGU, MO); D. Rodriguez et al. 37 (B, LAGU, NY); J. Lagos 1619 (ITIC); J. Monterrosa et al. 528 (B, LAGU, MO); 938 (B, LAGU, NY); K. Prestegard 25 (MP-00009) (LAGU); R. Seiler 15, 131 (ITIC, MHES); 360 (MHES); S. Winkler 54 (ITIC); W. Berendsohn et al. 1710 (B, BM, LAGU, MO).

**Chalatenango**: R. Seiler 412 (JBL04946) (LAGU, MHES).

**Morazán**: R. Seiler 1017 (ITIC, MHES).


Global distribution: Mexico, Guatemala, Costa Rica, Nicaragua y Panama.

Local names: helecho barba de cacique, helecho cola de gorrión.

Salvadoran distribution: **Ahuachapán**: E. Sandoval & M. Sandoval 1439 (B, LAGU); W. Berendsohn et al. 1461 (LAGU).

**Vittaria graminifolia** Kaulf., Enum. Filic. 192. 1824.

**Vittaria filifolia** Fée, *V. dimorpha* Müll.

Global distribution: Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Suriname, Ecuador, Peru, Brazil, Bolivia.

Salvadoran distribution: **Ahuachapán**: R. Seiler 820, 960 (F, MHES). **Sonsonate**: A. Molina et al. 21722 (F, ITIC); R. Seiler 605 (F, MHES). **Santa Ana**: A. del Cid 1621 (ITIC); E.A. Montalvo 3281 (ITIC); F. Wunderlin 559 (ITIC); G. Davidge et al. 37281 (B, BM, ITIC, LAGU, MO); J.L. Linares s.n. (JBL01322) (LAGU); J. Monterrosa et al. 950, 991 (LAGU, NY); M.B. Siu s.n. (ITIC); R. Seiler 17 (ITIC, MHES); 128 (F, MHES); 99, 283, 356 (F, ITIC, MHES). **San Salvador**: M.C. Carlson 426 (F). **San Vicente**: R. Seiler 402 (JBL00208) (F, LAGU, MHES); W. Heed 39 (ITIC). **San Vicente**: R. Seiler 335 (F, ITIC, MHES). **Morazán**: R. Seiler 991 (F, MHES).

**SALVINIACEAE**

*Azolla filiculoides* Lam., Encycl. I: 343. 1783.

*Azolla caroliniana* Willd.

Global distribution: USA; Mexico, Guatemala, Honduras, Nicaragua, Colombia, Venezuela, Bolivia, Chile, Argentina, Uruguay, E Asia, Australia, Hawaii.


*Azolla mexicana* C. Presl

Global distribution: Canada; Mexico, Honduras, Nicaragua, Antilles, Colombia, Venezuela, French Guyana, Ecuador, Peru, Brazil, Bolivia, Argentina, Uruguay.


Salvinia rotundifolia Willd.  

Global distribution: Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Guayana, Suriname, French Guyana, Ecuador, Peru, Brazil, Bolivia, Chile, Paraguay, Argentina, Uruguay.  

Salvadoran distribution: La Unión: R. Villacorta et al. 2706 (B, CR, LAGU, MEXU); N.C. Fassett 28631 (ITIC, MO) (Moran in Davidse et al. 1995); 28662 (ITIC); J. Monterrosa & R. Villacorta 1637 (BM, LAGU, MO).  


Salvinia rotundifolia auct. non Willd.  

Global distribution: USA, Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, French Guyana, Ecuador, Peru, Brazil, Bolivia, Paraguay, Argentina, Uruguay.  


TECTARIACEAE  


Aspidium heracleifolium Willd., Polypodium cordifolium M. Martens & Galeotti, Tectaria heracleifolia (Willd.) Underw. var. maxima C.V. Morton  

Local names: helecho cisne, helecho cola de perro, helecho corazón, helecho palma de costa.  

Global distribution: Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Ecuador.  

Salvadoran distribution: Ahuachapán: E. Sandoval & F. Chinchilla 84 (B, LAGU); 732 (B, LAGU, MO); J.M. Rosales 231, 745 (AAU, B, BM, LAGU, MO); 946 (LAGU); R. Seiler 941 (JBL04819) (F, LAGU, MHES); R. Villacorta & Martínez 409 (LAGU, MO); W. Berendsohn & R. Villacorta 1110 (B, LAGU); W. Berendsohn et al. 1319, 1324, 1361, 1605 (B, LAGU, MO). Sonsonate: D. Rodríguez & G. Trejo 200 (B, LAGU, MO). Santa Ana: K. Prestegard 35 (MP-00024) (LAGU). La Libertad: L.O. Williams et al. 16779 (F); R.A. Carballo et al. 38 (B, BM, LAGU, MO). San Vicente: P. Standley et al. 3532 (F). San Miguel: A. Salgado s.n. (JBL04802) (LAGU); A. Salgado 77 (F, MHES). Cabañas: A.K. Monro et al. 3745 (B, BM, ITIC, LAGU, MO).  

Tectaria incisa Cav. f. incisa, Descr. Pl. 249. 1801.  

Aspidium macrophyllum Sw. var. pittieri Christ, A. martiniicense Spreng., Tectaria martiniicensis (Spreng.) Copel.  

Local name: helecho samaritana.  

Global distribution: Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Guayana, Suriname, French Guyana, Ecuador, Peru, Brazil, Bolivia, Paraguay, Argentina.  

Salvadoran distribution: Ahuachapán: E. Sandoval & F. Chinchilla 212 (LAGU);
1352 (B, LAGU); R. Seiler 930 (F, MHES). **Sononate**: D. Rodríguez 161 (LAGU). **La Libertad**: S. Winkler 70 (ITIC). **San Salvador**: S. Winkler 89 (ITIC). **San Vicente**: P. Standley et al. 3771 (F).


Local names: helecho cola de pavo, helecho falsa salamandra, helecho pié de león.

**Global distribution**: Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Colombia, Ecuador.

**Salvadoran distribution**: Ahuachapán: A.K. Monro et al. 2002 (B, BM, ITIC, LAGU, MO); E. Sandoval & H. Rivera 1313 (B, LAGU); F. Chinchilla & E. Sandoval s.n. (ISB00276) (B, LAGU, MO); s.n. (ISB00670) (AAU, B, LAGU); J.M. Rosales 1314 (LAGU); M. Sandoval & E. Sandoval s.n. (ISB00870) (AAU, B, F, LAGU); M. Sandoval & E. Sandoval 93 (B, F, LAGU); P. Standley et al. 2607 (F); R. Seiler 816 (F, MHES); 934 (MHES). **Sononate**: D. Rodriguez & M. Trejo 82 (LAGU); J. Tucker 1351 (F). **La Libertad**: A.K. Monro et al. 2306, 3090 (B, BM, ITIC, LAGU, MO); J. Monterrosa et al. s.n. (JBL04486) (B, BM, ITIC, LAGU, MO); M.C. Carlson 141 (F); M. Magaña 38 (MP-00038), 39 (MP-00014) (LAGU); N. Ventura 5003 (ITIC); O. González et al. s.n. (JBL04495) (B, BM, ITIC, LAGU, MO). **San Salvador**: A.K. Monro et al. 3438 (B, BM, ITIC, LAGU, MO); A. Molina et al. 21848 (F, ITIC); K. Sidwell et al. 573 (B, BM, ITIC, LAGU, MO); R. Seiler 197 (F, MHES). **Chalatenango**: L. González 1721 (ITIC). **San Vicente**: P. Standley et al. 3772 (F). **Usulután**: D. Williams 132 (LAGU, MO). **San Miguel**: A.K. Monro et al. 2947 (B, BM, ITIC, LAGU, MO); A. Salgado 74 (MHES); M. Renderos et al. 685 (AAU, B, LAGU, MO); R. Villacorta et al. 2824 (B, BM, LAGU, MEXU, MO). **Cuscatlán**: S. Dar s.n. (JBL03664) (B, LAGU, MO).

*Tectaria rivalis* (Mett. ex Kuhn) C. Chr., Index Filic., Suppl. 3. 184. 1934. *Tectaria rheosora* auct. non. (Baker) C. Chr.

**Global distribution**: Belize, Guatemala, Nicaragua, Costa Rica, Panama, Colombia, Ecuador.

**Salvadoran distribution**: Ahuachapán: R. Seiler 943 (F, MHES).


**Global distribution**: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Trinidad and Tobago, Ecuador, Peru.


**THELYPTERIDACEAE**

Local names: helecho amarillo, helecho palma de pozo, helecho pata de paloma.

*Global distribution*: USA, Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Ecuador, Peru, Brazil, Bolivia, Paraguay, Argentina, Africa, Asia, Pacific Islands.

*Salvadoran distribution*: Ahuachapán: A.K. Monro *et al.* 1930 (B, BM, ITIC, LAGU, MO); E. Sandoval & H. Rivera 1276 (B, LAGU); E. Sandoval & O. Rivera s.n. (ISB00814) (AAU, LAGU); F. Chinchilla & E. Sandoval s.n. (ISB00270) (LAGU); J.M. Rosales 1052 (B, LAGU); M. Sandoval & E. Sandoval s.n. (ISB00843) (AAU, B, LAGU); s.n. (JBL01367), 305 (B, LAGU); 208 (B, F, LAGU); S. Castillo s.n. (ISB00688) (LAGU); S. de Moore s.n. (12-933) (MHES).

Santa Ana: G. Davidse *et al.* 37227 (B, BM, ITIC, LAGU, MO); K. Prestegard 20 (MP-00049) (LAGU); R. Seiler 470 (F, ITIC, MHES); 839 (MHES).

La Libertad: A.K. Monro *et al.* 2309, 3733, 3775 (B, BM, ITIC, LAGU, MO); W. Berendsohn *et al.* 1047 (B, LAGU); 1444 (LAGU).

San Salvador: M. Renderos 707 (B, LAGU, MO); R. Seiler 369 (F, MHES); 1504 (F).

Cabañas: A.K. Monro *et al.* 3753 (B, BM, ITIC, LAGU, MO).

*Thelypteris subg. Amauropelta*


*Polypodium balbisii* Spreng., *Aspidium sprengelii* Kaulf., *Dryopteris sprengelii* (Kaulf.) Kuntze, *D. balbisii* (Spreng.) Urb., *Thelypteris sprengelii* (Kaulf.) Proctor

Local name: helecho palma de río.

*Global distribution*: Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Guayana, Ecuador, Peru, Bolivia.

*Salvadoran distribution*: Ahuachapán: A.K. Monro *et al.* 1931 (B, BM, ITIC, LAGU, MO); E. Sandoval & F. Chinchilla 918 (B, LAGU); M. Sandoval & E. Sandoval 303 (B, F, LAGU); P. Standley *et al.* 2499 (F); R. Seiler 918, 935 (F, MHES); S. de Moore s.n. (12-932) (MHES); W. Berendsohn *et al.* 1346 (B, LAGU, MO); 1722 (B, LAGU).


*Phegopteris amplificata* Fée, *Dryopteris amplificata* (Fée) C. Chr., *Aspidium kunzei* Fée

*Global distribution*: Mexico, Guatemala, Honduras, Costa Rica, Panama, Antilles, Colombia, Venezuela, Ecuador, Peru, Brazil, Bolivia.

*Salvadoran distribution*: Santa Ana: V.M. Martínez s.n. (CMC00980) (B, EAP, LAGU, MO).


**Global distribution:** Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Ecuador, Peru, Bolivia.

**Salvadoran distribution:** S. Calderón 1994, LAGU (photo), NY. **Chalatenango:** R. Seiler 256 (F, MHES). **Morazán:** J. Tucker 701 (F).


*Nephrodium deflexum* C. Presl, *Dryopteris lindigii* C. Chr., *Thelypteris lindigii* (C. Chr.) Alston, *Amauropelta deflexa* (C. Presl) Å. Löve & D. Löve

**Global distribution:** Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Colombia, Venezuela, Ecuador, Peru, Bolivia.

**Salvadoran distribution:** **Morazán:** R. Seiler 1010 (F, LAGU (photo), MHES, NY, UC).


*Gymnogramma diplazioides* Desv., *G. polypodioides* Link, *G. cheilosora* Fée,

*Grammitis linkiana* C. Presl, *Dryopteris linkiana* (C. Presl) Maxon, *D. diplazioides* (Desv.) Proctor

**Global distribution:** Mexico, Guatemala, Belice, Honduras, Nicaragua, Costa Rica, Antilles, Colombia, Venezuela, Guayana, Ecuador, Peru, Bolivia.

**Salvadoran distribution:** **Santa Ana:** J.Monterrosa, D.Rodríguez & R.González 1528 (BM, LAGU, MHES, UC).

*Thelypteris melanochlaena* (C. Chr.) C. F. Reed, Phytologia 17: 292. 1968.

*Dryopteris melanochlaena* C. Chr.

**Global distribution:** Mexico, Guatemala, Honduras, Nicaragua.

**Salvadoran distribution:** **Ahuachapán:** R. Seiler 826 (F, MHES). **Santa Ana:** G. Davidse et al. 37234 (B, BM, ITIC, LAGU, MO).


**Global distribution:** Mexico, Costa Rica, Nicaragua, Panama.

**Salvadoran distribution:** **Chalatenango:** Tucker 1043 (F, MICH) (A.R. Smith in Davidse et al. 1995).


Local names: helecho trensillo.

**Global distribution:** Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Ecuador, Peru, Brazil, Bolivia.

**Salvadoran distribution:** **Ahuachapán:** E. Sandoval & F. Pérez 1242 (B, LAGU). **Sonsonate:** R. Seiler 600 (MHES). **Santa Ana:** J. Monterrosa et al. 935, 969 (B, LAGU, NY); R. Seiler 117, 279, 281, 347 (F, MHES); 671 (MHES); 873 (F, ITIC, MHES). **San Salvador:** A.K. Monro et al. 3455 (B, BM, ITIC, LAGU, MO); M.C. Carlson 4b (F); R. Seiler 33, 362 (F, MHES). **Chalatenango:** R. Seiler 421 (F, MHES). **Morazán:** R. Seiler 1059 (F, MHES).

*Nephrodium pilosohispidum* Hook., *Dryopteris pilosohispida* (Hook.) C. Chr., *Alsophila pilosa* M. Martens & Galeotti

Global distribution: Mexico, Guatemala, Honduras, Nicaragua, Antilles, Colombia, Venezuela, Ecuador, Peru, Bolivia.

Salvadoran distribution: Santa Ana: A. Molina *et al.* 16745 (F); J. Monterrosa *et al.* 207 (B, LAGU); R. Seiler 248 (F, MHES); S. Winkler 66 (ITIC). Morazán: R. Seiler 1008 (F, MHES).


*Aspidium pilosulum* Mett., *Dryopteris pilosula* (Klotzsch & H. Karst. ex Mett.) Hieron., *Amauropelta pilosula* (Mett.) Á. Löve & D. Löve

Global distribution: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Colombia, Venezuela, Ecuador, Peru, Bolivia.

Salvadoran distribution: Santa Ana: G. Davidson *et al.* 37310 (B, BM, ITIC, LAGU, MO); R. Seiler 1193 (F, ITIC, MHES). Chalatenango: R. Seiler 421 (JBL00207) (LAGU); R. Seiler 728 (MHES).


Local name: helecho palma de río.

Global distribution: USA, Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Ecuador.

Salvadoran distribution: Ahuachapán: A.K. Monro & M.L. Fomtg 2976 (B, BM, ITIC, LAGU, MO); E. Sandoval & E. Fuentes 1302 (B, LAGU); F. Chinchilla & E. Sandoval s.n. (ISB00152) (B, LAGU); J.M. Rosales 431 (B, BM, LAGU, MO); 943 (B, LAGU, MO); P. Standley *et al.* 2969, 2982 (F); S. Castillo s.n. (ISF00593) (B, LAGU, MO).

Santa Ana: B. Pfeiffer-Berendsohn 64 (LAGU, MO); E.A. Montalvo 3417 (ITIC).

La Libertad: A.K. Monro *et al.* 2291 (B, BM, ITIC, LAGU, MO); E.A. Montalvo 3417 (ITIC).

San Salvador: A.K. Monro *et al.* 2239 (B, BM, ITIC, LAGU, MO); E.A. Montalvo 3585 (ITIC); R. Seiler 784 (F, ITIC, MHES). Chalatenango: A. Molina *et al.* 21556 (F, ITIC); R. Seiler 261 (F, MHES); R. Villacorta *et al.* 982 (B, LAGU, MO). San Vicente: P. Standley *et al.* 3409, 3697 (F). Morazán: A.K. Monro *et al.* 3803 (B, BM, ITIC, LAGU, MO); J. Tucker 645, 700 (F); K. Sidwell *et al.* 750 (B, BM, ITIC, LAGU, MO); R. Seiler 1049a (F, ITIC, MHES).


Global distribution: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Guayana, Ecuador, Peru, Bolivia.

Salvadoran distribution: Santa Ana: A. Molina *et al.* 16745 (LAGU (photo), NY); R. Seiler 194 (F).
Aspidium scalare Christ, Dryopteris scalaris (Christ) C. Chr., Amauropelta scalaris (Christ) Å. Löve & D. Löve
Global distribution: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Colombia, Venezuela, Ecuador, Peru.

Polypodium thomsonii Jenman, Dryopteris thomsonii (Jenman) C. Chr., D. stuebelii Hieron., Amauropelta thomsonii (Jenman) Pic. Serm.
Global distribution: Mexico, Guatemala, Costa Rica, Panama, Antilles, Ecuador, Peru.

Thelypteris subg. Cyclosorus

Christella cretacea (A. R. Sm.) Å. Löve & D. Löve
Global distribution: Mexico, Guatemala, Nicaragua, Costa Rica.

Thelypteris dentata (Forssk.) E. P. St. John, Amer. Fern J. 26: 44. 1936.
Polypodium dentatum Forssk., Dryopteris dentata (Forssk.) C. Chr., D. mollis (Sw.) Hieron., Cyclosorus dentatus (Forssk.) Ching, Christella dentata (Forssk.) Brownsey & Jermy, Aspidium molle Sw.
Local name: palmarín.
Global distribution: USA, Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Ecuador, Peru, Brazil, Paraguay, Argentina, Africa, Asia, Pacific Islands.

Thelypteris hispidula (Decne.) C. F. Reed, Phytologia 17: 283. 1968.
Aspidium hispidulum Decne., Christella hispidula (Decne.) Holtum, Nephrodium quadrangularare Fée, Dryopteris quadrangularis (Fée) Alston, Thelypteris quadrangularis (Fée) Schelpe
Local names: helecho de río, helecho palma de río, helecho trensillo, palma de barranco.
Global distribution: USA, Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Guayana, Suriname, French Guyana, Ecuador, Peru, Brazil, Bolivia, Paraguay, Argentina,
Uruguay, Africa, Asia.

Salvadoran distribution: **Ahuachapán**: E.A. Montalvo 5061 (ITIC); E. Sandoval 206 (LAGU); 1147 (B, LAGU, MO); F. Chinchilla & E. Sandoval s.n. (ISB00426) (LAGU); J.M. Rosales 43 (AAU, B, BM, LAGU, MO, MEXU); 987 (B, BM, LAGU, MO); 340, 2667 (B, LAGU, MO); 688, 2177 (AAU, B, BM, LAGU, MO); M. Sandoval & E. Sandoval 251 (B, F, LAGU); R. Seiler 942 (F, MHES); S. Castillo s.n. (ISF00582) (B, F, LAGU, MO).

**Santa Ana**: K. Prestegard 4 (MP-00047) (LAGU); M. Magaña 3 (LAGU); O. Pank s.n. (12-1000) (MHES).

**La Libertad**: A.K. Monro et al. 3092 (B, BM, ITIC, LAGU, MO); N. Ventura 5022, 5023 (ITIC); W. Berendsen et al. 1443 (LAGU).

**San Salvador**: R. Seiler 50, 220, 453 (F, MHES).

**Usulután**: D. Williams & R.W. Herrera 237 (LAGU).

**San Miguel**: A.K. Monro et al. 2945 (B, BM, ITIC, LAGU, MO).

**Cabañas**: G. Davidse et al. 37115 (B, BM, ITIC, LAGU, MO); R. Seiler 227, 229 (MHES).


Global distribution: USA, Mexico, Guatemala, Honduras, Costa Rica, Panama, Antilles, Colombia, Venezuela, Guayana, Suriname, French Guiana, Ecuador, Peru, Brazil, Bolivia, Paraguay, Argentina, Uruguay, Africa, Asia.

Salvadoran distribution: **Ahuachapán**: G. Davidse et al. 37454 (B, BM, ITIC, LAGU, MO); J.M. Rosales 2447 (B, LAGU, MO); N. Herrera s.n. (JBL03767) (B, LAGU, MO); R. Seiler 950 (F, MHES).

**Nephrodium kunthii** Desv., *Dryopteris normalis* C. Chr., *T. normalis* (C. Chr.) Moxley, *Christella normalis* (C. Chr.) Holttum.

Global distribution: USA, Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Antilles, Colombia, Venezuela, Brazil.

Salvadoran distribution: **San Miguel**: R. Villacorta et al. 2703 (B, BM, LAGU, MO); 2890 (B, BM, EAP, LAGU, MO).

**Thelypteris patens** (Sw.) Small var. *patens*, Ferns S.E. States 243. 1938.

*Polypodium patens* Sw., *Dryopteris patens* (Sw.) Kuntze, *Christella patens* (Sw.) Holttum

Local name: helecho palma de pozo.

Global distribution: USA, Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Peru, Brazil, Bolivia, Paraguay.

Salvadoran distribution: **Ahuachapán**: E. Sandoval & F. Chinchilla 81 (B, LAGU); R. Seiler 936 (F, ITIC, MHES). **Sonsonate**: D. Rodriguez 160 (LAGU); J. Tucker 1352 (F); M.B. Siu s.n. (ITIC). **Santa Ana**: E.A. Montalvo 3246 (ITIC); S. Winkler 87 (ITIC). **La Libertad**: A.K. Monro et al. 3731, 3734 (B, BM, ITIC, LAGU, MO); R. Villacorta 1068 (B, LAGU, MO). **San Salvador**: A. Molina et al. 21846 (F); R. Seiler 340, 519 (F, MHES). **San Vicente**: P. Standley et al. 3675 (F). **Usulután**: D. Williams 261 (LAGU). **Cabañas**: A.K. Monro et al. 3744, 3756 (B, BM, ITIC, LAGU, MO); R.
Seiler 226 (F, MHES).

**Thelypteris patens** (Sw.) Small var. smithiana Ponce, Darwiniana 28: 373. 1987.  
*Global distribution*: Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Ecuador, Peru, Bolivia, Brazil.  

*Local name*: helecho peloso.  
*Global distribution*: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Antilles.  
*Salvadoran distribution*: Santa Ana: J. Lagos 1622 (ITIC); R. Seiler 676 (F); V.M. Martinez s.n. (CMC00854) (B, LAGU); R. Seiler 876 (MHES). San Salvador: A. Molina & E.A. Montalvo 21653 (EAP, LAGU (photo), NY); R. Seiler 51 (F, MHES). La Libertad: J. Williams s.n. (ITIC); L.O. Williams et al. 15092 (F); R. Seiler 1520 (F).

**Thelypteris subg. Goniopteris**

*Goniopteris hatchii* (A. R. Sm.) Å. Löve & D. Löve  
*Global distribution*: Mexico, Guatemala, Honduras, Costa Rica.  
*Salvadoran distribution*: Morazán: R. Seiler 1063 (F, ITIC, MHES).

*Dryopteris nicaraguensis* (E. Fourn.) C. Chr. var. minor C. Chr.  
*Local name*: helecho nido de guachota.  
*Global distribution*: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama.  
*Salvadoran distribution*: Ahuachapán: A.K. Mono et al. 1977 (B, BM, ITIC, LAGU, MO); D. Witsberger 653, 690, 691 (MHES); E. Sandoval 42 (LAGU, MO); 1136 (B, LAGU); G. Davidse et al. 37373, 37376 (B, BM, ITIC, LAGU, MO); N. Herrera s.n. (JBL03861) (LAGU, MO); R. Seiler 815 (F, ITIC, MHES). Sonsonate: A. Molina et al. 21624 (ITIC). Santa Ana: M.B. Siu s.n. (ITIC); S. Winkler 88 (ITIC). Morazán: R. Seiler 905 (F, ITIC, MHES).

*Polypodium obliteratum* Sw., *P. faucium* Liebm., *Goniopteris obliterata* (Sw.) C. Presl., *Dryopteris obliterata* (Sw.) C. Chr.  
*Global distribution*: Mexico, Guatemala, Belice, Honduras, Nicaragua, Costa Rica, Antilles.  
Thelypteris tetragona (Sw.) Small, Ferns S. E. States 256. 1938.
Polypodium tetragonum Sw., Goniopteris tetragona (Sw.) C. Presl, Dryopteris tetragona (Sw.) Urb., D. subtetragona (Link) Maxon

Global distribution: USA, Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Guayana, Suriname, Ecuador, Peru, Brazil, Bolivia.

Thelypteris subg. Meniscium

Meniscium angustifolium Willd., Dryopteris angustifolia (Willd.) Urb., Polypodium salicifolium Vahl
Global distribution: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Ecuador, Peru, Brazil, Bolivia, Paraguay.

Meniscium serratum Cav., Dryopteris serrata (Cav.) C. Chr.
Local name: helecho gallardete.
Global distribution: USA, Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Guayana, Suriname, French Guyana, Ecuador, Peru, Brazil, Bolivia, Paraguay, Argentina.

Dryopteris standleyi Maxon & C. V. Morton
Global distribution: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Colombia, Ecuador, Peru, Bolivia.
Salvadoran distribution: Morazán: A.K. Monro et al. 3828 (B, BM, ITIC, LAGU, MO); J. Monterrosa & R. Carballo 795, 871 (LAGU).

WOODSIACEAE

Athyrium paucifrons C. Chr.
Global distribution: Mexico, Guatemala.
Salvadoran distribution: Morazán: R. Seiler 1056 (ITIC, MHES).

Cystopteris fragilis (L.) Bernh. var. palmensis Christ
Global distribution: Mexico, Costa Rica.
Salvadoran distribution: Santa Ana: M.L. Reyna de Aguilar 760 (MHES); R. Seiler 620 (MHES); 1202 (ITIC). La Libertad: W. Berendsohn et al. 1442 (LAGU). San


*Asplenium skinneri* Baker

**Global distribution:** Mexico, Guatemala, Nicaragua, Costa Rica, Panama, Colombia, Ecuador.


**Global distribution:** USA, Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Ecuador, Peru, Brazil, Bolivia, Chile, Argentina, Europe, Africa, Asia, Hawaii.

**Salvadoran distribution:** Santa Ana: G. Davidse et al. 37250 (B, BM, ITIC, LAGU, MO); J. Monterrosa et al. 982 (B, LAGU, MO, NY); R. Seiler 353 (JBL04809) (F, LAGU, MHES); R. Seiler 278, 343, 502 (F, MHES). Chalatenango: R. Seiler 155 (F, MHES); R. Seiler 405 (JBL00090) (F, LAGU, MHES).

*Diplazium cristatum* (Desr.) Alston, J. Bot. 74: 173. 1936.


**Global distribution:** Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Guayana, Suriname, French Guyana, Ecuador, Peru, Brazil, Bolivia, Paraguay, Argentina.

**Salvadoran distribution:** Ahuachapán: J.M. Rosales 922, 947 (AAU, B, BM, LAGU, MO); M. Magaña 40 (MP-00015) (LAGU); R. Seiler 916 (F, MHES). Santa Ana: M. B. Siu s.n. (ITIC). San Salvador: R. Seiler 371 (F, ITIC, MHES); 532 (F, MHES). Chalatenango: R. Seiler 358 (JBL04810) (LAGU, MHES); 689 (JBL04816) (F, LAGU, MHES); 273 (MHES); 474 (F, MHES); V.M. Martinez s.n. (CMC00896) (B, EAP, LAGU, MO). San Salvador: A. Molina & E.A. Montalvo 21852 (JBL01464), EAP (F, LAGU); R. Seiler 336 (F, MHES); S. Winkler 32 (ITIC).


**Global distribution:** Mexico, Guatemala, Honduras, Nicaragua, Costa Rica.

**Salvadoran distribution:** Ahuachapán: A.K. Monro et al. 1980 (B, BM, ITIC, LAGU, MO); R. Seiler 825 (F, ITIC, MHES); S. de Moore s.n. (12-912) (MHES). Santa Ana: R. Seiler 358 (JBL04810) (LAGU, MHES); 689 (JBL04816) (F, LAGU, MHES); 273 (MHES); 474 (F, MHES); V.M. Martinez s.n. (CMC00896) (B, EAP, LAGU, MO). San Salvador: A. Molina & E.A. Montalvo 21852 (JBL01464), EAP (F, LAGU); R. Seiler 336 (F, MHES); S. Winkler 32 (ITIC).


**Global distribution:** Mexico, Guatemala.

**Salvadoran distribution:** Sonsonate: R. Villacorta et al. 323 (B, F, LAGU, MO).

Asplenium franconis (Liebm.) Mett., A. franconis (Liebm.) Mett. var. gracile E. Fourn., A. aspidiforme Fée, A. distans Fée, A. shepherdii Spreng. var. bipinnatum Christ, Diplazium camptocarpon Fée.

Local names: helecho pacún, helecho crisalia.

Global distribution: Mexico, Guatemala, Belize, Honduras, Nicaragua, Panama.

Salvadoran distribution: Ahuachapán: E. Sandoval & F. Chinchilla 334 (LAGU, MO); E. Sandoval & F. Chinchilla 43 (LAGU). Santa Ana: A. Molina et al. 16896 (F); G. Cerén & D. Rodríguez s.n. (JBL04662) (LAGU); G. Davídse et al. 37225 (B, BM, ITIC, LAGU, MO); R. Seiler 178, F (LAGU). Chalatenango: R. Seiler 380 (F, MHES).

Diplazium lindbergii (Mett.) Christ, Prim. Fl. Costaric. 3(I): 27. 1901.

Asplenium lindbergii Mett., A. induratum Christ, Diplazium induratum Diels

Global distribution: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Ecuador, Peru, Brazil, Bolivia, Uruguay.


Diplazium inaequilaterum Liebm., D. actuale Fée.

Local names: helecho de coqueta, helecho palma de ángel, helecho pluma de tucán, helecho trencilla de bajo.

Global distribution: Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Colombia, Ecuador.

Salvadoran distribution: Ahuachapán: E. Sandoval & F. Chinchilla 130 (LAGU); E. Sandoval & F. Chinchilla 487, 1165 (B, LAGU); E. Sandoval & M. Sandoval 1372 (B, LAGU); F. Chinchilla & E. Sandoval s.n. (ISB00151) (B, LAGU, MO); J.M. Rosales 451 (AAU, B, BM, LAGU, MO); M. Sandoval & E. Sandoval s.n. (ISB00869), 289, 294 (B, F, LAGU); P. Standlee et al. 2567 (F); R. Seiler 917, 931 (F, MHES); W. Berendsdoth 1312 (B, LAGU, MO); W. Berendsdoth et al. 1400 (B, LAGU, MO).

Sonsonate: J. Tucker 1350 (F); R. Seiler 596 (F, MHES). Santa Ana: K. Prestegard 5 (MP-00019) (LAGU); R. Seiler 244 (F, ITIC, MHES); V.M. Martinez s.n. (CMC00853) (B, LAGU, MO); V.M. Martinez s.n. (CMC00873), s.n. (CMC00967), s.n. (CMC01010), s.n. (CMC01032) (B, EAP, LAGU, MO). La Libertad: J. Mauricio et al. s.n. (JBL04480), s.n. (JBL04490) (B, BM, ITIC, LAGU, MO); R. Seiler 714 (F, MHES).


Global distribution: Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Antilles, Colombia, Venezuela, Trinidad and Tobago, Ecuador, Peru, Brazil, Bolivia.

Salvadoran distribution: Ahuachapán: E. Sandoval & F. Chinchilla 211 (LAGU); E. Sandoval & M. Sandoval s.n. (JBL01385) (B, LAGU); F. Chinchilla s.n. (ISB00572) (AAU, F, LAGU), s.n. (ISB00662) (AAU, F, LAGU); R. Seiler 933 (F, MHES).
Sonsonate: J. Tucker 1353 (F). **San Salvador**: S. Winkler 44 (ITIC). **Morazán**: R. Seiler 981 (F).

*Asplenium ternatum* (Liebm.) Hook.  
**Global distribution**: Mexico, Guatemala, Honduras, Nicaragua.  
**Salvadoran distribution**: **Santa Ana**: R. Seiler 772 (ITIC); **Morazán**: J.L. Linares & A. Pool 2292 (JBL01931) (LAGU).

**Diplazium vera-pax** (Donn. Sm.) Hieron., Hedwigia 59: 322. 1917.  
*Asplenium vera-pax* Donn. Sm., *A. cordovense* Baker  
**Global distribution**: Mexico, Guatemala, Belize, Nicaragua, Costa Rica, Panama.  
**Salvadoran distribution**: **Santa Ana**: M.L. Reyna de Aguilar 659 (MHES).

**Global distribution**: Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Colombia.  
**Salvadoran distribution**: **Ahuachapán**: R. Seiler 902 (F, ITIC, MHES); 952 (F, MHES). **Sonsonate**: A. Molina & E.A. Montalvo 21625 (JBL01491) (F, EAP, LAGU), 21774 (JBL01555) (F, EAP, LAGU). **Santa Ana**: B. Pfeiffer-Berendsohn 50 (B, LAGU, MO); D. Rodríguez & G. Cerén s.n. (JBL04596) (LAGU); J. Tucker 1214 (F); J. Monterrosa & R. Martínez 939, 946 (LAGU, NY); K. Prestegard 31 (MP-00020) (LAGU); K. Sidwell et al. 844 (B, BM, ITIC, LAGU, MO); O. Pank s.n. (12-979) (MHES); R. Seiler 275, 483 (F, MHES); S. Winkler 1b (ITIC). **San Salvador**: R. Seiler 355 (F, MHES). **Chalatenango**: R. Seiler 379 (JBL00089) (F, LAGU, MHES). **Morazán**: R. Seiler 1025 (F).

**Woodsia mollis** (Kaulf.) J. Sm., J. Bot. (Hooker) 4: 191. 1841.  
*Physematium molle* Kaulf., **Woodsia guatemalensis** Hook., *W. fragilis* Liebm.  
**Global distribution**: Mexico, Guatemala, Nicaragua.  
**Salvadoran distribution**: **Sonsonate**: R. Seiler 496 (F, MHES). **Santa Ana**: M.B. Siu s.n. (ITIC); R. Seiler 43, 661 (F, MHES); 501 (ITIC, MHES); S. Winkler 83 (ITIC).
INSTRUCTIONS FOR AUTHORS

PAPERS should not usually exceed 20 printed pages and are generally expected to be considerably shorter. Review articles, as well as reports of original research, are encouraged. Short notes are acceptable e.g. new records. The senior author should supply a fax and email address to facilitate correspondence.

MANUSCRIPTS should be submitted in English (British) in electronic format (preferably) or hard copy (two copies), in 10-point Times New Roman font and double spaced. Electronic versions of text and tables should be compatible with WORD, with figures as pdf or jpg files, and sent as email attachments or CDroms. All manuscripts will be refereed.

THE TITLE should reflect the content of the paper and be in BOLD CAPITALS (11-point) and centrally aligned. Generic and specific names should be in italics and any title containing a generic or specific name must be followed by the family and Pteridophyta in brackets e.g.

TRICHOMANES SPECIOSUM (HYMENOPHYLLACEAE: PTERIDOPHYTA) IN SOUTHERN SPAIN


MAIN HEADINGS: should be in BOLD CAPITALS (10-point) and centrally aligned.

SUBSIDIARY HEADINGS: should be in bold, the first letter of each word in capitals, the rest in lower case and left-aligned.

AUTHORS' NAMES AND FULL ADDRESSES: follow the title and are centrally aligned.

KEY WORDS: up to ten.

ABSTRACT: should reflect the content of the paper.

FIGURES: there is no distinction between photographs and line drawings in numbering. All should be presented in a form ready for reproduction, ideally in JPG format (please contact editor with queries), with a scale bar where appropriate. Lettering or numbers (Arabic) should be in the bottom left using uppercase Times Roman and be sufficiently large to be legible if reduction is necessary during printing. The number of photographs allowed in any one issue is limited by cost. Figure captions should be on a separate sheet.

TABLES: can be printed in either portrait or landscape format. Authors should consider this when preparing tables. Authors should ensure that tables fit the printed page size in a legible form.

MEASUREMENTS: should follow the metric system.


JOURNAL ABBREVIATIONS: should follow Botanico Periodicum Huntianum & Supplements.

Alterations from the original text at proof stage will be charged for unless they are minor points of detail. Twenty-five offprints will be supplied free to the senior author.
A SUMMARY OF INDIAN CHEILANTHOID FERNS AND THE DISCOVERY OF NEGRIPTERIS (PTERIDACEAE), AN AFRO-ARABIAN FERN GENUS NEW TO INDIA

C.R. FRASER-JENKINS¹ & C.S. DULAWAT²

¹Student Guest House, Thamel, P.O. Box no. 5555, Kathmandu, Nepal (Email: chrisophilus@yahoo.co.uk)
²Bryology Laboratory, Dept. of Botany, University College of Science, M.L.S. University, Udaipur, Rajasthan - 313001, India (Email: csdulawat@rediffmail.com)

Key words: Cheilanthes, Aleuritopteris, Notholaena, Negripteris, fern, Rajasthan, India

ABSTRACT
A summary of Indian cheilanthoid ferns treated under nine genera includes three new names, Notholaena dipinnata Fras.-Jenk., Cheilanthes bhutanica Fras.-Jenk. & Wangdi and Cheilanthes tibetica Fras.-Jenk. & Wangdi, and five new combinations, Cheilanthes nitidula Hook. subsp. henryi (Christ) Fras.-Jenk., Aleuritopteris bicolor (Roxb.) Fras.-Jenk. & Dulawat, Aleuritopteris subdimorpha (C.B.Clarke & Baker) Fras.-Jenk. and Notholaena muelleri (Hook.) Fras.-Jenk. Negripteris scioana (Chiov.) Pic.Serm. (Pteridaceae), a close relative of both Aleuritopteris and Chrysochosma, was discovered by the second author in semi-arid conditions in the Kumbhalgarh and Sitama Reserves of the Aravalli Hills in central Rajasthan, N.W. India, the first record for the Indian sub-continent. It was known previously only from N.E. Africa, Socotra and S. Arabia and is an Afro-Arabian species which, as now found, extends eastwards into the hills of the semi-arid region of W. India.

INTRODUCTION
The cheilanthoid ferns of India have at various times been placed in the families Sinopteridaceae, Negripteridaceae, Cheilanthaceae and Hemionitidaceae, but are now generally accepted as belonging to subfamily Cheilanthoideae, within Pteridaceae, with the other four families, among others, in its synonymy. The common term cheilanthoid is a vague and undefined one, though it should be recognisable to most fern-workers. The most obviously “cheilanthoid” ferns of India belong to nine genera, though various other genera are also allied or within Subfam. Cheilanthoideae, but are not dealt with here (see, for example, Tryon, Tryon & Kramer 1990). These nine genera with their Indian subcontinental species are as follows:

1. Notholaena R.Br., includes Cosentinia Tod., Paraceterach Copel. and Paragymnopteris K.H.Shing, perhaps also Chrysochosma (J.Sm.) Kümmerle. This genus has long been accepted internationally as typified by N. marantea (L.) Desv., following Christensen (1905) and subsequently the carefully reasoned work of Pichi Sermolli (1981, 1989). An apparent lectotypification by Smith (1875) merely used the word “type” in the sense of “typical species”, or even “representative species” and in several other cases Smith cited species not included by the original author of a genus, or even cited more than one species after the word “type”. His misuse of the word
“type” is therefore not acceptable as effective lectotypification. Christensen’s proper lectotypification was also followed world-wide, including in N. America (Tryon 1956, 1964 et al.), but Tryon & Tryon (1980) subsequently reversed it in favour of his own local regional misapplication of the name *Notholaena* to the N. and C. American segregate-genus, *Chrysochosma* (J.Sm.) Kümmesle, on the basis that Smith’s “lectotypification” was earlier, though that was then rejected by the International Committee for Nomenclature (Pichi Sermolli 1981), which Tryon did not mention again. He thus ignored the bulk of literature across four other continents of the Old World, which created considerable nomenclatural confusion, and was subsequently supported locally in the USA by Yatskievych & Smith (2003). The conservation of *Notholaena* with a conserved type, *N. marantae*, is therefore advisable to restore the *status quo ante* without any room for doubt and allow current Old World authors to continue using *Notholaena* in its usual sense. Neither the Australian genus *Paraceterach*, nor Shing’s genus, *Paragymnopteris*, are accepted as replacing *Notholaena* for the eight well marked Old World species. *Notholaena*, in its traditional and present sense, and *Chrysochosma* are very close, critical genera, very difficult to define separately, and maintained largely on molecular grounds of unknown and possibly minor taxonomic significance. Their separability at a rank as high as genus is somewhat doubtful, despite being accepted in the USA, but if maintained, Pichi Sermolli (1989) has already made the great majority of necessary combinations for the New World species within *Chrysochosma*. *Notholaena* species are frequently exindusiate (without a pseudoindusium) and usually markedly hairy/scaly on the surfaces and axes; they often have the sori spreading down the veins from the margin, as a derivative from the marginal condition in many other cheilanthoid ferns. The five Indian subcontinental species are:

*N. himalaica* Fras.-Jenk. (1997) (syn.: *Gymnopteris vestita* (Hook.) Underw., shown to have been misplaced in that genus by Mickel (1974)). Simply pinnate, with slightly elongated-ovate, densely silky-hairy pinnae. Widespread throughout the W. and E. Indo-Himalayan region, except for the far west Himalaya; Tibet; and S.W. China.


*Notholaena dipinnata* Fras.-Jenk., nom. nov., for *Gymnopteris bipinnata* Christ, Not. Syst. (Lecomte) 1: 55 (1909), non *N. bipinnata* Liebm. The lower pinnae are again pinnate and the upper ones lobed. The relationship between this species and *N. borealisinensis* is unclear as some intermediate plants appear to connect them together, though not in the Indian subcontinent. They were therefore treated as two varieties by Ching, but it is not considered likely here that the two extremes could merely represent variation within a single species. The intermediates require further study. This species has not been found in India, as the record by Fraser-Jenkins (2008), from Arunachal Pradesh (Lohit. *B. Krishna* 48966, ASSAM) was in error for a scrumpled specimen of *N. borealisinensis*, but it is mentioned here to explain its separation from the previous species and because it occurs very near to the border in S.W. China.

*N. marantae* (L.) Desv. Sometimes stated to consist of three subspecies in Europe and Macaronesia, subsp. *marantae*, subsp. *subcordata* (Cav.) Benl & Poelt and subsp. *cupripaleacea* (Benl) Rivas Mart. et al., but these merely represent minor variation
within the species and are not considered here to be appropriately ranked as subspecies, or needing recognition. Cape Verdes; Morocco; Algeria; Ethiopia; Macaronesia; across S. Europe; the Caucasus and Turkey; Cyprus; Lebanon; Syria; Iran; Yemen; from the west to east Indo-Himalaya; Tibet; and S.W. China. *N. marantae* is diploid sexual, with \( n = 29 \), including from Uttarakhand, and a report by Khullar, Sharma & Verma (1988) of \( n = 58 \), from Jamunotri, Uttarakhand, is considered to have been in error (Fraser-Jenkins 1997: 184).

*N. lanuginosa* (Desf.) Desv. *ex* Poir. (syn.: *N. vellaea* (Aiton) Tod.). Pichi Sermolli (1985) treated this species as a separate genus, *Cosentinia*, which he revived from earlier Italian literature, on the basis of its more trilete spores, but this has seldom been accepted. Morocco; Tunisia; Libya; Macaronesia; across S. Europe; Turkey; Cyprus; Lebanon; Syria; Israel; Yemen; Sudan; Iran; Afghanistan; Pakistan; N.W. India (Himalach Pradesh). A typical Mediterranean European element in the W. Himalaya. There are two subspecies, the tetraploid subsp. *lanuginosa*, which occurs throughout the range, excluding Pakistan and India, and the very closely similar, and cryptic diploid subsp. *bivalens* Reichst. (Badré & Reichstein 1983), apparently confined to Macaronesia, Spain and the Indian subcontinent.

A further species is the Chinese *N. sargentii* (Christ) Fras.-Jenk. (1997). Two additional Australian species, *Notholaena muelleri* (Hook.) Fras.-Jenk., *comb. nov.*, basionym: *Gymnogramma muelleri* Hook., *Sp. Fil.* 5: 143, t. 295 (1864), and *N. reynoldsii* F.Muell., were formerly placed in the genus *Paraceterach*, which was treated as endemic to Australia, but *N. marantae* and four other species were placed within *Paraceterach* by Tryon (1986) in order to accommodate his misapplication of *Notholaena*.

2. *Cheilanthes* Sw., which includes *Cheilosoria* Trevis, and *Mildella* Trevis., normally consists of efarinose species in Asia, with generally narrow stipe-scales and small segments. The 11 species present in the Indian subcontinent are:

- *C. pteridioides* (Reichard) C.Chr. subsp. *acrosticha* (Balb.) O.Bolós (syn.: *C. acrosticha* (Balb.) Tod..). W. Himalaya westwards to Mediterranean S.W. Asia and Europe, N. Africa and the Cape Verdes Islands. Subsp. *pteridioides* (syn.: *C. fragrans* L.f.) Webb & Berth., *non* Sw; *C. maderensis* R.Lowe; *Negripteris quezeli* Tardieu) occurs from Mediterranean S.W. Asia, west across Mediterranean Europe to Macaronesia and across N. Africa, but is not present in the Indian subcontinent or near to it. The two subspecies are different cytotypes with a close reticulate relationship and are very similar to each other, differing only in the length of the indusium. They have thus been much confused in earlier literature, usually under the name *C. fragrans*, which is illegitimate. Following the rejection by Committee of Nardi & Reichstein’s (1986) proposal to reject *Polypodium pteridioides* Reichard, in order to preserve their nomenclature, the nomenclature of this critical complex is now stable at either the specific or subspecific rank.


W. Bhutan (Chele La Pass, Ha District, T. Wangdi, CRFJ no. 31625, 12 Oct. 2005, THIM, TAIF, det. CRFJ). Specimens from S. Tibet by the N. Sikkim border and from Lhasa in Herb. Lloyd Botanic Garden, Darjeeling (!). Lamina pale-green, with long rather unlobed pinnules, a pale-brown stipe and rachis and hair-tipped, linear red-brown scales up the stipe; fronds deltate-lanceolate, bipinnate; indusia both short and long, arising at the curled over laminar edge rather than shortly within it as in other species formerly placed in Mildella.

C. nitidula Hook. subsp. nitidula (syn.: Pellaea nitidula (Hook.) Baker; Mildella nitidula (Hook.) C.C.Hall & Lellinger), from the W. Himalaya only, reaching eastwards to W. Nepal.

C. nitidula subsp. henryi (Christ) Fras.-Jenk., comb. nov., basionym: Pellaea henryi Christ, Bull. Herb. Boissier 7: 7 (1890) (syn.: Mildella henryi (Christ) C.C. Hall & Lellinger). N.E. India (Arunachal Pradesh), Bhutan (Thimphu, Tabā, CRFJ 31496, 8 Oct. 2005, THIM, TAIF), S.E. Tibet, S. China (Yunnan (type), Szechuan, Kweichow, Kwangtung, Fukien), Taiwan, Vietnam. Reported from Namdapha, Arunachal Pradesh, by Singh & Panigrahi (2005) sub Aleuritopteris albomarginata (C.B.Clarke) Ching in error. Their drawing shows A. albomarginata from some other source, that being a higher altitude species they could not have found in the lower reaches of Namdapha they visited. However their photograph is of C. nitidula subsp. henryi, whose presence at Namdapha has been verified by CRFJ, from specimens previously cited by Chauhan (1996), but misreported by them as the Afro-Arabian C. farinosa (Forssk.) Kaulf. Very close to subsp. nitidula and differing only in the rachis hairs being denser and more prominent and sometimes extending further around the sides of the rachis and the smaller fronds with slightly less lobed pinna and pinna-lobes. This subspecies is a vicariant of subsp. nitidula and replaces it in the eastern part of its range. Previous records and collections of C. nitidula from further east referred to the present subspecies, which merges into it morphologically. The interesting bicentric range of this species is a well known distribution-pattern for species that prefer a somewhat drier climate and thus occur scattered behind the Himalayan line in the otherwise wetter parts of the central and east Himalaya.

C. opposita Kaulf. (syn.: C. mysurensis Wall. ex Hook., C. fragrans Sw.). Sri Lanka, S. India (N. to Orissa), S. China (Yunnan, Hainan, Kwangtung, Fukien), Taiwan, Myanmar and the Philippines. This beautiful species with narrow, upright and finely dissect, bright green leaves has been nomenclaturally confused until recently (see Fraser-Jenkins 1997), though its nomenclature was clarified by Alston (1936) and in detail by Fuchs (1961). Its range has sometimes been given as throughout China and other areas in error for the closely related, but less dissect C. chusana Hook.

C. tematifolia (Burm.f.) Sw. Sri Lanka, through most of the Indian subcontinent except the N.W., China, Taiwan, S.E. Asia, Australia, New Guinea and Oceania. Although reported as diploid apomict by Verma (1961) it is now known that this species is tetraploid sexual in India and Sri Lanka, but like apomictic species produces only 32 spores per sporangium, as do several other sexually reproducing Cheilanthes species.

C. hancockii Baker. Newly reported from the Indian subcontinent, from Tabā, Thimphu, Bhutan, CRFJ 31497, 8 Oct. 2005, THIM, TAIF; previous records from the E. Indo-Himalaya were in error for Aleuritopteris bicolor. S.W. China. *N. Thailand (C. delicatula Tagawa & K.Iwats., which may otherwise be distinct).

C. belangeri (Bory) C.Chr. (syn.: C. varians Hook.). N.E. India, from Nepal eastwards; Bangladesh; Myanmar; S.E. China; Thailand; and S.E. Asia to the Philippines.
Reported from S. India by Beddome (1864) in error for C. thwaitesii (below), which he included within his concept of this species. *C. trichophylla* Baker (syn.: *Pellaea trichophylla* (Baker) Ching; *Cheilanthes undulata* C.Hope & C.H.Wright). S.W. China. Reported tentatively by S.C. Verma in Mehra & Bir (1964), from the Kyangnosla pass, below Chhangu [Tsomgo] Lake, E. Sikkim (Verma, pers. comm. to CRFJ, 2004), but the specimen lost and unverified, though perhaps correctly recorded due to its distinct appearance, as recalled by Verma and illustrated in a drawing in his unpublished Ph.D. thesis of 1962 at Panjab University, Chandigarh. Distinctive zig-zag rachides and the axes and deeply tripinnatifid lamina densely covered in short yellowish-brown hairs.


*C. thwaitesii* Mett. ex Kuhn (syn.: *Cheilanthes laxa* T.Moore ex Bedd., nom. superfl. for *C. thwaitesii*; *Cheilanthes keralensis* N.C. Nair & S.R. Ghosh, *Aleuritopteris thwaitesii* (Mett. ex Kuhn) Saiki). Sri Lanka (type) and South India; a Hindu-Lankan endemic. Type from Sri Lanka. This often overlooked species is important in illustrating that the presence or absence of farina is not confined to *Aleuritopteris*, but also occurs in some true *Cheilanthes* species.

3. *Aleuritopteris* Fée, formerly treated by most authors as *Cheilanthes* subgen. *Aleuritopteris* (Fée) W.C. Shieh, and all the species, except *A. stenochlamys* Ching ex S.K. Wu, have names in *Cheilanthes*. But it was recognised generically by Ching in Ching & Wu (1981, 1983) and subsequent Chinese workers and Saiki (1984). It appears likely that it constitutes a distinct, if probably heterogeneous entity, which being easily recognisable is practicably and usefully recognisable as a genus. The species are usually well-marked and readily distinguishable by their stipe-scales (bicolorous or concolorous) and their distribution up the axes, though most were at one time referred to the African and Arabian species, *A. farinosa* (Forssk.) Kaulf., which does not occur in Asia. The genus includes *Sinopteris* C.Chr. & Ching and *Leptolepidium* Ching & S.K. Wu (in the sense of its type species and also in the sense of Ching & Wu, which was based on a misapplication of the name *Cheilanthes dalhousiae* Hook.). It also has two sections, the first being the less dissect, more palmate species related to *A. argentea* (below) and the rest being the more pinnate species along the pattern of *A. farinosa*. Morphologically *Aleuritopteris* is slightly difficult to define in a way that distinguishes it from some species of *Doryopteris*, which are rather close to the *A. argentea* group, but are perhaps more likely to be related to the imparipinnate genus, *Pellaea*. Most species have rather wide segments and a strong white or yellow farina, with wide stipe-scales. Due to considerable lack of clarity and confusion, the cytology and reported aneuploid base-numbers for various species need to be carefully reinvestigated with accurate identification and preservation of voucher-specimens. The 18 species present
in the Indian subcontinent have mostly been detailed by Fraser-Jenkins (1992, 1993 and 1997) and are:

*A. argentea* (S.G. Gmel.) Fée (syn.: *A. flava* (Ching & S.K.Wu) S.R.Ghosh, non Saiki, nec sensu Ghosh [= *A. subargentea*]). Far N.E. India, a single collection of J.D. Hooker & T. Thomson’s from the Khasi Hills, Meghalaya (K?), might be correctly localised, but it has never been collected since in this generally well known area and is normally a higher-altitude, and usually higher latitude species. A similar case occurs with their collection at Kew of *Lycopodium annotinum* L. subsp. *alpestre* (Hartm.) Å. Löve & D. Löve, said to be from Khasia, but almost certainly from N. Sikkim. However *A. argentea* (S.G. Gmel.) Fée, which otherwise occurs in W., S.W., C., N. and E. China; Tibet; Taiwan; Korea, and Siberia, has now been discovered in Bhutan (Taba, near Thimphu, CRFJ 31500, 8 Oct. 2005, THIM, TAIF), and was previously collected from N. Lohit, at the Tibetan border in or on the border of Arunachal Pradesh (F. Kingdom-Ward, BM!). A further species, close to *A. argentea*, but without white farina and with small, narrow, less lobed segments has also turned up in N.E. Arunachal Pradesh (Changlang, Namdapha, Shirung to Hunung, c. 1100 m., B.K. Shukla 88207, 7 Feb. 1986, ASSAM, det. CRFJ). It appears to belong to the efarinose Chinese species, *A. shensiensis* Ching, though further comparative study may be required.

*A. subargentea* Ching et S.K.Wu. Similar to *A. argentea* but slightly more dissect and the frond slightly more pinnately arranged, less palmate. Newly discovered in the Indian subcontinent (Marpha to Tukuche, Mustang, N.C. Nepal, CRFJ 30509, 27 June 2004, with G. Tamang, TAIF); Songgong, Sikkim, 1,400ft, Ribu & Rhomoo Lepcha, for G.H. Cave 7634, 4 Oct. 1923 (Herb. Lloyd Botanic Garden, Darjeeling!, det. CRFJ). Tibet; S.W. China.

*A. tamburii* (Hook.) Ching et S.K.Wu. Ching ex S.K.Wu. Similar to *A. argentea* but slightly more dissect and the frond slightly more pinnately arranged, less palmate. Newly discovered in the Indian subcontinent (Marpha to Tukuche, Mustang, N.C. Nepal, CRFJ 30509, 27 June 2004, with G. Tamang, TAIF); Songgong, Sikkim, 1,400ft, Ribu & Rhomoo Lepcha, for G.H. Cave 7634, 4 Oct. 1923 (Herb. Lloyd Botanic Garden, Darjeeling!, det. CRFJ). Tibet; S.W. China.

*A. subvillosa* (Hook.) Ching (syn.: *A. tenella* (Ching & S.K.Wu) Saiki). W. to E. Indo-Himalaya; Tibet; S.W. China. Efarinose, but closely related to the farinose *A. caesia* (Christ) Ching and *A. kuhnii* (Milde) Ching, from Tibet and S.W. or C. to N.E. China; Japan (the latter reported from India in error for *A. dalhousiae* by Dixit (1984)).

*A. duthiei* (Baker) Ching. W. Indo-Himalaya (very rare); N.W. Nepal; Bhutan. Efarinose, related to *A. leptolepis* (Fras.-Jenk.) Fras.-Jenk., but with a wider-triangular and more dissect lamina; both have wide, pale stipe-scales.

*A. leptolepis* (Fras.-Jenk.) Fras.-Jenk. (2008) (misapplied name: *A. dalhousiae* (Hook.) Ching, nom. utrique rejic.). The totally efarinose, higher-altitude species long known as *A. dalhousiae* [“dalhousiae”] in error due to Hooker’s confusing the efarinose Summer (monsoon) fronds of *A. albomarginata* (below) with this species. W. to E. Indo-Himalaya; Myanmar; Tibet; S.W. China. Misreported sub “C. dalhousiae” sensu auct. *Ind.*, by Dixit (1996) from Orissa, in error for *A. bicolor* with the powder washed off by alcohol during herbarium-poisoning.

*A. rufa* (D.Don) Ching. Common from the W. to E. Indo-Himalaya; also in S.W. China; Myanmar; Thailand. The fronds are lanceolate, narrowing slightly to the base, and the axes are densely covered with narrow, hair-like, fibrillose scales.

*A. dubia* (C.Hope) Ching (syn.: *A. subrufa* (Baker) Ching; *C. leveillei* Christ; *A. humatoides* Saiki; *C. wusukungii* Miyamoto & Ohba). Intermediate between the last and next species and sharing the same phytochemistry of its white flavonoid powder (Fraser-Jenkins & Wollenweber in prep.). W. to E. Indo-Himalaya; N. Western Ghats;
Myanmar; Tibet; S.W. and S. China; Taiwan; Thailand; the Philippines. Confused in China and reported as the next species.

*A. albomarginata* (C.B.Clarke) Panigrahi (syn.: *A. dalhousieae* (Hook.) Ching, nom. utrique rejic., non sensu auct. Ind.). Widespread at somewhat higher altitudes from the far W. to N.E. Himalaya; Orissa; N. Western Ghats; Tibet; S.W. China; Taiwan; Thailand; Vietnam. The fronds are deltate and instead of hair-like scales have bicolorous scales extending up the stipe, rachis and costae. The Summer (monsoon) fronds are taller and more developed and almost or quite without farina, unlike the smaller, basal Winter fronds.

*A. chrysophylla* (Hook.) Ching (syn.: *A. humatifolia* X.C.Zhang & L.Shi; *A. flavopygmaea* S.R.Ghosh). The only species with bright sulphur-yellow farina beneath in the Indian subcontinent. The W. Indo-Himalaya (Simla); C. Nepal to N.E. India; Myanmar; Tibet; S.W. China; Thailand.

*A. formosana* (Hayata) Tagawa (syn.: *C. brevifrons* (Khullar) Khullar). One of the most widespread species, frequently reported from China under the name *A. anceps* in error. W. Africa (Guinea); far W. to the E. Indo-Himalaya; Rajasthan (C.S. Dulawat, det. CRFJ); Uttar Pradesh; Bihar (Parasnath); Orissa; N.W. Ghats; Arunachal Pradesh; Tibet; S.W. and S. China; Taiwan; Myanmar; Thailand; the Philippines. It is fairly close to *A. anceps*, but has a narrower and usually smaller frond, which is characteristically bullulate-wrinkled above, and the slightly narrower, bicolorous stipe-scales extend up the rachis as well, but not (except rarely an odd one) onto the costae. The rachis usually bears scattered glands.

*A. anceps* (Blanf.) Panigrahi (syn.: *A. pseudofarinosa* Ching & S.K.Wu; *A. interrupta* Saiki; ?*A. javanensis* Saiki, non *C. javanensis* (Willd.) T.Moore). Widespread at lower altitudes in India etc., far W. to N.E. Himalaya; Rajasthan; N.W. Ghats; C. India; S. India; Sri Lanka; Tibet; S.W. China (rare); Taiwan; Myanmar; Thailand; ?Java; ?Timor. The lamina is deltate-lanceolate, but not as triangular and wide-based as in *C. bicolor* (below), and has a brighter white farina; the slightly wide, bicolorous stipe-scales do not normally extend above the top of the stipe.

*A. dealbata* Fée (syn.: *C. dealbata* D.Don, non Pursh; *A. doniana* S.K.Wu ex Ching, nom. superfl.; *C. doniana* Fras.-Jenk. & Khullar; *A. sikkimensis* S.R.Ghosh). E. part of the W. Himalaya (Uttarakhand); Nepal to N.E. India; Tibet; S.W. China; Myanmar; ??Thailand. This species is closely related to *C. anceps*, but has a longer, often very large frond and wider, less lobed segments, with narrower indusia, and a very bright white farina. The stipe-scales, though vaguely bicolorous, do not have such an obvious dark central stripe and tend to have a yellower basal region and slightly darker apical region. It was illustrated from Nagarjun, Kathmandu, Nepal, on the front dust-jacket by Fraser-Jenkins (1997).

*A. bullosa* (Kunze) Ching (syn.: ?*A. indica* Fée; *A. flaccida* (Bedd.) B.K.Nayar & S.Kaur; *C. flaccida* (Bedd.) Mehra & Bir, non sensu Mehra & Bir [= *A. bicolour*]). Sri Lanka and S. India. A very large species with long fronds, a bullulate upper surface, well lobed pinnules, thick stipes and concolorous red stipe-base scales.

A small-sized, more creamy-yellowish powdered segregate of *A. dealbata* from S. India (especially the Shevaroy Hills) is *A. wollenweberi* Fras.-Jenk. (2008), superficially similar to the Chinese, Taiwan and Japanese *A. krameri* (Franch. & Sav.) Ching.

*A. stenochlamys* Ching ex S.K.Wu. E. part of the W. Himalaya (Uttarakhand); Nepal; Bhutan; Manipur; Tibet, S.W. China. This rare, high-altitude taxon is closely related to *A. grisea* and is perhaps of slightly doubtful status, requiring further study, though
possibly a good species. Fraser-Jenkins previously confused its type and used the name C. stenochlamys for it in error.

A. grisea (Blanf.) Panigrahi, non sensu Panigrahi (syn.: A. platychlamys Ching; C. platychlamys (Ching) Fras.-Jenk.). A high-altitude Himalayan species with concolorous red stipe-scales; widely misrecorded from C. or S. India and Orissa by Panigrahi (1965) and Dixit (1996) in error for A. formosana among other species. Far W. to E. Indo-Himalaya; Tibet, S.W. China; Taiwan.

A. bicolor (Roxb.) Fras.-Jenk., comb. nov., basionym: Pteris bicolor Roxb. in Griff., Calcutta J. Nat. Hist. 4: 507 (1844) (syn.: Cheilanthes farinosa var. tenera C.B.Clarke & Baker; C. bicolor (Roxb.) Griff. ex Fras.-Jenk.; A. bicolor (Roxb.) Punetha & Kholia, comb. inval., sin. basionym; A. kathmanduensis Ching & S.K.Wu; misapplied name: Cheilanthes farinosa sensu auct. Ind. plur., Blanf. et al., non (Forssk.) Kaulf.). A very common and widespread, rather low-altitude species in India. W. Africa (Nigeria, Jos); far W. to N.E. Indo-Himalaya; Rajasthan; Bihar (Parasnath); C. India; Orissa; S. India; Bangladesh; Myanmar; ?Thailand; Laos. A similar taxon, but more delicate and with russet, concolorous stipe-base scales (like those of A. subdimorpha) occurs in Sumatra. There is some apparent transition, or some intermediate taxon, between the otherwise highly distinct A. bicolor and A. anceps (and also somewhat towards A. subdimorpha) in S.E. Bangladesh (Chittagong Hills), S. India, Myanmar, S.E. China and ?New Guinea (Papua). But it is not yet clear why this should appear to be so.

A. subdimorpha (C.B.Clarke & Baker) Fras.-Jenk., comb. nov., basionym.: Cheilanthes farinosa (Forssk.) Kaulf. var. subdimorpha C.B.Clarke & Baker, J. Linn. Soc., Lond. 24: 411 (1888) (syn.: Cheilanthes subdimorpha (C.B.Clarke & Baker) Hieron.; A. longipes Ching & S.K.Wu, nom. inval., sin. typ. (which is not A. bicolor, as tentatively thought by Fraser-Jenkins 1997, in the absence of the type); C. longipes (Ching & S.K.Wu) Dixit & Bal Krishna, comb. inval.; A. pentagona Saiki; A. pseudoargentea S.K.Wu). From C. Nepal eastwards to N.E. India; Arunachal Pradesh; Manipur; abundant in Meghalaya; ?Bangladesh; Myanmar; Thailand; S.W. to S.E. China; Vietnam. This rather little known species is generally similar to C. bicolor, but has a longer, thicker stipe, shorter and more coarsely lobed lamina and concolorous, russet stipe-scales.

4. Negriferas Pic.Serm. is closely similar to Aleuritopteris but differs in having only rather few (1-4) sporangia per sporangium (also shown by some Aleuritopteris), which are rather deeply embedded in the laminar powder ("subsessile") and an apparently primitive, large sporangium, without a definite stomium area and a very broad annulus with all its walls thickened (indurated), including the outer one, appearing like a solid, dark cap to the sporangium. During dehiscence, the sporangium splits laterally and the whole annulus or top half of the sporangium falls off to release the spores. This may be a retained adaptive feature connected with a very dry climate, allowing protection of the developing sporangium against desiccation. However, on the strength of this hypothetically being supposed to be a very primitive characteristic Pichi Sermolli not only raised a new genus, but even a new family for the single specimen he had seen (which was undoubtedly and obviously mistaken), despite pointing out its evident similarity to Aleuritopteris. In all its other features it is not separable from Aleuritopteris in its concolorous, lanceolate, pale-reddish stipe-scales, frond-shape, white farina beneath and shallow, interrupted pseudo-indusia formed by the leaf-margins. Weatherby (1948) pointed out tendencies within what is now Chrysochosma
from N. America, towards a similar annulus and embedded sporangium, and pointed out the likeness of *N. scioana* to some "*Notholaena*" species (i.e. *Chrysochosma* spp.). While not in any way invalidating the genera *Aleuritopteris* and *Notholaena*, it must be said that a few species in either genus can hardly be distinguished morphologically from the other genus. The likelihood is therefore that *Negripteris* is either an *Aleuritopteris* or a *Chrysochosma*, or may perhaps be nearer to an ancient ancestor of both. However it is maintained here as a somewhat dubious genus, resting on its peculiar sporangia, pending further study. *A. rosulata* (C.Chr.) Ching (syn.: *A. pygmaea* Ching), from Tibet and S.W. China, has similar scales and lamina (with the lobes rather broadly joined at their bases and fusing at the apex as in *Negripteris*) and appears to be very close to it, but without the characteristic sporangia. A rare S.W. Chinese species, *A. sichouensis* Ching & S.K.Wu, is again similar and by definition only would most probably be placed in *Chrysochosma*.

*N. scioana* (Chiov.) Pic.Serm. (syn.: *Mohria scioana* Chiov.; *Negripteris tricholepifera* Pic.Serm.). An Afro-Arabian species, formerly known from N.E. Africa and South Arabia only; Ethiopia, Sudan, Somalia, Socotra (also seen there by the first author in 1967), N. Kenya, Yemen, Saudi Arabia. To this must now be added a remarkable discovery of it from W. India in the semi-arid hills of Rajasthan. Last year, Dr. C.S. Dulawat (the second author) sent the first author material of his Rajasthan *Aleuritopteris* for identification and most surprisingly there was some fine, unidentified material of typical *Negripteris scioana* (Chiov.) Pic.Serm. among them that he had collected from the Kumbhalgarh and Sitamata Sanctuaries, Aravalli Hills and Chittorgarh, Rajasthan. This discovery is of considerable phytogeographical interest as it was otherwise only known to be in N.E. Africa and S. Arabia and fits in with a small handful of other Afro-Arabian connections in Western India, mainly in Rajasthan. The photograph purported to be *Cheilanthes albomarginata* C.B.Clarke sensu lato published by Chaudhary & Khichi (2007) is actually of the tip of the frond of *Negripteris* from Sitamata. Specimens collected are:


5. *Doryopteris* J.Sm. Characterised by the long, uninterrupted sori and often palmate fronds, but though widely and usefully accepted, is difficult to define exclusively, especially in relation to the *Aleuritopteris argentea* group, which also contains some efarinose species. Two species occur in the Indian subcontinent: *D. concolor* (Langsd. & Fisch.) Kuhn (syn.: *Doryopteris geraniifolia* (Raddi) Klotsch). S. and C. America; Africa; Sri Lanka; S. India (N. to Orissa); S. China; throughout S.E. Asia; Australia; Oceania. *D. kirkii* (Hook.) Alston from Africa has occasionally been reported from India in error for *D. concolor*, but is anyway a somewhat doubtful taxon. The taxonomic position of this fern has long been in some doubt as it is very similar to an efarinose member of the *Aleuritopteris argentea* group.
and has often been placed in *Cheilanthes*. Pending further study, including molecular DNA work, it is maintained here in *Doryopteris*, where it appears most likely to belong and has more usually been placed.

*D. ludens* (Wall. *ex* Hook.) J.Sm. A distinctive species with tall black stipes and black midribs and the horizontal frond varying from cordate to considerably and deeply palmate-pinnately lobed into long, narrow segments, the lowest lobe basiscopically lobed again and the fertile fronds taller and more narrowly lobed than the sterile. It occurs in Orissa (Dixit 1996) and from N.E. India eastwards; Assam; Manipur; Nagaland; Tripura; Mizoram; Bangladesh; Myanmar; S.W. and S. China; Thailand; and S.E. Asia. Hope (1901) reported it from Chitral, N.W. Pakistan, in error on the basis of a specimen given to him by General Gatacre, ostensibly collected during the Chitral Relief Military Expedition, at Kaffir Rock on the road S. of Ziarat, along with *Lygodium microphyllum* (Link) R.Br. The specimens of both species, along with drawings and a sketch-map provided by Gatacre are in DD (!) and are correct. But anyone who knows the Pakistan fern-flora (Fraser-Jenkins 1992, 1993) and who has been there, where Kaffir Rock still exists beside the main road into Chitral from the Lowarai Pass, would know that neither species could possibly occur there or anywhere within thousands of miles. The specimens were almost certainly collected during Gatacre’s duty in Myanmar shortly previous to the Chitral expedition and seem most likely to have been more in the way of a “military prank”, than due to confusion. It is surprising that such an experienced expert as Hope could possibly have swallowed it!

6. *Pellaea* Link, nom. cons. Although various species, including those subsequently placed in *Mildella* by Hall & Lellinger (1967) and now in *Cheilanthes*, have been put into *Pellaea* in the past because of their glabrous, efarinose segments with long sori, the genus is now confined to those species with imparipinnate fronds, the apical segment being similar to a lateral one. The species may be glabrous or hirsute. Ghosh (1985) claimed to have “done” the taxonomy of Indian *Pellaea* and listed 3 species, but the 5 species occurring in India are as follows:

*P. falcata* (R.Br.) Fée (syn.: *P. seticaulis* (Hook.) S.R.Ghosh). This species has simple, unlobed, elongated, nearly glabrous pinnae with a only few hair-like scales beneath, and a hairy and scaly stipe and rachis, similar in both Australasia and S. India. It is absent from Malaysia (given by Ghosh), Hooker’s type-locality of “Penang” being in error for Lady Dalhousie’s collection from Sri Lanka (from where it was reported by Sledge 1982), which was omitted by Ghosh (1985).

*P. longipilosa* Bonap. (syn.: *P. malabarica* B.K.Nayar & Geev.). Similar to *P. falcata*, but with narrow, tripartite lower and mid pinnae. Africa; S. India; confined to a few localities in Kerala. Though redescribed as if a new, endemic species, Fraser-Jenkins has reidentified it as being the African species, *P. longipilosa*, which is thus one of a rather small group of tropical African elements in S. India.

*P. boivinii* Hook. A rather small, bipinnate species with from 2 to 3 pairs of elongated ovate, articulated-stalked pinnae on the lower pinnae and all the axes densely covered in very short, dark, blackish-brown hairs. S. and E. Africa; Madagascar; Mascarenes; Sri Lanka (Sledge 1982, omitted by Ghosh 1985); and S. India. Another tropical African element in S. India.

*P. viridis* (Forssk.) Prantl. Another bipinnate species, with slightly larger, thinner and non-articulate-stalked, often biauriculate-based segments and glabrous axes. Adventive in S. India and Sri Lanka (Sledge 1982). Also naturalised in Australia and Oceania. S.
and E. Africa; Madagascar; and Yemen (type).

*P. calomelanos* (Sw.) Link *non* *Pityrogramma calomelanos* (L.) Link. (syn.: *P. hastata* (Thunb.) Prantl, *non* (L.) Thunb.). A rare and very seldom-collected species occurring in a few scattered localities in very dry rocky areas. The stalked leaf-segments are cordate-hastate and without scales, borne on glossy black costae. Africa; Pakistan (Swat; Hazara); Himachal Pradesh; Uttarakhand; W. Nepal; S.W. China. An Afro-Arabian element reaching the W. Himalaya.

7. *Pityrogramma* Link. The “silver ferns” and “gold ferns” of cultivation where they often spread by self-sporing. They are exindusiate and the sori spread along the veins and cover the whole surface beneath the segments. Four New World species are adventive in the Indian subcontinent:

*P. calomelanos* (L.) Link. The farina beneath the leaf, which is usually rather thin and weak, is white. S. and C. America. Adventive throughout the world in warmer climates and so abundant in even remote places throughout nearly all of the Indian subcontinent that it is sometimes difficult to remember that it is in fact an alien species not recorded before the later 19th Century.

*P. australoamericana* Domin (syn.: *Pityrogramma calomelanos* var. *australoamericana* (Domin) Farw.; *P. calomelanos* (L.) Kaulf. var. *aureoflava* (Hook.) Weath. *ex* F.M.Bailey; misapplied name: *P. chrysophylla* (Sw.) Link). The farina beneath the leaf is sulphur yellow. S. and C. America. A common adventive in Sri Lanka and S. India. In addition to the bright yellow powder, which is often lost in old specimens by treatment with alcohol (containing pesticides), it also has a shorter lamina with rather shorter and often less lobed segments. For some reason it has not reached N. India to date. It was first recognised as a separate species by Domin (1928, 1929) and detailed further in his later publications. The genus was monographed by Tryon (1962), and information was thence extracted by Panigrahi (1975) and from the determinations at Kew.

*P. dealbata* (C.Presl) R.Tryon. White farina, a small, thin lamina with well lobed and toothed segments. C. America. Adventive in Sri Lanka, but probably not well established.

*P. sulphurea* (Sw.) Maxon. Pale lemon-yellow, rarely white farina and the frond narrowed towards the base, with the ultimate segments cuneate-based and fanned out or flabellate at their strongly toothed apices. C. America. Adventive in Samoa and Sri Lanka, but probably not well established in the latter.

8. *Parahemionitis* Panigrahi. Following Mickel's (1974) establishing that the Indian species is not a true *Hemionitis*, and Tryon, Tryon & Kramer's (1990) clear statement that “*H. arifolia*” is not readily included in any genus, Panigrahi (1993) took it upon himself to utilise that information and make several attempts to interject a new generic name of his own for it (see Fraser-Jenkins 1997: 187-188), finally succeeding in validating one. *Parahemionitis* is therefore accepted here as the name for the genus and its single species-complex.

*P. cordifolia* (Roxb.) Fras.-Jenk. (misapplied name: *Hemionitis arifolia* (Burm.f.) T.Moore). Distinctive cordate-rounded leaves. N.E. India (Bihar; Assam; Manipur; Nagaland; Tripura; Mizoram); Sri Lanka; S. India; Bangladesh; Myanmar; S. China; Vietnam; Malesia; Philippines. The widespread Indian triploid cytotype may often be prolificous with small plantlets developing in the axil of the leaf during the wet season,
but dropping off during the dry season. A Chinese diploid, which is more delicate, is never proliferous (Huang, Manickam & Chiou 2007).


**CONCLUSION**

The discovery of the African *Negripteris* in India is not only of considerable phytogeographical interest, but also suggests that further collection and study by Indian pteridologists with a specialist knowledge, able to recognise all the species they see, may reveal a number of other species hitherto overlooked in the subcontinent. The discovery of *Notholaena borealisinensis*, *Cheilanthes hancockii*, *C. bhutanica*, *C. tibetica* and *Aleuritopteris subargentea*, all previously unknown in the Indian subcontinent are further examples.

**ACKNOWLEDGEMENTS**

The author thanks Dr. Tandin Wangdi of the National Biodiversity Conservation Centre, Serbithang, Thimphu, Bhutan, who, along with Dr. Rebecca Pradhan, kindly accompanied him during collection excursions in W. Bhutan in October 2005 and is a joint authority of some of the resulting new taxa, above.

**REFERENCES**

CHRISTENSEN, C. 1905. Index Filicum: [i-] xli [-lix, 1-744]. H. Hagerup, Hafnia [København].
RANKER, T.A. 1989. Spore morphology and genetic delimitation of New World


CHECKLIST OF THE FERNS AND LYCOPHYTES OF ACRE STATE, BRAZIL

J. PRADO¹ & R. C. MORAN²

¹Instituto de Botânica, Seção de Curadoria do Herbário, C.P. 3005, CEP 01061-970, São Paulo, SP, Brazil
E-mail: jprado.01@uol.com.br
²The New York Botanical Garden, Bronx, NY 10456-5126, U.S.A.

Key words: checklist, Brazil, Acre State, Amazonian forest, ferns, lycophytes

ABSTRACT

One hundred and seventy eight species and five varieties in 24 families and 60 genera of ferns and lycophytes are recorded for state of Acre, Brazil. Data about habit, habitat, material examined, and distribution of each taxon are also presented. Acre contains about one-third of the species of ferns and lycophytes estimated to occur in the Brazilian Amazon region.

INTRODUCTION

The Project of the Flora of Acre State, Brazil, is a collaborative endeavour between the Federal University of Acre (UFAC) and The New York Botanical Garden (NY). For some groups of plants, specialists were invited to contribute, such as for ferns and lycophytes. This checklist is a result of the collaborative project.

The first expeditions to Acre and the Brazilian Amazon took place in 1900-1901 when Ernest Heinrich Georg Ule collected along the rivers Tejo and Juruá-Mirim. Locally, this area is called “Região do Alto Rio Juruá.” In 1911-1912, a second expedition was conducted by Ule in the region of the Acre River. The first Brazilian botanist to explore the state was João Geraldo Kuhlmann, who travelled with Marechal Rondon through Amazonia in 1923. Later, in 1933, Boris Alexander Krukoff collected in the region, especially around the Macauã River, in the Basin of Purus River. During the 1960s and 1970s, several botanists collected in Acre State, the most prominent being João Murça Pires, Ghillean T. Prance, Enrique Forero, Paul J. Maas, and Paulo G. Windisch. Other important collections from Acre were made for the Project RADAMBRASIL during the 1970s by Luis Coêlho, Cid Ferreira, Bruce Nelson, and Thomas Croat. They were among the members of three expeditions to Acre (Silveira, 2003).

In 1979 the Herbarium of the Federal University of Acre (HPZ) was established. Its main goal was to have a reference collection for the flora of Acre. In 1990 the herbarium signed an international agreement of cooperation with The New York Botanical Garden (NY) to promote studies of the Acre flora. During the last twenty years Douglas Daly (NY), Marcos Silveira (UFAC), and several other collaborators from many institutions have greatly increased the number of collections in Acre. According to Daly (personal communication), at the beginning of the project “Floristics and Economic Botany of Acre, Brazil” the Herbarium of the Federal University of Acre (HPZ) had 2,000 specimens. It now has more than 30,000 specimens, including non-vascular and vascular plants.

These collections provided many new records of ferns (e.g., Adiantum decoratum

Acre State is located in northwestern Brazil in the southwestern part of the Brazilian Amazon. It covers an area about 153,149 km² and harbours great variation in topography, soils, and climates. This variation promotes a high diversity of vegetation types, floristic affinities, and life forms. Several factors divide the state into two regions: the southeastern region is drained by the Purus River and by the Basin of the Rivers Acre/Purus. Here there is a pronounced dry season, and several species are shared with Central Brazil and with other extra Amazonian vegetation types (Prado & Gibbs, 1993). The second region is northwestern Acre, drained by the Jurú River. This area is continuously wet, lacking a dry season. Along its border with Peru are the mountainous Moa Range and Divisor Range (locally called the *Serra do Moa* and *Serra do Divisor*, respectively). These ranges shelter several Andean species and genera such as *Cyathea bipinnatifida* (Baker) Domin (Cyatheaceae), *Pteris haenkeana* C. Presl, (Pteridaceae), *Solanopteris bifrons* (Hook.) Copel. (Polypodiaceae); flowering plant examples include *Crotalaria lechleri* Mül Arg. (Euphorbiaceae), *Ladenbergia lambertiana* (A. Braun ex Mart.) Klotzsch, *L. oblongifolia* (Rubiaceae), and *Monolena primuliflora* Hook. f. (Melastomataceae)). This region has open vegetation called “Campinas” and “Caatingas Amazônicas” on whitish sandy soils. The flora of this region has affinities with those of the Rivers Rio Madeira and Negro (Silveira, 2003).

The preliminary checklist of the Acre Flora ([http://www.nybg.org/bsci/acre/www1/checklist.html](http://www.nybg.org/bsci/acre/www1/checklist.html)), which includes all vascular plants and fungi, lists about 3,273 species (including infraspecific taxa), of which 156 are either ferns or lycophytes, these belonging to 50 genera. In general, ferns and lycophytes from Acre are poorly known and papers containing some information about them are few and sparse (Tryon & Conant, 1975; Windisch, 1979; Prado, 2005, and Labiak & Prado, 2007). The present study revealed 178 species, 60 genera, and five varieties in 24 families (Table 1). According to our estimates, Amazonian Brazil has ca. 550 species of ferns and lycophytes; thus, Acre contains about 32% of that total number.

**LIST OF SPECIES**

The present list is based on material from the following herbaria: CEN, HB, HPZ, HRCB, INPA, K, MG, MO, NY, R, RB, SP, UC. In 2001 the senior author collected about 250 specimens in Acre. In total, about 820 specimens have been examined for the present checklist.

The list is organised in alphabetic order by families, genera, species, and varieties. The arrangement of families and genera follows Smith *et al.* (2006). For each species and variety the full name of the taxon is presented with the reference of the original publication, as well as additional information such as: habit, habitat, material examined, and geographic distribution. Voucher information for each species and variety is organised in alphabetic order by municipality; material collected by same collector for the same locality appears in ascending numerical order.

Author abbreviations follow Pichi-Sermolli (1996). In general, synonyms are omitted, except the basionym of the accepted name.
<table>
<thead>
<tr>
<th>Families</th>
<th>Number of genera</th>
<th>Number of spp.</th>
<th>Number of varieties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anemiaceae</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Aspleniaceae</td>
<td>1</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>Blechnaceae</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Cytatheaceae</td>
<td>2</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Dennstaedtiaceae</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Dryopteridaceae</td>
<td>10</td>
<td>21</td>
<td>1</td>
</tr>
<tr>
<td>Gleicheniaceae</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Hymenophyllaceae</td>
<td>4</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>Lindsaeaceae</td>
<td>1</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>Lomariopsidaceae</td>
<td>3</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Lycopodiaceae</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Lygodiaceae</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Marattiaceae</td>
<td>1</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Metaxyaceae</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Polypodiaceae</td>
<td>9</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>Psilotaceae</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Pteridaceae</td>
<td>8</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Saccolomataceae</td>
<td>1</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Salviniaeae</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Schizaeaceae</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Selaginellaceae</td>
<td>1</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Tectariaceae</td>
<td>2</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Thelypteriaceae</td>
<td>1</td>
<td>12</td>
<td>1</td>
</tr>
<tr>
<td>Woodsiaceae</td>
<td>2</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Totals: 24</td>
<td>60</td>
<td>178</td>
<td>5</td>
</tr>
</tbody>
</table>
ANEMIACEAE

*Anemia phyllitidis* (L.) Sw., Syn. Fil. 155. 1806.
*Osmunda phyllitidis* L., Sp. Pl. 1064. 1753.

Habit/Habitat: Herb; terrestrial on riverside vegetation and on Terra Firme forest.
Distribution: Mexico, Greater Antilles, except Puerto Rico, Mesoamerica, tropical and subtropical South America.

ASPLENIACEAE

*Asplenium angustum* Sw., Vet. Ak. Handl. 38: 66, tab. 4, fig. 1. 1817.

Habit/Habitat: Herb; epiphyte in forest on Terra Firme.
Distribution: N South America.

*Asplenium auritum* Sw., J. Bot. (Schrader) 1800(2): 52. 1801.

Habit/Habitat: Herb; epiphyte in forest on Terra Firme.
Distribution: S Mexico, Antilles, Mesoamerica, N South America.


Habit/Habitat: Herb; epiphyte on flooded vegetation.
Distribution: Mexico, Antilles, Mesoamerica and tropical South America.

*Asplenium cuneatum* Lam., Encycl. 2: 309. 1786.

Habit/Habitat: Herb; epiphyte on Terra Firme.
Distribution: Antilles, Mesoamerica and tropical South America, Polynesia, Africa.

*Asplenium delitescens* (Maxon) L. D. Gómez, Brenesia 8: 52. 1976.


Habit/Habitat: Herb; terrestrial grows riverside vegetation and on Terra Firme forest.
Distribution: S Mexico, Antilles, Mesoamerica, N South America.


Habit/Habitat: Herb; epiphyte on Terra Firme.
Distribution: N South America.

Asplenium juglandifolium Lam., Encycl. 2: 307. 1786.
Habit/Habitat: Herb; epiphyte on flooded vegetation near river margins.
Material examined: BRAZIL. ACRE: Bujari, D. C. Daly et al. 8464 (HPZ, NY), D. C. Daly et al. 9330 (NY); Cruzeiro do Sul, G. T. Prance et al. 2786 (MG, NY); Mâncio Lima, J. Prado et al. 1224 (HPZ, SP); Mâncio Lima, J. Prado et al. 12246A (MG, NY); J. Prado et al. 1225 (HPZ, SP).
Distribution: N South America.

Habit/Habitat: Herb; terrestrial.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, D. C. Daly et al. 11707 (NY).
Distribution: N South America.

Asplenium pearcei Baker, Syn. Fil. (ed. 2) 483. 1874.
Habit/Habitat: Herb; epiphyte on trees in Terra Firme forests.
Material examined: BRAZIL. ACRE: Brasiléia, D. C. Daly et al. 11906 (NY); Cruzeiro do Sul, J. Prado et al. 1350 (HPZ); Feijó, P. Delprete et al. 8543 (NY); Mâncio Lima, G. T. Prance et al. 12168 (NY); Manoel Urbano, D. C. Daly et al. 11226 (NY); Marechal Thaumaturgo, D. C. Daly et al. 7336 (HPZ, NY); Porto Valter, G. T. Prance et al. P13269 (NY), P. J. M. Maas et al. P13295 (NY), S. R. Lowrie et al. 525 (NY); Santa Rosa, D. C. Daly et al. 9948 (NY); Tarauacá, C. Herinhaus et al. 397 (NY); Without locality, J. J. Jangoux et al. 85-096 (MG, NY).
Distribution: N South America.

Habit/Habitat: Herb; epiphyte on forest on Terra Firme.
Material examined: BRAZIL. ACRE: Mâncio Lima, D. C. Daly et al. 8926 (HPZ, NY), G. T. Prance et al. 12246 (NY).
Distribution: Guianas and Brazil.

Habit/Habitat: Herb; epiphyte on forest on Terra Firme and on flooded vegetation near river margins.
Material examined: BRAZIL. ACRE: Assis Brasil, D. C. Daly et al. 9808 (HPZ, NY); Brasileia, D. C. Daly et al. 6771 (HPZ, NY); Bujari, D. C. Daly et al. 9328 (NY), M. de Pardo et al. 80 (NY); Cruzeiro do Sul, D. C. Daly et al. 11717 (NY), G. T. Prance et al. 2785 (NY), P. J. M. Maas et al. P12863 (MG, NY), J. Prado et al. 1187 (HPZ, SP), J. Prado et al. 1197 (HPZ), J. Prado et al. 1317 (HPZ, SP), J. Prado et al. 1340 (HPZ, SP), J. Prado et al. 1382 (HPZ, SP); Mâncio Lima, J. Prado et al. 1135 (HPZ, SP); Manoel Urbano, D. C. Daly et al. 9136 (NY), D. C. Daly et al. 11241 (NY); Plácido de Castro, C. Figueiredo & I. Riveiro 592 (NY), L. G. Lohmann & E. C. de Oliveira 492 (NY); Rodrigues Alves, J. Prado et al. 1237 (HPZ, SP), J. Prado et al. 1255 (HPZ, SP), J. Prado et al. 1291 (HPZ, SP); Santa Rosa, D. C. Daly et al.
Asplenium stuebelianum Hieron., Hedwigia 47: 222. 1908.
Habit/Habitat: Herb; epiphyte or terrestrial, in open forest with bamboo.
Material examined: BRAZIL. ACRE: Feijó, D. C. Daly et al. 8500 (NY); Mâncio Lima, D. C. Daly et al. 8952 (HPZ, NY); Marechal Thaumaturgo, D. C. Daly et al. 10524 (NY), D. C. Daly et al. 10552 (NY); Rio Branco, D. C. Daly et al. 6871A (HPZ, NY).
Distribution: Tropical South America.

BLECHNACEAE

Habit/Habitat: Herb; terrestrial in forest on Terra Firme.
Distribution: S EUA, Mexico, Antilles, Mesoamerica, tropical and subtropical South America.

Habit/Habitat: Herb; climbing on flooded vegetation near stream margins.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, J. Prado et al. 1161 (HPZ, SP); Mâncio Lima, J. Prado et al. 1229 (HPZ, SP).
Distribution: N South America.

Salpichlaena volubilis (Kaulf.) J. Sm., J. Bot. (Hooker) 4: 168. 1841.
Blechnum volubile Kaulf., Enum. Filic. 159. 1824.
Habit/Habitat: Herb; climbing on flooded vegetation near stream margins.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, J. Prado et al. 1200 (HPZ, SP).
Distribution: Antilles, Mesoamerica, and tropical South America.

CYATHEACEAE

Habit/Habitat: Tree-fern; forest on Terra Firme.
Material examined: BRAZIL. ACRE: Brasiléia, D. C. Daly et al. 9881 (NY), D. C. Daly et al. 11886 (NY); Marechal Thaumaturgo, D. C. Daly et al. 7427 (HPZ, NY).
Distribution: Mesoamerica and tropical South America.

Cyathea microdonta (Desv.) Domin, Pteridophyta 263. 1929.
Habit/Habitat: Tree-fern; forest near river margins.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, J. Prado et al. 1190 (HPZ, SP); Manoel Urbano, D. C. Daly et al. 11558 (NY).
Distribution: S Mexico, Antilles, Mesoamerica and N South America.
Cyathea pilosissima (Baker) Domin, Pteridophyta 262. 1929.
Habit/Habitat: Tree-fern; in disturbed forest on Terra Firme.
Material examined: BRAZIL. ACRE: Mâncio Lima, D. C. Daly et al. 11603 (NY); Rodrigues Alves, J. Prado et al. 1231 (HPZ, SP).
Distribution: Mesoamerica and N South America.

Cyathea pungens (Willd.) Domin, Pteridophyta 263. 1929.
Habit/Habitat: Tree-fern; flooded vegetation near stream margins.
Material examined: BRAZIL. ACRE: Brasiléia, D. C. Daly et al. 6823 (HPZ, NY), L. Ferreira & L. C. Ming 117 (HPZ, NY); Mâncio Lima, D. C. Daly et al. 1252 (NY); Manoel Urbano, D. C. Daly et al. 9087 (NY); Marechal Thaumaturgo, D. C. Daly et al. 10239 (NY); Santa Rosa, D. C. Daly et al. 10165 (NY), D. C. Daly et al. 11175 (NY).
Distribution: Antilles and N South America.

DENNSTAEDTIACEAE

*Dicksonia bipinnata* Cav., Descr. Pl. 154. 1802.
Habit/Habitat: Tree-fern; flooded vegetation near stream margins.
Material examined: BRAZIL. ACRE: Manoel Urbano, D. C. Daly et al. 11418 (NY).
Distribution: S Mexico, Antilles, Mesoamerica and N South America.

Habit/Habitat: Herb; terrestrial in cleared land beside tracks.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, J. Prado et al. 1178 (HPZ, SP); Mâncio Lima, G. T. Prance et al. 2864 (NY).
Distribution: S Florida, Mexico, Antilles, Mesoamerica and N South America.

DRYOPTERIDACEAE

Habit/Habitat: Herb; terrestrial, in open forest on undulating terrain, except for baixios (waterlogged low-lying areas).
Material examined: BRAZIL. ACRE: Mâncio Lima, G. T. Prance et al. 12069A (NY); Marechal Thaumaturgo, D. C. Daly et al. 10252 (NY).
Distribution: Mesoamerica and N South America.

Habit/Habitat: Herb; terrestrial, in open forest on undulating terrain, except for baixios (waterlogged low-lying areas).
Material examined: BRAZIL. ACRE: Bujari, D. C. Daly et al. 9477 (NY), W. R. Anderson 12122 (NY); Cruzeiro do Sul, J. Prado et al. 1349 (HPZ); Manoel Urbano, D. C. Daly et al. 9128 (NY), D. C. Daly et al. 11143 (NY); Porto Valter, P. J. M. Maas et al. P13292 (NY); Sena Madureira, D. C. Daly et al. 8072 (NY).
Distribution: Antilles, Mesoamerica and N South America.

Acrostichum oligarchicum Baker, Syn. Fil. 418. 1868.

Habit/Habitat: Herb; terrestrial, in forest.


Distribution: Mesoamerica and N South America.


Habit/Habitat: Herb; terrestrial, in forest.

Material examined: BRAZIL. ACRE: Cruzeiro do Sul, J. Prado et al. 1343 (HPZ, SP).

Distribution: Mexico, Mesoamerica and N South America.


Aspidium guianense Klotzsch, Linnaea 20: 364. 1847.

Habit/Habitat: Herb; terrestrial, in Terra Firme forest.

Material examined: BRAZIL. ACRE: Cruzeiro do Sul, J. Prado et al. 1342 (HPZ, SP);

Distribution: N South America.

Cyclodium meniscioides (Willd.) C. Presl, Tent. Pterid. 85. 1836.


Infraspecific: var. meniscioides

Habit/Habitat: Herb; terrestrial, in Terra Firme forest.

Material examined: BRAZIL. ACRE: Cruzeiro do Sul, J. Prado et al. 1330 (HPZ, SP);

Distribution: N South America.

Didymochlaena truncatula (Sw.) J. Sm., J. Bot. (Hooker) 4: 196. 1841-1842 [1841].

Aspidium truncatulum Sw., J. Bot. (Schrader) 1800(2): 36. 1801.

Habit/Habitat: Herb; terrestrial in primary forest, undulating terrain, in places dissected by many small streams.

Material examined: BRAZIL. ACRE: Brasíliéa, D. C. Daly et al. 9880 (HPZ, NY), D. C. Daly et al. 11893 (NY); Cruzeiro do Sul, G. T. Prance et al. 12087 (MG, NY), G. T. Prance et al. 12377 (NY); Mâncio Lima, D. G. Campbell et al. 8913 (NY).

Distribution: S Mexico, Antilles, Mesoamerica and N South America. Tropical Asia and Africa.

Dryopteris patula (Sw.) Underw., Native Ferns ed. 4 117. 1893.


Habit/Habitat: Herb; terrestrial in moist forest on Terra Firme, canopy discontinuous.

Material examined: BRAZIL. ACRE: Plácido de Castro, C. Figueiredo & I. Riveiro 560 (NY); Sena Madureira, D. C. Daly et al. 8117 (NY).

Distribution: S Mexico, Antilles, Mesoamerica and tropical South America.

Elaphoglossum discolor (Kuhn) C. Chr., Index Filic. 306. 1905.

Acrostichum discolor Kuhn, Linnaea 36: 53. 1869.

Habit/Habitat: Herb; terrestrial or epipetric, in Campina.

Material examined: BRAZIL. ACRE: Cruzeiro do Sul, D. C. Daly et al. 10607 (NY),

Distribution: N South America.

**Elaphoglossum flaccidum** (Fée) T. Moore, Index Filic. 356. 1862.

*Acrostichum flaccidum* Fée, Mem. Foug. 2: 35, tab. 7, fig. 2. 1845.

Habit/Habitat: Herb; epiphyte, in Terra Firme forest.

Material examined: BRAZIL. ACRE: Rodrigues Alves, J. Prado et al. 1266 (HPZ, SP); Xapuri, Silva et al. 186 (CEN, SP).

Distribution: Antilles and N South America.

**Elaphoglossum glabellum** J. Sm., London J. Bot. 1: 197. 1842.

Habit/Habitat: Herb; epiphyte, in Terra Firme forest.

Material examined: BRAZIL. ACRE: Cruzeiro do Sul, J. Prado et al. 1297 (HPZ, SP).

Distribution: S Florida, Mexico, Antilles, Mesoamerica, and N South America.


*Acrostichum luridum* Fée, Mem. Foug. 2: 35, tab. 19, fig. 1. 1845.

Habit/Habitat: Herb; epiphyte, in Terra Firme forest.


Distribution: Antilles, Mesoamerica and N South America.

**Elaphoglossum plumosum** (Fée) T. Moore, Index Filic. 364. 1862.

*Acrostichum plumosum* Fée, Mem. Foug. 54, tab. 20, fig. 1. 1845.

Habit/Habitat: Herb; epiphyte, in Terra Firme forest.

Material examined: BRAZIL. ACRE: Cruzeiro do Sul, J. Prado et al. 1154 (HPZ, SP), J. Prado et al. 1285 (HPZ); Mâncio Lima, J. Prado et al. 1221 (HPZ, SP), J. Prado et al. 1390 (HPZ, SP).

Distribution: N South America.


Habit/Habitat: Herb; epiphyte, in Terra Firme forest.

Material examined: BRAZIL. ACRE: Cruzeiro do Sul, J. Prado et al. 1314 (HPZ, SP); Mâncio Lima, D. C. Daly et al. 8948 (HPZ, NY).

Distribution: N South America.

**Elaphoglossum styriacum** Mickel, Brittonia 39: 326, fig. 4l-K. 1987.

Habit/Habitat: Herb; epiphyte, in Terra Firme forest.

Material examined: BRAZIL. ACRE: Cruzeiro do Sul, J. Prado et al. 1381 (HPZ, SP).
Distribution: N South America.

Habit/Habitat: Herb; epiphyte, in Terra Firme forest.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Prado et al. 1179* (HPZ, SP),
*J. Prado et al. 1321* (HPZ, SP), *J. Prado et al. 1384* (HPZ, SP).
Distribution: N South America.

**Lastreopsis effusa** (Sw.) Tindale, Victoria Naturalist 73: 184. 1957.
*Polypodium effusum* Sw., Prodr. 134. 1788.
Habit/Habitat: Herb; terrestrial, forested slope between Baixio and higher terrace.
Distribution: S Mexico, Antilles, Mesoamerica, and tropical South America.

Habit/Habitat: Herb; hemiepiphyte, in Terra Firme forest.
Material examined: BRAZIL. ACRE: Brasiléia, *D. C. Daly et al. 6757* (HPZ, NY), *D. C. Daly et al. 6786* (NY), *D. C. Daly et al. 11882* (NY); Cruzeiro do Sul, *D. C. Daly et al. 1292* (HPZ, SP); Mâncio Lima, *D. C. Daly et al. 11623* (NY); Marechal Thaumaturgo, *D. C. Daly et al. 7430* (HPZ, NY); Rodrigues Alves, *J. Prado et al. 1252* (HPZ, SP), *J. Prado et al. 1278* (HPZ, SP); Xapuri, *L. G. Lohmann & E. C. de Oliveira 590* (NY).
Distribution: Greater Antilles (except Jamaica) and tropical South America.

**Polybotrya caudata** Kunze, Linn. 9: 23. 1834.
Habit/Habitat: Herb; hemiepiphyte, in Terra Firme forest.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Prado et al. 1295* (HPZ, SP),
*M. Silveira et al. 1662* (NY); Cruzeiro do Sul, *J. Prado et al. 1287* (HPZ, SP).
Distribution: S Mexico, Mesoamerica and N South America.

**Polybotrya pubens** Martius, Icon. Pl. Crypt. 87, tab. 25. 1834.
Habit/Habitat: Herb; hemiepiphyte, in Terra Firme forest.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Prado et al. 1205* (HPZ, SP),
*J. Prado et al. 1207* (HPZ, SP), *J. Prado et al. 1394* (HPZ, SP).
Distribution: N South America.

**Rumohra adiantiformis** (G. Forst) Ching, Sinensia 5: 70. 1934.
*Polypodium adiantiforme* G. Forst, Prodr. 82. 1786.
Habit/Habitat: Herb; terrestrial, in Terra Firme forest.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Prado et al. 1157* (HPZ, SP),
Distribution: Bermuda, Antilles, N South America. Africa, Madagascar, New Zealand and Australia.

**GLEICHENIACEAE**

**Gleichenella pectinata** (Willd.) Ching, Sunyatsenia 5: 276. 1940.
Habit/Habitat: Herb; terrestrial along forest margins.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, J. Prado et al. 1189 (HPZ, SP);
Mâncio Lima, G. T. Prance et al. 12119 (MG, NY), M. Silveira et al. 1348 (HPZ, NY).
Distribution: S Mexico, Antilles, Mesoamerica and tropical South America.

Sticherus remotus (Kaul.) Chrysler, Amer. J. Bot. 31: 483. 1944.
Mertensia remota Kaulf., Enum. Filic. 39. 1824
Habit/Habitat: Herb; terrestrial along forest margins.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, J. Prado et al. 1300 (HPZ, SP).
Distribution: Mesoamerica and N South America.

HYMENOPHYLLACEAE
Didymoglossum krausii (Hook. & Grev.) C. Presl, Hymenophyllaceae 115. 1843.
Trichomanes krausii Hook. & Grev., Icon. Filic. 2: pl. 149. 1830
Habit/Habitat: Herb; epiphyte in forest.
Material examined: BRAZIL. ACRE: Manoel Urbano, D. C. Daly et al. 9115 (HPZ, NY).
Distribution: Florida, Mexico, Antilles, Mesoamerica, tropical South America.

Habit/Habitat: Herb; epiphyte along river margins.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, J. Prado et al. 1288 (HPZ, SP);
Mâncio Lima, J. Prado et al. 1230 (HPZ, SP).
Distribution: S Mexico, Antilles, Mesoamerica and N South America.

Trichomanes punctatum Poir., Encycl. 8: 64. 1808.
Habit/Habitat: Herb; epiphyte.
Material examined: BRAZIL. ACRE: Marechal Thaumaturgo, D. C. Daly et al. 10330 (NY).
Distribution: Antilles, Mesoamerica and N South America.

Habit/Habitat: Herb; epiphyte in waterlogged low-lying areas.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, J. Prado et al. 1153 (HPZ, SP).
Distribution: Amazonian Brazil.

Hymenophyllum polyanthos (Sw.) Sw., J. Bot. (Schrader) 1800(2): 102. 1801.
Trichomanes polyanthos Sw., Prodr. 137. 1788.
Habit/Habitat: Herb; epiphyte in forest.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, J. Prado et al. 1149 (HPZ, SP);
J. Prado et al. 1389 (HPZ, SP), P. J. M. Maas et al. 12722 (NY); Mâncio Lima, J. Prado et al. 1222 (HPZ, SP).
Distribution: Mexico, Mesoamerica and tropical South America.

Trichomanes ankersii C. Parker ex Hook. & Grev., Icon. Filic. 2(11): tab. 201. 1831.
Habit/Habitat: Herb; hemiepiphyte, in Terra Firme forest.

Distribution: Mesoamerica and N South America.

Habit/Habitat: Herb; terrestrial, in Terra Firme forest.
Distribution: N South America.

Habit/Habitat: Herb; terrestrial, in Terra Firme forest.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, J. Prado et al. 1313 (HPZ, SP), J. Prado et al. 1380 (HPZ, SP).
Distribution: S Mexico, Antilles, Mesoamerica, and N South America

Habit/Habitat: Herb; terrestrial, in forest near stream margins.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, G. T. Prance et al. 12225 (MG, NY), J. Prado et al. 1212 (HPZ, SP); Mâncio Lima, M. Silveira et al. 1247 (NY), M. Silveira et al. 1250 (NY); Rodrigues Alves, J. Prado et al. 1364 (HPZ, SP).
Distribution: Antilles, Mesoamerica, tropical and subtropical South America.

*Neurophyllum hostmannianum* Klotzsch, Linnaea 18: 532. 1844.
Habit/Habitat: Herb; terrestrial, in forest near stream margins on wet soils.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, J. Prado et al. 1194 (HPZ, SP), L. R. Marinho 217 (NY); Rodrigues Alves, J. Prado et al. 1272 (HPZ, SP).
Distribution: N South America.

Habit/Habitat: Herb; terrestrial in waterlogged low-lying areas.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, J. Prado et al. 1385 (HPZ, SP).
Distribution: N South America.

*Trichomanes martiusii* C. Presl, Hymenophyllaceae 15, 36. 1843.
Habit/Habitat: Herb; terrestrial in forest on Terra Forme.
Distribution: N South America.

*Trichomanes pilosum* Raddi, Opusc Sci. 3: 296. 1819.
Habit/Habitat: Herb; terrestrial in forest on Terra Firme.
Trichomanes pinnatum Hedw., s.l., Fil. Gen. Sp. tab. 4, fig. 1. 1799.
Habit/Habitat: Herb; terrestrial in forest on Terra Firme, on clay and sand soils.
Material examined: BRAZIL. ACRE: Assis Brasil, D. C. Daly et al. 9608 (HPZ, NY); Cruzeiro do Sul, J. Prado et al. 1183 (HPZ), J. Prado et al. 1311 (HPZ, SP), D. C. Daly et al. 11640 (NY); Mâncio Lima, D. C. Daly et al. 11589 (HPZ, NY), G. T. Prance et al. 12178 (MG, NY); Porto Valter, D. C. Daly et al. 7576 (HPZ, NY), D. C. Daly et al. 11739 (NY), P. J. M. Maas et al. 13010 (MG, NY); Rodrigues Alves, J. Prado et al. 1244 (HPZ); Sena Madureira, G. T. Prance et al. 7730 (NY), G. T. Prance et al. 7948 (NY).
Distribution: S Mexico, Antilles, Mesoamerica and N South America.
Obs.: the material studied for this taxon cited above probably belong to more than two or three species, but more studies are necessary to clarify this situation.

Habit/Habitat: Herb; hemiepiphyte, in Terra Firme forest.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, J. Prado et al. 1209 (HPZ); Rodrigues Alves, J. Prado et al. 1254 (HPZ), J. Prado et al. 1258 (HPZ).
Distribution: N South America.

Trichomanes trollii Bergdolt, Flora 127: 256, 264, fig. 3. 1933.
Habit/Habitat: Herb; terrestrial, in forest on Terra Firme.
Material examined: BRAZIL. ACRE: Rodrigues Alves, J. Prado et al. 1366 (HPZ, SP).
Distribution: N South America.

Trichomanes collariatum Bosch, Ned. Kruidk. Arch. 4: 368. 1859 [1858].
Habit/Habitat: Herb; epiphyte in forest on Terra Firme.
Distribution: Mexico, Mesoamerica and N South America.

LINDSAAEACEAE

Lindsaea divaricata Klotzsch, Linnaea 18: 547. 1844.
Habit/Habitat: Herb; terrestrial in forest on Terra Firme, on sandy soils.
Distribution: Mesoamerica and tropical South America.

Habit/Habitat: Herb; terrestrial in forest on Terra Firme, on slopes.
Distribution: N South America.
**Lindsaea lancea** (L.) Bedd., Suppl. Ferns S. Ind. 6. 1876.
Infraspecific: var. *lancea*
Habit/Habitat: Herb; terrestrial in forest on Terra Firme.
Distribution: S Mexico, Antilles, Mesoamerica and tropical South America.

Distribution: Mexico, Mesoamerica and N South America.

**Lindsaea schomburgkii** Klotzsch, Linnaea 18: 545. 1844.
Habit/Habitat: Herb; terrestrial in forest on Terra Firme.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Prado et al. 1172* (HPZ, SP).
Distribution: N South America.

**Lindsaea sp.**
Habit/Habitat: Herb; terrestrial in forest on Terra Firme, on clay soils.
Distribution: Peru and Brazil.

**Lindsaea stricta** (Sw.) Dryand. Trans. Linn. Soc. London 3: 42. 1797.
*Adiantum strictum* Sw., Prodr.: 135. 1788.
Infraspecific: var. *stricta*
Habit/Habitat: Herb; terrestrial, in Campina.
Distribution: Widespread in the Neotropics.

**Lindsaea ulei** Hieron., Hedwigia 44: 365. 1905.
Habit/Habitat: Herb; terrestrial in forest on Terra Firme, on sandy soils.
Distribution: N South America.

**LOMARIOPSIDACEAE**

**Cycloplepis semicordata** (Sw.) J. Sm., Bot. Mag. 72: 36. 1846.
*Polypodium semicordatum* Sw., Prodr. 132. 1788.
Habit/Habitat: Herb; terrestrial in forest on Terra Firme, on sandy soils.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *D. C. Daly et al. 11721* (NY); Manoel Urbano, *D. C. Daly et al. 11427* (NY), *M. Silveira et al. 1574* (NY); Marechal Thaumaturgo, *D. C. Daly et al. 7342* (HPZ, NY), *D. C. Daly et al. 10473* (NY), *D. C. Daly et al. 10810* (NY); Porto Acre, *C. A. Cid & B. Nelson 2877* (NY), *P. J. M. Maas et al. 13247* (MG, NY); Quixadá, *C. A Cid & A. Rosas 2961* (NY); Reserva Extrativista
Chico Mendes, Colocação Simitumba, A. R. S. Oliveira et al. 131 (HPZ, NY); Santa Rosa, D. C. Daly et al. 11367 (NY); Santa Rosa, D. C. Daly et al. 10978 (NY); Sena Madureira, D. C. Daly et al. 7857 (HPZ, NY); Rio Branco, D. C. Daly et al. 6881 (HPZ, NY); Tarauacá, G. T. Prance et al. 7516 (NY), D. C. Daly et al. 8667 (HPZ, NY), D. C. Daly et al. 8799 (HPZ, NY); Xapuri, D. C. Daly et al. 8420 (NY); Without locality, J. Jangoux et al. 85-074 (MG, NY).

Distribution: S Mexico, Antilles, Mesoamerica and N South America.

Lomariopsis japurensis (Mart.) J. Sm., Hist. Fil. 140. 1875.
Habit/Habitat: Herb; hemiepiphyte, in Terra Firme forest.
Material examined: BRAZIL. ACRE: Assis Brasil, D. C. Daly et al. 9817 (HPZ, NY); Cruzeiro do Sul, P. J. M. Maas et al. P12886 (NY); Mâncio Lima, G. T. Prance et al. 12055 (NY); Marechal Thaumaturgo, L. G. Lohmann et al. 480 (NY); Santa Rosa, D. C. Daly et al. 9945 (NY).

Distribution: Mesoamerica and N South America.

Habit/Habitat: Herb; hemiepiphyte, in Terra Firme forest.
Material examined: BRAZIL. ACRE: Brasília, S. R. Lowrie et al. 726 (NY); Cruzeiro do Sul, J. Prado et al. 1202 (HPZ, SP), J. Prado et al. 1211 (HPZ, SP), J. Prado et al. 1352 (HPZ, SP); Mâncio Lima, D. C. Daly et al. 11568 (NY); Marechal Thaumaturgo, L. C. Ming & L. A. Ferreira 324 (NY).

Distribution: N South America.

Lomariopsis prieuriana Féé, Mem. Foug. 2: 66, pl. 25, fig. 1. 1845.
Habit/Habitat: Herb; hemiepiphyte, in Terra Firme forest.
Material examined: BRAZIL. ACRE: Mâncio Lima, J. Prado et al. 1137 (HPZ, SP); Rodrigues Alves, J. Prado et al. 1363 (HPZ, SP).

Distribution: Mesoamerica and N South America.

Nephrolepis biserrata (Sw.) Schott, Gen. Fil. pl. 3. 1834.
Aspidium biserratum Sw., J. Bot. (Schrader) 1800(2): 32. 1801.
Habit/Habitat: Herb; epiphyte in forest on Terra Firme near stream margins.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, J. Prado et al. 1163 (HPZ, SP), J. Prado et al. 1180 (HPZ, SP), J. Prado et al. 1199 (HPZ, SP); Mâncio Lima, J. Prado et al. 1216 (HPZ, SP).

Distribution: Florida, Mexico, Antilles, Mesoamerica, tropical South America.

Habit/Habitat: Herb; epiphyte in forest on Terra Firme near stream margins.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, P. Delprete et al. 8111 (NY); Mâncio Lima, D. C. Daly et al. 11595 (NY).

Distribution: Florida, S Mexico, Antilles, Mesoamerica, tropical South America, Paleotropics.
**Nephrolepis pendula** (Raddi) J. Sm., J. Bot. (Hooker) 4: 197. 1841-1842 [1841].

Aspidium pendulum Raddi Opusc. Sci. 3: 289. 1819.

Habit/Habitat: Herb; epiphyte on Terra Firme.

Material examined: BRAZIL. ACRE: Tarauacá, G. T. Prance et al. 7296 (NY).

Distribution: S Mexico, Mesoamerica and N South America.


Polypodium rivulare Vahl, Eclog. Amer. 3: 51. 1807.

Habit/Habitat: Herb; epiphyte on Várzea forest.

Material examined: BRAZIL. ACRE: Cruzeiro do Sul, J. Prado et al. 1286 (HPZ, SP), J. Prado et al. 1325 (HPZ, SP); Mâncio Lima, G. T. Prance et al. 12179 (MG, NY).

Distribution: S Mexico, Antilles, Mesoamerica and N South America.

**LYCOPODIACEAE**


Habit/Habitat: Herb; epiphyte in forest on Terra Firme.


Distribution: Florida, Mexico, Antilles, Mesoamerica and N South America.


Lycopodium cernuum L., Sp. Pl. 2: 1103. 1753

Habit/Habitat: Herb; terrestrial on sandy soils in open places.

Material examined: BRAZIL. ACRE: Cruzeiro do Sul, J. Prado et al. 1160 (HPZ, SP), J. Prado et al. 1191 (HPZ, SP), J. Prado et al. 1331 (HPZ), A. Rosas et al. 313 (NY), D. C. Daly et al. 10599 (NY), D. C. Daly et al. 10683 (NY), G. T. Prance et al. 12525 (MG, NY), L. R. Marinho 64 (NY), L. R. Marinho 212 (NY), P. Delprete et al. 8063 (NY).

Distribution: Pantropical.

**LYGODIACEAE**

**Lygodium venustum** Sw., J. Bot. (Schrader) 1801(2): 303. 1803.

Habit/Habitat: Herb; vine-like, in forest on Terra Firme.

Material examined: BRAZIL. ACRE: Manoel Urbano, M. Silveira et al. 1543 (HPZ, NY); Rio Branco, L. Coêlho & A. Rosas 1925 (NY); Tarauacá, C. Ehringhaus et al. 346 (NY).

Distribution: Mexico, Antilles, Mesoamerica and tropical South America.

**Lygodium volubile** Sw., J. Bot. (Schrader) 1801(2): 303. 1803.

Habit/Habitat: Herb; vine-like, in forest on Terra Firme.

Material examined: BRAZIL. ACRE: Cruzeiro do Sul, J. Prado et al. 1371 (HPZ, SP).

Distribution: Mexico, Antilles, Mesoamerica and tropical South America.

**MARATTIACEAE**


Habit/Habitat: Herb; terrestrial in forest on Terra Firme, near stream margins

Material examined: BRAZIL. ACRE: Cruzeiro do Sul, J. Prado et al. 1204 (HPZ, SP).
Distribution: S Mexico, Antilles, Mesoamerica, and N South America.


* Achrostichum nodosum * L., Sp. Pl. 2: 1070. 1753.

Habit/Habitat: Herb; terrestrial in forest on Terra Firme.

Material examined: BRAZIL. ACRE: Brasiléia, D. C. Daly et al. 6787 (HPZ, NY), D. C. Daly et al. 9884 (HPZ, NY); Feijó, P. Delprete et al. 8301A & B (NY); Sena Madureira, D. C. Daly et al. 8137 (HPZ, NY); Without locality, J. Jangoux et al. 85-071 (NY).

Distribution: S Mexico, Antilles, Mesoamerica and N South America.

**Danaea trifoliata** Reichenb. ex Kunze, Analecta Pteridogr. 4, tab. 2. 1837.

Habit/Habitat: Herb; terrestrial in forest on Terra Firme, near stream margins.

Material examined: BRAZIL. ACRE: Rodrigues Alves, J. Prado et al. 1365 (HPZ, SP).

Distribution: Guianas and Brazil.

**METAXYACEAE**

* Metaxya rostrata * (Kunth) C. Presl, Tent. Pterid. 60, tab. 1, fig. 5. 1836.


Habit/Habitat: Herb; terrestrial in forest on Terra Firme, near stream margins.

Material examined: BRAZIL. ACRE: Cruzeiro do Sul, D. C. Daly et al. 11705 (NY), J. Prado et al. 1186 (HPZ, SP), J. Prado et al. 1301 (HPZ, SP), J. Prado et al. 1320 (HPZ, SP); Mâncio Lima, D. C. Daly et al. 11624 (NY), M. Silveira et al. 1365 (NY); Marechal Thaumaturgo, D. C. Daly et al. 10526 (NY); Porto Valter, D. C. Daly et al. 7577 (NY), P. J. M. Maas et al. P13150 (NY); Without locality, J. Jangoux et al. 85-071 (NY).

Distribution: S Mexico, Lesser Antilles, Mesoamerica and N South America.

**POLYPODIACEAE**


Habit/Habitat: Herb; epiphyte, Várzea forest.

Material examined: BRAZIL. ACRE: Manoel Urbano, D. C. Daly et al. 11225 (NY), M. Silveira et al. 1582 (NY).

Distribution: N South America.

* Campyloneurum angustifolium * (Sw.) Fée, Mem. Foug. 5: 257. 1852.

* Polypodium angustifolium * Sw., Prodr. 130. 1788.

Habit/Habitat: Herb; epiphyte in forest on Terra Firme.

Material examined: BRAZIL. ACRE: Bujari, M. de Pardo et al. 93 (NY); Cruzeiro do Sul, G. T. Prance et al. 12617 (NY), L. R. Marinho 163 (NY); Feijó, P. Delprete et al. 8311 (NY); Marechal Thaumaturgo, D. C. Daly et al. 10936 (NY); Porto Valter, P. J. M. Maas et al. 12931 (NY); Tarauacá, D. C. Daly et al. 8628 (HPZ, NY), G. T. Prance et al. 7384 (NY), G. T. Prance et al. 7249 (NY), M. Silveira et al. 1146 (NY).

Distribution: S Mexico, Lesser Antilles, Mesoamerica and tropical South America.
**Campyloneurum aphanophlebium** (Kunze) T. Moore, Index Filic. 223. 1861.
Habit/Habitat: Herb; epiphyte, forest in broad, meandering stream valley in steeply hilly terrain.
Material examined: BRAZIL. ACRE: Brasiléia, G. P. da Silva et al. 173 (NY); Mâncio Lima, D. C. Daly et al. 11601 (NY); Marechal Thaumaturgo, D. C. Daly et al. 7496 (HPZ, NY); D. C. Daly et al. 10255 (NY); Porto Valter, P. J. M. Maas et al. P13181 (NY); Rodrigues Alves, J. Prado et al. 1261 (HPZ, SP); Santa Rosa, D. C. Daly et al. 10173 (NY); Tarauacá, D. C. Daly et al. 8630 (HPZ, NY), G. T. Prance et al. 7267 (NY).
Distribution: Mesoamerica and N South America.

**Campyloneurum fuscosquamatum** Lellinger, Amer. Fern J. 78: 21, fig. 4, 10. 1988.
Habit/Habitat: Herb; epiphyte on Terra Firme forest and Várzea forest.
Material examined: BRAZIL. ACRE: Brasiléia, D. C. Daly et al. 6802 (HPZ, NY), D. C. Daly et al. 11894 (NY); Bujari, W. R. Anderson 12123 (NY); Feijó, P. Delprete et al. 8580 (NY); Mâncio Lima, G. T. Prance et al. 12052 (MG, NY), G. T. Prance et al. 120524 (NY); Quixadá, E. Forero et al. 6388 (MG, NY); Santa Rosa, D. C. Daly et al. 10151 (NY), D. C. Daly et al. 10994 (NY); Sena Madureira, D. C. Daly et al. 7856 (HPZ, NY), G. T. Prance et al. 7694 (NY); Tarauacá, D. C. Daly et al. 8620 (HPZ, NY); Without locality, J. Jangoux et al. 85-039 (MG, NY).
Distribution: N South America.

**Campyloneurum ophiocaulon** (Klotzsch) Fée, Mem. Foug. 258. 1852.
*Polypodium ophiocaulon* Klotzsch, Linnaea 20: 401. 1847.
Habit/Habitat: unknown.
Material examined: BRAZIL. ACRE: Bujari, M. de Pardo et al. 94 (NY).
Distribution: N South America.

**Campyloneurum phyllitidis** (L.) C. Presl, Tent. Pterid. 190. 1836.
Habit/Habitat: Herb; epiphyte in forest on Terra Firme.
Material examined: BRAZIL. ACRE: Brasiléia, D. C. Daly et al. 11922 (NY); Cruzeiro do Sul, D. C. Daly et al. 11716 (NY); J. Prado et al. 1315 (HPZ, SP), J. Prado et al. 1377 (HPZ, SP), G. T. Prance et al. 2783 (NY), G. T. Prance et al. 2818 (NY), G. T. Prance et al. 12530 (NY), G. T. Prance et al. 12622 (MG, NY); Feijó, G. T. Prance et al. 7317 (NY); Mâncio Lima, J. Prado et al. 1136 (HPZ, SP), J. Prado et al. 1142 (HPZ, SP), J. Prado et al. 1215 (HPZ, SP); Manoel Urbano, D. C. Daly et al. 9129 (NY); Marechal Thaumaturgo, D. C. Daly et al. 10592 (NY); Porto Acre, A. R. S. Oliveira et al. 763 (NY); Porto Valter, P. J. M. Maas et al. P12932 (MG, NY); Rodrigues Alves, J. Prado et al. 1264 (HPZ, SP), J. Prado et al. 1280 (HPZ, SP); Sena Madureira, D. C. Daly et al. 7906 (HPZ, NY); Without locality, J. Jangoux et al. 85-098 (NY).
Distribution: S Florida, Mexico, Antilles, Mesoamerica, tropical and subtropical South America.

**Campyloneurum repens** (Aubl.) C. Presl, Tent. Pterid. 190. 1836.
Habit/Habitat: Herb; epiphyte in forest on Terra Firme.
Distribution: Mexico, Antilles, Mesoamerica and tropical South America.

**Campyloneurum sphenodes** (Klotzsch) Fée, Mem. Foug. 5: 258. 1852.
*Polypodium sphenodes* Klotzsch, Linnaea 20: 402. 1847.
Habit/Habitat: Herb; epiphyte in forest on Terra Firme.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Prado et al. 1290* (HPZ, SP); Mâncio Lima, *J. Prado et al. 1141* (HPZ, SP); Marechal Thaumaturgo, *D. C. Daly et al. 10345* (NY); Porto Valter, *D. C. Daly et al. 7556* (NY).
Distribution: Mesoamerica and N South America.

**Dicranoglossum desvauxii** (Klotzsch) Proctor, Rhodora 63: 35. 1961.
*Taenitis desvauxii* Klotzsch, Linnaea 20: 431. 1847.
Habit/Habitat: Herb; epiphyte in forest on Terra Firme.
Distribution: Lesser Antilles, tropical South America.

Habit/Habitat: Herb; epiphyte in forest near stream margins.
Distribution: N South America.

*Polypodium bifrons* Hook., Fil. Exot. 1859.
Habit/Habitat: Herb; epiphyte, in open forest.
Material examined: BRAZIL. ACRE: Mâncio Lima, *D. C. Daly et al. 8998* (HPZ, NY); *D. G. Campbell et al. 8932* (NY); Tarauacá, *G. T. Prance et al. 7258* (MG, NY); Without locality, *J. Jangoux et al. 85-094* (MG, NY).
Distribution: Mesoamerica and N South America.
Obs: This species has long been called *Solanopteris bifrons* (Hook.) Copel.

**Microgramma dictyophylla** (Kunze ex Mett.) de la Sota, Novon 17: 27. 2007.
Habit/Habitat: Herb; epiphyte, in forest on Terra Firme.
Distribution: Mesoamerica and N South America.
Obs: This species has long been called *Microgramma fuscopunctata* (Hook.) Vareschi.

Habit/Habitat: Herb; epiphyte, in forest on Terra Firme.

Material examined: BRAZIL. ACRE: Cruzeiro do Sul, G. T. Prance et al. 12595 (MG, NY), J. Prado et al. 1196 (HPZ, SP), J. Pruski et al. 3465 (NY), P. J. M. Maas et al. P12725 (MG, NY); Mâncio Lima, M. Silveira et al. 1307 (NY); Rodrigues Alves, J. Prado et al. 1265 (HPZ, SP); Without locality, J. Jangoux et al. 85-015 (NY).

Distribution: N South America.


Polypodium percussum Cav., Descr. Pl. 243. 1802.

Habit/Habitat: Herb; epiphyte, Terra Firme forest on gently undulating terrain, undistributed but canopy open.

Material examined: BRAZIL. ACRE: Bujari, M. de Pardo et al. 92 (HPZ, NY); Cruzeiro do Sul, D. C. Daly et al. 11714 (NY), D. C. Daly et al. 11657 (NY), J. Prado et al. 1346 (HPZ), J. Prado et al. 1375 (HPZ), P. J. M. Maas et al. P13133B (NY); Feijó, P. Delprete et al. 8310 (NY), P. Delprete et al. 8488 (NY); Manoel Urbano, D. C. Daly et al. 11218 (NY), D. C. Daly et al. 11420 (NY); Marechal Thaumaturgo, D. C. Daly et al. 10297 (NY), L. G. Lohmann et al. 458 (NY); Sena Madureira, M. Silveira et al. 616 (HPZ, NY); Tarauacá, C. Ehringhaus et al. 382 (NY), G. T. Prance et al. 7380 (NY).

Distribution: S Mexico, Mesoamerica and tropical South America.

Microgramma Persicariifolia (Schrad.) C. Presl, Tent. Pterid. 214. 1836.


Habit/Habitat: Herb; epiphyte in Várzea forest.

Material examined: BRAZIL. ACRE: Bujari, D. C. Daly et al. 8497 (HPZ, NY); Cruzeiro do Sul, D. C. Daly et al. 7300 (HPZ, NY); Manoel Urbano, D. C. Daly et al. 11003 (NY), D. C. Daly et al. 11340 (NY); Sena Madureira, A. R. S. Oliveira et al. 622 (NY), M. de Pardo et al. 148 (HPZ, NY); Xapuri, L. G. Lohmann et al. 600 (NY); Without locality, D. G. da Silva et al. 57 (NY).

Distribution: Costa Rica, Panama and tropical South America.


Habit/Habitat: Herb; epiphyte in forest on Terra Firme.

Material examined: BRAZIL. ACRE: Bujari, M. de Pardo et al. 100 (NY); Cruzeiro do Sul, D. C. Daly et al. 11813 (NY); Manoel Urbano, D. C. Daly et al. 11252 (NY); Marechal Thaumaturgo, D. C. Daly et al. 10571 (NY); Port Acre, A. R. S. Oliveira et al. 744 (NY); Porto Valter, P. J. M. Maas et al. 13057 (NY); Sena Madureira, D. C. Daly et al. 8081 (HPZ, NY).

Distribution: Mexico, Cuba, Mesoamerica and tropical South America.


Polypodium tectum Kaulf., Enum. Fil. 87. 1824.

Habit/Habitat: Herb; epiphyte in forest near stream margins.

Material examined: BRAZIL. ACRE: Cruzeiro do Sul, J. Prado et al. 1296 (HPZ, SP), J. Prado et al. 1372 (HPZ, SP); Rodrigues Alves, J. Prado et al. 1274 (HPZ, SP).

Distribution: Guianas and Brazil.


Habit/Habitat: Herb; epiphyte in forest on Terra Firme.


Distribution: N South America.


Habit/Habitat: Herb; epiphyte in forest on Terra Firme.

Material examined: BRAZIL. ACRE: Brasílêia, *D. C. Daly et al.* 11889 (NY); Marechal Thaumaturgo, *D. C. Daly et al.* 10246 (NY); Rodrigues Alves, *J. Prado et al.* 1263 (HPZ, SP).

Distribution: Mexico, Antilles, Mesoamerica and tropical South America.


Habit/Habitat: Herb; epiphyte in open forest on Terra Firme with palms, undulating terrain.

Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *D. C. Daly et al.* 7488 (NY); Santa Rosa, *D. C. Daly et al.* 10176 (NY), *D. C. Daly et al.* 10988 (NY).

Distribution: S Mexico, Mesoamerica and N South America.


Habit/Habitat: Herb; epiphyte in Várzea forest.


Distribution: Antilles, Mesoamerica and tropical South America.


Habit/Habitat: Herb; epiphyte in forest on Terra Firme.


Distribution: N South America.


Habit/Habitat: Herb; epiphyte, in riverside vegetation.

Material examined: BRAZIL. ACRE: Manoel Urbano, *D. C. Daly et al.* 11546 (NY); Marechal Thaumaturgo, *D. C. Daly et al.* 10530 (NY); Quixadá, *E. Forero et al.* 6347.
(NY); Rio Branco, D. C. Daly et al. 6923 (NY); Santa Rosa, D. C. Daly et al. 11057 (NY); Sena Madureira, D. C. Daly et al. 7907 (NY); Tarauacá, G. T. Prance et al. 7248 (NY); G. T. Prance et al. 7385 (MG, NY).
Distribution: Florida, Mexico, Antilles, Mesoamerica, tropical South America.

*Phlebodium decumanum* (Willd.) J. Sm., J. Bot. (Hooker) 4: 59. 1841.

Habit/Habitat: Herb; epiphyte in forest on Terra Firme.
Material examined: BRAZIL. ACRE: Manoel Urbano, D. C. Daly et al. 11209 (NY); Porto Valter, P. J. M. Maas et al. P13299 (NY); Rio Branco, C. A. Cid & A. Souza 2986 (NY), D. C. Daly et al. 6871 (NY); Santa Rosa, D. C. Daly et al. 10119 (NY), D. C. Daly et al. 11272 (NY); Sena Madureira, D. C. Daly et al. 10119 (NY), D. C. Daly et al. 11272 (NY); Sena Madureira, D. C. Daly et al. 11057 (NY); Tarauacá, G. T. Prance et al. 7248 (NY), G. T. Prance et al. 7385 (MG, NY).
Distribution: S Florida, Antilles, Mesoamerica, tropical and subtropical South America.


Habit/Habitat: Herb; epiphyte in forest on Terra Firme.
Material examined: BRAZIL. ACRE: Manoel Urbano, D. C. Daly et al. 11209 (NY); Porto Valter, P. J. M. Maas et al. P13299 (NY); Rio Branco, C. A. Cid & A. Souza 2986 (NY), D. C. Daly et al. 6871 (NY); Santa Rosa, D. C. Daly et al. 10119 (NY), D. C. Daly et al. 11272 (NY); Sena Madureira, D. C. Daly et al. 8096 (HPZ, NY); Tarauacá, P. Delprete et al. 8257 (NY); Xapuri, D. C. Daly et al. 8414 (NY).
Distribution: Mesoamerica and N South America.


Habit/Habitat: Herb; epiphyte in forest on Terra Firme.
Material examined: BRAZIL. ACRE: Assis Brasil, D. C. Daly et al. 9813 (HPZ, NY); Manoel Urbano, D. C. Daly et al. 9081 (NY), D. C. Daly et al. 11219 (NY), D. C. Daly et al. 11562 (NY); Rio Branco, B. Nelson 737 (MG, NY), D. C. Daly et al. 9516 (HPZ, NY), D. C. Daly et al. 9526 (HPZ, NY), D. C. Daly et al. 1234 (HPZ, SP), D. C. Daly et al. 1234 (HPZ, SP), E. Forero et al. 6346 (NY); Rodrigues Alves, J. Prado et al. 1234 (HPZ, SP).
Distribution: Mesoamerica and N South America.

*Serpocaulon caceresii* (Sodiro) A. R. Sm., Taxon 55: 928, fig. 3A. 2006.

Habit/Habitat: Herb; epiphyte in forest on Terra Firme.
Material examined: BRAZIL. ACRE: Cruziero do Sul, J. Prado et al. 1210 (HPZ, SP); Manoel Urbano, D. C. Daly et al. 11219 (NY); Rio Branco, B. Nelson 737 (MG, NY), D. C. Daly et al. 9516 (HPZ, NY), D. C. Daly et al. 9526 (HPZ, NY), C. A. Cid 2893 (MG, NY); Sena Madureira, D. C. Daly et al. 7908 (HPZ, NY).
Distribution: Antilles, Mesoamerica, tropical South America.

*Polypodium triseriale* Sw., J. Bot. (Schrader) 2: 26. 1800 [1801].

Habit/Habitat: Herb; epiphyte, in open forest.
Material examined: BRAZIL. ACRE: Mâncio Lima, D. C. Daly et al. 8944 (HPZ, NY). Distribution: S Mexico, Antilles, Mesoamerica and N South America.

**PSILOTACEAE**


Habit/Habitat: Herb; epiphyte, in open forest.

Material examined: BRAZIL. ACRE: Brasiléia, D. C. Daly et al. 9693 (NY); Rio Branco, D. C. Daly et al. 6669 (HPZ, NY); Sena Madureira, B. Nelson 614 (NY), G.T. Prance et al. 7956 (NY); Xapuri, C. Figueiredo 211 (HPZ, NY), D. C. Daly et al. 8430 (HPZ, NY); Without locality, J. M. Pires et al. 10058 (NY).

Distribution: Cosmopolitan.

**PTERIDACEAE**


Habit/Habitat: Herb; terrestrial in forest on Terra Firme near stream margins.

Material examined: BRAZIL. ACRE: Bôca do Acre, G. T. Prance et al. 2533 (MG, NY); Cruzeiro do Sul, J. Prado et al. 1344 (HPZ, SP); Porto Acre, D. C. Daly et al. 7990 (HPZ); Rio Branco, D. C. Daly et al. 6675 (NY), S. R. Lowrie et al. 650 (GH, NY, R, RB, US); Sena Madureira, M. Silveira et al. 668 (NY), T. B. Croat & A. Rosas Jr. 62716 (HPZ); Xapuri, K. A. Kainer et al. 126 (NY), L. C. Ming et al. 356 (HPZ), M. Pinard 809 (NY), D. C. Daly et al. 7261 (HPZ, NY).

Distribution: Guianas and Brazil.

*Adiantum cajennense* Willd. ex Klotzsch, Linnaea 18: 552. 1845.

Habit/Habitat: Herb; terrestrial in forest on Terra Firme on gently undulating terrain, undistributed but canopy open.

Material examined: BRAZIL. ACRE: Cruzeiro do Sul, D. C. Daly et al. 11658 (NY), D. C. Daly et al. 11704 (NY), J. Prado et al. 1201 (HPZ, SP); Porto Acre, D. C. Daly et al. 1293 (HPZ, SP); Mâncio Lima, J. Prado et al. 1140 (NY), J. Prado et al. 1249 (HPZ).

Distribution: Guianas and Brazil.


Habit/Habitat: Herb; terrestrial, forest in broad, meandering stream vally in steeply hilly terrain.

Material examined: BRAZIL. ACRE: Santa Rosa, D. C. Daly et al. 10164 (NY), D. C. Daly et al. 11365 (NY).

Distribution: Mexico, Mesoamerica, N South America.


Habit/Habitat: Herb; terrestrial in forest on Terra Firme, on clay soils.

Material examined: BRAZIL. ACRE: Bujari, D. C. Daly et al. 9385 (NY).

Distribution: South America.


Habit/Habitat: Herb; terrestrial in forest on Terra Firme, on clay soils.

Distribution: South America.

**Adiantum humile** Kunze, Linnaea 9: 80. 1834.
Habit/Habitat: Herb; terrestrial in forest on Terra Firme, on clay soils.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, J. Prado et al. 1302 (HPZ, SP), J. Prado et al. 1339 (HPZ, SP); Rodrigues Alves, J. Prado et al. 1246 (HPZ, SP).
Distribution: Belize and tropical South America.

**Adiantum latifolium** Lam., Encycl. 1: 43. 1783.
Habit/Habitat: Herb; terrestrial in forest on Terra Firme, on sandy soils.
Distribution: Mexico, Antilles, Mesoamerica and South America.

Habit/Habitat: Herb; terrestrial in forest on Terra Firme near stream margins, on clay soils.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, J. Prado et al. 1358 (HPZ, SP).
Distribution: N South America.

Habit/Habitat: Herb; terrestrial in forest on Terra Firme near stream margins, on clay soils.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, W. C. Steward et al. P12679 (NY); Mâncio Lima, D. C. Daly et al. 8854 (NY).
Distribution: N South America.

Habit/Habitat: Herb; terrestrial in forest on Terra Firme near stream margins.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, J. Prado et al. 1345 (HPZ, SP), J. Jangoux et al. 85-008 (NY); Rodrigues Alves, J. Prado et al. 1259 (HPZ); J. Prado et al. 1360 (HPZ, SP).
Distribution: Mexico, Antilles, Mesoamerica and tropical South America.

**Adiantum pectinatum** Kunze ex Baker, Syn. Fil. 120. 1867.
Habit/Habitat: Herb; terrestrial, riverside vegetation.
Material examined: BRAZIL. ACRE: Manoel Urbano, D. C. Daly et al. 11474 (NY).
Distribution: Mesoamerica and tropical South America.

Habit/Habitat: Herb; terrestrial, riverside vegetation.
Material examined: BRAZIL. ACRE: Basin of Rio Juruá, Rio Juruá Mirim and Igarapé Periquito (right-bank tributary), across from Santo Antônio, D. C. Daly et al. 11708 (NY); Mâncio Lima, J. Prado et al. 1139 (HPZ, SP); Manoel Urbano, D. C. Daly et al. 11528 (NY); Rodrigues Alves, J. Prado et al. 1275 (HPZ, SP).
Distribution: Mexico, Antilles, Mesoamerica and tropical South America.

**Adiantum poeppigianum** (Kuhn) Hieron., Hedwigia 48: 231. 1909.
Habit/Habitat: Herb; terrestrial in forest on steep slopes.
Material examined: BRAZIL. ACRE: Assis Brasil, *D. C. Daly et al.* 9810 (HPZ, NY); Manoel Urbano, *D. C. Daly et al.* 11473 (NY); Marechal Thaumaturgo, *D. C. Daly et al.* 10950 (NY); Sena Madureira, *D. C. Daly et al.* 7972 (NY); Santa Rosa, *D. C. Daly et al.* 10034 (NY).
Distribution: South America.

**Adiantum pulverulentum** L., Sp. Pl. 2: 1096. 1753.
Habit/Habitat: Herb; terrestrial in primary forest in low-lying area (Baixio) shallowly dissected by many small streams.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *D. C. Daly et al.* 7365 (HPZ, NY); G. T. Prance et al. 12065 (K, NY); W. C. Steward et al. P12894 (K, NY); J. Prado et al. 1347 (HPZ, SP); Manoel Urbano, *D. C. Daly et al.* 9173 (NY); *D. C. Daly et al.* 11392 (NY); Rio Azul, J. Jangoux et al. 85-064 (NY); Rio Branco, S. R. Lowrie et al. 649 (GH, NY, R, US); Tarauacá, C. Figueiredo et al. 883 (NY); Santa Rosa, *D. C. Daly et al.* 10050 (NY), *D. C. Daly et al.* 11004 (NY); Rio Juruá between Mundurucus & Tatajuba, *Maas et al.* P12894 (GH, K, NY, R, US).
Distribution: Mexico, Antilles, Mesoamerica and tropical South America.

Habit/Habitat: Herb; terrestrial in moist forest on Terra Firme, tertiary sediments, undulating terrain.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *D. C. Daly et al.* 7331 (NY); Marechal Thaumaturgo, *D. C. Daly et al.* 10304 (NY); Tarauacá, G. T. Prance et al. 12203 (INPA, MO, NY); Porto Valter, *D. C. Daly et al.* 11786 (NY), *D. C. Daly et al.* 11788 (NY); Rodrigues Alves, J. Prado et al. 1361 (HPZ, SP).
Distribution: N South America.

Habit/Habitat: Herb; terrestrial in forest on Terra Firme, on clay soils.
Distribution: Mexico, Antilles, Mesoamerica and tropical South America.

Habit/Habitat: Herb; terrestrial in forest on Terra Firme, on clay soils.
Material examined: BRAZIL. ACRE: Brasíliéa, *D. C. Daly et al.* 11878 (NY).
Distribution: Mexico, Antilles, Mesoamerica and tropical South America.

**Adiantum tomentosum** Klotzsch, Linnaea 18: 553. 1844.
Habit/Habitat: Herb; terrestrial in forest on Terra Firme, on clay soils.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, G. T. Prance 11390 (MG, NY),
J. Prado et al. 1165 (HPZ, SP), J. Prado et al. 1195 (HPZ, SP), P. J. M. Maas et al. P12791 (NY); P. G. Windisch 2574 (HB, HRCB); Porto Valter, D. C. Daly et al. 7378 (HPZ, NY); Rodrigues Alves, J. Prado et al. 1242 (HPZ).
Distribution: Tropical South America.

**Adiantum windischii** J. Prado, Kew Bull. 60: 119-121, fig. 2. 2005.
Habit/Habitat: Herb; terrestrial in forest on Terra Firme, on clay soils.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, G. T. Prance et al. P13045 (UC); Rodrigues Alves, J. Prado et al. 1276 (HPZ, SP).
Distribution: Tropical South America.

Pteris angustifolia Sw., Prodr. 129. 1788.
Habit/Habitat: Herb; epiphyte in forest on Terra Firme.
Material examined: BRAZIL. ACRE: Bujari, D. C. Daly et al. 9336 (NY); Cruzeiro do Sul, D. C. Daly et al. 7479 (NY), G. T. Prance et al. 12616 (MG, NY); Rio Branco, B. Nelson 739 (MG, NY); Santa Rosa, D. C. Daly et al. 10160 (NY); Sena Madureira, M. Silveira et al. 615 (HPZ, NY); Tarauacá, D. C. Daly et al. 8737 (HPZ, NY), G.T. Prance et al. 7379 (MG, NY).
Distribution: Mexico, Antilles and N South America.

Habit/Habitat: Herb; epiphyte in forest on Terra Firme.
Material examined: BRAZIL. ACRE: Tarauacá, D. C. Daly et al. 8269 (NY), G. T. Prance et al. 7426 (MG, NY).
Distribution: Mexico, Mesoamerica and tropical South America.

Gymnogramma pumila Spreng., Tent. Suppl. 31. 1828.
Habit/Habitat: Herb; epiphyte on the base of trunks in forest on Terra Firme.
Material examined: BRAZIL. ACRE: Tarauacá, D. C. Daly et al. 8269 (NY), G. T. Prance et al. 7426 (MG, NY).
Distribution: Mexico, Antilles, Mesoamerica and tropical South America.

**Pityrogramma calomelanos** (L.) Link, Handbuch 3: 20. 1833.
Habit/Habitat: Herb; terrestrial in forest on Terra Firme near river margins on clay soils.
Material examined: BRAZIL. ACRE: Brasiléia, S. R. Lowrie et al. 696 (NY); Cruzeiro do Sul, J. Prado et al. 1173 (HPZ, SP), J. Prado et al. 1304 (HPZ, SP); Assis Brasil, D. C. Daly et al. 9634 (HPZ, NY); Mâncio Lima, M. Silveira et al. 1294 (NY); Quixadá, E. Forero et al. 6381 (NY); Sena Madureira, M. Silveira et al. 670 (HPZ, NY); Tarauacá, G. T. Prance et al. 7302A (NY), M. Silveira et al. 868 (NY).
Distribution: S Florida, Mexico, Antilles, Mesoamerica and tropical South America.

Habit/Habitat: Herb; epiphyte in forest on Terra Firme.

Material examined: BRAZIL. ACRE: Cruzeiro do Sul, D. C. Daly et al. 11688 (NY); Feijó, G. T. Prance et al. 7342 (NY), P. Delprete et al. 8475 (NY); Mâncio Lima, D. C. Daly et al. 8962 (HPZ, NY); Marechal Thaumaturgo, D. C. Daly et al. 7350 (HPZ, NY), D. C. Daly et al. 10277 (NY); Porto Valter, M. Silveira et al. 1646 (NY); Santa Rosa, D. C. Daly et al. 11088 (NY), D. C. Daly et al. 10166 (NY), D. C. Daly et al. 11178 (NY); Tarauacá, D. C. Daly et al. 8619 (HPZ, NY), G. T. Prance 7267A (NY); Without locality, J. Jangoux 85-095 (NY).

Distribution: Mexico, Antilles, Mesoamerica and tropical South America.

**Polytaenium guayanense** (Hieron.) Alston, Kew Bull. 1932(7): 134. 1932.

Habit/Habitat: Herb; epiphyte in forest on Terra Firme.

Material examined: BRAZIL. ACRE: Cruzeiro do Sul, J. Prado et al. 1316 (HPZ), J. Prado et al. 1351 (HPZ); Marechal Thaumaturgo, D. C. Daly et al. 10254 (NY), D. C. Daly et al. 10837 (NY); Porto Valter, W. C. Steward et al. P13013 (MG, NY); Rodrigues Alves, J. Prado et al. 1240 (HPZ, SP), J. Prado et al. 1248 (HPZ, SP), J. Prado et al. 1277 (HPZ, SP); Without locality, J. Jangoux et al. 85-026 (NY), J. Jangoux et al. 85-095A (NY).

Distribution: N South America.

**Pteris altissima** Poir., Encycl. 5: 722. 1804.

Habit/Habitat: Herb; terrestrial in forested slope between Baixio and higher terrace, canopy relatively closed, understory relatively rich in herbs.

Material examined: BRAZIL. ACRE: Brasília, D. C. Daly et al. 9879 (HPZ, NY); Manoel Urbano, D. C. Daly et al. 9086 (NY), D. C. Daly et al. 11195 (NY), D. C. Daly et al. 11260 (NY), D. C. Daly et al. 11422 (NY); Marechal Thaumaturgo, D. C. Daly et al. 7702 (NY); Porto Valter, W. C. Steward et al. P13013 (MG, NY); Rodrigues Alves, J. Prado et al. 1240 (HPZ, SP), J. Prado et al. 1248 (HPZ, SP), J. Prado et al. 1277 (HPZ, SP); Without locality, J. Jangoux et al. 85-026 (NY), J. Jangoux et al. 85-095A (NY).

Distribution: Mexico, Antilles, Mesoamerica and tropical South America.

**Pteris grandifolia** L., Sp. Pl. 2: 1073. 1753.

Habit/Habitat: Herb; terrestrial on substrate hard and brittle, seeping clear water.

Material examined: BRAZIL. ACRE: Brasília, D. C. Daly et al. 11697 (HPZ, NY); Manoel Urbano, D. C. Daly et al. 10054 (HPZ, NY); Porto Valter, P. J. M. Maas et al. 13239 (K, NY).

Distribution: Mexico, Antilles, Mesoamerica, and N South America.


Habit/Habitat: Herb; terrestrial in moist forest on Terra Firme, tertiary sediments, undulating terrain.

Material examined: BRAZIL. ACRE: Assis Brasil, D. C. Daly et al. 9791 (HPZ, NY); Manoel Urbano, D. C. Daly et al. 11426 (NY); Marechal Thaumaturgo, D. C. Daly et al. 7341 (NY); Porto Valter, P. J. M. Maas et al. 13239 (K, NY).

Distribution: Mexico, Antilles, Mesoamerica, and N South America.
Habit/Habitat: Herb; terrestrial in undisturbed forest in low-lying area with moist soils, canopy open.
Material examined: BRAZIL. ACRE: Manoel Urbano, D. C. Daly et al. 11475 (NY); Sena Madureira, D. C. Daly et al. 7920 (MO); Marechal Thaumaturgo, D. C. Daly et al. 10465 (NY); Rio Branco, L. Coelho & A. Rosas 1941 (HPZ, NY).
Distribution: Mexico, Mesoamerica and tropical South America.

**Pteris pungens** Willd., Sp. Pl. 5: 387. 1810.
Habit/Habitat: Herb; terrestrial in forest on Terra Firme.
Material examined: BRAZIL. ACRE: Without locality, J. Jangoux et al. 0 (NY).
Distribution: Mexico, Antilles, Mesoamerica and tropical South America.

**Vittaria lineata** (L.) Sm., Mem. Acad. Roy. Sci. (Turin) 5 (1790-1791): 421, pl. 9, fig. 5. 1793.
**Pteris lineata** L., Sp. Pl. 2: 1073. 1753.
Habit/Habitat: Herb; epiphyte in forest.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, P. J. M. Maas et al. P12768 (NY); Mâncio Lima, J. Prado et al. 1227 (HPZ, SP); Rodrigues Alves, J. Prado et al. 1279 (HPZ, SP).
Distribution: Mexico, Antilles, Mesoamerica and tropical South America.

Habit/Habitat: Herb; terrestrial in forest on Terra Firme.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, J. Prado et al. 1341 (NY); Sena Madureira, C. A. Cid & B. Nelson 2574 (NY); Without locality, J. Jangoux et al. 85-100 (MG, NY).
Distribution: Mexico, Antilles, Mesoamerica and tropical South America.

**Davallia inaequalis** Kunze, Linnaea 9: 87. 1834.
Habit/Habitat: Herb; terrestrial on Terra Firme forest on high terrace.
Material examined: BRAZIL. ACRE: Bujari, D. C. Daly et al. 9456 (NY); Cruzeiro do Sul, G. T. Prance et al. 12194 (MG, NY), G. T. Prance et al. 12333 (NY), G. T. Prance et al. 12574 (NY), J. Prado et al. 1203 (HPZ, SP); Rodrigues Alves, J. Prado et al. 1256 (HPZ, SP); Santa Lucia, J. Pruski et al. 3497 (NY); Without locality, J. Jangoux et al. 85-011 (NY).
Distribution: Mexico, Antilles, Mesoamerica and tropical South America.

**Saccoloma membranaceum** Mickel, Amer. Fern J. 74: 119, fig. 2A, B. 1984.
Habit/Habitat: Herb; terrestrial in forest on mountains.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, G. T. Prance et al. 12432 (NY).
Distribution: N South America.

**SALVINIACEAE**
**Salvinia minima** Baker, J. Bot. 24: 98. 1886.
Habit/Habitat: Herb; aquatic in lakes along road margins.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, J. Prado et al. 1378 (HPZ, SP).
Distribution: S United States, Mexico, Antilles, Mesoamerica and tropical South America.

SCHIZAEACEAE

Schizaea elegans (Vahl) Sw., J. Bot. (Schrader) 1800(2): 103. 1801.
Habit/Habitat: Herb; terrestrial in forest on Terra Firme
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, J. Prado et al. 1162 (HPZ, SP), J. Prado et al. 1175 (HPZ, SP); Mâncio Lima, C. A. Cid et al. 10095 (NY), G. T. Prance et al. 12101 (NY), M. Silveira et al. 1259 (NY).
Distribution: S Mexico, Greater Antilles, Mesoamerica and tropical South America.

SELAGINELLACEAE

Habit/Habitat: Herb; terrestrial in forest on Terra Firme.
Material examined: BRAZIL. ACRE: Sena Madureira, D. C. Daly et al. 7891 (NY), D. C. Daly et al. 8139 (NY).
Distribution: Mesoamerica and N South America.

Selaginella asperula Spring, Fl. Bras. 1(2): 127. 1840.
Habit/Habitat: Herb; terrestrial in Campina forest, on sandy soils.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, D. C. Daly et al. 10646 (NY), G. T. Prance et al. 12643 (NY), J. Prado et al. 1169 (HPZ, SP), J. Prado et al. 1185 (HPZ, SP), J. Prado et al. 1192 (HPZ, SP), J. Prado et al. 1391 (HPZ, SP), T. B. Croat & A. Rosas Jr. 62643 (HPZ, NY); Porto Valter, D. C. Daly et al. 7573 (HPZ, NY).
Distribution: N South America.

Lycopodium exaltatum Kunze, Linnaea 9: 8. 1834[1835].
Habit/Habitat: Herb; terrestrial in forest on Terra Firme and Várzea forest.
Material examined: BRAZIL. ACRE: Bujari, W. A. Anderson 12124 (NY); Brasiléia, D. C. Daly et al. 6820 (HPZ, NY); Cruzeiro do Sul, J. Prado et al. 1289 (HPZ, SP), L. R. Marinho 258 (NY); Mâncio Lima, G. T. Prance et al. 12157 (NY), J. Jangoux et al. 85-093 (MG, NY); Plácido de Castro, D. C. Daly et al. 6123 (HPZ, NY); Porto Valter, P. J. M. Maas et al. P12951 (MG, NY); Rio Branco, D. C. Daly et al. 6676 (HPZ, NY); Sena Madureira, B. Nelson et al. 527 (NY), G. T. Prance et al. 7626 (NY); Tarauacá, G. T. Prance et al. 7405 (NY); Xapuri, A. R. S. Oliveira et al. 198 (MG, NY); Without locality, E. Forero et al. 6305 (NY).
Distribution: Mesoamerica and N South America.

Habit/Habitat: Herb; terrestrial in “Baixio”: low terraces possibly flooded occasionally by overflowing streams.
Material examined: BRAZIL. ACRE: Manoel Urbano, D. C. Daly et al. 11439 (NY).
Distribution: Mexico, Mesoamerica and tropical South America.
Selaginella haematodes (Kunze) Spring, Fl. Bras. 1(2): 126. 1840.
Lycopodium haematodes Kunze, Linnaea 9: 9. 1834[1835].
Habit/Habitat: Herb; terrestrial in open forest on steep hilly terrain.
Material examined: BRAZIL. ACRE: Santa Rosa, D. C. Daly et al. 11141 (NY).
Distribution: Mesoamerica and N South America.

Habit/Habitat: Herb; terrestrial in forest on Terra Firme near stream margins.
Distribution: N South America.

Lycopodium sulcatum Desv. ex Poir., Encycl. 3: 549. 1814.
Habit/Habitat: Herb; terrestrial in forest on Terra firme, on poorly drained soils, undulating terrain dissected by numerous streams.
Material examined: BRAZIL. ACRE: Manoel Urbano, D. C. Daly et al. 9134 (NY); Sena Madureira, D. C. Daly et al. 8075 (NY), L. de Lima et al. 540 (HPZ, NY).
Distribution: Tropical South America.

Habit/Habitat: Herb; terrestrial, in primary forest, undulating terrain, in places dissected by many small streams.
Material examined: BRAZIL. ACRE: Brasíliena, D. C. Daly et al. 9882 (HPZ, NY), D. C. Daly et al. 11891(NY).
Distribution: Mesoamerica and N South America.

Tectaria incisa Cav., Descr. Pl. 249. 1802.
Habit/Habitat: Herb; terrestrial in forest on Terra Firme near stream margins, on sandy and clay soils.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, D. C. Daly et al. 7493 (HPZ, NY); Marechal Thaumaturgo, D. C. Daly et al. 10340 (NY), D. C. Daly et al. 10343 (NY); Quixadá, C. A. Cid & A. Rosas 2952 (MG, NY); Rio Branco, C. A. Cid & A. Rosas 2899 (NY); Santa Rosa, D. C. Daly et al. 10052 (NY), D. C. Daly et al. 11335 (NY); Sena Madureira, G. T. Prance et al. 7667 (MG, NY); Tarauacá, D. C. Daly et al. 8617 (HPZ, NY), G. P. da Silva et al. 98 (NY); Xapuri, C. Figueiredo 207 (HPZ, NY), Xapuri, D. C. Daly et al. 7273 (HPZ, NY).
Distribution: S Florida, Mexico, Antilles, Mesoamerica, tropical and subtropical South America.

Habit/Habitat: Herb; terrestrial on Várzea forest.
Material examined: BRAZIL. ACRE: Mâncio Lima, G. T. Prance et al. 12047 (MG, NY), M. Silveira et al. 1229 (NY); Rio Branco, C. A. Cid & A. Souza 2988 (NY); Sena Madureira, G. T. Prance et al. 7812A (NY).
Distribution: Mesoamerica and tropical South America.

Habit/Habitat: Herb; terrestrial in forest of Terra Firme, on undulating terrain, canopy discontinuous.
Material examined: BRAZIL. ACRE: Brasiléia, D. C. Daly et al. 1229 (HPZ, NY).
Distribution: Antilles and N South America.

Habit/Habitat: Herb; terrestrial in forest on Terra Firme, undulating terrain.
Material examined: BRAZIL. ACRE: Assis Brasil, D. C. Daly et al. 9883 (HPZ, NY); Brasiléia, D. C. Daly et al. 8463 (HPZ, NY); Bujari, D. C. Daly et al. 9856 (HPZ, NY).
Distribution: N South America.

Habit/Habitat: Herb; terrestrial in forest on Terra Firme, on clay soils.
Material examined: BRAZIL. ACRE: Brasiléia, D. C. Daly et al. 1229 (HPZ, NY); Cruzeiro do Sul, J. Prado et al. 1334 (HPZ, SP); Rodrigues Alves, J. Prado et al. 1247 (HPZ).
Distribution: Antilles, Mesoamerica and N South America.

**THELYPTERIDACEAE**

Habit/Habitat: Herb; terrestrial in forest on Terra Firme, on sandy soil.
Material examined: BRAZIL. ACRE: Mâncio Lima, M. Silveira et al. 1299 (NY), M. Silveira et al. 1299 (NY), D. C. Daly et al. 8921 (HPZ, NY); Marechal Thaumaturgo, D. C. Daly et al. 10196 (NY); Tarauacá, D. C. Daly et al. 8764 (HPZ, NY).
Distribution: Mexico, Antilles, Mesoamerica and tropical South America.

Habit/Habitat: Herb; terrestrial in forest on Terra Firme near stream margins.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, J. Prado et al. 1164 (HPZ, SP), J. Prado et al. 1298 (HPZ, SP).
Distribution: Mesoamerica and tropical South America.

Habit/Habitat: Herb; terrestrial in forest on Terra Firme near stream margins.
Distribution: N South America.
Infraspecific: var. *decussata*
Habit/Habitat: Herb; terrestrial in forest on Terra Firme, on steep slopes.
Distribution: Antilles, Mesoamerica and tropical South America.

*Nephrodium jamesonii* Hook., Sp. Fil. 4: 66. 1862.
Habit/Habitat: Herb; terrestrial in forest on Terra Firme, on steep slopes.
Distribution: N South America and southern Brazil.

Habit/Habitat: Herb; terrestrial in forest on Terra Firme.
Distribution: N South America and southern Brazil.

*Meniscium macrophyllum* Kunze, Flora 22(1): Beibl. 44. 1838.
Habit/Habitat: Herb; terrestrial in forest on Terra Firme.
Distribution: N South America and southern Brazil.

Habit/Habitat: Herb; terrestrial in forest on Terra Firme.
Distribution: N South America.

Habit/Habitat: Herb; terrestrial, riverside vegetation.
Distribution: Antilles, Mesoamerica and tropical South America.

**Thelypteris opulenta** (Kaulf.) Fosberg, Smithsonian Contr. Bot. 8: 3. 1972.
*Aspidium opulentum* Kaulf., Enum. Fil. 238. 1824.
Habit/Habitat: Herb; terrestrial in open forest with palms and weak presence of Guadua sarcocarpa, canopy ca. 25 m, deeply dissected terrain. Sandy clay soil.
PRADO & MORAN: CHECKLIST OF THE FERNS OF ACRE STATE, BRAZIL  262

*Thelypteris patens* (Sw.) Small, Ferns S. E. States 243. 1938.
*Polypodium patens* Sw., Prodr. 133. 1788.

Habit/Habitat: Herb; terrestrial in forest on steep slopes.
Material examined: BRAZIL. ACRE: Assis Brasil, *D. C. Daly et al. 9635* (NY); Porto Valter, *D. C. Daly et al. 11780* (NY).

Distribution: Mexico, Antilles, Mesoamerica and tropical South America.

*Meniscium serratum* Cav., Descr. Pl. 548. 1802.

Habit/Habitat: Herb; terrestrial in primary moist forest on Terra Firme.

Distribution: S Florida, Antilles, Mesoamerica, tropical and subtropical South America.

*Polypodium triste* Kunze, Linnaea 9: 47. 1834.

Habit/Habitat: Herb; terrestrial in forest of Terre Firme, on clay soils.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Prado et al. 1376* (HPZ, SP); Marechal Thaumaturgo, *D. C. Daly et al. 10464* (NY).

Distribution: Mexico, Antilles, Mesoamerica and N South America.

**WOODSIACEAE**

*Diplazium ambiguum* Raddi, Opusc Sci. 3: 292. 1819.

Habit/Habitat: Herb; terrestrial on disturbed area of Terra Firme.
Material examined: BRAZIL. ACRE: Marechal Thaumaturgo, *D. C. Daly et al. 10464* (NY).

Distribution: tropical South America.

*Diplazium grandifolium* (Sw.) Sw., J. Bot. (Schrader) 1800(2): 62. 1801.
*Asplenium grandifolium* Sw., Prodr. 130. 1788.

Habit/Habitat: Herb; terrestrial in forest on Terra Firme near stream margins.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *D. C. Daly et al. 7394* (HPZ, NY); Marechal Thaumaturgo, *D. C. Daly et al. 10302* (NY); Xapuri, *M. Pinard et al. 812* (NY).

Distribution: Mexico, Antilles, Mesoamerica and N South America.

*Diplazium lechleri* (Mett.) T. Moore, Index Filic. 141. 1859.

Habit/Habitat: Herb; terrestrial in forest on Terra Firme.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, J. Prado et al. 1332 (HPZ, SP).


Habit/Habitat: Herb; terrestrial in forest on Terra Firme.

Material examined: BRAZIL. ACRE: Marechal Thaumaturgo, D. C. Daly et al. 7721 (HPZ, NY); Tarauacá, G. T. Prance et al. 7400 (MG, NY).

Distribution: N South America.

*Hemidictyum marginatum* (L.) C. Presl, Tent. Pterid. 111, tab. 3, fig. 24. 1836.

Habit/Habitat: Herb; terrestrial in Várzea forest.


Distribution: S Mexico, Antilles, Mesoamerica, tropical South America.

**ACKNOWLEDGEMENTS**

We thank Dr. Douglas Daly (NY) for inviting us to participate in this project. The senior author thanks The New York Botanical Garden Herbarium for the use of facilities during his three visits to compile these data for publication. This study received financial support from the Brazilian Research Council CNPq (Proc. n. 303867/2004-3). We also thank Dr. Alan Smith (UC) for corrections and constructive comments on the manuscript.

**REFERENCES**


DESICCATION TOLERANCE IN SOME BRITISH FERNS

M.C.F. PROCTOR

School of Biosciences, University of Exeter, Geoffrey Pope Building, Stocker Road, Exeter EX4 4QD

Key-words: Asplenium, chlorophyll fluorescence, drying rate, light responses, Polypodium, recovery rate, relative humidity, relative water content.

ABSTRACT
Leaves of ten British fern species were tested for their tolerance of desiccation. Asplenium ruta-muraria, A. septentrionale, A. trichomanes, A. ceterach, Polypodium cambricum and P. interjectum withstood drying for periods of a week or more to a relative water content (RWC) of c. 4–7%. This is far below the RWC (c. 30%) at which most vascular-plant tissues are irretrievably damaged. One population of Asplenium adiantum-nigrum was desiccation tolerant, another was not. Asplenium obovatum was fairly tolerant, behaviour differing with intensity of desiccation and in old and young growth. Polypodium cambricum and P. interjectum were both highly tolerant. Polystichum aculeatum was not tolerant. Recovery rates of RWC and the chlorophyll-fluorescence parameter \( F'_v/F_m \) did not vary greatly between species, with half-recovery times around 2–4 h. The small Asplenium species and A. ceterach dried quickly (half-drying times a few hours), suggesting little stomatal control over drying. The much slower drying of the Polypodium species suggests that their stomata close under water stress. Photosynthetic electron flow in most species saturated at a quarter to a half of full summer sunlight. Asplenium ruta-muraria, A. septentrionale and A. trichomanes showed a similar tendency to non-saturating electron flow at high irradiances as many desiccation-tolerant bryophytes. In A. ceterach and Polypodium cambricum electron flow was somewhat depressed at high irradiances. The results are discussed in relation to their ecological and evolutionary implications.

INTRODUCTION
The tolerance to desiccation of the rusty-back fern Asplenium ceterach L., the widespread Mediterranean Notholaena marantae (L.) Desv. and the American ‘resurrection’ ferns Polypodium polypodioides (L.) Watt and P. virginicum L. is well known (Oppenheimer & Halevy, 1962; Schwab et al., 1989; Ilijin, 1931; Potts & Penfound, 1948; Stuart, 1968; Gildner & Larson, 1992; Muslin & Homann, 1992; Reynolds & Bewley, 1993). Many other ferns have been reported as desiccation tolerant, including a number of species of Cheilanthes, Pellaea, Asplenium and Polypodium; a list with references was given by Proctor & Pence (2002) and further species were added by Kessler & Siorak (2007). Most of these are essentially ferns of seasonally arid regions, or saxicolous or epiphytic species of intermittently water-stressed habitats. Kappen (1964) investigated freezing, heat and drought tolerance round the seasons of the common ferns around Göttingen in central Germany. He found no sharp line between poikilohydric, desiccation-tolerant ferns and homoiohydric, more sensitive species, as did Kessler & Siorak in North America. In general, Kappen found
the summer-green ferns were sensitive to drying at all times, but most winter-green species were more tolerant of drying in the cold, dry Central European winter and spring than from midsummer to autumn. The most desiccation-tolerant species (in descending order of tolerance) were Polypodium vulgare, Asplenium septentrionale, A. ruta-muraria and A. trichomanes. Perhaps paradoxically, there is as much physiological information on desiccation tolerance of the moisture-loving Hymenophyllaceae as on most other ferns (Shreve, 1911; Holloway, 1923a, b; Härtel, 1940a, b; Richards & Evans, 1972; Proctor, 2003).

The response of Asplenium ceterach to desiccation and its ability to revive after rain are very apparent in dry summers. The desiccation tolerance of the two common small saxicolous Asplenium species is less obvious until they are observed closely. The present project grew out of work on desiccation tolerance in bryophytes, and developed over a number of years as opportunity offered or material came to hand. Its aims were to establish which of our common ferns are tolerant to desiccation, and to collect data on the desiccation-tolerance of ferns (in particular rates of drying and recovery) for comparison with bryophytes and angiosperm ‘resurrection plants.’

MATERIALS AND METHODS

All the measurements in this paper were made on excised leaves. Material of Asplenium trichomanes, A. ruta-muraria, A. ceterach and Polypodium cambricum was collected from Devonian limestone rocks and walls near Chudleigh, Devon (most on 10 December 2000 and 5 January 2001; some A. ceterach in March–April 2008). Some measurements were made on leaves of A. adiantum-nigrum from a mortared pebble wall facing the sea at Budleigh Salterton, Devon (4 January 2001); most measurements on this species were on material from a dry Permian conglomerate roadside bank at Kennford, Devon (8 February 2006). A. obovatum was from schist outcrops on Gammon Head, near East Prawle, Devon (30 April 2006). A. septentrionale was from a slate dry-stone roadside wall south of Trefriw, Gwynedd (11 September 2005). Polypodium interjectum was from a Permian roadside outcrop near Kennford, Devon (8 February 2006). Polystichum aculeatum came from Malham, Yorkshire (26 July 2006).

Chlorophyll fluorescence measurements using a modulated fluorometer (FMS-1, Hansatech, King’s Lynn) were used throughout this work. Chlorophyll fluorescence provides a simple and rapid non-invasive method of monitoring various aspects of the photosynthetic performance of a plant. Schreiber et al., (1995) and Maxwell & Johnson (2000) provide an introduction to the technique and explain the calculation of the commonly used parameters. The parameter \( F_v/F_m \) measures the maximum quantum efficiency of photosystem II; it is generally in the range 0.76–0.84 in dark-adapted unstressed material, and is widely used as a quick general measure of ‘stress’ or (conversely) ‘viability’, and is so used here. The non-photochemical quenching parameter NPQ is largely a measure of photo-protection. The photochemical quenching parameter \( q_P \) is a measure of the oxidation state of the first electron acceptor QA of photosystem II; it is often used (as here) in the inverse form \( 1 – q_P \).

In the light, the effective quantum yield of photosystem II (FPSII) multiplied by the irradiance in quantum units (PPFD) provides a relative measure of the rate of electron transport through PSII, and hence of photosynthetic electron flow (RETR). This figure includes not only electron transport resulting in carbon fixation, but also photorespiration and flow to any other electron sinks. However, under most conditions the bulk of the electron flow will be to carbon fixation, so for many purposes RETR
provides a convenient non-invasive surrogate measure of photosynthetic performance; for comparisons of chlorophyll-fluorescence and gas-exchange data in bryophytes, see Marschall & Proctor (2004) and Proctor et al. (2007).

In general, the recovery of both $F_v/F_m$ and RWC were well fitted by logistic curves on a logarithmic timescale. For the RWC curves, and in those cases where $F_v/F_m$ for the dry material was substantially $>0.0$, a 4-parameter logistic curve was appropriate. This has a lower asymptote corresponding to the value of RWC or $F_v/F_m$ in dry material and an upper asymptote at the maximum (fully recovered) value of $F_v/F_m$. Where $F_v/F_m$ in dry material was $~0$ or unknown, a 3-parameter logistic starting at 0 was fitted. In either case, the IC-50 value (point of inflection) of the curve was taken as a measure of the time for ‘half-recovery’. The relation of RETR to irradiance is generally well fitted by negative-exponential curve of the form $y = (A - e^{-kx})$, where $y$ = RETR and $x$ = PPFD and $A$ and $k$ are constants, at least at low irradiances (<400 mmol m$^{-2}$ s$^{-1}$). Deviations may arise through electron flow to sinks other than photosynthetic carbon fixation (bryophytes often show non-saturating electron flow of this kind (Marschall & Proctor, 2004)), or through photoinhibition depressing electron flow at high irradiances. A useful test of goodness-of-fit of the exponential curve is that the product $Ak$ should approximate to the dark-adapted value of $F_v/F_m$ (c. 7.5–8.5). NPQ is generally well fitted by a logistic curve starting at 0. The parameter $1 - qP$ is also often well fitted by a logistic curve, but the fit is very sensitive to the top few data points, which can lead to misleading estimates of the upper asymptote and IC-50 value; suspect values have been omitted from Table 4.

Some comment may be made on measures of water content and water availability. The water content of desiccation-tolerant plants is often given as a percentage of dry weight. This is useful for comparisons within a population of a single species, but not for comparisons between different populations or different species because of differences in the proportion of cell-wall materials and cell contents. Water content relative to that at full turgor (RWC) is a much more widely useful measurement, and has been emphasised here. Relative humidity (RH) of the air is only useful if the temperature is known (in this paper c. 20°C), and its biological relevance is limited. Evaporation rates depend on saturation deficit, the difference between the absolute humidity of the air and the saturated absolute humidity at the same temperature (which can be looked up in tables); it is usually expressed in terms of partial pressure of water vapour (kPa). Water potential ($\Psi$) which defines the tendency for water to move from one place to another, is usually expressed in pressure units (MPa); for air, it can be calculated from relative humidity and temperature. For the physical and mathematical relations between these quantities see, e.g., Slatyer (1967), Nobel (1974), Jones (1992).

RESULTS

Table 1 lists some water-content data for the ferns investigated, expressed as a percentage of oven-dry weight, and as relative water content. Water content at full turgor on a dry-weight basis varies widely even within the same species; at full turgor RWC for all species is 1.0 by definition. A number of measurements were made on ‘air dry’ material. The figures in the table show clearly that ‘air dry’ can embrace a substantial range in actual water content measured as RWC; cold dry weather outdoors will tend to give low absolute (and relative) humidity indoors, and warm or humid weather the opposite. Fern material equilibrated in a desiccator at c. 74% RH had an RWC around 0.14–0.16; material equilibrated at 43% RH showed RWC mostly below
0.10. Of the air dried material, *Asplenium trichomanes* (1) and *Polypodium cambricum* (1) were probably dried to an equivalent of c.60–70% RH at 20 °C, and the other samples at c.30–40% RH.

*Three small saxicolous Asplenium species*

The recovery of relative water content and the fluorescence parameter $F_v/F_m$ on re-wetting after a few days’ desiccation in *Asplenium ruta-muraria* L. and *A. trichomanes* L. is shown in Figures 1a and 1b and Table 2. *A. trichomanes* that had been dried to 14% RWC recovered rather faster than material dried to a RWC of 7.5%; the half-recovery times of $F_v/F_m$ in the fitted curves of Figure 1b are respectively 1.7 and 3.9 hours, but the asymptotes of the two curves are not significantly different. A much rarer species than either of these in Britain, *A. septentrionale* L. was reported as highly desiccation tolerant by Kappen. Leaves collected from a population in North Wales in September 2005, were allowed to air dry. The chlorophyll fluorometer was not available from then until January 2006, by which time the leaves had been dry for four months. However, on re-wetting (12 Jan.) they recovered their normal fresh appearance and appeared fully turgid the following day. Ten leaves re-wetted after 3 days moist followed by 2 days air dry gave $F_v/F_m$ 0.754 ± 0.035 after 24 h rehydration (Figure 1c). Of these three *Asplenium* species, *A. ruta-muraria* showed the highest light-saturation level, followed by *A. septentrionale* with *A. trichomanes* the lowest; all three showed at least some indication of non-saturating electron flow at high irradiances (Figure 11a).

*Two further species of Asplenium*

*Asplenium adiantum-nigrum* L. sometimes accompanies the other small saxicolous *Asplenium* species in crevices of rocks and walls, but usually avoids the most sun-exposed and water-stressed situations. Leaves of this species from a mortared pebble wall facing the sea at Budleigh Salterton were promisingly firm textured, and looked possible candidates for desiccation tolerance. However, re-wetted after a few days’ desiccation at 43% RH they showed only slight temporary signs of recovery of $F_v/F_m$ for the first few hours, and by the following day it was clear they would not recover further (Table 2.)

Plants from another population, on a steep dry roadside bank near Kennford, Devon, behaved quite differently. Figure 2 shows the rapid and progressive loss of weight of leaf segments dried at 74% and 43% RH, with fitted exponential curves; the asymptotes approximated to the figures in Table 1; the leaves dried quickly, losing half their water within 6.2 h at 74% RH (−41 MPa) and 4.7 h at 43% RH (−114 MPa). The recovery of $F_v/F_m$ on re-wetting after the two desiccation regimes is shown in Figure 3. The data and the fitted curves suggest that intensity of drying has a marked effect, but neither the asymptotes nor the half-recovery times are significantly different, and the slope factor just fails to reach significance at the 5% level.

*Asplenium obovatum* Viv. dried rather more slowly than *A. adiantum- nigrum*; the half-drying times seen in Figure 4 are around 11 h at 74% RH and 9 h at 43% RH. Recovery of $F_v/F_m$ on re-wetting was both less complete and more variable than in the Kennford *A. adiantum-nigrum*. After drying at 74% RH, the dark green leaves of the previous season showed only a transient rise in $F_v/F_m$ on re-wetting; further recovery failed completely. However, in material dried at 43% RH, the older leaves recovered consistently and well. The bright green new-season’s leaves recovered well from drying at 74% RH, but very erratically from the 43% RH treatment (Figure 5).
Table 1. Water content of fern leaves at full turgor (as % oven-dry weight at 70°C), and ‘air dry’ and in equilibrium with air at 74% RH (c. –40 MPa at 20°C) and 43% RH (c. –114 MPa at 20°C) as % dry weight and as relative water content (RWC). The two sets of measurements on Asplenium trichomanes and Polypodium cambricum were both from Chudleigh, in Dec. 2000 and Jan. 2001 respectively. A. adiantum-nigrum (1) is from Budleigh Salterton; A. adiantum-nigrum (2) is from Kennford.

<table>
<thead>
<tr>
<th>Species</th>
<th>Full turgor %DW</th>
<th>Water content ‘air dry’</th>
<th>Water content at 74% RH (-41 MPa)</th>
<th>Water content at 43% RH (-114 MPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>%DW</td>
<td>RWC</td>
<td>%DW</td>
</tr>
<tr>
<td>Asplenium ruta-muraria</td>
<td>409 ± 16</td>
<td>20.9 ± 4.4</td>
<td>0.068 ± 0.013</td>
<td>-</td>
</tr>
<tr>
<td>A. trichomanes (1)</td>
<td>139 ± 4</td>
<td>19.3 ± 4.6</td>
<td>0.140 ± 0.037</td>
<td>-</td>
</tr>
<tr>
<td>A. trichomanes (2)</td>
<td>108 ± 11</td>
<td>7.9 ± 0.8</td>
<td>0.075 ± 0.014</td>
<td>-</td>
</tr>
<tr>
<td>A. adiantum-nigrum (1)</td>
<td>344 ± 36</td>
<td>29.6 ± 2.9</td>
<td>0.087 ± 0.017</td>
<td>-</td>
</tr>
<tr>
<td>A. adiantum-nigrum (2)</td>
<td>170 ± 22</td>
<td>-</td>
<td>-</td>
<td>26.1 ± 4.7</td>
</tr>
<tr>
<td>A. obovatum</td>
<td>279 ± 82</td>
<td>-</td>
<td>-</td>
<td>33.9 ± 9.2</td>
</tr>
<tr>
<td>A. ceterach</td>
<td>156 ± 34</td>
<td>9.4 ± 0.4</td>
<td>0.063 ± 0.018</td>
<td>-</td>
</tr>
<tr>
<td>Polypodium cambricum (1)</td>
<td>110 ± 16</td>
<td>18.6 ± 8.3</td>
<td>0.167 ± 0.056</td>
<td>-</td>
</tr>
<tr>
<td>Polypodium cambricum (2)</td>
<td>213 ± 10</td>
<td>-</td>
<td>-</td>
<td>33.2 ± 5.7</td>
</tr>
<tr>
<td>P. interjectum</td>
<td>306 ± 35</td>
<td>-</td>
<td>-</td>
<td>44.3 ± 13.7</td>
</tr>
</tbody>
</table>
The rusty-back fern, Asplenium ceterach
The curling of the dry leaves in *Asplenium ceterach* initially prevented measurement of $F_v/F_m$ in the early stages of rehydration, so the data in Figure 6 are from leaves dried under light pressure to keep them flat. The rise in $F_v/F_m$ was rather slower to get going in *A. ceterach*, but climbed more steeply once it had started. Light saturation was reached at around half noon summer sunlight, but showed some depression of electron flow at higher irradiances.

An experiment with *Polystichum aculeatum* (L.) Roth
Pinnae of *Polystichum aculeatum* dried rather quickly, giving half-drying times of 12.9 h at 74% RH and 8.4 h at 43% RH, reaching practical equilibrium with the atmosphere in the desiccator in the course of a week. The corresponding equilibrium water contents (asymptotes of the curves) were 0.109 and 0.069 RWC. Remoistened after 9 days, they showed small but erratic increases of $F_v/F_m$ for an hour or two, but these were not maintained and by the following day it was clear that all the pinnae were moribund.

The polypodies, *Polypodium cambricum* L. and *P. interjectum* Shivas
These two species were very tolerant of desiccation, and differ in important respects from the ferns just considered. They dried very much more slowly (Figure 7); the half-drying times for *P. interjectum* at 74% RH (–41 MPa) and 43% RH (–114 MPa) were respectively 2.33 days (56 h) and 1.4 days (34 h). These drying times are almost an order of magnitude longer than those seen in *Asplenium adiantum-nigrum*, around five times longer than in *A. obovatum*. As a consequence, the asymptotes of the exponential curves, 0.074 and 0.037 RWC respectively, are substantially below the figures in Table 1 from weighings after a week’s drying. Clearly these latter figures do not reflect equilibrium with the air.

The recovery curves of $F_v/F_m$ in Figures 8 and 9 thus start from relative water contents above equilibrium with the ambient air – but still well below levels at which normal metabolism is possible, or survivable by typical vascular-plant mesophyll tissues. The curves differ significantly only in the initial level of $F_v/F_m$. Little sign of recovery is apparent in the first hour after re-wetting, either in the physical appearance of the leaves (Figure 10) or in $F_v/F_m$, but after that recovery is rapid. The half-recovery times are around 2h, and in the same range as in the other species examined (Table 3).

Photosynthetic electron flow saturated at around 40% of noon summer sunlight, but was markedly depressed at high irradiances so that the effective saturation irradiance must be below the PPFD$_{95\%}$ figure in Table 4 (Figure 11b).

**DISCUSSION**

The results confirm that the leaves of some ferns are remarkably tolerant to desiccation, recovering well from drying for a week or more to a water content of 15–20% of their dry weight, and a tissue relative water content (RWC) of 4–7%. The mesophyll of typical vascular plants is generally damaged beyond recovery if RWC falls below about 30% (or a water potential below about –7 MPa), so these ferns are far more tolerant of desiccation than most drought-tolerant vascular plants (Larcher 1995). Their tolerance is comparable with such mosses as *Tortula (Syntrichia) ruralis* or *Racomitrium lanuginosum*. However it is also clear there are degrees of desiccation tolerance, and that tolerance may vary within species. Of our *Asplenium species*, *A. septentrionale* is
Figure 1. Recovery on remoistening of (a) $F_v/F_m$ and RWC in air-dry leaves of *Asplenium ruta-muraria*. Fitted logistic curves. Mean ± s.d., $n = 3$, (b) $F_v/F_m$ in two samples of air-dry leaves of *A. trichomanes* (sample (1) from 0.140 RWC, (2) from 0.075 RWC), and recovery of RWC for sample (1). Means ($n = 3$), error bars omitted for clarity (log scale), (c) $F_v/F_m$ in *A. septentrionale* after four months air dry, with fitted 4-parameter logistic curve. Mean ± s.d., $n = 6$. 
Table 2. $F_v/F_m$ at full turgor before desiccation and 24 h after rehydration.

<table>
<thead>
<tr>
<th>Species</th>
<th>$F_v/F_m$ at full turgor before desiccation</th>
<th>$F_v/F_m$ after 24 h rehydration</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>‘Air-dry’</td>
</tr>
<tr>
<td>Asplenium ruta-muraria</td>
<td>-</td>
<td>0.756 ± 0.035</td>
</tr>
<tr>
<td>A. trichomanes (1)</td>
<td>-</td>
<td>0.796 ± 0.020</td>
</tr>
<tr>
<td>A. trichomanes (2)</td>
<td>-</td>
<td>0.707 ± 0.059</td>
</tr>
<tr>
<td>A. adiantum-nigrum (1)</td>
<td>-</td>
<td>0.075 ± 0.059</td>
</tr>
<tr>
<td>A. adiantum-nigrum (2)</td>
<td>0.785 ± 0.037</td>
<td>-</td>
</tr>
<tr>
<td>A. obovatum</td>
<td>0.800 ± 0.017</td>
<td>-</td>
</tr>
<tr>
<td>A. ceterach</td>
<td>0.816 ± 0.018</td>
<td>-</td>
</tr>
<tr>
<td>Polypodium cambricum (1)</td>
<td>-</td>
<td>0.703 ± 0.109</td>
</tr>
<tr>
<td>Polypodium cambricum (2)</td>
<td>0.868 ± 0.012</td>
<td>-</td>
</tr>
<tr>
<td>P. interjectum</td>
<td>0.821 ± 0.017</td>
<td>-</td>
</tr>
</tbody>
</table>
**PROCTOR: DESICCATION TOLERANCE IN SOME BRITISH FERNS**

Figure 2. Drying data for leaves of *Asplenium adiantum-nigrum* in desiccators at ~74% and 43% RH (−41 and −114 MPa); the fitted exponential curves give half-drying times of respectively 6.2 h and 4.7 h. Means ± s.d., *n* = 6.

Figure 3. Recovery of *F₀/Fₘ* on re-wetting leaves of *Asplenium adiantum-nigrum* after 6 days drying at 74% RH (−41 MPa; circles and full line) and 43% RH (−114 MPa; triangles and broken line; error bars omitted for clarity), with fitted 4-parameter logistic curves. Means ± s.d., *n* = 6.
probably the most tolerant, followed by *A. ruta-muraria* and *A. trichomanes*. In *A. adiantum-nigrum* it appears that some populations are tolerant, but others are not, or perhaps that tolerance varies with season, as Kappen found. *A. obovatum* seems (from one sample) to be less tolerant than *A. adiantum-nigrum*, and to show some differences between young and old leaves. Two leaves of *A. marinum* L. from near Kynance Cove, Cornwall in early June 2001 did not recover after drying, but this species should be tested from more sites. Kappen (1964) found the leaves of summer-green ferns such as *Dryopteris filix-mas* are similar to flowering plant leaves in their sensitivity to drying, with little variation through the season. Species which remained green through the winter were in general more tolerant in the winter and spring months, but the limiting leaf saturation-deficit given by Kappen for *Polystichum lobatum* (*aculeatum*) is little different from his corresponding figure for *Dryopteris filix-mas*. The experiment reported here gave no indication of desiccation tolerance in *P. aculeatum*. A high degree of desiccation tolerance is seen in *Polypodium cambricum* and *P. interjectum*; the ‘*Polypodium vulgare*’ that Kappen found the most desiccation tolerant of all his ferns was probably *P. vulgare* L. sensu stricto.

The *Asplenium* species dried quickly, with a half-drying time of a few hours, and there is clearly little stomatal control over water loss; six leaves of *A. ceterach* gave half-drying times ranging from 2.5 to 9.0 h (depending on size), with a mean of 4.8 ± 2.3 h. Drying of *Polystichum aculeatum* was only a little slower. The *Polypodium* species dried much more slowly, with half-drying times in *P. interjectum* of a day or two, suggesting that the stomata close under water stress. This may be related to the habitats of the plants. The *Asplenium* species primarily occupy open, brightly lit and often sunny rock-crevice habitats. In bright sunshine in summer, a small *Asplenium* is sitting immovably in the steep temperature gradient close to the ground surface. In this situation a turgid, actively metabolising plant needs the cooling effect of transpiration to keep its leaves from reaching lethal temperatures (c.45–50°C), and leaves of these small ferns are correspondingly dependent on a constant supply of water from the root system to maintain turgor. Once air dry, desiccation-tolerant plants can withstand much higher temperatures. Plants tall and open enough for the air to circulate freely around their leaves do not face this overheating hazard, and *Polypodium* leaves, held free of the substratum on flexible petioles would be expected to be more closely coupled to the temperature of the air. Perhaps *Asplenium ceterach*, with its dry leaves curved away from the substratum and protected by their thick scaly covering, comes somewhere between *A. ruta-muraria* and *Polypodium cambricum* in this respect. In their photosynthetic responses, the small *Asplenium* species have something in common the desiccation-tolerant mosses in the same habitats. In this they differ from *A. ceterach* and *P. cambricum*, but these latter two are still not, photosynthetically, unequivocal sun plants.

The ferns rooted in rock crevices can probably all draw on substantial reserves of water at depth, which dry up only in hot dry spells in summer. *Polypodium* is probably drawing mainly on a more superficial reserve of water, which both dries up and is replenished more frequently, and this must underlie its success as an epiphyte (Zotz & Hietz, 2001). Recovery took place at similar rates in all the ferns examined, with half-recovery times around 2–4 hours, in contrast to the wide range of recovery rates in bryophytes (Table 3).

These desiccation-tolerant ferns are interesting in an ecological and evolutionary context. Proctor & Tuba (2002) postulated two strategies for plant life on land,
Figure 4. The course of RWC during drying and re-wetting with (a) desiccation at 74% RH (−41 MPa) and (b) at 43% RH (−114 MPa). Note in (a) the lower final RWC and less complete recovery of new leaves, and lack of significant difference between old and new growth in (b); half-drying times in (a) are about 11 h, and in (b) about 9 h.
Figure 5. The course of $F_v/F_m$ over the duration of the experiment. Note more rapid decline in $F_v/F_m$ in the new growth, parallelling its faster drying, and the varied recovery of old and new growth following the two desiccation treatments.

Figure 6. Recovery of $F_v/F_m$ and RWC (from different samples) in Asplenium ceterach. (data set (2) of Table 3) Mean ± s.d., $n = 2$ ($F_v/F_m$), $n = 3$ (RWC). Fitted 4-parameter logistic curves. Note the very wide error bars in the lower part of the curve, reflecting the variation between replicates in the ‘latent’ time before recovery of $F_v/F_m$ begins.
Figure 7. Drying data for RWC in *Polypodium interjectum* at 74 and 43% RH (–41 and –114 MPa), with fitted exponential curves.

Figure 8. Recovery of $F_{v}/F_{m}$ following re-wetting of *Polypodium cambricum* after 8 days’ drying at 74% and 43% RH (–41 and –114 MPa). The only significant difference in the parameters of the fitted curves is in their lower limit.
Figure 9. Recovery of $F_{v}/F_{m}$ following re-wetting of Polypodium interjectum after 8 days’ drying at 74% and 43% RH (−41 and −114 MPa). As in P. cambricum, the only significant difference between the fitted curves is in their lower limit.

Figure 10. The 74% RH recovery curve of Figure 10 annotated with the appearance of the leaves at intervals during re-wetting; the comments relate to the successive data points. The mean value of $F_{v}/F_{m}$ in dry leaves is arbitrarily plotted at 0.01 h.
Figure 11. Light response of photosynthetic electron flow in (a) *Asplenium trichomanes*, showing (very variable) non-saturating electron flow at high irradiance, and (b) *Polypodium cambricum*, showing (consistent) depression of electron flow at high irradiance.
Table 3. Parameters of logistic curves fitted to $F_v/F_m$ recovery data; fitted values ± standard errors. Upper and lower asymptotes are given for 4-parameter curves; logistic curves starting from zero have only an upper asymptote, estimating fully-recovered $F_v/F_m$. The figures for *A. ceterach* are from Spring 2008 data.

<table>
<thead>
<tr>
<th>Species</th>
<th>Half-recovery (IC-50) /h</th>
<th>Rate (slope) parameter</th>
<th>Upper and lower asymptotes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Upper limit</td>
</tr>
<tr>
<td><em>Asplenium ruta-muraria</em></td>
<td>3.05 ± 0.48</td>
<td>-1.34 ± 0.28</td>
<td>0.79 ± 0.10</td>
</tr>
<tr>
<td><em>A. trichomanes</em> (1)</td>
<td>1.73 ± 0.27</td>
<td>-0.86 ± 0.11</td>
<td>0.88 ± 0.04</td>
</tr>
<tr>
<td><em>A. trichomanes</em> (2)</td>
<td>3.90 ± 0.22</td>
<td>-0.81 ± 0.03</td>
<td>0.87 ± 0.0.02</td>
</tr>
<tr>
<td><em>A. septentroniale</em></td>
<td>1.64 ± 0.08</td>
<td>-1.11 ± 0.06</td>
<td>0.75 ± 0.02</td>
</tr>
<tr>
<td><em>A. adiantum-nigrum</em> (2) [-41 MPa]</td>
<td>2.11 ± 0.20</td>
<td>-1.12 ± 0.11</td>
<td>0.79 ± 0.02</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td><em>A. adiantum-nigrum</em> (2) [-114 MPa]</td>
<td>4.46 ± 3.42</td>
<td>-0.68 ± 0.20</td>
<td>0.86 ± 0.17</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td><em>A. ceterach</em> (1)</td>
<td>3.59 ± 0.27</td>
<td>-1.97 ± 0.27</td>
<td>0.94 ± 0.16</td>
</tr>
<tr>
<td><em>A. ceterach</em> (2)</td>
<td>5.80 ± 0.33</td>
<td>-3.07 ± 0.44</td>
<td>0.75 ± 0.05</td>
</tr>
<tr>
<td><em>Polypodium cambricum</em> (-41 MPa)</td>
<td>2.92 ± 0.20</td>
<td>-3.68 ± 0.55</td>
<td>0.84 ± 0.02</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.48 ± 0.01</td>
</tr>
<tr>
<td><em>Polypodium cambricum</em> (-114 MPa)</td>
<td>2.45 ± 0.27</td>
<td>-1.09 ± 0.13</td>
<td>0.85 ± 0.05</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.04 ± 0.03</td>
</tr>
<tr>
<td><em>P. interjectum</em> (-41 MPa)</td>
<td>2.03 ± 0.18</td>
<td>-2.43 ± 0.43</td>
<td>0.81 ± 0.05</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.18 ± 0.02</td>
</tr>
<tr>
<td><em>P. interjectum</em> (-114 MPa)</td>
<td>1.87 ± 0.43</td>
<td>-1.51 ± 0.50</td>
<td>0.80 ± 0.11</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.02 ± 0.05</td>
</tr>
</tbody>
</table>
Table 4. Light-response parameters of some desiccation tolerant ferns. The 95% saturation values (mean ± SD) are calculated from negative-exponential curves fitted to the data-points for irradiances below 400 mmol m\(^{-2}\) s\(^{-1}\); all the species give a good fit to this part of the curve. At higher irradiances, *Asplenium ruta-muraria*, *A. trichomanes* and *A. septentrionale* all show the non-saturating electron flow commonly observed in desiccation-tolerant bryophytes (Marschall & Proctor, 2004). Most of the other species show at least some depression of photosynthetic electron flow at high irradiance, so that *Asplenium ceterach* and *Polypodium cambricum* may in practice seldom reach the ‘95% saturation’ values given above. All species show high NPQ values by typical vascular-plant standards. Parameters have been given for 1-\(q_P\) only when the logistic curves gave a sufficiently satisfactory fit to the data; the fit of the curves is very sensitive to error in the highest few data points.

<table>
<thead>
<tr>
<th>Species and comments</th>
<th>PPFD(_{95%}) /(\mu)mol m(^{-2}) s(^{-1})</th>
<th>NPQ</th>
<th>1 - (q_P)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>y-range</td>
<td>IC-50</td>
</tr>
<tr>
<td><em>Asplenium ruta-muraria</em>, Chudleigh, Dec 2000</td>
<td>821 ± 40</td>
<td>10.68</td>
<td>511</td>
</tr>
<tr>
<td><em>Asplenium ruta-muraria</em>, Chudleigh, Jan 2001</td>
<td>772 ± 192</td>
<td>10.91</td>
<td>1077</td>
</tr>
<tr>
<td><em>Asplenium septentrionale</em>, Trefriw, Sep 2004</td>
<td>566 ± 82</td>
<td>7.91</td>
<td>1813</td>
</tr>
<tr>
<td><em>Asplenium trichomanes</em>, Chudleigh, Dec 2000</td>
<td>405 ± 41</td>
<td>7.91</td>
<td>487</td>
</tr>
<tr>
<td><em>Asplenium adiantum-nigrum</em>, Budleigh Salterton, Jan 2001</td>
<td>524 ± 301</td>
<td>5.56</td>
<td>368</td>
</tr>
<tr>
<td><em>Asplenium obovatum</em>, Gammon Head, (last season’s growth)</td>
<td>421 ± 81</td>
<td>4.99</td>
<td>295</td>
</tr>
<tr>
<td><em>Asplenium obovatum</em>, Gammon Head (new-season’s leaves)</td>
<td>550 ± 91</td>
<td>6.12</td>
<td>440</td>
</tr>
<tr>
<td><em>Asplenium ceterach</em>, Chudleigh, Jan 2001 (last season’s growth)</td>
<td>1142 ± 104</td>
<td>7.85</td>
<td>772</td>
</tr>
<tr>
<td><em>Asplenium ceterach</em>, Chudleigh, Jan 2001 (new-season’s leaves)</td>
<td>834 ± 84</td>
<td>8.33</td>
<td>644</td>
</tr>
<tr>
<td><em>Polypodium cambricum</em>, Chudleigh, Jan 2001</td>
<td>772 ± 215</td>
<td>5.43</td>
<td>400</td>
</tr>
</tbody>
</table>
exemplified by the homoiohydric mainstream vascular plants on the one hand, and the poikilohydric, desiccation-tolerant bryophytes on the other. Alongside the contrast between homoiohydry and poikilohydro there is another contrast, between endohydry and ectohydry. In vascular plants the physiologically important free water is in the xylem; they are endohydric, and the plant body is isolated from its surroundings by a waterproof and water-repellent epidermis. In most bryophytes, the physiologically important water is in capillary spaces outside the plant; they are ectohydric. The desiccation tolerant fern sporophytes considered in this paper withstand drying (and are to that extent poikilohydric), but are endohydric. This is also true of most other vascular ‘resurrection plants’. All of these plants function as normal vascular plants when water is freely available, but they have added to their repertoire of responses the fall-back option of desiccation tolerance (already inherent in their spores) when the water supply fails. We are in a region of ecological niche-space where several adaptive strategies converge, and none is optimal. Desiccation-tolerant ferns share their habitat with fully poikilohydric (and ectohydric) mosses and liverworts, with small succulents, and (seasonally) with winter annuals. Fern gametophytes, on the other hand are unequivocally poikilohydric and ectohydric, and take their place alongside bryophytes in a diversity of habitats where some of them are as desiccation tolerant as their bryophyte neighbours (Watkins et al., 2007).

REFERENCES


INSTRUCTIONS FOR AUTHORS

PAPERS should not usually exceed 20 printed pages and are generally expected to be considerably shorter. Review articles, as well as reports of original research, are encouraged. Short notes are acceptable e.g. new records. The senior author should supply a fax and email address to facilitate correspondence.

MANUSCRIPTS should be submitted in English (British) in electronic format (preferably) or hard copy (two copies), in 10-point Times New Roman font and double spaced. Electronic versions of text and tables should be compatible with WORD, with figures as pdf or jpg files, and sent as email attachments or CDroms. All manuscripts will be refereed.

THE TITLE should reflect the content of the paper and be in BOLD CAPITALS (11-point) and centrally aligned. Generic and specific names should be in italics and any title containing a generic or specific name must be followed by the family and Pteridophyta in brackets e.g.

TRICHOMANES SPECIOSUM (HYMENOPHYLLACEAE: PTERIDOPHYTA) IN SOUTHERN SPAIN


MAIN HEADINGS: should be in BOLD CAPITALS (10-point) and centrally aligned.

SUBSIDIARY HEADINGS: should be in bold, the first letter of each word in capitals, the rest in lower case and left-aligned.

AUTHORS' NAMES AND FULL ADDRESSES: follow the title and are centrally aligned.

KEY WORDS: up to ten.

ABSTRACT: should reflect the content of the paper.

FIGURES: there is no distinction between photographs and line drawings in numbering. All should be presented in a form ready for reproduction, ideally in JPG format (please contact editor with queries), with a scale bar where appropriate. Lettering or numbers (Arabic) should be in the bottom left using uppercase Times Roman and be sufficiently large to be legible if reduction is necessary during printing. The number of photographs allowed in any one issue is limited by cost. Figure captions should be on a separate sheet.

TABLES: can be printed in either portrait or landscape format. Authors should consider this when preparing tables. Authors should ensure that tables fit the printed page size in a legible form.

MEASUREMENTS: should follow the metric system.

CHECKLISTS: should follow the format of Baksh-Comeau, Fern Gaz. 16(1, 2): 11-122.

REFERENCES: should follow the style of a recent issue of The Fern Gazette, e.g.:-


JOURNAL ABBREVIATIONS: should follow Botanico Periodicum Huntianum & Supplements.

Alterations from the original text at proof stage will be charged for unless they are minor points of detail. Twenty-five offprints will be supplied free to the senior author.
LECTOTYPIFICATION OF *DRYOPTERIS PSEUDOMAS* BASED ON
WOLLASTON'S SPECIMEN OF *D. AFFINIS*

C.R. FRASER-JENKINS

Student Guest House, Thamel, P.O. Box 5555, Kathmandu, Nepal.
e-mail: chrisophilus@yahoo.co.uk

ABSTRACT

*Dryopteris pseudomas* (Woll.) Holub & Pouzar is lectotypified from Wollaston's specimen of *D. affinis* (Lowe) Fras.-Jenk. at MANCH, which maintains the stability of the nomenclature of the group.

INTRODUCTION

*Dryopteris pseudomas* (Woll.) Holub & Pouzar was raised by Holub to provide a name for the European *D. affinis* (Lowe) Fras.-Jenk. group, *sens. lat.*, and following the subdivision of the group as a critical complex, was subsequently applied by him to what is now called *D. borreri* Newm. However Wollaston also intended his name to apply to what is now the whole *D. affinis* aggregate and had no intention to confine it to *D. borreri*. His description emphasised the scaly, truncate-pinnuled, glossy nature of the plant and would obviously be most aptly applied to what is now *D. affinis*. But in fact his original specimen, marked by him as type, contains both species, so could be lectotypified in either sense. However the most obvious and characteristic morphology, as emphasised in Wollaston's description, is that of the larger, left hand and main specimen on the sheet, which is a specimen of *D. affinis*, and is therefore selected here as lectotype. The small right-hand specimen is a compact and scaly *D. borreri*.

LECTOTYPIFICATION


**Lectotype** of *L. pseudomas*, designated here: Britain, England: "*Lastrea pseu-do-mas* (Wol.) Type. Geo. B. Wollaston [G.B. Wollaston scripsit]. Nat. order 93, no 1793 C. *Lastrea filix-mas* (Presl) var. *paleacea* (Moore). Loc.-, Coll. George B. Wollaston, Date July 1884. Herbarium Walter W. Reeves [printed label of Reeves]. Herbarium Manchester Museum. [With lectotype labels from H.V. Corley in 1972 [ined. ] and C.R. Fraser-Jenkins in 1979 and 1981]." (MANCH!). Left hand specimen only, which fits Wollaston's protologue descriptions (Wollaston 1855 and see also 1863 and 1915 and Wollaston's description in Moore 1855) much better than does *D. borreri*. The date of July 1884 is almost certainly, and is presumed here to be the date of acquisition by Reeves, filled in by him on his herbarium label, printed with the categories, 'Loc.', 'Date' etc., rather than the date of actual collection by Wollaston, whose own label suggests that this is original (pre 1855) material and can therefore be chosen as lectotype rather than neotype. Other Reeves specimens in MANCH collected by him (sometimes with others) have a full date (including day) and locality given, unlike the present one, and another specimen from Wollaston of *D. oreades*, labelled var. *abbreviatum*, likewise has the same date of July 1884 and no locality. Manchester is where Wollaston's herbarium was sent (via Reeves) and there exists no other pre 1855 Wollaston material labelled as
representing *L. pseudo-mas* at MANCH or at KEW (in Moore's herbarium and the general herbarium), nor at BM, E, CGE or OXF, but at Paris there are two sheets (Herb. C.W.W. Hope 29 Jan. 1914) of *D. affinis borreri*, labelled as cultivated by P. Neill Fraser from plants sent to him by Wollaston as typical (P!). These specimens (along with his citing var. *paleacea* Moore [*sensu* Moore, *pro parte* = *D. affinis*] and var. *borreri* Newm. in his protologue) help to indicate that Wollaston's concept of *Lastrea pseudomas* was mixed and, as might be expected, he did not distinguish between what are now the constituent species of the aggregate, but referred to the more typical or characteristic "*D. affinis*-like" plants, more-or-less regardless of the modern species in the group. This further supports the suitability of the above lectotype of *D. affinis* as representing the "more characteristic" species.

**CONCLUSION**

Lectotypification in the present and most obvious sense has the effect of stabilising the current nomenclature of the group (see Fraser-Jenkins 2007) regarding the widely used name *D. borreri*, which might otherwise have been replaced by *D. pseudomas* had that been lectotypified from the other specimen on Wollaston's sheet. Although Fraser-Jenkins (1980) mentioned that *L. pseudomas* was illegitimate, he was merely misusing the term at that time to mean a synonym and has not subsequently thought of it as being illegitimate. In the same paper, when placing *D. pseudomas* in the synonymy of *D. affinis* subsp. *borreri* (Newm.) Fras.-Jenk., he had not then fully investigated the identity of many names applied to the group, as he did subsequently in his detailed unpublished monograph of the *D. affinis* group (copy at BM). The present lectotypification helps clarify the views expressed by Ekrt et al. (2009), where it is suggested that *D. pseudomas* might apply to *D. borreri*.

**ACKNOWLEDGEMENTS**

I am grateful for the helpful discussion and kind acknowledgment from Dr. Libor Ekrt, University of South Bohemia, České Budějovice, Czech Republic.

**REFERENCES**


AN ANNOTATED CHECKLIST OF FERNS AND LYCOPHYTES
FROM THE BIOLOGICAL RESERVE OF UATUMÃ, AN AREA WITH
PATCHES OF RICH-SOILS IN CENTRAL AMAZONIA, BRAZIL

G. ZUQUIM1,2, J. PRADO3 & F.R.C. COSTA1
1 Instituto Nacional de Pesquisas da Amazônia, Coordenação de Pesquisas em
Ecologia, C.P. 478, CEP 69083-000, Manaus, AM, Brazil.
2 Author for correspondence: gabizuquim@gmail.com
3 Instituto de Botânica, Seção de Curadoria do Herbário, C.P. 3005, CEP 01061-970,
São Paulo, SP, Brazil.

Key words: Amazonia, Brazil, diversity, edaphic factor, floristic survey, pteridophytes,
rainforest
Palavras-chave: Amazônia, Brasil, diversidade, levantamento florístico, pteridófitas

ABSTRACT
There are few inventories of ferns and lycophytes of the Brazilian Amazon and
most of them were made in areas of poor soils. The general species richness
found in previous studies is low. This study presents an annotated list containing
122 species and three varieties of ferns and lycophytes from Biological Reserve
of Uatumã, a large reserve that includes small patches of rich soils in Central
Amazonia. The study site is located ca. 200 km north of Manaus, AM, Brazil.
Inventories were made more intensively inside a grid system of trails of 5 x 5
km and less intensively in some white-sand forests and waterfalls in the
surroundings of Balbina’s Village. Reference to the original description, habit,
habitat, material examined, geographic distribution and voucher information are
presented for each taxon. This is the first floristic survey of ferns and lycophytes
from areas with relatively rich soils of Central Amazonia. The high number of
species found challenges the concept that Central Amazonia is species-poor for
the two groups studied and the strong relationship with soil conditions reinforces
the proposal to include ferns and lycophytes as indicator groups of the
distribution of biodiversity in the region.

RESUMO
Poucos são os inventários de samambaias e licófitas feitos na Amazônia
brasileira e a maioria destes foram feitos em áreas cujos solos são pobres em
nutrientes. Não obstante, a riqueza de espécies encontrada em estudos prévios
foi baixa. Neste estudo é apresentada uma lista anotada de 122 espécies e três
variedades de samambaias e licófitas da Reserva Biológica do Uatumã, uma
reserva grande em extensão e com pequenas manchas de solo rico na Amazônia
Central. O estudo foi realizado a cerca de 200 km ao norte de Manaus, AM,
Brasil. Os inventários foram mais intensos dentro de uma grade de trilhas de 5 x
5 km e com menor intensidade em áreas de campinas e campinaranhas e em
cachoeiras nos arredores da Vila de Balbina. Para cada táxon são apresentadas
informações acerca do local da publicação original, hábito, habitat, material
examinado, distribuição geográfica e voucher. Este é o primeiro estudo sobre
samambaias e licófitas em áreas com solos relativamente ricos na Amazônia
Central. A alta riqueza de espécies encontrada afeta a idéia geral de que a Amazônia Central é pobre em espécies destes dois grupos e a forte relação entre as espécies e as condições do solo reforça a sugestão de se incluir samambaias e licófitas como grupos indicadores da distribuição da biodiversidade.

INTRODUCTION

Central Amazonian soils are generally deep, highly lixiviated and nutrient-poor (Chauvel et al., 1987, Laurence, 2001, Mertens, 2004), and this may be the reason for the low species richness of ferns and lycophytes (39 to 83 species per site) reported in many inventories in this region (Costa et al., 1999, Costa et al., 2005, Zuquim et al., 2007). The same pattern is probably true for the Rio Negro Basin, which is mainly covered by poor sandy soils (Freitas & Prado, 2005). In Western Amazon, Tuomisto et al. (2002) sampled relatively richer-soil areas and found 140 species in a 20 x 25 km study site in Ecuador.

To contribute to the knowledge of the Brazilian Amazonian flora, we present here an annotated checklist of the species of ferns and lycophytes found in the Biological Reserve of Uatumã. Our evidence suggests that the low species richness in Central Amazonia sampled until now (as compared with other Neotropical forests) may be due to low sampling effort from the infrequent patches of rich soils that are difficult to access.

MATERIALS AND METHODS

Study area - the study was conducted at the Biological Reserve of Uatumã (Rebio Uatumã) and surroundings of Balbina’s Village, about 200 km to the North of the city of Manaus, AM, Brazil (Fig. 1). It is located in the municipalities of Presidente Figueiredo, São Sebastião do Uatumã, and Urucará. The Reserve was created in 1990 and it is the largest Biological Reserve in Brazil.

The reserve comprises a mosaic of white-sand shrublands (campinas), white-sand forests (campinaranas), and dense Terra Firme forests. The gradient of soils is broad and varies from very poor and coarse sandy soils to rich clayey soils. We have considered as rich soils those with more than 3 cmol/kg of exchangeable bases[(Research Program in Biodiversity (PPBio) - unpublished data] since this concentration represents around three times the amount found in the soils of the most studied areas in Central Amazonia (see Laurance 2001 - DBFFP Reserves, and Mertens 2004 - Reserva Ducke).

Inventory of ferns and lycophytes

Field work was carried out from July 2006 to February 2008. In 2006, the Research Program in Biodiversity (hereafter PPBio – the Portuguese acronym) with the support of the Chico Mendes Institute of Biodiversity Conservation installed a 5 x 5 km grid system of trails in the southernmost part of Rebio Uatumã (Fig. 1). Sampling effort was more intense in the trail system, and special attention was given to the streams crossing the trails. The trail system encompasses only 25 km² of the 5,600,000 km² of the limits of the reserve. The grid comprises non-inundated Tropical Dense Forest (also called Terra Firme forests) and is crossed by many streams. To cover the variety of environments found in the region, one waterfall and a surrounding campinarana area close to the village of Balbina were visited. These two habitats occur in the landscape but were not included within the grid system.
Figure 1. Location of the study site. Black patches represent water and gray scale patches represent vegetation. Solid lines are the limits of the Biological Reserve of Uatumã, AM, Brazil. The white square shows the area intensively sampled.
Presentation of the checklist

The list is arranged in alphabetic order by families, genera, species, and varieties. The arrangement of families and genera follows Smith et al. (2006). For each species and variety the full name of the taxon is given, followed by the reference of original publication, as well as additional information such as: habit, habitat, material examined, and geographic distribution. Voucher information for each species and variety is also cited. Author abbreviations follow Pichi-Sermolli (1996).

RESULTS

One hundred and twenty two species and three varieties of pteridophytes distributed in 21 families were found. The richest families were Pteridaceae (with 22 species.), Polypodiaceae (18 spp.), and Dryopteridaceae (16 spp.). The most diverse genera were Adiantum (with 13 species) and Trichomanes (12 spp.). Near 35 % of the species are epiphytes, but these were probably underestimated due to the difficulty to access the canopy. Four species (Blechnum serrulatum, Gleichenella pectinata, Dicranopteris flexuosa, and Palhinhaea cernua) were found only in disturbed areas along road margins. Actinostachys pennula, Adiantum cinnamomeum, Lindsaea tetraperta, L. schomburgkii, Elaphoglossum plumosum, Thelypteris arborescens, Trichomanes bicorne, and T. martiusii were collected exclusively in white-sand forests (campinaranas). A population of around 50 individuals of Hemionitis rufa was found in a conspicuous rocky patch of ca. 100 m² covered by open vegetation (mainly grasses and ground bromeliads). Apparently, H. rufa is strongly related to this kind of habitat in Amazonia, but more observations are needed. The other species were distributed over habitats ranging from stream valleys to hillsides, plateaus, rocky soils and tree-fall gaps in the Terra Firme forests. Images of almost all species can be accessed by downloading the “Guide to the ferns and lycophytes of REBIO Uatumã – Central Amazonia” at http://ppbio.inpa.gov.br/Port/guias/. Two species (Schizaea elegans and Gleichenella pectinata) were accidentally not collected but are common in the region and are easy to recognise. Both were recorded in photographs.

LIST OF SPECIES

ASPLENIACEAE

Asplenium auritum Sw., J. Bot. (Schrader) 1800(2): 52. 1801.
Habit/Habitat: herb, epiphytic (canopy), Terra Firme forests.
Studied specimen(s): Zuquim & Junqueira 296 (INPA).
Distribution: S Mexico, Antilles, Mesoamerica, N South America.

Habit/Habitat: herb, epiphytic (base of trunks and rocks), Terra Firme forest over rich soils.
Studied specimen(s): Tuomisto & Prado 15699 (INPA, SP, TUR).
Distribution: Mexico, Antilles, Mesoamerica, and tropical South America.

Asplenium cristatum Lam., Encyc. 2(1): 310. 1786.
Habit/Habitat: herb, epiphytic (base of trunks and rocks), Terra Firme forests.
Studied specimen(s): Zuquim 241 (INPA).
Distribution: Antilles, Mesoamerica, and tropical South America.
**Asplenium laetum** Sw., Syn. Fil.: 79, 271. 1806.
Habit/Habitat: herb, terrestrial or rupiculous, in Terra Firme forests, near streams.
Studied specimen(s): Zuquim & Figueiredo 97 (INPA); 107 (INPA); Zuquim & Braga-Neto 138 (INPA); Zuquim & Jakovac 228 (INPA).
Distribution: Mexico, Antilles, Mesoamerica, and tropical South America.

Habit/Habitat: herb, terrestrial, rupiculous or epiphytic, in Terra Firme forests over rich soils.
Studied specimen(s): Zuquim & Braga-Neto 185 (INPA); Zuquim 232 (INPA).
Distribution: N South America.

**Asplenium salicifolium** L., Sp. Pl. 2: 1080. 1753.
Habit/Habitat: herb, epiphytic (canopy), Terra Firme forests.
Studied specimen(s): Zuquim & Junqueira 297 (INPA).
Distribution: S Mexico, Antilles, Mesoamerica, and tropical South America.

**Asplenium serratum** L., Sp. Pl. 2: 1079. 1753.
Habit/Habitat: herb, epiphytic, in Terra Firme forests.
Studied specimen(s): Zuquim & Figueiredo 105 (INPA); 106 (INPA); Zuquim & Costa 252 (INPA).
Distribution: S Florida, Mexico, Antilles, Mesoamerica, tropical and subtropical South America.

**Asplenium stuebelianum** Hieron., Hedwigia 47: 222. 1908.
Habit/Habitat: herb, terrestrial or epiphytic, in Terra Firme forests over rich soils*.
Studied specimen(s): Tuomisto & Zuquim 15609 (INPA, SP, TUR).
Distribution: Tropical South America.

* Prado & Moran (2009) report it in open forest with bamboo in Acre State.

**BLECHNACEAE**

Habit/Habitat: herb, terrestrial, in disturbed and loamy open areas.
Studied specimen(s): Prado & Zuquim 1872 (INPA, SP, TUR).
Distribution: S. Florida, Mesoamerica, Antilles, tropical South America. Also occurs in Malasia and Australia.

**Salpichlaena volubilis** (Kaulf.) J. Sm., J. Bot. (Hooker) 4: 168. 1841.
Habit/Habitat: herb, terrestrial, climber, in plateaus or slopes of Terra Firme forests.
Studied specimen(s): Zuquim & Figueiredo 103 (INPA); Zuquim & Junqueira 325 (INPA).
Distribution: Antilles, Mesoamerica, and tropical South America.

**CYATHEACEAE**

**Cyathea** sp.
Habit/Habitat: tree-fern, terrestrial, in Terra Firme forests.
Studied specimen(s): Tuomisto & Zuquim 15618 (INPA, SP, TUR).
**Cyathea lasiosora** (Kuhn) Domin, Pteridophyta: 262. 1929.
Habit/Habitat: tree-fern, terrestrial, in Terra Firme forests near streams.
Studied specimen(s): Zuquim & Braga-Neto 386 (INPA).
Distribution: N South America.

**Cyathea microdonta** (Desv.) Domin, Pteridophyta: 263. 1929.
Habit/Habitat: tree-fern, terrestrial, in Terra Firme forests near streams.
Studied specimen(s): Zuquim & Junqueira 323 (INPA).
Distribution: S Mexico, Antilles, Mesoamerica, and N South America.

**Cyathea pungens** Domin, Sp. Pl. 5: 206. 1810.
Habit/Habitat: tree-fern, terrestrial, in Terra Firme forests near streams.
Studied specimen(s): Zuquim & Jakovac 197 (INPA); Zuquim & Jakovac 216 (INPA).
Distribution: Antilles and N South America.

**DENNSTAEDTIAEACEAE**

**Dennstaedtia** sp.
Habit/Habitat: herb, terrestrial, in Terra Firme forests, near streams.
Studied specimen(s): Zuquim & Braga-Neto 172 (INPA).

**DRYOPTERIDACEAE**

**Bolbitis lindigii** (Mett.) Ching, Index Filic., Suppl. 3: 48. 1934.
Habit/Habitat: herb, hemi-epiphytic, in Terra Firme forests.
Studied specimen(s): Zuquim & Vieira 444 (INPA).
Distribution: Mesoamerica and N South America.

Habit/Habitat: herb, terrestrial and rupiculous or hemi-epiphytic, in Terra Firme forests.
Studied specimen(s): Zuquim & Figueiredo 113 (INPA); Zuquim & Braga-Neto 186 (INPA); Zuquim & Costa 286 (INPA).
Distribution: Antilles, Mesoamerica, and N South America.

Habit/Habitat: herbs, terrestrial and rupiculous, in Terra Firme forests over rich soils.
Studied specimen(s): Zuquim & Figueiredo 94 (INPA); Zuquim & Jakovac 217 (INPA); Zuquim 240 (INPA).
Distribution: Lesser Antilles and N South America.

Habit/Habitat: herb, terrestrial and rupiculous, in Terra Firme forests over rich soils.
Studied specimen(s): Zuquim & Junqueira 329 (INPA).
Distribution: S Mexico, Mesoamerica, and tropical South America.

**Ctenitis refulgens** (Klotzsch ex Mett.) Vareschi, Fl. Venezuela 1: 404. 1969.
Habit/Habitat: herb, terrestrial and rupiculous, in Terra Firme forests near streams.
Studied specimen(s): Zuquim 231 (INPA).
Distribution: Mexico, Mesoamerica and N South America.
Habit/Habitat: herb, terrestrial and rupiculous, in Terra Firme forests over rich soils, near streams.  
Studied specimen(s): Zuquim & Jakovac 205 (INPA); 209 (INPA), Zuquim 237 (INPA).  
Distribution: N South America.

**Cyclodium meniscioides** (Willd.) C. Presl, Tent. Pterid.: 85. 1836.  
Infraspecific: var. meniscioides  
Habit/Habitat: herb, terrestrial or hemi-epiphytic, in swamps of Terra Firme forests.  
Studied specimen(s): Zuquim & Jakovac 210 (INPA); Zuquim & Fontelles 375 (INPA).  
Distribution: N South America.

**Didymochlaena truncatula** (Sw.) J. Sm., J. Bot. (Hooker) 4: 196. 1841-1842 [1841].  
Habit/Habitat: herb, terrestrial and rupiculous, in Terra Firme forests over rich soils.  
Studied specimen(s): Zuquim & Braga-Neto 164 (INPA).  
Distribution: S Mexico, Antilles, Mesoamerica, and N South America. Tropical Asia and Africa.

**Elaphoglossum flaccidum** (Fée) T. Moore, Index Filic.: 356. 1862.  
Habit/Habitat: herb, epiphytic (canopy), in Terra Firme forests.  
Studied specimen(s): Zuquim & Braga-Neto 391 (INPA).  
Distribution: Antilles and N South America.

Habit/Habitat: herb, epiphytic (canopy), in Terra Firme forests.  
Studied specimen(s): Zuquim 337 (INPA); Zuquim & Vieira 400 (INPA).  
Distribution: Antilles, Mesoamerica, and N South America.

**Elaphoglossum plumosum** (Fée) T. Moore, Index Filic.: 364. 1862.  
Habit/Habitat: herb, epiphytic, in white-sand forests (campinaranas).  
Studied specimen(s): Zuquim 125 (INPA).  
Distribution: N South America.

Habit/Habitat: herb, epiphytic, in Terra Firme forests.  
Studied specimen(s): Zuquim & Figueiredo 66 (INPA).  
Distribution: N South America.

Habit/Habitat: herb, hemi-epiphytic, in Terra Firme forests over rich soils.  
Studied specimen(s): Tuomisto & Zuquim 15607 (INPA, SP, TUR).  
Distribution: Greater Antilles (except Jamaica) and tropical South America.

**Olfersia cervina** (L.) Kunze, Flora 7: 312. 1824.  
Habit/Habitat: herb, terrestrial and hemi-epiphytic.  
Studied specimen(s): Sobrinho 1026 (INPA).  
Distribution: S. Mexico, Antilles, Mesoamerica, and tropical South America.
Habit/Habitat: herb, hemi-epiphytic, in Terra Firme forests, near streams.
Studied specimen(s): Zuquim & Braga-Neto 178 (INPA); Zuquim 242 (INPA).
Distribution: S Mexico, Mesoamerica, and N South America.

Habit/Habitat: herb, hemi-epiphytic, in Terra Firme forests.
Studied specimen(s): Zuquim & Vieira 401 (INPA).
Distribution: N South America.

Gleicheniaceae

Habit/Habitat: herb, terrestrial, in disturbed and opened areas.
Studied specimen(s): Zuquim & Jakovac 194 (INPA).
Distribution: SE USA, Antilles, Mesoamerica, and tropical South America.

Gleichenella pectinata (Willd.) Ching, Sunyatsenia 5(4): 276. 1940.
Habit/Habitat: herb, terrestrial, in disturbed and opened areas.
Distribution: S Mexico, Antilles, Mesoamerica, and tropical South America.

Hymenophyllaceae

Habit/Habitat: herb, terrestrial, in Terra Firme forests, near streams
Studied specimen(s): Zuquim & Figueiredo 77 (INPA); Zuquim& Jakovac 215 (INPA).
Distribution: Antilles, Mesoamerica, and tropical and subtropical South America.

Hymenophyllum polyanthos (Sw.) Sw., J. Bot. (Schrader) 1800(2): 102. 1801.
Habit/Habitat: herb, epiphytic, in Terra Firme forests
Studied specimen(s): Zuquim & Junqueira 305 (INPA).
Distribution: Mexico, Mesoamerica, and tropical South America.

Trichomanes ankersii C. Parker ex Hook. & Grev., Icon. Filic. 2(11): tab. 201. 1831.
Habit/Habitat: herb, terrestrial with climbing raquis, in Terra Firme forest.
Studied specimen(s): Zuquim & Costa 245 (INPA); 273 (INPA).
Distribution: Mesoamerica and N South America.

Habit/Habitat: herb, terrestrial or rupiculous, in Terra Firme and White Sand forests, in both cases, near streams.
Studied specimen(s): Zuquim 123 (INPA).
Distribution: N South America.

Trichomanes cellulosum Klotzsch, Linnae 18: 531. 1844.
Habit/Habitat: herb, terrestrial, in Terra-Firme forests, near streams.
Studied specimen(s): Zuquim & Figueiredo 71 (INPA); Zuquim 121 (INPA).
Distribution: N South America.
**Trichomanes cristatum** Kaulf., Enum. Filic. 265. 1824.
Habit/Habitat: herb, terrestrial, in Terra Firme forests.
Studied specimen(s): Zuquim & Figueiredo 78 (INPA); Zuquim 122 (INPA); Zuquim & Braga-Neto 388 (INPA).
Distribution: tropical South America.

Habit/Habitat: herb, terrestrial, in Terra Firme forests.
Studied specimen(s): Zuquim & Junqueira 299 (INPA).
Distribution: S Mexico, Antilles, Mesoamerica, Trinidad, and N South America.

Habit/Habitat: herb, rupiculous and epiphytic, in Terra Firme forests.
Studied specimen(s): Zuquim & Figueiredo 118 (INPA); Zuquim & Braga-Neto 153 (INPA); 191 (INPA); Zuquim & Junqueira 292 (INPA).
Distribution: Antilles, Mesoamerica and N South America

**Trichomanes martiusii** C. Presl, Hymenophyllaceae 15, 36. 1843.
Habit/Habitat: herb, terrestrial, rupiculous and epiphytic, in Terra Firme and white sand forests, near streams.
Studied specimen(s): Zuquim 120 (INPA).
Distribution: N South America.

**Trichomanes pinnatum** Hedw., s.l., Fil. Gen. Sp., tab. 4, fig. 1. 1799.
Habit/Habitat: herb, terrestrial, in Terra Firme forests.
Studied specimen(s): Zuquim & Figueiredo 75 (INPA); Zuquim & Braga-Neto 189 (INPA); 385 (INPA); Zuquim & Junqueira 300 (INPA).
Distribution: Distribution: S Mexico, Antilles, Mesoamerica, and N South America.

*NB. The material cited here probably belongs to more than one taxon, but more studies are necessary to clarify this situation.*

Habit/Habitat: herb, rupiculous and epiphytic, in Terra Firme forests.
Studied specimen(s): Zuquim & Junqueira 291 (INPA); 313 (INPA); Zuquim & Braga-Neto 382 (INPA).
Distribution: Mexico, Antilles, Mesoamerica, and widespread in South America.

Habit/Habitat: herb, terrestrial with climbing rachis, in Terra Firme forests.
Studied specimen(s): Zuquim & Junqueira 328 (INPA).
Distribution: S Mexico, Mesoamerica, and N South America.

**Trichomanes vittaria** DC. ex Poir., Encycl. 8: 65. 1808.
Habit/Habitat: herb, terrestrial, in Terra Firme Forest.
Studied specimen(s): Zuquim & Braga-Neto 155 (INPA); Zuquim & Jakovac 196 (INPA); Zuquim 243 (INPA); Zuquim & Junqueira 320 (INPA).
Distribution: N South America.
LINDSAEACEAE

Lindsaea divaricata Klotzsch, Linnaea 18: 547. 1844.
Habit/Habitat: herb, terrestrial, in Terra Firme forests, near streams.
Studied specimen(s): Zuquim & Figueiredo 67 (INPA); Zuquim & Jacovak 218 (INPA);
Zuquim & Vieira 406 (INPA).
Distribution: Mesoamerica and tropical South America.

Habit/Habitat: herb, terrestrial, in Terra Firme forests, near streams.
Studied specimen(s): Zuquim 128 (INPA).
Distribution: Lesser Antilles, Mesoamerica, N South America.

Lindsaea sp.
Habit/Habitat: herb, terrestrial, in Terra Firme forests.
Studied specimen(s): Zuquim & Costa 248 (INPA); 253 (INPA); Zuquim & Junqueira 295 (INPA).

Lindsaea lancea (L.) Bedd. var. lancea
Habit/Habitat: herb, terrestrial, in Terra Firme forests.
Studied specimen(s): Zuquim & Figueiredo 74 (INPA); Zuquim & Vieira 402 (INPA).
Distribution: S Mexico, Antilles, Mesoamerica, and tropical South America.

Lindsaea lancea var. falcata (Dryand.) Rosenst., Hedwigia 46: 79. 1906.
Habit/Habitat: herb, terrestrial, occasionally epiphytic (in decaying wood), in Terra
Firme forests, near streams.
Studied specimen(s): Zuquim & Figueiredo 70 (INPA).
Distribution: Mexico, Mesoamerica, and N South America.

1957.
Habit/Habitat: herb, terrestrial, in white sand forests.
Studied specimen(s): Zuquim & Braga-Neto 165 (INPA); Zuquim 233 (INPA).
Distribution: Antilles, Guianas, and Brazil.

Lindsaea schomburgkii Klotzsch, Linnaea 18: 545. 1844.
Habit/Habitat: herb, terrestrial and epiphytic, in white sand forests.
Studied specimen(s): Zuquim 338 (INPA).
Distribution: N South America.

Habit/Habitat: herb, terrestrial, in white sand forests.
Studied specimen(s): Zuquim 124 (INPA); Tuomisto & Prado 15718 (INPA SP, TUR).
Distribution: N South America.

LOMARIOPSIDACEAE

Cyclopeltis semicordata (Sw.) J. Sm., Bot. Mag. 72: 36. 1846.
Habit/Habitat: herb, terrestrial, in Terra Firme forests over rich soils.
Studied specimen(s): Zuquim & Jakovac 140 (INPA); 221 (INPA).
Distribution: S Mexico, Antilles, Mesoamerica, and N South America.
Lomariopsis japurensis (Mart.) J. Sm., Hist. Fil.: 140. 1875.  
Habit/Habitat: herb, hemi-epiphytic, in Terra Firme forests.  
Studied specimen(s): Zuquim & Figueiredo 112 (INPA); Zuquim & Braga-Neto 182 (INPA); 183 (INPA); 188 (INPA).  
Distribution: Mesoamerica and N South America.

Lomariopsis prieuriana Fée, Mem. Foug. 2: 66, Tab. 25, fig. 1. 1845.  
Habit/Habitat: herb, hemi-epiphytic, in Terra Firme forests.  
Studied specimen(s): Zuquim 372 (INPA).  
Distribution: Mesoamerica and N South America.

Habit/Habitat: herb, terrestrial, epiphytic, in Terra Firme forests.  
Studied specimen(s): Zuquim 126 (INPA); 127 (INPA); Zuquim & Costa 251 (INPA); Zuquim & Junqueira 289 (INPA).  
Distribution: S Mexico, Antilles, Mesoamerica, and N South America.

LYCOPODIACEAE
Habit/Habitat: herb, terrestrial, in disturbed open areas.  
Studied specimen(s): Zuquim & Jakovac 195 (INPA).  
Distribution: tropical South America.

LYGODIACEAE
Habit/Habitat: herb, terrestrial with climbing rachis, in Terra Firme forests.  
Studied specimen(s): Zuquim 332 (INPA).  
Distribution: Mexico, Antilles, Mesoamerica, and tropical South America.

MARATTIACEAE
Habit/Habitat: herb, terrestrial, in Terra Firme forests, near streams.  
Studied specimen(s): Zuquim & Figueiredo 68 (INPA).  
Distribution: S Mexico, Antilles, Mesoamerica, and N South America.

Habit/Habitat: herb, terrestrial and rupicolous, in Terra Firme forests over rich soils.  
Studied specimen(s): Zuquim & Braga-Neto 139 (INPA).  
Distribution: S Mexico, Antilles, Mesoamerica, and N South America.

Danaea trifoliata Reichenb. ex Kunze, Analecta Pteridogr.: 4, tab. 2. 1837.  
Habit/Habitat: herb, terrestrial, in Terra Firme forests.  
Studied specimen(s): Zuquim & Braga-Neto 377 (INPA); Zuquim & Junqueira 409 (INPA).  
Distribution: Guianas and Brazil.
METAXYACEAE

*Metaxya rostrata* C. Presl, Tent. Pterid.: 60, tab. 1, fig. 5. 1836.
Habit/Habitat: herb, terrestrial, in Terra Firme forests, near streams.
Studied specimen(s): Zuquim & Costa 249 (INPA); Zuquim & Junqueira 304 (INPA).
Distribution: S Mexico, Lesser Antilles, Mesoamerica, and N South America.

POLYPODIACEAE

*Campyloneurum phyllitidis* C. Presl, Tent. Pterid.: 190. 1836.
Habit/Habitat: herb, epiphytic, in Terra Firme forests.
Studied specimen(s): Zuquim & Costa 279 (INPA).
Distribution: S Florida, Mexico, Antilles, Mesoamerica, tropical and subtropical South America.

*Campyloneurum repens* (Aubl.) C. Presl, Tent. Pterid.: 190. 1836.
Habit/Habitat: herb, epiphytic, in Terra Firme forests.
Studied specimen(s): Zuquim & Figueiredo 108 (INPA); Zuquim & Braga-Neto 157 (INPA); 383 (INPA).
Distribution: Mexico, Antilles, Mesoamerica, and tropical South America.

Habit/Habitat: herb, epiphytic, in Terra Firme forests.
Studied specimen(s): Zuquim & Figueiredo 408 (INPA).
Distribution: Mexico, Antilles, Mesoamerica, and tropical South America.

Habit/Habitat: herb, epiphytic, in Terra Firme forests.
Studied specimen(s): Zuquim & Costa 265 (INPA); Zuquim & Junqueira 293 (INPA).
Distribution: Lesser Antilles, tropical South America.

Habit/Habitat: herb, epiphytic, in Terra Firme forests.
Studied specimen(s): Zuquim & Costa 266 (INPA); Zuquim 336 (INPA).
Distribution: Mesoamerica and N South America.

Habit/Habitat: herb, epiphytic, in Terra Firme forests.
Studied specimen(s): Zuquim & Figueiredo 104 (INPA); Zuquim & Junqueira 312 (INPA); Zuquim & Braga-Neto 384 (INPA).
Distribution: S Mexico, Antilles, Mesoamerica, South America.

Habit/Habitat: herb, epiphytic, in Terra Firme forests.
Studied specimen(s): Zuquim & Neres 376 (INPA).
Distribution: N South America.

Habit/Habitat: herb, epiphytic, in Terra Firme forests.
Studied specimen(s): Zuquim & Braga-Neto 168 (INPA).
Distribution: S Mexico, Mesoamerica, and tropical South America.
Habit/Habitat: herb, epiphytic, in Terra Firme forests.
Studied specimen(s): Zuquim & Jakovac 213 (INPA); Zuquim & Costa 250 (INPA); Zuquim & Junqueira 290 (INPA).
Distribution: Mexico, Cuba, Mesoamerica, and tropical South America.

Microgramma sp.
Habit/Habitat: herb, epiphytic, in Terra Firme forests.
Studied specimen(s): Zuquim & Vieira 405 (INPA).

Habit/Habitat: herb, epiphytic, in Terra Firme forests.
Studied specimen(s): Zuquim & Braga-Neto 152 (INPA); 170 (INPA); Zuquim & Jakovac 229 (INPA).
Distribution: Guianas and Brazil.

Habit/Habitat: herb, epiphytic, in Terra Firme forests.
Studied specimen(s): Zuquim & Mesquita 129 (INPA); Zuquim & Costa 274 (INPA).
Distribution: N South America.

Habit/Habitat: herb, epiphytic, in Terra Firme forests.
Studied specimen(s): Zuquim & Jakovac 224 (INPA).
Distribution: Greater Antilles, Mesoamerica, and N South America.

Habit/Habitat: herb, epiphytic, in Terra Firme forests.
Studied specimen(s): Zuquim & Braga-Neto 389 (INPA).
Distribution: N South America.

Phlebodium decumanum (Willd.) J. Sm., J. Bot. (Hooker) 4: 59. 1841.
Habit/Habitat: herb, epiphytic, in Terra Firme forests and in open areas.
Studied specimen(s): Zuquim & Figueiredo 111 (INPA).
Distribution: S Florida, Antilles, Mesoamerica, tropical and subtropical South America.

Habit/Habitat: herb, epiphytic, in Terra Firme forests.
Studied specimen(s): Zuquim & Jakovac 201 (INPA).
Distribution: Mesoamerica and N South America.

Habit/Habitat: herb, epiphytic, in Terra Firme forests.
Studied specimen(s): Zuquim & Jakovac 212 (INPA).
Distribution: N South America.

Serpocaulon caceresii (Sodiro) A. R. Sm., Taxon 55(4): 928, fig. 3A. 2006.
Habit/Habitat: herb, epiphytic, in Terra Firme forests.
Studied specimen(s): Zuquim & Jakovac 208 (INPA); Zuquim & Junqueira 301 (INPA); Zuquim & Braga-Neto 392 (INPA).
Distribution: N South America.

PTERIDACEAE

*Adiantum adiantoides* (J. Sm.) C. Chr., *Ind.: 123. 1905.
Habit/Habitat: herb, terrestrial, in Terra Firme forests.
Studied specimen(s): Zuquim & Braga-Neto 380 (INPA); Zuquim & Vieira 395 (INPA).
Distribution: Guianas and Brazil.

Habit/Habitat: herb, terrestrial, in Terra Firme forests.
Studied specimen(s): Zuquim & Braga-Neto 142 (INPA); 167 (INPA).
Distribution: Guianas and Brazil.

*Adiantum cajennense* Willd. ex Klotzsch, *Linnaea 18: 552. 1845
Habit/Habitat: herb, terrestrial, in Terra Firme forests.
Studied specimen(s): Zuquim & Braga-Neto 180 (INPA); 379 (INPA); Zuquim 235 (INPA).
Distribution: Guianas and Brazil.

Habit/Habitat: herb, terrestrial, in Terra Firme forests, in slightly disturbed areas.
Studied specimen(s): Zuquim 130 (INPA).
Distribution: Guianas and Brazil.

Habit/Habitat: herb, terrestrial, in Terra Firme forests.
Studied specimen(s): Zuquim & Costa 278 (INPA); Zuquim & Junqueira 288 (INPA).
Distribution: South America.

Habit/Habitat: herb, terrestrial, in Terra Firme forests.
Studied specimen(s): Zuquim & Jakovac 223 (INPA).
Distribution: South America.

Habit/Habitat: herb, terrestrial, in Terra Firme forests.
Studied specimen(s): Zuquim & Braga-Neto 147 (INPA); Zuquim & Junqueira 315 (INPA).
Distribution: Belize, and tropical South America.

*Adiantum lucidum* (Cav.) Sw., *Syn. fil.: 121. 1806.
Habit/Habitat: herb, terrestrial, in Terra Firme forests.
Studied specimen(s): Zuquim & Jakovac 207 (INPA).
Distribution: Meosamerica, Antilles, and South America.
Habit/Habitat: herb, terrestrial, in Terra Firme forests.
Studied specimen(s): Zuquim & Figueiredo 98 (INPA); Zuquim & Braga-Neto 146 (INPA); 150 (INPA); Zuquim & Junqueira 298 (INPA).
Distribution: Mexico, Antilles, Mesoamerica, and tropical South America.

Habit/Habitat: herb, terrestrial, in Terra Firme forests, near streams.
Studied specimen(s): Zuquim & Braga-Neto 163 (INPA); Zuquim & Jakovac 225 (INPA).
Distribution: Mexico, Antilles, Mesoamerica, and tropical South America.

Habit/Habitat: herb, terrestrial, in Terra Firme forests over rich soils.
Studied specimen(s): Zuquim & Braga-Neto 141 (INPA); Zuquim & Jacovak 222 (INPA).
Distribution: Mexico, Antilles, Mesoamerica, and tropical South America.

Habit/Habitat: herb, terrestrial, in Terra Firme forests.
Studied specimen(s): Zuquim & Figueiredo 69 (INPA); 99 (INPA); 101 (INPA); Zuquim & Braga-Neto 148 (INPA); 169 (INPA).
Distribution: Mexico, Antilles, Mesoamerica, and tropical South America.

Adiantum tomentosum Klotzsch, Linnaea 18: 553. 1844.
Habit/Habitat: herb, terrestrial, in Terra Firme forests.
Studied specimen(s): Zuquim & Jakovak 198 (INPA).
Distribution: Tropical South America.

Habit/Habitat: herb, epiphytic, in Terra Firme forests.
Studied specimen(s): Zuquim & Junqueira 302 (INPA); 309 (INPA).
Distribution: Mexico, Antilles and N South America.

Habit/Habitat: herb, epiphytic, in Terra Firme forests.
Studied specimen(s): Zuquim & Braga-Neto 190 (INPA); Zuquim 333 (INPA).
Distribution: Mexico, Mesoamerica and tropical South America.

Habit/Habitat: herb, epiphyti, in Terra Firme forests.
Studied specimen(s): Zuquim & Junqueira 294 (INPA).
Distribution: Mexico, Antilles, Mesoamerica, and tropical South America.
Habit/Habitat: herb, terrestrial, in Terra Firme forests, in rocky areas.  
Studied specimen(s): Zuquim & Jakovac 206 (INPA).  
Distribution: S Mexico, Greater Antilles, Mesoamerica, and N South America.

Habit/Habitat: herb, terrestrial, in Terra Firme forests.  
Studied specimen(s): Zuquim & Braga-Neto 173 (INPA).  
Distribution: S Florida, Mexico, Antilles, Mesoamerica, and tropical South America.

Polytaenium guayanense (Hieron.) Alston, Kew Bull. 1932(7): 134. 1932.  
Habit/Habitat: herb, epiphytic, in Terra Firme forests.  
Studied specimen(s): Zuquim & Jakovac 211 (INPA).  
Distribution: N South America.

Habit/Habitat: herb, terrestrial, in Terra Firme forests.  
Studied specimen(s): Zuquim & Junqueira 331 (INPA); Zuquim & Vieira 399 (INPA).  
Distribution: Mexico, Antilles, Mesoamerica, and tropical South America.

Habit/Habitat: herb, terrestrial, in Terra Firme forests, near streams.  
Studied specimen(s): Zuquim & Braga-Neto 171 (INPA); Zuquim & Jakovac 226 (INPA).  
Distribution: naturalized and widespread in tropical America, native in Africa, Asia, and Polynesia.

Vittaria lineata (L.) Sm., Mem. Acad. Roy. Sci. (Turin) 5(1790-1791): 421, pl. 9, fig. 5. 1793.  
Habit/Habitat: herb, epiphytic, in Terra Firme forests.  
Studied specimen(s): Zuquim & Junqueira 303 (INPA); 310 (INPA).  
Distribution: Mexico, Antilles, Mesoamerica, and tropical South America.

**SACCOLOMATACEAE**  
Habit/Habitat: herb, terrestrial, in Terra Firme forest.  
Studied specimen(s): Zuquim & Figueiredo 73 (INPA); Zuquim & Braga-Neto 166 (INPA); Zuquim & Junqueira 311 (INPA).  
Distribution: Mexico, Antilles, Mesoamerica, and tropical South America.

**SALVINIACEAE**  
Habit/Habitat: herb, aquatic, in low energy and large water bodies.  
Studied specimen(s): Zuquim & Braga-Neto 187 (INPA).  
Distribution: Mexico, Greater Antilles, Mesoamerica, and tropical South America.
SCHIZAEACEAE
Actinostachys pennula (Sw.) Hook., Gen. Fil., tab. 111A. 1842.
Habit/Habitat: herb, terrestrial, in white sand forests and shrub lands.
Studied specimen(s): Prado et al. 1885 (INPA, SP, TUR).
Distribution: Mesoamerica, Trinidad, tropical South America, and Uruguay.

Schizaea elegans (Vahl) Sw., J. Bot. (Schrader) 1800(2): 103. 1801.
Habit/Habitat: herb, terrestrial, in Terra Firme and white sand forests.
Studied specimen(s): not collected
Distribution: S Mexico, Greater Antilles, Mesoamerica, and tropical South America.

SELAGINELLACEAE
Habit/Habitat: herb, terrestrial, in Terra Firme forests.
Studied specimen(s): Zuquim & Braga-Neto 393 (INPA).
Distribution: Colombia and Brazil.

Selaginella breynii Spring, Fl. Bras. 1(2): 121. 1840.
Habit/Habitat: herb, terrestrial, in Terra Firme forests.
Studied specimen(s): Zuquim & Vieira 404 (INPA).
Distribution: Colombia, French Guiana, and N Brazil.

Selaginella pedata Klotzsch, Linnaea 17: 521. 1844.
Habit/Habitat: herb, terrestrial, in Terra Firme forests.
Studied specimen(s): Zuquim & Figueiredo 95 (INPA); 96 (INPA); Zuquim & Braga-Neto 181 (INPA); Zuquim 234 (INPA).
Distribution: N South America.

TECTARIACEAE
Habit/Habitat: herb, terrestrial and rupicolous, in Terra Firme forests over rich soils.
Studied specimen(s): Zuquim & Figueiredo 102 (INPA); Zuquim & Braga-Neto 184 (INPA); Zuquim & Junqueira 314 (INPA).
Distribution: S Florida, Mexico, Antilles, Mesoamerica, and tropical and subtropical South America.

Habit/Habitat: herb, terrestrial, in Terra Firme forests.
Studied specimen(s): Zuquim & Figueiredo 100 (INPA); Zuquim & Braga-Neto 158 (INPA); 159 (INPA); 162 (INPA); 193 (INPA); 387 (INPA); Zuquim & Jakovac 200 (INPA); Zuquim 239 (INPA); Zuquim & Costa 246 (INPA).
Distribution: N South America.

Habit/Habitat: herb, terrestrial, in Terra Firme forests.
Studied specimen(s): Zuquim & Souza 444 (INPA); Zuquim & Neres 445 (INPA).
Distribution: Trinidad and South America.
Habit/Habitat: herb, terrestrial, in Terra Firme forests.
Studied specimen(s): Zuquim 238 (INPA).
Distribution: Antilles, Mesoamerica and N South America.

Habit/Habitat: herb, terrestrial, in Terra Firme forests, near streams.
Studied specimen(s): Zuquim & Costa 284 (INPA); Zuquim & Vieira 403 (INPA).
Distribution: Venezuela, Guiana, and N Brazil.

Habit/Habitat: herb, terrestrial, in Terra Firme forests.
Studied specimen(s): Zuquim & Figueiredo 76 (INPA); Zuquim & Costa 268 (INPA); Zuquim & Vieira 298 (INPA).
Distribution: Mesoamerica, Antilles, and South America.

**THELYPTERIDACEAE**

Habit/Habitat: herb, terrestrial, in Terra Firme forests.
Studied specimen(s): Zuquim & Figueiredo 109 (INPA); Zuquim & Braga-Neto 144 (INPA); 149 (INPA); 175 (INPA); 176 (INPA); 192 (INPA); 381 (INPA).
Distribution: Antilles and N South America.

Habit/Habitat: herb, terrestrial, in Terra Firme and white-sand forests, near streams.
Studied specimen(s): Zuquim 119 (INPA).
Distribution: Mesoamerica and tropical South America.

Habit/Habitat: herb, terrestrial and rupiculous, in Terra Firme forests, near streams.
Studied specimen(s): Zuquim & Braga-Neto 179 (INPA); Zuquim & Junqueira 330 (INPA); Zuquim & Jakovac 335 (INPA).
Distribution: N South America and southern Brazil.

Habit/Habitat: herb, terrestrial, in Terra Firme forests, in tree fall gaps or disturbed areas.
Studied specimen(s): Zuquim & Braga-Neto 143 (INPA); 390 (INPA).
Distribution: Antilles, Mesoamerica, N South America. Native to Asia and Africa.

Habit/Habitat: herb, terrestrial or rupiculous, in Terra Firme forests over rich soils.
Studied specimen(s): Zuquim & Braga-Neto 145 (INPA); 174 (INPA).
Distribution: S Mexico, Antilles, and N South America.
WOODSIACEAE

*Diplazium cristatum* (Desr.) Alston, J. Bot. 74: 173. 1936.
Habit/Habitat: herb, terrestrial, in Terra Firme forests.
Studied specimen(s): Zuquim & Neres 371 (INPA).
Distribution: S Mexico, Antilles, Mesoamerica, and tropical South America.

*Diplazium grandifolium* (Sw.) Sw., J. Bot. (Schrader) 1800(2): 62. 1801.
Habit/Habitat: herb, terrestrial or hemi-epiphytic, in Terra Firme forest over rich soils.
Studied specimen(s): Zuquim & Braga-Neto 156 (INPA); Zuquim & Jakovac 219 (INPA); Zuquim & Junqueira 319 (INPA).
Distribution: Mexico, Antilles, Mesoamerica, and N South America.

**DISCUSSION**

The vegetation is heterogeneous in the Rebio Uatumã region; physiognomies vary from the open areas of *campinas* to the dense Terra Firme forests with closed canopy and emergent trees more than 45 m tall. Within the Terra Firme forests heterogeneity arises from variations in edaphic factors such as fertility (exchangeable bases content varies, at least, from 0.16 to 5.68 cmol/kg), texture (clay content varies from 16 to 85 %) and water availability (from stream margins to high plateaus). The environmental heterogeneity, including a large edaphic gradient, probably determined the high species richness (122 spp.) found in the area in comparison with previous inventories made in the Brazilian Amazon: 83 species in the North of Reserva Ducke (Costa et al., 1999); 48 species in upper Rio Negro (Freitas & Prado, 2005); - 39 species in Madeira-Purus interfluve (Carvalho et al., 2007); 60 species in DBFF Project areas (Zuquim, 2006); - 70 species in Eastern Amazon (Costa & Pietrobom, 2007); 39 species in the metropolitan region of the city of Belém (Maciel et al., 2007); and 50 species in northern Amazon (Edwards, 1998).

In fact, ferns and lycophytes have been long recognised as habitat specialists in the Amazon (Tuomisto & Poulsen, 1996). In the present work, we found some genera that are not common in Central Amazonia such as *Bolbitis* and *Tectaria*. The species of these genera tend to colonise relatively rich soils (Tuomisto & Poulsen, 1996). On the other hand, some genera such as *Lindsaea*, that tends to be more diverse in poor soils (Tuomisto, 1998), also showed high number of species. High environmental heterogeneity itself tends to increase species richness for virtually every plant group. To our knowledge, Prado & Moran (2009) is the only checklist that found a comparative number of species (178 spp.). Their study comprises almost all the State of Acre and probably encompasses areas with rich soils since the checklist contains rich soil indicator species, such as *Adiantum pulverulentum, Bolbitis lindgii, B. nicotianifolia, Didymochlaena truncatula, Tectaria incisa* etc (Tuomisto & Poulsen, 1996).

Ferns and lycophytes are sensitive to changes in environmental conditions and land uses (Paciencia & Prado, 2005). The strong species-environment relationship and the diversity found in Uatumã region and in previous studies in Amazonia (Costa et al., 2005, Tuomisto et al., 2002, Tuomisto et al., 2003, and Zuquim et al., 2009) reinforce the proposal to include ferns and lycophytes as indicator groups of the distribution of biodiversity in Rapid inventories (RAP). RAP methodology is being applied widely in Amazonia by NGOs (e.g. World Wild Fund for Nature - WWF, Fundação Vitória Amazónica - FVA) and governmental institutions (Secretaria de Desenvolvimento Sustentável do Estado do Amazonas – SDS/AM, Instituto Nacional de Pesquisas da
Fern and lycophyte inventories would enhance the knowledge of the spatial distribution of diversity and heterogeneity of a given area, providing low-cost information for conservation planning and management.

ACKNOWLEDGEMENTS

We acknowledge the assistance of Joelson Nogueira and Ailton Neres during field work. The ICMBio staff (especially Caio Pamplona) made it easier to work in REBIO Uatumã. We thank Carlos H. Franciscon for herbarium facilities at INPA and Hanna Tuomisto (TUR) for taxonomic and ecological discussions. This work was funded by CNPq/PPG7.

REFERENCES


MERTENS, J. 2004. The characterization of selected physical and chemical soil properties of the surface soil layer in the ‘Reserva Ducke’, Manaus, Brazil, with
emphasis on their spatial distribution. Bachelor thesis. Humboldt University, Berlin.


INSTRUCTIONS FOR AUTHORS

PAPERS should not usually exceed 20 printed pages and are generally expected to be considerably shorter. Review articles, as well as reports of original research, are encouraged. Short notes are acceptable e.g. new records. The senior author should supply a fax and email address to facilitate correspondence.

MANUSCRIPTS should be submitted in English (British) in electronic format (preferably) or hard copy (two copies), in 10-point Times New Roman font and double spaced. Electronic versions of text and tables should be compatible with WORD, with figures as pdf or jpg files, and sent as email attachments or CDroms. All manuscripts will be refereed.

THE TITLE should reflect the content of the paper and be in BOLD CAPITALS (11-point) and centrally aligned. Generic and specific names should be in italics and any title containing a generic or specific name must be followed by the family and Pteridophyta in brackets e.g.

TRICHOMANES SPECIOSUM (HYMENOPHYLLACEAE: PTERIDOPHYTA) IN SOUTHERN SPAIN

AUTHOR ABBREVIATIONS should follow Pichi Sermolli’s (1996) Authors of scientific names in Pteridophyta, Royal Botanic Gardens, Kew.

MAIN HEADINGS: should be in BOLD CAPITALS (10-point) and centrally aligned.

SUBSIDIARY HEADINGS: should be in bold, the first letter of each word in capitals, the rest in lower case and left-aligned.

AUTHORS' NAMES AND FULL ADDRESSES: follow the title and are centrally aligned.

KEY WORDS: up to ten.

ABSTRACT: should reflect the content of the paper.

FIGURES: there is no distinction between photographs and line drawings in numbering. All should be presented in a form ready for reproduction, ideally in JPG format (please contact editor with queries), with a scale bar where appropriate. Lettering or numbers (Arabic) should be in the bottom left using uppercase Times Roman and be sufficiently large to be legible if reduction is necessary during printing. The number of photographs allowed in any one issue is limited by cost. Figure captions should be on a separate sheet.

TABLES: can be printed in either portrait or landscape format. Authors should consider this when preparing tables. Authors should ensure that tables fit the printed page size in a legible form.

MEASUREMENTS: should follow the metric system.

CHECKLISTS: should follow the format of Baksh-Comeau, Fern Gaz. 16(1, 2): 11-122.

REFERENCES: should follow the style of a recent issue of The Fern Gazette, e.g.:-


JOURNAL ABBREVIATIONS: should follow Botanico Periodicum Huntianum & Supplements.

Alterations from the original text at proof stage will be charged for unless they are minor points of detail. Twenty-five offprints will be supplied free to the senior author.
THE COLONISATION OF WOODLAND GAPS BY FERNS AND HORSETAILS

P. BREMER

Wageningen University, Plant Ecology and Nature Conservation, Wageningen, The Netherlands
(E-mail: pietbremer@planet.nl)

Key words: woodland gaps, Voorsterbos, boulder clay, ferns, spore bank, Equisetum

ABSTRACT

In the Voorsterbos, a planted woodland on a former sea-floor (the Netherlands), artificial gaps within stands of Fagus sylvatica on boulder clay were monitored for five or six years after cutting. Ten fern species and three species of horsetail established in these gaps, with Dryopteris cristata, Thelypteris palustris, Matteuccia struthiopteris and Equisetum telmateia not previously known from the Voorsterbos. Athyrium filix-femina was most successful and formed dense stands in some gaps. Two species (Gymnocarpium dryopteris, Dryopteris cristata) established but have since disappeared. Thelypteris palustris has built up a sustainable population. It seems plausible that the germination of ferns and horsetails took place during the first season following cutting of the gaps and was derived from a spore bank with an optimal microclimate with constant high moisture and humidity in the shaded part of the gaps. Competition from recruiting trees and shrubs was suppressed in some of the gaps for a period of five year through herbivory by Roe deer.

INTRODUCTION

Woodlands are the climax vegetation over much of the Earth and do not need any human intervention to be sustained. As humans need timber and fibre, they manage woodlands and harvest boles. Numerous silvicultural options are available to forest managers. They include a wide range of harvesting systems, regeneration methods and rotation lengths. Various studies have been published on the effects of harvest practices on understory and overstory conditions in managed temperate forest (e.g. Halpern & Spies 1995, Thysell & Carey 2000, Bergstedt & Milberg 2001), but with the exception of one study on Pteridium aquilinum (den Ouden 2000), none of them focussed on ferns.

In 1997 the management objective in one of the planted forest in the province of Flevoland (Voorsterbos) changed from timber production to ecological forestry. Homogeneous thinning with a short return interval was banned and replaced by heterogeneous thinning, artificial gap formation and longer periods of no management, in order to increase the variation within the stands and to convert single cohort stands into stands with a mosaic of phases (Koop 1989, Koop & Siebel 1993, van den Burgh et al. 1995, Hunter 1999). The first series of gaps in the Voorsterbos offered an opportunity for studying the effect of these gaps on the herb layer. We expected gaps would be vegetated by recruiting trees while ferns would play a subordinate role as they had been scarce in the beech stands prior to the gap formation. Natural gaps in beech
stands on sandy soil in the Speulderbos (The Veluwe, the Netherlands) showed hardly any role for ferns (two species with little cover) while rejuvenation of trees was suppressed by browsing of deer (personal observations). In the Neuenburger Urwald, an ancient Hornbeam woodland on loamy soil (Stellario – Carpinetum), Koop (1989) recorded few fern species colonising the natural gaps.

**STUDY SITE**
The Noordoostpolder was reclaimed in 1941/1942 and the Voorsterbos (Figure 1) planted in the period 1944 -1955 (Bremer 2001). The area is below mean sea level: the altitude varies from -2.5 to -1m. The Voorsterbos has been planted on sand and boulder clay. Here, *Quercus robur* dominates (48% of the area), while other tree species are less important: *Pinus* spp. (12%), *Fagus sylvatica* (8%) and *Fraxinus excelsior* (7%) (Bremer 2001). Drainage trenches were dug at a density of up to 1 km per ha in the Voorsterbos (boulder clay); their depth ranges from 0.4 m to more than 1.2m. A large area on the boulder clay has a water table at a depth of less than 0.5m in the winter. Currently the trees extract much water, making drainage by trenches less important than in the years after these woodlands were planted. In winter these trenches have a shallow water level, while in summer they are dry, only being filled after heavy rainfall. In the Voorsterbos a management strategy started in 1997, aiming to produce a shifting mosaic by making artificial gaps in various stands (Koop & Siebel 1993). In the period 2000 - 2006, 54 gaps were created by cutting down trees. The diameter of these gaps was 1.5 - 2 times tree height, and their size varied from 0.08 to 0.15ha per gap, with the exception of one gap of 0.25ha (Bremer 2007a). Nearly all the felled trees were transported with heavy equipment, causing soil disturbance over more than 50% of the surface of these gaps. All the gaps were intersected with 0.4 – 1m deep drainage trenches with a density of 1km per ha.

**METHODS**
This study focuses on 12 gaps in *Fagus sylvatica* stands on boulder clay in which trees were felled at the start of the years 2000, 2001 or 2004; monitoring took place in the

![Figure 1](image-url)  
*Figure 1. The location of the study area (Voorsterbos) in the Netherlands.*
period 2000 – 2008. Each gap was monitored for a period of six years, except for three plots with a five year period. In these gaps the vegetation and recruitment of tree species were mapped, and ferns and horsetails recorded. For those ferns and horsetails that are less common in the Netherlands (listed in Table 1) individuals were mapped on 1:1000 maps, and the length of the longest frond per plant measured and the presence of spore producing fronds noted. Special attention was paid to trenches, as this habitat can be rich in fern species (Bremer 2007b). In the second year following tree felling, a 50m zone surrounding the gaps was surveyed for ferns and horsetails. These ‘plots’ were used as controls. Shade by the trees surrounding the gaps was mapped on or near 21 June (with largest area of gap floor receiving direct light) and 21 September (the end of the astronomical summer, approximately the end of the growing season) during more or less cloudless weather. The shade line of 21 June is defined as the 100% shade line (the part of the gap south of this line is always in shade), while the shade line of 21 September is defined as the 0% shade (the part of the gap north of this line has no shade in the period between 21 June and 21 September). The position of each individual fern and horsetail (n = 25) was recorded with reference to these two lines and the number of days with shade for each was determined (Figure 2). For the group of common fern species only *Athyrium filix-femina* was analysed because it is the species most prone to desiccation. This species was analysed using a matrix of 1 x 1m plots in one of the gaps when this gap was five years old and ferns in their subadult or adult phase. Only sporophytes were included in this study, as gametophytes are difficult to monitor. The gametophyte phase was frequent in the first year after tree felling and subsequent sporophytes could be identified when two or three years old. Data were collected in August. Data on cover of the fern layer, herb layer (< 1m) and young shrub layer (> 1m) were estimated per gap in late summer.

**Statistical analysis**

A chi-square test was used to analyse habitat preference. A Kruskall–Wallis test was used to analyse a gradient in density of *Athyrium filix-femina* in one of the gaps.

**RESULTS**

Within three years the gaps were dominated by the herb or initial tree layer (< 1m in height). Fern cover reached a maximum of 21% in the fifth year (Figure 3) and varied from 1– 70% per gap. *Fraxinus excelsior* recruited at a density of more than one sapling per m² in 50% of the monitored gaps. In these gaps, after five years, patches of trees were able to build up a young woodland phase despite heavy browsing by Roe deer (*Capreolus capreolus*). In three other gaps shrubs and young trees present before felling were able to cover these gaps within five years. Ten fern species became established in the gaps, of which five were present in adjacent woodland zones, and three species of horsetail (Table 1). The average number of fern species per gap was at its maximum in the early years and decreased slightly after three years (Figure 4). Three fern species (*Thelypteris palustris, Dryopteris cristata, Matteuccia struthiopteris*) and one species of horsetail (*Equisetum telmateia*), had not previously been recorded in the woodland. A single plant of *Asplenium scolopendrium* was found adjacent to one of the gaps; it was not recorded within the gap habitat.

Within the gaps, ferns established on trench banks and on the woodland floor. *Athyrium filix-femina*, the most successful fern coloniser, had its highest density in the trenches ($\chi^2 = 6.5, p < 0.05$). The group of less common fern species (Table 1) showed no preference for trench or woodland floor habitat in terms of the population size ($\chi^2 =$
Table 1. Fern species found within 12 gaps of *Fagus sylvatica* stands (5 – 6 years after tree-felling) compared with uncut woodland surrounding these gaps, based on annual monitoring.

- **ng** = number of gaps with species listed
- **np g** = total number of estimated or counted plants/colonies in 12 gaps after six seasons
- **tr** = number of gaps with species listed growing in drainage trenches
- **wfl** = number of gaps with species listed growing on the woodland floor
- **f** = fertility of plants after establishing in the gaps; **f** = with fertile fronds within four years, **n.f** = not fertile within four years
- **sh %** = average time in shade during the period 21 June - 21 September based on plants/colonies and presented as percentage (e.g. 100% means plants are shaded during the whole season within the 21 June shade line), **na** = not analysed
- **a** = number of 50m zones surrounding gaps with species listed
- **np a** = total number of plants in 50m zones surrounding the gaps (data of all these gaps summed) after two seasons
- **VB** = species found elsewhere in the Voorsterbos since 2000

<table>
<thead>
<tr>
<th>Woodland species</th>
<th>Woodland gaps</th>
<th>50 m zone</th>
<th>VB</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ferns</strong></td>
<td>ng</td>
<td>np g</td>
<td>tr</td>
</tr>
<tr>
<td>Common species</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Athyrium filix-femina</em></td>
<td>12</td>
<td>100</td>
<td>12</td>
</tr>
<tr>
<td><em>Dryopteris dilatata</em></td>
<td>11</td>
<td>91.7</td>
<td>11</td>
</tr>
<tr>
<td><em>Dryopteris filix-mas</em></td>
<td>8</td>
<td>66.7</td>
<td>8</td>
</tr>
<tr>
<td><em>Dryopteris carthusiana</em></td>
<td>6</td>
<td>50.0</td>
<td>6</td>
</tr>
<tr>
<td>Less common species</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Thelypteris palustris</em></td>
<td>7</td>
<td>58.3</td>
<td>3</td>
</tr>
<tr>
<td><em>Dryopteris affinis</em></td>
<td>5</td>
<td>16.6</td>
<td>1</td>
</tr>
<tr>
<td><em>Matteuccia struthiopteris</em></td>
<td>2</td>
<td>16.7</td>
<td>1</td>
</tr>
<tr>
<td><em>Dryopteris cristata</em></td>
<td>2</td>
<td>16.7</td>
<td>2</td>
</tr>
<tr>
<td><em>Gymnocarpium dryopteris</em></td>
<td>1</td>
<td>8.3</td>
<td>1</td>
</tr>
<tr>
<td><em>Polystichum aculeatum</em></td>
<td>1</td>
<td>8.3</td>
<td>1</td>
</tr>
<tr>
<td><em>Asplenium scolopendrium</em></td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Horsetails</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Common species</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Equisetum arvense</em></td>
<td>4</td>
<td>33.3</td>
<td>0</td>
</tr>
<tr>
<td><em>Equisetum fluviatile</em></td>
<td>2</td>
<td>16.7</td>
<td>3</td>
</tr>
<tr>
<td>Less common species</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Equisetum telmateia</em></td>
<td>1</td>
<td>8.3</td>
<td>2</td>
</tr>
</tbody>
</table>
**Figure 2.** Woodland gap within *Fagus sylvatica* stand showing the shade lines and the distribution of rare ferns and horsetails.
Figure 3. Change in cover layers (average values) during 7 years in woodland gaps in beech stands on boulder clay. The layer of < 1 m comprises the herb layer including recruiting trees, the layer > 1 m comprises the initial tree layer and shrub layer. Data for the sixth year are based on nine gaps (years 1-5 based on 12 gaps). The x-axis gives the number of growing seasons after gap formation.
Figure 4. The average number of fern species found in the woodland gaps each year from the year before gap formation (year = 0) to six years after gap formation. Data for the sixth year are based on nine gaps (instead of 12).
0.5 n.s), but when densities were corrected for the area of both habitats there was a preference for the drainage trench habitat ($\chi^2 = 12.7 p < 0.001$). Plants of *Thelypteris palustris* showed no preference, while *Equisetum telmateia* was found only on the woodland floor. Fertility within four years after establishment was observed only in the group of the most common species (present in more than 49% of the gaps). Some plants of *Athyrium filix-femina* reached the adult phase in the third season after cutting and became co-dominant in five out of the 12 gaps, growing alongside horsetails, grasses and bryophytes.

The establishment of ferns was most successful in the southern parts of the gaps, within the 100% shade line: *Thelypteris palustris, Dryopteris cristata, Dryopteris affinis* and *Polystichum aculeatum* were found almost exclusively within this line. *Gymnocarpium dryopteris* and *Matteuccia struthiopteris* were found within the 75% shade line (Figure 2) and *Athyrium filix-femina* reached its highest density in this zone ($\chi^2 = 8.3 p < 0.01 n = 12$). Within the largest gap (0.25 ha) the average herb layer cover in the fifth year was 92%, with *Athyrium filix-femina* contributing 17%. In this gap, a gradient in density of *Athyrium filix-femina* could be correlated with the period of shade in the summer period ($\chi^2 = 10.8 p < 0.01$). Three species of *Equisetum* became established: *Equisetum arvense* was co-dominant with *Athyrium filix-femina* in three gaps, *Equisetum telmateia* colonised neutral boulder clay in one gap, while *Equisetum fluviatile* established within the 100% shade line in two gaps. Forty-two gaps were created in other stand and soil types. Sandy soils with low pH were poor in fern species. *Dryopteris dilatata* was present prior to tree felling and increased afterwards. In a stand of *Carpinus betulus* on boulder clay, gaps were created by bark ringing trees. Although this led to a gradual increase of light intensity, no ferns or horsetails established in these gaps, but young trees, already present in high density prior to the girdling, formed a dense stand.

**DISCUSSION**

Artificial gaps on boulder clay were studied in the Voorsterbos. Recruiting trees were expected to form a dense juvenile stand, contributing to the horizontal and vertical structure of the woodland. We had expected that ferns would not expand as they had been scarce prior to the gap formation, yet they proved to be successful both in cover and number of species. On boulder clay, *Fraxinus excelsior* recruits successfully, but the >1m saplings were intensely browsed by Roe Deer in the first five years, preventing a dense growth and facilitating vegetation with local dominance of *Athyrium filix-femina* at the southern parts of gaps. Other ferns were also present from the outset with, e.g., *Athyrium filix-femina* outcompeting *Gymnocarpium dryopteris*. On the boulder clay, ten ferns and three species of horsetail established; this included species not previously recorded in the area. From records of young sporophytes it appears that all these species established from spores in the first year following tree felling and soil disturbance. Spores of these species may have been derived from dry and wet spore rain to colonise the disturbed areas. However, there was a high density (establishment of >50 plants per m$^2$) of *Athyrium filix-femina* in five out of 12 gaps. As *Athyrium filix-femina* grew only at a low density prior to tree felling there may have been an extensive accumulation of spores preserved in the spore bank. Viable spores of *Athyrium filix-femina* were reported to be the most frequent type of fern spore in the soil spore bank in a boreal old-growth spruce forest, yet there were no plants in the herb layer (Rydgren & Hestmark 1996). In contrast in the Kuinderbos fern colonisation by numerous fern
species (with no extensive spore bank) always started with one fern individual at a particular site, followed in subsequent years sometimes by mass colonisation in the spore shadow of adult plants (Bremer 2007).

In the group of less common fern and horsetail species, the almost simultaneous colonisation within two years suggests that the spore bank may play a dominant role rather than spore rain; the spore bank here has had c. 60 years to accumulate. There appears to be no relationship between the burst of colonisation in the new gaps and the fern diversity of surrounding populations. This contrasts with the long term study (50 years) of fern colonisation in the Kuinderbos (also on a former sea floor), where Bremer (2007b) showed that colonisation of 25 fern species was correlated with the population size within 50 km from the forest.

Gymnocarpium dryopteris, Matteuccia struthiopteris, Dryopteris cristata and Thelypteris palustris had not previously been recorded from boulder clay in this kind of habitat within the Netherlands. All three species were able to colonise the bare soils, and thrive until eliminated by competition. A similar observation was made for a group of seed plants in the gaps, with establishment of pioneer species (e.g. Puccinellia distans, Juncus gerardii). These plants established on the boulder clay between the period of reclamation of the sea floor (1942) and afforestation (c. 1948) and must have survived the period 1948 – c. 2000 through a seed bank.

Gaps have a characteristic microclimate (Moore & Vankat 1986, Stoutjesdijk & Barkman 1992). Gaps with a diameter of less than 0.7 times the tree height do not get any direct sunlight, while in gaps with a diameter equal to the tree height, c. 80% of the gap area is shaded when the foliage is fully developed. Gaps with a diameter 1 - 2 times the tree height deviate most from the adjacent woodland, having a microclimate that is more Atlantic in summer and more continental in winter (Stoutjesdijk & Barkman 1992). As rainwater is not intercepted by the canopy in these gaps and without tree transpiration, the soil in these gaps becomes constantly wet, with on average a low saturation deficit during the growing season, while in winter there is more radiation. In the Voorsterbos, the diameter of most gaps is 1-2 times the tree height which is an optimal habitat for many terrestrial woodland ferns and horsetails. The dominance of Athyrium filix-femina is related to soil conditions (boulder clay with reduced percolation, moisture and neutral substrate). Godefroid et al. (2006) show an effect of light intensity but also a combined effect of the air temperature and air humidity on the occurrence of this species in clear cuts. The results of this study show that the less common species were confined mostly within the 100% shade line; this indicates that they prefer a constantly wet soil and high air humidity. Comparing gaps formed through tree-felling with those developed through bark-ringing demonstrates that cutting and concomitant soil disturbance is important for the germination of fern spores. Equisetum fluviatile, E. telmateia and to some extent Matteuccia struthiopteris are indicators of seepage (e.g. Grootjans 1985), indicating a flux of pH neutral,groundwater. That these species were found growing on impermeable boulder clay shows that seepage is not the dominant factor, but that a continuously moist, pH neutral habitat is needed, which can also be achieved by rainwater stagnating on pH neutral boulder clay. Gaps on sandy soils do not facilitate the growth of ferns, as the water percolates to the water table.

When constant high humidity can be assured, one might expect species such as Blechnum spicant, Osmunda regalis and Oreopteris limbosperma to establish. Matteuccia struthiopteris is a common garden plant in the Netherlands, and occurrences of M. struthiopteris outwith gardens are nearly always related to garden rubbish
deposited at the edge of woodlands by man. The species established for the first time naturally in one of the planted woodlands of E.-Flevoland (province of Flevoland) in 1988 and still grows there. In the Voorsterbos it was recorded for the first time on boulder clay; a habitat not known from neighbouring countries (Bremer 2005).

In the woodland experiment, felling trees in *Fagus sylvatica* stands on boulder clay in order to make gaps facilitated the establishment and expansion of fern and horsetail populations with large differences in microclimate between gaps and the adjacent woodland. It seems likely that the crucial factors are soil composition (weakly acid - pH neutral boulder clay), moisture, and the light regime. Creating woodland gaps allows ferns to gain from their anemochoric dispersal capacity and the cumulative effect of spore dispersal (i.e. spore bank) and from the ability to develop prior to the phase in which seed plants might become dominant. Ferns, horsetails, bryophytes and liverworts are the first to establish before seed plants become dominant. Cutting woodland gaps on soils prone to desiccation would not be beneficial to the fern flora.

**ACKNOWLEDGMENTS**

Natuurmonumenten (beheerseenheid Voorsterbos/ Zwarte meer) created the woodland gaps. I thank Jan Akkerman, Klaas Althuis, Dick Buitenhuis and Lykele Zwanenburg for their cooperation. The analysis of data was financed by Natuurmonumenten. I thank Prof. Dr. F. Berendse for his comment on and Dr. J. Burrough for improving the English text. An anonymous reviewer provided helpful suggestions on the manuscript.

**REFERENCES**


BOOK REVIEW

FLORE DES MASCAREIGNES, LA REUNION, MAURICE (MAURITIUS), RODRIGUES. PTERIDOPHYTES, 1.PSILOTACEES A 26. MARSILEACEES. Published by Institut de Recherché pour le Développement, Mauritius Sugar Industry Research Institute and Royal Botanic Gardens (Kew), Paris 2008. 

Floras of far off tropical islands are always interesting but given that the BPS held a full excursion to La Reunion only two years ago this flora is one of the most welcome new publications in recent years. How unfortunate it could not have been published three years earlier!

Floras of these islands seem to be few and far between. Apart from J. G. Baker, Flora of Mauritius and Seychelles: Description of flowering plants and ferns of those islands, 1877, and Jacob de Cordemoy, Flore de l`isle de La Reunion. Fascicule 1: Cryptogames vasculaires, 1891, no complete fern catalogues seem to have been published. Although about 25% of the fern flora is endemic to the three islands many of the remaining taxa occur in Madagascar where florists by Tardieu-Blot and others give good coverage. The current volume would have been improved by a full history of fern research on the islands and a full fern bibliography. For a good review of all botanical research over the three islands see Botanical History of the Mascarene Islands by Wendy Strahm in Curtis`s Botanical Magazine, Vol.13, Part 4, November 1996, pp. 217-228.

The format here is concise with a very brief introduction on the classification of ferns, a key to families, then under each family a key to genera with species keys under each genus. In the body of the book the genera follow a standard systematic order with the lycophytes included at the front. There is a glossary at the end and finally a very comprehensive 38 page index. The text is in French throughout.

Each species entry gives full synonymy with authors, first publication, full description, plate number and page (if illustrated) and full distribution on the three islands. The authorship of each family varies. F. Badre is the major author but here and there specialist authors have written chapters. For example, the treatment of the Cyatheaceae by T. Janssen is very comprehensive, much of it based on his recent research, as is the treatment of Lomariopsidaceae by D. Lorence and G. Rouhan. Other major contributors include the late Prof. Holtum, the late M.-L. Tardieu-Blot (proof of the long gestation period of this volume) and J. P. Roux.

Happily I can find no discrepancies between the full species list given here and that prepared by Edmond Grangaud for the BPS excursion. I can only conclude that this volume is an accurate, concise and very welcome addition to the world`s fern florals.

This volume is part of a multi-volume set covering the complete flora of these islands; so far 25 parts have been published since the first part appeared in 1976. Currently still in production are volumes on Cyperaceae, Orchidaceae and Gramineae.

Martin Rickard
**CYATHEA SLEDGEI** (CYATHEACEAE): A NEW SPECIES OF TREE-FERN FROM SRI LANKA

R.H.G. RANIL¹, D.K.N.G. PUSHPAKUMARA², T. JANSSEN³, C.R. FRASER-JENKINS⁴ and D.S.A. WIJESUNDARA⁵

¹Postgraduate Institute of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka (e-mail: rajapaksha76@yahoo.com)
²Department of Crop Science, Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka
³Department of Botany, Senckenberg Research Institute, Frankfurt, Germany
⁴Student Guest House, Thamel, P.O. Box no 5555, Kathmandu, Nepal (e-mail: chrisophilus@yahoo.co.uk)
⁵Department of National Botanical Gardens, Peradeniya, Sri Lanka

Key words: Tree-fern, new species, *Cyathea sledgei*, hybridisation, Sri Lanka.

**ABSTRACT**

*Cyathea sledgei* Ranil, Pushpakumara & Fras.-Jenk. is a new tree-fern species from Sri Lanka, morphologically intermediate between *C. sinuata* Hook. & Grev. and *C. hookeri* Thwaites. It is easily recognised by its simple but deeply lobed leaves; each lobe has 8-10 pairs of forked veins and 6-9 pairs of sori. It was first recorded as a putative hybrid and the origin of this species is postulated to have been directly through hybridisation between the above two species. It behaves as a species, readily forming populations and apparently being fertile. *C. sledgei* occurs among populations of the two other species, *C. hookeri* being similarly restricted in occurrence. All three species are endemic to Sri Lanka, though Large & Braggins (2004) misreported *C. sinuata* from South India.

**INTRODUCTION**

Interspecific and, according to some authors, inter-generic hybridisation is not uncommon in tree-ferns and has been reported by a number of authors (Conant, 1975; Tryon, 1976; Conant & Cooper-Driver, 1980; Holttum, 1984; Caluff, 2002; Caluff & Serrano, 2002; Janssen & Rakotondrainibe, 2007). Tree-fern hybrids have been reported mainly in the Cyatheaceae, but also in Dicksoniaceae (Large & Braggins, 2004, where a wider sense of the term “tree-fern” is employed, which we do not follow here). Evidence for hybridisation in the Cyatheaceae was first presented by Holttum and Sen (1961) from Malaya and from Sumatra and Borneo by Conant and Cooper-Driver (1980). Tryon (1976) published a list of ten putative hybrids from the West Indies, Mexico and Central America. Holttum (1981) and Conant et al. (1996) have reported hybrids from Brazil, Venezuela and Colombia. Caluff (2002) and Caluff and Serrano (2002) have provided evidence for the occurrence of four natural hybrids from Cuba. Large and Braggins (2004) tentatively reported hybrids from Australia, Tasmania, New Zealand and the Philippines and a single case has been reported from mainland Africa by Edwards (2005). A recent work by Janssen and Rakotondrainibe (2007) reported three putative hybrids from Madagascar.

However Sri Lanka is the only country in South Asia from which a putative tree-fern hybrid has been reported (Sledge, 1982). The taxon concerned was first found in
January 1951 by the late Drs W.A. Sledge and F. Ballard as a sterile plant or plants, labelled by Sledge as being collected in the Kanneliya Forest Reserve near Udugama, and labelled by Ballard as from near Panangala in Kanneliya Forest Reserve, both probably referring to the same locality and collection. From the distinctively intermediate frond-morphology, Sledge postulated that it was not an immature Cyathea hookeri, but represented a putative hybrid between C. sinuata and C. hookeri. Rather surprisingly it was omitted by Philcox (2007) from the Revised Handbook of the Flora of Ceylon, perhaps due to their being sterile collections and uncertainty as to its taxonomic status. Fifty-three years after its original collection, more than 30 individuals of the same taxon were rediscovered in Kanneliya forest reserve (Ranil et al., 2004). We were subsequently able to find four mature plants with ripe spores amid populations of this taxon at both Kanneliya Forest and a new locality at Sinharaja Forest.

The morphology of this taxon is constant and readily recognisable and though intermediate between the other two species mentioned there is at present no actual evidence, other than its morphological intermediacy, that it is a hybrid. This, combined with its very probable fertility (see below) and apparent formation of populations, suggests that it should be considered to be a species in its own right, even if its most likely origin would seem to have been directly from F1 hybrids between the two species. According to previous studies of Cyathea hybrids (see below) such plants may be expected to be fertile immediately upon formation.

It is therefore described here as follows and should be added to the list of non-Malaysian species in Asia (Holttum 1965):

**Cyathea sledgei** Ranil, Pushpakumara & Fras.-Jenk., spec. nov. Filix morphologia intermedia inter C. hookeri et C. sinuatum. Folia simplicia angusta profunde lobata vel pinnatifida. Sporae bene evolutae non abortivae. (Plate 1 C, F, I; Plate 2 C, D, E, F).

Etymology: This species is named after the late Dr. W. Arthur Sledge (1904 - 1991), of the Botany Dept., University of Leeds, UK, to honour his immense contribution to knowledge of the Sri Lankan Pteridophyte flora.


**Trunk** erect, unbranched, 90-135 cm in height, 1.2-1.7 cm in diameter, entirely covered by persistent dead petiole bases, leaf scars not visible, usually with few adventitious shoots. **Crown** 112-168 cm in width and 18-28 cm height, with 18-26 leaves crowded at the apex of the trunk. **Petiole** (stipe) dark brown, glossy, 4.5-4.7 cm long, 0.3-0.5 cm in diameter at its base, with blunt, 0.05-0.1 cm long squaminate spines. **Petiole-scales** 0.4-0.6 cm long, 0.1 cm wide at their base, dark brown, linear to narrowly triangular, with an apical spine, margin sometimes bearing several conspicuous dark setae, scales densely covering the young leaves. **Lamina** simple, pinnatifid about halfway to the rachis, 60-90 cm long, 3.7-5.1 cm wide, linear, light green adaxially, olive green abaxially, subcoriaceous to coriaceous. **Lobes** short, obtuse with a crenate apex, veins free, once forked, 8-10 pairs in each lobe. **Lamina-apex** gradually reduced to a serrate margin. **Lamina-base** gradually reduced, the lowest lobes deeply cut almost to the rachis. **Rachis** grooved and dark brown adaxially, light brown abaxially, glabrous and...
glossy. Sori round, about 0.1 cm in diameter, borne at the forks of the veins, 6-9 pairs in each lobe in two rows on either side of the mid-vein, indusiate. *Indusia* globose, light brown, very thin, membranous, only a reduced disc persisting around the base of the receptacle at maturity. *Spores* well-formed, trilete, regular and not showing much variation in size or shape.

Distribution: Endemic to Sri Lanka. This species is known so far only from the Sinharaja forest in Ratnapura district (Sabaragamuwa Province) and Kanneliya forest in Galle district (Southern Province), occurring in both places along with its presumed ancestral species, *C. sinuata* and *C. hookeri*.

Habitat: Stream-side or road-side banks in lowland rain forests, 320 - 450 m alt.


Note: Both presumed ancestral species are endemic to Sri Lanka. *C. sinuata* was listed by Large & Braggins (2004) as occurring in South India as well, but in error as it is not known from there. *C. sinuata* (Plate 1 A, D, G; Plate 2 A) and *C. hookeri* (Plate 1 B, E, H; Plate 2 B) are limited to a few isolated pockets in the two main lowland rain forests, Kanneliya and Sinharaja Forests. *C. sinuata* is the only *Cyathea* species known worldwide with simple leaves (Kramer, 1990) and is fairly common in its places of occurrence. The intermediate morphology (Table 1) of *C. sledgei* between a species with long, narrow, simple, strap-like fronds and another with pinnate fronds makes it very distinctive and easy to recognise. In contrast to *C. sinuata*, *C. hookeri* is very limited in numbers in both localities. All three species occur in close proximity in the same microhabitats. Sledge (1982) had mentioned previously that what he had assumed to be both parents were observed in the immediate vicinity of his collection.

A couple of small sporophytes of *C. sledgei* transferred from the wild into cultivation at Peradeniya soon grew normally and were able to produce spores. Spores of this species were cultured and germinated on a medium of soil and produced prothalli with both sexes present (Plate 2E and 2F), but did not produce sporophytes in the pots, perhaps not having the correct stages or conditions to allow fertilisation in culture.

*Cytological comments*: Chromosome counts of *C. sinuata* and *C. hookeri*, have shown 2n = c. 130-140 and n = 69-70, respectively (Manton & Sledge, 1954) and similar results were obtained by Abraham, Ninan & Mathew (1962) from Sri Lankan material. *C. sledgei* has not yet been investigated cytologically and further study is intended to be carried out at Peradeniya. All species that have been cytologically investigated so far in *Cyathea* are sexual diploids with approximately n = 69 (Tryon 1970). Conant *et al.* (1996) suggested that the family Cyatheaceae is unusual because it is the only fern-family known showing such uniformity in chromosome number and is further unusual
Plate 1: Habit and frond characters of *Cyathea sinuata*, *C. hookeri* and *C. sledgei* (A) Habit of *Cyathea sinuata*; (B) Habit of *Cyathea hookeri*; (C) Habit of *Cyathea sledgei*; (D) Soral arrangement of *Cyathea sinuata*; (E) Soral arrangement of *Cyathea hookeri*; (F) Soral arrangement *Cyathea sledgei*; (G) Venation of *Cyathea sinuata* (×20); (H) Venation of *Cyathea hookeri* (×20); (I) Venation of *Cyathea sledgei* (×1).

Note: Rachis and secondary rachis represented by a and b, respectively.
among ferns due to the occurrence of apparently fertile diploid hybrids (or hybrid-derived species) with full bivalent formation at meiosis. Thus the cytology of some hybrids recognised between the sections or genera *Alsophila* and *Nephelea* (which we prefer to treat within *Cyathea*, following Holttum, in Holttum and Tryon, 1977, due to their overall strong morphological similarity, in preference to recent molecular-based classifications) is very unusual in ferns as a full complement of bivalents are formed during meiosis between the two genomes present and viable spores are produced (Conant & Cooper-Driver, 1980), which is not due to apomixis. Conant & Cooper-Driver (1980) reported that the new world hybrids, *A. bryophila* R.M.Tryon x *C. portoricensis* Spring ex Kuhn, *A. x dryopteroides* (Maxon) R.M.Tryon (*A. amintae* Conant x *A. bryophila*) and *A. amintae* x *C. portoricensis* have 69 bivalent

---

**Plate 2**: (A) Sori of *Cyathea sinuata* (x 40); (B) Sori of *Cyathea hookeri* (x 40); (C) Sori of *Cyathea sledgei* (x 40); (D) *Cyathea sledgei* in *ex situ* condition; (E) Developed gametophytes of *Cyathea sledgei*; (F) Gametophyte of *Cyathea sledgei* with archegonia (x 40).
<table>
<thead>
<tr>
<th>Major characters</th>
<th>C. sinuata</th>
<th>C. sledgei</th>
<th>C. hookeri</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trunk height (cm)</td>
<td>70-170 (-200)</td>
<td>90-135</td>
<td>100-360</td>
</tr>
<tr>
<td>Trunk diameter (cm)</td>
<td>1.3-1.6</td>
<td>1.2-1.7</td>
<td>2.8-3.5</td>
</tr>
<tr>
<td>Crown width (cm)</td>
<td>78-114</td>
<td>112-168</td>
<td>145-195</td>
</tr>
<tr>
<td>Crown height (cm)</td>
<td>15-25</td>
<td>18-28</td>
<td>12-28</td>
</tr>
<tr>
<td>No. of leaves</td>
<td>20-32</td>
<td>18-26</td>
<td>7-13</td>
</tr>
<tr>
<td>Lamina dissection</td>
<td>Simple</td>
<td>Pinnatifid</td>
<td>Simply pinnate</td>
</tr>
<tr>
<td>Leaf shape</td>
<td>Narrowly Linear</td>
<td>Linear</td>
<td>Lanceolate</td>
</tr>
<tr>
<td>Leaf base</td>
<td>With sinuate or entire margin</td>
<td>With deeply cut lobes</td>
<td>With separate pinnae</td>
</tr>
<tr>
<td>Petiole length (cm)</td>
<td>3.8-4.2</td>
<td>4.5-4.7</td>
<td>7.5-11.5</td>
</tr>
<tr>
<td>Width and length of petiole-scale (cm)</td>
<td>0.05-0.1 x 0.3-0.4</td>
<td>0.1 x 0.4-0.6</td>
<td>0.1 x 0.4-0.8</td>
</tr>
<tr>
<td>Density of squaminate spines on the petiole</td>
<td>Absent or slight</td>
<td>Moderate</td>
<td>Dense</td>
</tr>
<tr>
<td>Length of squaminate spines on the petiole (cm)</td>
<td>≤0.05</td>
<td>0.05-0.1</td>
<td>0.1</td>
</tr>
<tr>
<td>Length of lamina (cm)</td>
<td>45-56</td>
<td>60-90</td>
<td>90-120</td>
</tr>
<tr>
<td>Width of lamina (cm)</td>
<td>2.4-3.5</td>
<td>3.7-5.1</td>
<td>21-37.8</td>
</tr>
<tr>
<td>Veinlets</td>
<td>Simple</td>
<td>Forked</td>
<td>Simple</td>
</tr>
<tr>
<td>No. of pairs of sori</td>
<td>1-4</td>
<td>6-9</td>
<td>1-3</td>
</tr>
<tr>
<td>Soral arrangement</td>
<td>On 1-3 lower pairs of secondary veins</td>
<td>At fork of tertiary veins</td>
<td>On 1-3 lower pairs of quaternary veins</td>
</tr>
</tbody>
</table>
chromosomes at meiosis. The usual cytological methods for detecting or confirming hybridity from failure of chromosome-pairing at meiosis between the different genomes and thus production of abortive spores have not been useful in this genus. Because cytological investigation of this sort is apparently not useful to confirm hybridity in *Cyathea*, the reproductive biology and gametophyte morphology of the presumed ancestral species and *C. sledgei* are being studied further at Peradeniya and it is hoped that molecular study can also be carried out in the future to help investigate the nature and origin of *C. sledgei*. It is suggested that further consideration of the taxonomic status of what have hitherto been reported as hybrids may be required world-wide if such apparent hybrids are observed to form populations and behave as species. We would treat such taxa as species, rather than hybrids, if they demonstrate a high degree of fertility, form populations which apparently have the potential to spread and are sufficiently distinct morphologically.

**ACKNOWLEDGEMENTS**

The authors thank the National Herbarium of Sri Lanka (PDA) for support and the Forest Department of Sri Lanka for granting permission to carry out study at Sinharaja and Kenneliya forests. The research was financed by the National Science Foundation of Sri Lanka (Grant: RG/06/EB/05). We are thankful to Dr. Monika Shaffer-Fehre, Royal Botanic Garden, Kew, UK (K), for providing photocopies of the first collections of *C. sledgei*. CRFJ is grateful to the late Dr. W.A. Sledge for frequent encouragement, guidance and help during his younger days.

**REFERENCES**


**DRYOPTERIS REMOTA (A. BRAUN EX DÖLL) DRUCE**
**(DRYOPTERIDACEAE: PTERIDOPHYTA) IN POLAND**

Dariusz Tłalka¹ & Krzysztof Piątek²

¹Os. nad Sołą 4/19, Kęty, Poland;
²Institute of Botany, Jagiellonian University, Kraków, Kopernika 27, 31-501 Kraków, Poland, e-mail: piatek@interia.eu

Keywords: Dryopteris remota, Poland, ferns, Pteridophyta, distribution;

**ABSTRACT**

The presence of *Dryopteris remota* (A. Braun ex Döll) Druce in Poland was unclear (Piękos-Mirkowa 1979). Recently the presence of this species in Poland has been confirmed and this paper presents a review and description of Polish localities. Fifteen new localities of *D. remota* were found in the Beskidy Mountains (S Poland), and two contemporary and six historical sites confirmed. Ecological requirements in Poland are described. Determination of the Polish specimens of *D. remota* was based on comparison with descriptions and iconography of this species and in consultation with specialists in *Dryopteris*. A map of the distribution of *D. remota* within Poland is provided.

**INTRODUCTION**

The presence of *Dryopteris remota* (A. Braun ex Döll) Druce in Poland was unclear (Piękos-Mirkowa 1979). *Dryopteris remota* had been recorded in Poland from eight sites, of which six are historical. Fraser-Jenkins (pers. comm.) reported two sites from Poland based on a revision of Polish herbarium materials, one of which (Przemysł) appeared on a map of the overall distribution of this species (Ekrt et al. 2007). The species has also been reported by Fiek (1881) and Shube (1903) from four sites. Two contemporary localities were reported by Kwiatkowski (2006). During 2007-2009 D. Tłalka found 15 further localities of this species in Poland (Tłalka, 2008; Tłalka & Rostański, 2008; Tłalka, 2009; Szczeńiak, Tłalka & Rostański, 2009; Wilczek, Tłalka & Rostański, 2009; Tłalka 2010), and voucher specimens were confirmed by K. Piątek. This paper presents a review and description of material from all Polish localities. A map of the distribution of *D. remota* within Poland is provided. A detailed description of the species, nomenclature, general distribution as well as a complete literature review was published by Ekrt et al. (2007).

**MATERIAL AND METHODS**

The distribution of this species within Poland is based upon examination of specimens from the KTU herbarium (abbreviations follow Holmgren *et al.* 1990) and from the literature (Fiek, 1881; Shube, 1903; Kwiatkowski, 2006). Voucher herbarium specimens from the Carpathian localities found by Tłalka are preserved at KTU and duplicates are preserved at KRA. Phytosociological survey was made in accordance with the methodology proposed by the Zurich-Montpellier school.

**ECOLOGICAL REQUIREMENTS IN POLAND**

*Dryopteris remota* is reported from altitudes of 480 to 730 m from ravines, steep rocky
slopes and screes. It grows in forest communities, especially in Carpathian beech forest Dentario glandulosae-Fagetum. At one of the stations a phytosociological survey (relevé) was made:

Phytosociological relevé:

RECORDS OF DRYOPTERIS REMOTA FROM POLAND

All currently known Polish stations of Dryopteris remota are presented below. The distribution map of D. remota in Poland is presented in Figure. 1. The map was created using cartogram method based on an artificial grid of square units 10 x 10 km (Zając A. & Zając M., 2001).

Historical records
2. Przemyśl, ATPOL square GF90, rev. Fraser-Jenkins C. R., (pers. inf.);
3. Buchberg (Bukowiec Mount), ATPOL square BE9303 (Fiek 1881);
4. Schierlischskoppe (Kostrzyna Mount), ATPOL square BE9313 (Fiek 1881);
5. Storchberg (Stożek Wielki Mount), ATPOL square BE9302 (Fiek 1881);
6. Freudenkamm (a valley in the vicinity of Sokolowsko (Görbersdorf)), ATPOL square BE9313 (Shube 1903).

Contemporary localities
7. Góry Ołowieńskie / Turzec, ATPOL square BE6123 (Kwiatkowski 2006);
8. Ciechanówka, ATPOL square BE7103 (Kwiatkowski 2006);
9. Beskid Mały Mountains, Wielka Puszcza valley, on the SW slope of Wielka Bukowa Mount and N slope of Beskid Mount, 540-590 a.s.l., 22 individuals in beech forest. Porąbka, Porąbka gmina, Bielsko-Biała powiat, Silesia Province, ATPOL square DF9530, KTU;
10. Beskid Mały Mountains, Kocierska Pass, on the N slope, Wielka Puszcza Valley, on the S slope of Wielka Bukowa Mount and on the N and NE slope of Beskid Mount, 550-610 m a.s.l., 19 individuals in beech forest and fir-spruce forest. Targanice, Andrychów gmina, Wadowice powiat, Małopolska Province; Porąbka, Porąbka gmina, Bielsko-Biała powiat, Silesia Province, ATPOL square DF9531;
11. Beskid Mały Mountains, Targaniczanka valley, on the N slope of Kiczora Mount and on the W slope of Potrójna Mount, Kiczora, on the NW slope, 530-630 m a.s.l., several hundred individuals in beech forest and fir-spruce forest, Targanice, Andrychów gmina, Wadowice powiat, Małopolska Province, ATPOL square DF9532, KTU;
12. Beskid Mały Mountains, Potrójna Mount between Łamana Skała and Leskowice,
on the E slope, 630-640 m a.s.l., 2 individuals in beech forest. Targoszów, Stryszawa gmina, Sucha Beskidzka powiat, Małopolska Province, ATPOL square DF9640, KTU;

13. Beskid Mały Mountains, Leskowiec Mount, on the SW slope, 700-730 m a.s.l., 26 individuals in beech forest, Targoszów, Stryszawa gmina, Sucha Beskidzka powiat, Małopolskie Province, ATPOL square DF9630, KTU;

14. Beskid Żywiecki Mountains, Sucha Góra Mount on the SW slope, 600-620 m a.s.l., 3 individuals in fir-spruce forest, Rajcza, Rajcza gmina, Żywiec powiat, Silesia Province, ATPOL square DG2334;

15. Beskid Śląski Mountains, Jasionka valley, on the NW slope of Błatna Mount, 600 m a.s.l., 1 plant in beech forest, Brenna, Brenna gmina, Cieszyn powiat, Silesia Province, ATPOL square DG0202;

16. Beskid Maly Mountains, Łamana Skała Mount, on the SE slope above Komoniecki Cave, 720-730 m a.s.l., 15 individuals in young fir-spruce forest, Las, Ślemień gmina, Żywiec powiat, Silesia Province, ATPOL square DF9544, KTU;

17. Beskid Maly Mountains, Beskid Mount near Kocierska Pass on the SE slope, 650-

Figure 1. Map of the distribution of *Dryopteris remota* in Poland: ● — historical records, ■ — current sites.
660 m a.s.l., 4 individuals in beech forest, Kocierz Rychwałdski, Lękawica gmina, Żywiec powiat, Silesia Province, ATPOL square DF9541;

18. Beskid Mały Mountains, Nad Planem Mount, on the NW slope, 610-620 m a.s.l., 17 individuals in beech forest, Kocierz Rychwałdski, Lękawica gmina, Żywiec powiat, Silesia Province, ATPOL square DG0501;

19. Beskid Mały Mountains, Mały Gibasów Wierch Mount, on the SW slope below Czarne Działy Caves, 700-710 m a.s.l., 10 individuals in beech forest, Ślemień, Ślemień gmina, Żywiec powiat, Silesia Province, ATPOL square DG0503;

20. Beskid Mały Mountains, Potrójna (Czarny Groń) Mount, on the W and SW slopes, 620-710 m. a.s.l., 10 individuals in beech forest, Targanice, Andrychów gmina, Wadowice powiat, Małopolska Province; Kocierz Rychwałdski, Lękawica gmina, Żywiec powiat, Silesia Province, ATPOL square DF9542;

21. Beskid Mały Mountains, Kiczera, on the E slope, 530 m a.s.l., 2 individuals in beech forest, Porąbka, Porąbka gmina, Bielsko-Biała powiat, Silesia Province, ATPOL square DF9434;

22. Beskid Mały Mountains, Łamana Skała Mount, on the SE slope below Dusica waterfall, 660-680 m a.s.l., 4 individuals in young fir-spruce forest, Las, Ślemień gmina, Żywiec powiat, Silesia Province, ATPOL square DG0504;

23. Beskid Mały Mountains, Magurka Ponikiewska Mount, on the NE slope, 480-490 m a.s.l., 3 individuals in beech forest, Koziniec, Mucharz gmina, Wadowice powiat, Małopolska Province, ATPOL square DF9622.

CONCLUSION

Dryopteris remota should be included in the list of the native species of the flora of Poland. The species is probably more common, but has been overlooked. It should be included as a mountain species in the list of Zając (1996). Considering the IUCN categories and criteria (IUCN 2001), we recommend that D. remota should be designated as a critically endangered species (CR) in Poland.

ACKNOWLEDGEMENTS

We are very grateful to C. R. Fraser-Jenkins for making available information about Polish specimens revised by him in herbaria and for confirmation of our identification; we also thank A. Zając for his help in preparation of the distribution map and translation of German geographical names.

REFERENCES


KWIAKTOWSKI, P. 2006. Current state, separateness and dynamics of vascular flora of the Góry Kaczawskie (Kaczawa Mountains) and Pogórze Kaczawskie (Kaczawa


BOOK REVIEW


The Flora of Peninsula Malaysia is an initiative of the Malaysian Government as part of its commitment to biodiversity conservation, and it is supporting employment and training for taxonomists, fieldwork and overseas collaboration. The Flora is founded on thorough taxonomic review, including examination of type material, and includes ecological information. A strong focus of the project is new botanical exploration, coupled with taxonomic training, to gather information from areas where there has been little collecting in the past and review old records, to acquire up-to-date information on the status of plants, their diversity and current distributions, in order to assess conservation needs.

The last published fern flora of Peninsula Malaysia was that of Holttum in 1968 (and covered ferns but not fern allies), but he continued to publish on ferns of this region during his long retirement at Kew, contributing a number of family accounts for Flora Malesiana.

The Volume starts with a conspectus by Barbara Parris of Orders, Families and Genera, to reflect the changes in classification of ferns and fern ‘allies’ that have emerged from recent phylogenies based on morphological and molecular data. The editors broadly follow the treatment of Smith et al. (2006) in placing Equisetaceae and Psilotaceae with the ferns, rather than with lycophytes, but have modified the treatment for ferns, e.g. Pteridaceae is divided into five monophyletic families, Parkeriaceae, Adiantaceae, Cryptogrammaceae, Sinopteridaceae and Pteridaceae; Polypodiaceae is divided into three families. Loxogrammaceae, Polypodiaceae and Grammitidaceae. Justification for the changes is provided.

A further chapter by Parris deals with the history of botanical collecting in Peninsula Malaysia, followed by a chapter on species assessment and conservation by L.S.L. Chua of the Forest Research Institute Malaysia.

Keys to families, genera and species are provided. Each taxonomic account in the Flora includes information on nomenclature and type material, detailed description, notes on distribution together with a distribution map, conservation assessment based on the current IUCN guidelines and notes on ecology. There are useful black and white figures and coloured plates that illustrate the variation within families, and some fern habitats.

Volume 1 covers accounts for 9 families, 21 genera and 100 species, and includes Selaginellaceae, Psilotaceae, Equisetaceae, Osmundaceae, Matoniaceae, Schizaceae,
Cibotiaceae, Loxogrammaceae and Grammitidaceae. The authors and editors are to be congratulated on a beautiful, scholarly and very valuable work.

**REFERENCE**


Mary Gibby
INSTRUCTIONS FOR AUTHORS

PAPERS should not usually exceed 20 printed pages and are generally expected to be considerably shorter. Review articles, as well as reports of original research, are encouraged. Short notes are acceptable e.g. new records. The senior author should supply a fax and email address to facilitate correspondence.

MANUSCRIPTS should be submitted in English (British) in electronic format (preferably) or hard copy (two copies), in 10-point Times New Roman font and double spaced. Electronic versions of text and tables should be compatible with WORD, with figures as pdf or jpg files, and sent as email attachments or CDroms. All manuscripts will be refereed

THE TITLE should reflect the content of the paper and be in BOLD CAPITALS (11-point) and centrally aligned. Generic and specific names should be in italics and any title containing a generic or specific name must be followed by the family and Pteridophyta in brackets e.g.

TRICHOMANES SPECIOSUM (HYMENOPHYLLACEAE: PTERIDOPHYTA) IN SOUTHERN SPAIN


MAIN HEADINGS: should be in BOLD CAPITALS (10-point) and centrally aligned.

SUBSIDIARY HEADINGS: should be in bold, the first letter of each word in capitals, the rest in lower case and left-aligned.

AUTHORS' NAMES AND FULL ADDRESSES: follow the title and are centrally aligned.

KEY WORDS: up to ten.

ABSTRACT: should reflect the content of the paper.

FIGURES: there is no distinction between photographs and line drawings in numbering. All should be presented in a form ready for reproduction, ideally in JPG format (please contact editor with queries), with a scale bar where appropriate. Lettering or numbers (Arabic) should be in the bottom left using uppercase Times Roman and be sufficiently large to be legible if reduction is necessary during printing. The number of photographs allowed in any one issue is limited by cost. Figure captions should be on a separate sheet.

TABLES: can be printed in either portrait or landscape format. Authors should consider this when preparing tables. Authors should ensure that tables fit the printed page size in a legible form.

MEASUREMENTS: should follow the metric system.

CHECKLISTS: should follow the format of Baksh-Comeau, Fern Gaz. 16(1, 2): 11-122.


JOURNAL ABBREVIATIONS: should follow Botanico Periodicum Huntianum & Supplements.

Alterations from the original text at proof stage will be charged for unless they are minor points of detail. Twenty-five offprints will be supplied free to the senior author.
A NEW GENUS FOR THE FERN FLORA OF IRAN: CYRTOMIUM

A. GHLIPOUR1 & W. GREUTER2

1 Payame Noor University, Sari, Mazandaran. abbas.gholipuor@gmail.com
2 Herbarium Mediterraneum, Orto Botanico, Università degli Studi, Palermo, Italy; and Botanischer Garten & Botanisches Museum Berlin-Dahlem, Freie Universität Berlin, Germany. Author for correspondence: w.greuter@bgbm.org

Keywords: Cyrtomium fortunei, Dryopteridoideae, Mazandaran, Hyrcanian forest, disjunct area.

ABSTRACT
A stand of Cyrtomium fortunei was found by the first author in a natural habitat on the northern slope of the Elburs range in N Iran, Mazandaran Province, growing on sandstone rocks in the Hyrcanian forest. The whole context strongly suggests it to be indigenous there, but phytogeographically this would result in a huge, puzzling disjunction between the known native area in SE Asia and the newly discovered stand.

INTRODUCTION
Cyrtomium C. Presl is a genus of the dryopteridoid ferns, closely related to and sometimes combined with Polystichum Roth, or alternatively with the New World Phanerophlebia C. Presl, a name of the same date but which is treated as having priority over Cyrtomium. Molecular systematics (Yatskievych et al. 1988, Lu et al. 2005) and karyosystematics (Lu et al. 2006) have helped elucidate the classification of the group, now thought to consist of four clades equivalent to Polystichum, Phanerophlebia, a group comprising Cyrtomidictyum Ching, Cyrtogonellum Ching plus some species formerly misplaced in Polystichum and Cyrtomium, and Cyrtomium sensu stricto. The latter, thus redefined, comprises ferns with irregularly scattered sori arising from included veinlets and imparipinnate fronds with a non-pinnatifid terminal segment.

Cyrtomium sensu lato has been monographed twice, by Christensen (1930) who recognised nine species and Shing (1965) who raised the species number to 59. According to recent floristic works (Iwatsuki 1995, Kung 2001) a more realistic number is 35 or less. Except for two species (C. caryotideum (Hook. & Grev.) C. Presl, also found on Hawai‘i, and C. micropterum (Kunze) Ching, which extends to Madagascar and tropical Africa, south to Natal) the genus is confined to S and SE Asia, with a marked centre of diversity in China from where it extends to Japan, Korea, Viet-Nâm, Thailand, India and the Himalaya. The westernmost native occurrences in Eurasia are in Pakistan, W Himalaya, from where three species have been reported: C. anomophyllum (Zenker) Fraser-Jenk. (= C. nervosum Ching & Shing), C. caryotideum, and C. macrophyllum (Makino) Tagawa (Fraser-Jenkins 1992, 2008, Kullar 2000).

Two species of Cyrtomium are widely cultivated as ornamental pot plants: C. falcatum (Sw.) C. Presl and C. fortunei J. Sm. Both have become established escapes in various parts of the world with a suitable climate, and either or both are reported as locally naturalised in, e.g., Britain, Italy, the Macaronesian Islands, the southern United States, Hawai‘i, and Australia. For C. falcatum, diploid, tetraploid and apomictic triploid karyotypes are known, whereas C. fortunei appears to be consistently triploid
and apomictic, comprising a number of discernible morphotypes that have been treated as varieties or sometimes species (Iwatsuki 1995).

**MATERIAL**

Voucher specimens of the Iranian *Cyrtomium* have been deposited in the herbarium, Payame Noor University, Sari, Mazandaran, Iran (PNUS; not yet registered in Index Herbariorum). Duplicates are kept in the Berlin-Dahlem herbarium (B) and the second author's herbarium (now: PAL-Gr). Identification has been checked by comparison with herbarium material from all over the generic range present in Berlin-Dahlem (B) as well as descriptions in the floristic and monographic literature.

**RESULTS**

Plants belonging to the genus *Cyrtomium* were discovered by the first author on 10 Sep 2010 in a single locality on the northern slopes of the Elburs range, 25 km S of the city of Sari and 8.5 km N of the village of Lajim (Fig. 1-3). *Cyrtomium* had not been recorded from Iran previously (Khoshravesh et al. 2009). Specimens sent to the second author for study proved to be typical *C. fortunei*, characterised e.g. by the shape and dimensions of its fronds and pinnae, the irregularly and distantly denticulate pinna margin with minute antrorse to incurved teeth, and the pale, thinly papery, entire indusia (Fig. 4).

About 30 tufts were observed, scattered over an area of ca. 300 m², growing in a small side valley on shaded sandstone rocks, on the trunks of fallen trees and on shallow soil of the valley bottom (Fig. 5). The dominant vegetation was natural Hrycanian deciduous forest, in which *Carpinus betulus* L. and *Fagus sylvatica* subsp. *orientalis* (Lipsky) Greuter & Burdet predominate, mixed with other characteristic elements such as *Alnus subcordata* C. A. Mey., *Parrotia persica* C. A. Mey., and *Acer velutinum* Boiss. Also, the following fern species were noted: *Asplenium scolopendrium* L., *Dryopteris affinis* (Lowe) Fraser-Jenk., *Polystichum aculeatum* (L.) Roth, and *Pteris cretica* L. The area in question, known locally as “Cron forest”, has no protected status.

Label data of the vouchers collected are as follows: Mazandaran, Sari, Aghmashhad, Cron, 36°20´08.2´´ N, 53°05´25.6´´ E, 520 m, 10 Sep 2010, A. Gholipour 890367 (PNUS, B); same place, 4 Oct 2010, A. Gholipour 890441 (PNUS, PAL-Gr) (Fig. 6).

**DISCUSSION**

The so far known native range of *Cyrtomium fortunei* extends from Japan and SE China to S Korea, Viêt-Nam and E Thailand (Iwatsuki 2000). There is a single record (not checked by us) from easternmost India (Manipur: Fraser-Jenkins 2008), which if correct would be the closest known occurrence to our new locality. The distance between Sari and Manipur is ca. 4200 km as the crow flies, roughly the same as that which separates Manipur from Tokyo at the eastern edge of the species range (4500 km). This is a huge disjunction, with the whole Himalayan range and the Iranian highlands lying in-between.

An easy explanation would be to suspect that the Iranian population, rather than being truly native, was brought to its new location by the voluntary action or unintentional assistance of humans. The ease with which cultivated *Cyrtomium* species, in various parts of the globe, escape from cultivation and become established in semi-natural habitats lends credibility to such a hypothesis. For *C. fortunei* proper, naturalised occurrence, while much less generalised than for *C. falcatum*, has been
reliably reported from the U.S.A. (4 states: Yatskievych 1993), SE France, where it enjoys protected status (Salanon 1998), and the southern Alps of Italy (Conti & al. 2005).

However, the entire context in which the plants are growing in Iran makes naturalisation an unlikely assumption. The place is literally in the middle of nowhere, and neither at this locality, nor in the surrounding area in general, is there any sign of degradation or indeed of any interference or activity by humans. Weedy, alien species are conspicuously absent. The closest village of note, Aghmasshad, is situated at a distance of ca. 4 km. It does not have any hotel, tourist resort or similar facility in which alien potted plants might be suspected to be grown for amenity. Even more significantly, *Cyrtomium* is not known to be or have been cultivated in Iran, and while its erratic presence cannot be entirely precluded it is definitely not a popular ornamental fern in Iran, nor is it available through the local horticultural trade.

We are therefore of the firm opinion that *Cyrtomium fortunei* is a member of the native Iranian flora. One may of course theorise that it has settled in its current site as a result of natural long-distance dispersal, but if so, there is no way to know when that event may have happened. The Hyrcanian forest of the Elburs range is rich in Tertiary relic species (and genera), and there is no reason to preclude considering *Cyrtomium* as one of their number.

**ACKNOWLEDGEMENTS**

Ms Sarah Bollendorff, Berlin, kindly produced the scanned specimen image. Brigitte Zimmer, Berlin, assisted with consultation of the Berlin Herbarium. Christopher Fraser-Jenkins provided valuable information on his Pakistani gatherings of *Cyrtomium*.

Figure 5. The native habitat of *Cyrtomium fortunei*, in Mazanderan. Photography, A. Gholipour.
Figure 6. One of the Iranian voucher specimens of *Cyrtomium fortunei*. 
REFERENCES


TWO NOVEL \textit{ASPLENIUM} HYBRIDS (ASPLENIACEAE: PTERIDOPHYTA) FROM TENERIFE, CANARY ISLANDS

F.J. RUMSEY$^1$ & A. LEONARD$^2$

$^1$Dept. of Botany, Natural History Museum, Cromwell Road, London, SW7 5BD, UK, e-mail: F.Rumsey@nhm.ac.uk

$^2$37 Lower Bere Wood, Waterlooville, Hants., PO7 7NQ, UK e-mail: mail@andrew-leonard.co.uk

Keywords: \textit{Asplenium hemionitis}, \textit{A. aureum}, \textit{A. onopteris}, \textit{A. × tagananaense}, hybridization, Macaronesia

\textbf{ABSTRACT}

A plant closely resembling \textit{Asplenium hemionitis} L. but with more dissected, lobed fronds was discovered during a trip to the Anaga mountains, Tenerife, Canary Islands in 2009. This was found to show almost complete spore abortion, indicating a hybrid origin. From the associated species and frond form we suggest the other parent to be \textit{A. onopteris} L. This represents the first documented hybrid of the rather taxonomically isolated \textit{A. hemionitis}. The hybrid, \textit{A. × tagananaense}, is described and its distinguishing features given. A further novel \textit{Asplenium} hybrid, photographed in 1995 but not subsequently refound, is identified as that between \textit{A. onopteris} and \textit{A. aureum} Cav. In the absence of a specimen it is not formally described but its distinctive features are illustrated and its occurrence reported.

\textbf{INTRODUCTION}

In February 2009 a small group of pteridologists led by the second author and comprising Alison Evans, Michael Hayward, Tim Pyner and Martin Rickard went to Tenerife. During the excursion, an odd looking fern, which several in the group considered to be an aberrant form of \textit{Asplenium hemionitis} was found. The plant had the palmate frond form unique in the region to this species but closer examination showed the lobes themselves to be more highly dissected, the lobules not apparent as they were largely in the same plane as the frond and closely imbricate. The possibility that this might constitute a hybrid was considered and accordingly photographs were taken (Fig. 1) along with a few voucher fronds (see drawing, Fig. 4a). On the groups’ return to the British Isles these were examined by FR and found to be producing highly abortive sporangia, strongly suggesting a hybrid origin. Comparison with recently collected Azorean material of the very rare hybrid \textit{A. × rouyi} Viane (\textit{A. scolopendrium} × \textit{A. onopteris}), showed some similarities, suggesting that the other parent might also be diploid \textit{A. onopteris}. The group returned to the site in November 2009, this time accompanied by Patrick Acock. They found the plant still to be present although no new foliage had developed. It gave the opportunity to make additional observations about the plant, its surroundings, etc. Apart from \textit{A. hemionitis} the only other \textit{Asplenium} species closely associated (and with juvenile plants in the immediate vicinity) was found to be \textit{A. onopteris} (Fig. 2).

The possibility that \textit{A. × tagananaense} is a hybrid with some other Canarian
Asplenium taxon may largely be ruled out on gross morphological grounds; the only other taxa with an appropriate frond shape are tetraploid and would be expected to show a greater influence on the hybrid frond form because of gene dosage effects (Bennert et al., 1991). Asplenium × rouyi (= A. onopteris × A. scolopendrium), another extremely rare hybrid, only ever found twice (Schäfer & Rasbach, 2000), shares similarities and the A. onopteris parent. This hybrid with the entire-fronded A. scolopendrium, a very rare plant in the Canaries, differs in its narrower more distinctly triangular frond form, the deeper divisions of the central lobe, the pinnules thus created more nearly at right angles to the rachis. It also appears to have a somewhat fleshier texture common to many A. scolopendrium hybrids (Rumsey et al., 2004).

Many years earlier AL had found another curious Asplenium on Tenerife which from its morphology (Figs. 3; 4b) could not be matched with any known species, although

Figure 1. Asplenium × tagananaense – head of Barranco de la Iglesia, Taganana, Tenerife. Feb. 2009. Photo: Alison Evans.
from its texture strongly suggested it may be a hybrid of *A. aureum* Cav., seen growing nearby. A voucher frond was collected and sent to the Department of Botany at the Natural History Museum; most unfortunately its present whereabouts have not been traced. Subsequent visits to the area, by a woodland trail in the hills c. 1km to the west of Erjos, Los Silos (c. 28° 19’ 49.35”N 16° 49’ 06.77”W) at an altitude of just over 720m, revealed the locality to have changed somewhat in character and the plant could no longer be refound. Photographs taken of the fern when first found, which unfortunately only reveal the upper surface of the fronds, show the plant to be very distinctive, clearly differing from *A. aureum* in its more dissected frond form and in its somewhat triangular shape, the lowest pinnules just the larger. While other taxa within the subgenus Ceterach are now known to occur on Tenerife, both morphological (frond width) and ecological factors indicate that *A. aureum* is involved. Again, on the basis of its morphology, only the 2-3 pinnate, deltate fronded *A. onopteris*, the only other *Asplenium* species seen in the vicinity, could be the other parent. Confirmation will however not be possible until the original specimen or similar wild plants are found. Few hybrids are known involving members of the morphologically distinctive subgenus Ceterach, although others are inferred in the origin of allopolyploids within this group (Trewick *et al.*, 2002; Van den Heede *et al.*, 2004); most examples of F1 hybrids found in the wild are backcrosses between allopolyploid derivatives and parental taxa (Van den Heede & Viane, 2002). The Canarian endemic *A. aureum* has been demonstrated to

![Figure 2. *Asplenium × tagananaense in situ* with juvenile plants of both putative parents, Nov. 2009. Photo: P. Acock.](image-url)
Figure 3. *Asplenium aureum × A. onopteris* – by forest trail c. 1km West of Erjos, Tenerife, Oct. 1995. Photo: A. Leonard.
be an allotetraploid (Pintér & Vida, 1993). Although its parentage is still uncertain, it is now known to be one parent of the Macaronesian endemic (Madeira, Canaries) hexaploid *A. lolegnamense* Gibby & Lovis (Pintér et al. 2002) and also involved in the origin of the Canarian endemic octoploid *A. octoploideum* Viane & Van den Heede (Van den Heede et al., 2004). The derived polyploid taxa may be more locally abundant than the more mesic *A. aureum*, particularly at altitude but they are more restricted in distribution across the Canarian archipelago.

Some earlier proposed hybrids involving crosses with taxa of other subgenera have subsequently been shown to be in error, eg. *Asplenoceterach badense*; only the hybrid of tetraploid *A. ceterach* L. with the allotetraploid *A. majoricum* (*A. × barrancense* (W. Bennert & D.E. Mey.) Pericás & Rosselló) has been cytologically confirmed (Rasbach et al., 1989). However, another very rare example in which *A. aureum* has been suggested to be parental is known (Hansen & Sunding, 1993). *Asplenium × newmani* Bolle was described from material collected by C. Bolle in the Barranco del Rio on La Palma in September 1852. It is a simply pinnate fern with fronds only c. 2cm broad, the rachis above green. Known only from the type gathering now in Herbarium Berolinense (B20 0026447), one parent is clearly either the Macaronesian endemic *A. anceps* or, and on ecological grounds less likely, its more cosmopolitan relative *Asplenium trichomanes* subsp. *quadrivalens*. Similar plants have never been refound.

**DESCRIPTION**

*Asplenium × tagananaense* F.J. Rumsey hybr. nov. (*A. hemionitis* L. × *A. onopteris* L.)

Habitu et textura *A. hemionitis* similis, praecipue frondis plus divisus, lobatus, plus minusve pinnatifidus, basi pinnatilobus, lobo terminali multo magis, sporae abortivus differt.

Holotypus: Canary Islands, Tenerife, Anaga mountains, by track to Taganana near Casa Forestal, at head of Barranco de la Iglesia, amongst rocks by path on steep slope in Laurel woodland, with both putative parents, c. 900m, 28° 32’ 43.50” N, 16° 13’ 34.50” W, Leonard et al., s.n. 2 February 2009. BM

Perennial from erect-ascending rhizome, leaves flushing annually, wintergreen, coriaceous, glabrous, to 35 cm; petiole 1.5-2.2 x lamina length, somewhat swollen at base, dark reddish brown for most of its length; lamina to c. 15 cm long, 12 cm broad, palmately (3-)5 lobed, the mid lobe distinctly longer, the lobes inconspicuously divided from ¼ to ¾ of their width, the basal more profoundly, lobes with small erect teeth at their apices, the apices sub-acute to obtuse. Sori linear, +/- curved, sporangia failing to mature, spores highly abortive.

*Asplenium × tagananaense* is most likely to be confused with its *A. hemionitis* parent, various frond forms of which have been described from the Canary Islands (Kunkel, 1966; 1967 and see Benl, 1967). While very distinctive amongst European *Asplenium* because of its entire, initially deltate, later palmate frond form, variability exists in *A. hemionitis* and the more markedly lobed and deeply divided forms appear to be more prevalent and perhaps exclusive to the Canary Islands. Rare monstrose forms such as described by Kunkel, 1966; 1967 may be similar in appearance to the newly described hybrid, although they would not show the spore abortion it clearly demonstrates. From the illustration in its original publication f. *cristatum* Kunkel (Kunkel, 1966) is clearly not synonymous; we have seen no material of f. *pinnatipartidum* Kunkel with which to compare our plants.
Figure 4.
A. (right) *Asplenium × tagananaense* – underside of frond drawn from Holotype – Leonard et. al., sn. (BM). Scale bar represents 1cm.
B. (left) *Asplenium aureum × A. onopteris* – upper surface of frond. Scale bar represents 1cm.
All herbarium material of *A. hemionitis* at BM has been checked and no further examples of *A. × tagananaense* have been found. Given its superficial similarity to *A. hemionitis* it may be overlooked but we believe it highly likely that it is genuinely, extremely rare.

Molecular studies based on the sequencing of small portions of the plastid genome, by which the maternal parent can be identified (Vogel et al., 1998), have been initiated but not yet concluded.

**DISCUSSION**

No hybrids of *Asplenium hemionitis* have previously been reported (Reichstein, 1981; Prelli, 2001). *A. hemionitis* is somewhat isolated within the broad genus *Asplenium*, the only European example of the section Hemionitidastrum Fée (Schneider et al., 2004). Similarly no hybrids of *A. aureum* have been conclusively found (the likely origin of *A. × newmani*, found only once in the mid 19th century, still open to debate). Hybridization events involving *A. aureum* are however known to have occurred as inferred from molecular studies of its allopolyploid progeny (Pintér et al. 2002) (Van den Heede et al., 2004). Observations in other pteridophyte groups such as *Equisetum* (Page, 1972) suggest greater levels of hybridization between phylogenetically closer taxa, where speciation has proceeded through ecological, hence physical separation and breeding barriers may not have been so well established. The occurrence of hybrids may thus give some indication of relationships and where apparent inter-generic hybrids are found give cause for taxonomic reconsideration (see recent studies in the Orchidaceae, eg. Bateman, 2006). Generic delimitation within Aspleniaceae has long been contentious with some apparently morphologically distinctive entities, eg. *Phyllitis, Ceterach, Pleurosorus* traditionally recognised by many authors. Molecular phylogenetic studies (eg. Schneider et al., 2004), are now contributing much to our understanding of the relationships within this highly speciose and taxonomically contentious genus. These studies show that these entities are firmly nested within *Asplenium* and would by their recognition render it paraphyletic. Essentially, if we recognise *Phyllitis* or *Ceterach* then an equally valid case is made for the recognition of other segregates; even the limited British flora would see its 13 species split between 8 genera. As evidenced by the finds reported here, even where phylogenetically distant, rare inter-specific reproductive events may occur, the offspring often instantly threatened by the very combination of factors which have enabled their production. It is potentially these unique combinations of more disparate genomes which are the more likely to promote polyploidy through disrupted cell division and thus fuel the abrupt speciation of very distinctive entities. As such these plants afford us unique insights into evolutionary mechanisms and processes but currently have no conservation standing.

**ACKNOWLEDGEMENTS**

The authors would like to thank the various members of the BPS who were present during the initial discovery of *A. × tagananaense* and during the re-visit to Tenerife later in 2009, particularly to those (Alison Evans, Patrick Acock) who have contributed photos and thoughts to this publication. Particular mention should go to Martin Rickard for immediately realising this plant was almost certainly a hybrid.

**REFERENCES**

BATEMAN, R.M. 2006. How many orchid species are currently native to the British


INSTRUCTIONS FOR AUTHORS

PAPERS should not usually exceed 20 printed pages and are generally expected to be considerably shorter. Review articles, as well as reports of original research, are encouraged. Short notes are acceptable e.g. new records. The senior author should supply a fax and email address to facilitate correspondence.

MANUSCRIPTS should be submitted in English (British) in electronic format (preferably) or hard copy (two copies), in 10-point Times New Roman font and double spaced. Electronic versions of text and tables should be compatible with WORD, with figures as pdf or jpg files, and sent as email attachments or CDroms. All manuscripts will be refereed.

THE TITLE should reflect the content of the paper and be in BOLD CAPITALS (11-point) and centrally aligned. Generic and specific names should be in italics and any title containing a generic or specific name must be followed by the family and Pteridophyta in brackets e.g.

TRICHOMANES SPECIOSUM (HYMENOPHYLLACEAE: PTERIDOPHYTA) IN SOUTHERN SPAIN


MAIN HEADINGS: should be in BOLD CAPITALS (10-point) and centrally aligned.

SUBSIDIARY HEADINGS: should be in bold, the first letter of each word in capitals, the rest in lower case and left-aligned.

AUTHORS' NAMES AND FULL ADDRESSES: follow the title and are centrally aligned.

KEY WORDS: up to ten.

ABSTRACT: should reflect the content of the paper.

FIGURES: there is no distinction between photographs and line drawings in numbering. All should be presented in a form ready for reproduction, ideally in JPG format (please contact editor with queries), with a scale bar where appropriate. Lettering or numbers (Arabic) should be in the bottom left using uppercase Times Roman and be sufficiently large to be legible if reduction is necessary during printing. The number of photographs allowed in any one issue is limited by cost. Figure captions should be on a separate sheet.

TABLES: can be printed in either portrait or landscape format. Authors should consider this when preparing tables. Authors should ensure that tables fit the printed page size in a legible form.

MEASUREMENTS: should follow the metric system.

CHECKLISTS: should follow the format of Baksh-Comeau, Fern Gaz. 16(1, 2): 11-122.

REFERENCES: should follow the style of a recent issue of The Fern Gazette, e.g.:-


JOURNAL ABBREVIATIONS: should follow Botanico Periodicum Huntianum & Supplements.

Alterations from the original text at proof stage will be charged for unless they are minor points of detail. Twenty-five offprints will be supplied free to the senior author.